LEARNING IN TIMES OF COVID-19: STUDENTS', FAMILIES', AND EDUCATORS' PERSPECTIVES

EDITED BY: Sina Fackler, Timo Gnambs, Karin Gehrer, Kathrin Lockl, Ariel Mariah Lindorff and Karin Sørlie Street

PUBLISHED IN: Frontiers in Psychology and Frontiers in Education

frontiers Research Topics

frontiers

ISSN 1664-8714
ISBN 978-2-88976-324-5
DOI 10.3389/978-2-88976-324-5

About Frontiers

Frontiers is more than just an open-access publisher of scholarly articles: it is a pioneering approach to the world of academia, radically improving the way scholarly research is managed. The grand vision of Frontiers is a world where all people have an equal opportunity to seek, share and generate knowledge. Frontiers provides immediate and permanent online open access to all its publications, but this alone is not enough to realize our grand goals.

Frontiers Journal Series

The Frontiers Journal Series is a multi-tier and interdisciplinary set of open-access, online journals, promising a paradigm shift from the current review, selection and dissemination processes in academic publishing. All Frontiers journals are driven by researchers for researchers; therefore, they constitute a service to the scholarly community. At the same time, the Frontiers Journal Series operates on a revolutionary invention, the tiered publishing system, initially addressing specific communities of scholars, and gradually climbing up to broader public understanding, thus serving the interests of the lay society, too.

Dedication to Quality

Each Frontiers article is a landmark of the highest quality, thanks to genuinely collaborative interactions between authors and review editors, who include some of the world's best academicians. Research must be certified by peers before entering a stream of knowledge that may eventually reach the public - and shape society; therefore, Frontiers only applies the most rigorous and unbiased reviews.
Frontiers revolutionizes research publishing by freely delivering the most outstanding research, evaluated with no bias from both the academic and social point of view. By applying the most advanced information technologies, Frontiers is catapulting scholarly publishing into a new generation.

What are Frontiers Research Topics?

Frontiers Research Topics are very popular trademarks of the Frontiers Journals Series: they are collections of at least ten articles, all centered on a particular subject. With their unique mix of varied contributions from Original Research to Review Articles, Frontiers Research Topics unify the most influential researchers, the latest key findings and historical advances in a hot research area! Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers Editorial Office: frontiersin.org/about/contact

LEARNING IN TIMES OF COVID-19: STUDENTS', FAMILIES', AND EDUCATORS' PERSPECTIVES

Topic Editors:
Sina Fackler, Deutsches Jugendinstitut, Germany
Timo Gnambs, Leibniz Institute for Educational Trajectories (LG), Germany
Karin Gehrer, Leibniz Institute for Educational Trajectories (LG), Germany
Kathrin Lockl, Leibniz Institute for Educational Trajectories (LG), Germany
Ariel Mariah Lindorff, University of Oxford, United Kingdom
Karin Sørlie Street, Western Norway University of Applied Sciences, Norway

Citation: Fackler, S., Gnambs, T., Gehrer, K., Lockl, K., Lindorff, A. M., Street, K. S., eds. (2022). Learning in Times of COVID-19: Students', Families', and Educators' Perspectives. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88976-324-5

Table of Contents

frontiers | Frontiers in Psychology

EDITORIAL
published: 18 May 2022
doi: 10.3389/fpsyg.2022.915250

Editorial: Learning in Times of COVID-19: Students', Families', and Educators' Perspectives

Karin Gehrer[1], Sina Fackler[2], Karin Sørlie Street[3], Timo Gnambs[1], Ariel Mariah Lindorff[4] and Kathrin Lockl[1]*

[1] Leibniz Institute for Educational Trajectories (LIfBi), Bamberg, Germany, [2] Deutsches Jugendinstitut, Munich, Germany, [3] Department of Pedagogy, Religion, and Social Studies, Western Norway University of Applied Sciences, Sogndal, Norway, [4] University of Oxford, Oxford, United Kingdom

Keywords: COVID-19, distance learning, home learning, student-teacher relationships, digital teaching and learning, learning

Editorial on the Research Topic

Learning in Times of COVID-19: Students', Families', and Educators' Perspectives

Whilst writing this editorial, we are looking back at almost 2 years of crisis due to the COVID-19-pandemic. From a first unprecedented lockdown in March 2020, after the first cases of this new virus disease were detected, to a series of more lockdowns, and hygiene regulations, it seems worthwhile to summarize findings that shed light on the situation of the education system. The present special issue on *"Learning in times of COVID-19: Students', Families', and Educators' Perspectives"* contains a collection of international empirical papers that analyze the situation of schoolteachers, pupils, university teachers, students, children, and parents. It offers insights into the situations of countries that had comparatively mild measures in place (e.g., Switzerland; cf. Garrote et al.; Helm and Huber) to countries that imposed weeks-long national lockdowns that completely isolated the country (such as Australia; cf. Martin et al.). Worldwide, parents had to juggle working from home while homeschooling or watching their children at the same time. Teachers and pupils had to move lessons online and get used to remote teaching formats. The same happened to university teachers and students around the world. Now, there is a generation of young people who have hardly seen their educational institution from the inside for the past 2 years and who, not to mention, suffered from severe contact restrictions that, in some cases, led to extreme social isolation. All of this was embedded in a situation of uncertainty regarding how the crisis would develop. The current special issue includes 40 research articles from all over the world that examined consequences of the pandemic in the educational context from multiple perspectives. Below, we present the articles according to four themes, pertaining to the situation of families, pupils, teachers and schools, and university students.

ON THE SITUATION OF FAMILIES

Families were under particular strain during the pandemic. They had to cope with home-schooling alongside home-office work (Canales-Romero and Hachfeld), and many parents reported feeling overburdened. Both social status and education level were related to how families were coping with the challenges of the pandemic (Sanrey et al.; Vogelbacher and Attig). Moreover, parents who had children attending primary as opposed to secondary school seemed to have been particularly affected (Garrote et al.).

Perhaps surprisingly, the findings of Canales-Romero and Hachfeld highlighted several positive effects of lockdowns for parents and families, with home-office-work positively affecting household

OPEN ACCESS

Edited and reviewed by:
Angela Jocelyn Fawcett, Swansea University, United Kingdom

****Correspondence:***
Karin Gehrer
karin.gehrer@lifbi.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *07 April 2022*
Accepted: *11 April 2022*
Published: *18 May 2022*

Citation:
Gehrer K, Fackler S, Street KS, Gnambs T, Lindorff AM and Lockl K (2022) Editorial: Learning in Times of COVID-19: Students', Families', and Educators' Perspectives. Front. Psychol. 13:915250. doi: 10.3389/fpsyg.2022.915250

dynamics and overall positive parental wellbeing. However, there were also increases in certain negative dynamics such as disputes. Taking on the role of "assistant teacher" in particular was a stressor, related negatively to household dynamics. The authors suggested implications for how schools communicate with and involve parents.

Sanrey et al. included preschool- to elementary-school-aged children and their parents in France to examine the risk of a digital divide during the COVID-19 lockdown. A higher social position was associated with a higher probability of owning more than one computer. At the same time, social position did not predict the time spent on computers to do schoolwork. The results revealed that nearly all parents were highly involved in setting up homeschooling for their children. However, parents with lower social position spent more time homeschooling their children and felt less able to support homeschooling, while also experiencing more fear about their children's academic failure.

Vogelbacher and Attig investigated predictors of parents' emotional stress and perceived abilities to support their children's learning during the first lockdown. Structural equation models demonstrated that these abilities were predicted by parents' level of education as well as previous perceived stress and socioeconomic status. Interestingly, higher-educated parents reported higher perceived stress during the COVID-19 lockdown.

Garrote et al. examined the relationship between parents' perceived threat of COVID-19 and their stress due to distance learning and their children's perceptions. As one of many interesting results they highlighted that parents of primary school students reported feeling more stressed than parents of secondary school students. Moreover, they found that female pupils experienced distance learning less positively than their male peers and felt more threatened by COVID-19.

Oppermann et al. investigated the role of parental support and home-learning environment on the provision of learning opportunities for 1–6 year-olds during day-care center lockdowns in Germany. Parental stress was negatively related to changes in the provision of home-learning environment (HLA). Parental self-efficacy and an intact social support system were protective factors against parental stress, alleviating the negative influence of stress on parents' ability to provide educational activities for their children at home. These results have important implications for supporting families with young children during challenging times.

ON THE SITUATION OF PUPILS

During the pandemic primary and secondary school students were challenged by distance learning, but also by returning to alternate teaching in small groups (Thorsteinsen et al.). An important issue in this context is whether existing educational inequalities were increasing as a consequence of the pandemic (Berger et al.; Weber et al.; Zinn and Bayer). Several papers explored what factors may play a role in strengthening students' resilience and mental health (Dändliker et al.; Helm and Huber; Martin et al.) or students' satisfaction after lockdown (Li et al.). Also, the impact of students' cognitive and affective-motivational factors as resources in this time was investigated (Lockl et al.).

Dändliker et al. focused on the mental health of pupils in secondary education in the early phase of the pandemic and the role of perceived social support by teachers, friends, and parents. They identified three resilience-profiles that differed in terms of students' educational concerns and perceived family support. These criteria were also strong risk or protective factors during school closures.

Zinn and Bayer investigated potential changes in educational inequality as a result of the initial school closure by focusing on the time spent on school-related activities in German secondary schools prior to and during the pandemic. In support of their hypotheses, the authors found an initial equalization effect (i.e., students spent similar amounts of time on school-related activities regardless of their parents' education level) during the spring 2020 lockdown, followed by an increase in educational inequality after the lockdown. That is, in the period after the lockdown, students with lower educated parents spent less time on school-related activities as compared with students whose parents had higher educational attainment.

Thorsteinsen et al. described the challenges experienced by elementary school children in Norway after the schools reopened, when classes were divided into smaller groups. They reported that children who did not like their new group showed reduced emotional school engagement and subjective wellbeing.

The changes in adolescent satisfaction before and after lockdown were investigated by Li et al. in a professional adolescent sport training school in China. As a main result, they found that the satisfaction of adolescents improved significantly after the lockdown.

Predictors for students' learning outcomes in Austria and Switzerland were the focus of Helm and Huber. Students' ability to self-organize emerged as the most significant predictor across all three informant groups (pupils, parents, and teachers), while the lack of parental support during school closures turned out to be relevant only from the parents' perspective.

In a mixed-methods study, Sim et al. investigated children's and adolescents' coping with home learning and related contextual factors. Most children and adolescents perceived their coping with home learning as successful, and school joy before COVID-19, parental support, and available equipment during home learning predicted children's coping. Moreover, family climate, a quiet place to study, and also equipment were important for adolescents learning at home. Interviews showed that students applied individual strategies for coping with home learning, where family and peers had a vital role, especially when contact with teachers was limited.

Adopting the job demands-resources theory, Martin et al. investigated the role of adaptability (i.e., the capacity to adjust behaviors, thoughts, and feelings in response to unexpected circumstances) in helping Australian high school students navigate their online learning. The authors found that beyond the effects of online learning demands, online and parental learning support, and background attributes, adaptability was significantly associated with higher levels of online learning self-efficacy and with gains in later achievement. Online learning self-efficacy

was also significantly associated with gains in achievement, and significantly mediated the relationship between adaptability and achievement. Consequently, the authors stressed the importance of adaptability as a personal resource in this process.

Investigating the longitudinal effects of distance schooling on existing educational inequalities of Austrian lower secondary school students, Berger et al. found a widening of the gap. Coping with out-of-school learning was especially challenging for students with low academic achievement and learning motivation prior to the pandemic. Furthermore, the findings demonstrated that support from parents and teachers fostered students' capabilities to cope with the self-regulatory demands connected with distance learning. The authors recommended strengthening self-regulation as an essential educational skill for academic achievement and life-long learning.

Using a within-person approach, Weber et al. investigated whether social and ethnic disparities in the reading achievement of Austrian primary school pupils widened during COVID-related school closures during spring 2020 and whether increased disparities were mediated by parental involvement in distance learning. Controlling for pre-lockdown reading differences, they found that low socioeconomic status and non-German language use at home negatively predicted post-lockdown reading achievement, indicating that post-lockdown disparities were larger than expected due to disparities at pre-lockdown. In contrast, they found no such effects during the pre-lockdown period. Second, a series of mediation models did not provide support for the hypothesis that parental involvement accounted for family background effects on reading achievement during the lockdown period.

Lockl et al. focused on cognitive and affective-motivational factors as possible predictors of coping with the demands of home learning in secondary school. Data from two measurement points from the German National Educational Panel Study (NEPS) revealed students' prior reading competencies and their willingness to exert effort as significant predictors, whereas other predictors (e.g., learning enjoyment, intrinsic motivation) had no effect on coping. Parents reported having more difficulties motivating children with lower reading competencies, or boys.

ON THE SITUATION OF TEACHERS AND SCHOOLS

Teachers were suddenly challenged to change their teaching styles and methods and to adopt diverse digital tools. Some of the articles included in this section examined resilience-building factors (Schneider et al.; Spicksley et al.) or causes of teachers' stress (Colville et al.; Lindner et al.; Pöysä et al.). Moreover, the challenges experienced by teachers of students with special educational needs (SEN) in the distance-learning mode were explored (Maurer et al.), as well as how teacher training students plan to use digital learning materials in their future practice (Paetsch and Drechsel). Finally, some articles focused on the collaboration with parents such as how teachers made contact with parents (Hemmerich et al.) or how parents experienced teachers during this time (Haller and Novita).

Schneider et al. focused on a large sample of primary and secondary school teachers in Germany who reported on different aspects of distance teaching. The results highlighted the importance of regular contacts between the teachers and students during the remote learning period.

In England, Spicksley et al. did qualitative research on how teachers perceived their relationships with other teachers during the crisis and how psychological states (both negative and positive) were reported. They showed that teachers with a strong collective identity could better cope with the challenges than teachers lacking social support by their colleagues.

Lindner et al. considered the wellbeing of teachers in Austria during the pandemic, using an online survey over three waves. The teachers reported on their emotional experiences and job satisfaction before and after the first lockdown, and then in the second lockdown. Teacher job satisfaction was high overall but tended to decline during lockdowns. Cross-lagged path models showed interesting relationships between job satisfaction and positive and negative emotional activation over time. The authors highlighted the importance of addressing teachers' job satisfaction even after the pandemic has eased.

Hemmerich et al. investigated how and why professionals working in early childhood education and care (ECEC) centers in Germany did or did not make contact with parents during the lockdown. The authors found differences in the responses given according to different ECEC types, as well as according to the professionals' understanding of their own role. The authors discussed the importance of shared perceptions of responsibility among ECEC professionals, adequate digital tool training and support, and outreach strategies to connect with disadvantaged parents.

The importance of parents' perceptions of schools as a central indicator for assessing school quality was underlined in a study by Haller and Novita. During school lockdown, parents' school satisfaction may reflect schools' abilities to adjust and react to fast social changes with almost no time for preparation. Using longitudinal NEPS data they identified predictors of parents' perceptions of school support. The results suggested that parents were likely to be satisfied during school lockdowns when they had positive attitudes toward teachers prior to school lockdowns.

Colville et al. interviewed primary teachers in Scotland against the theoretical background of new engaged pedagogy. Teachers reported on changes in pedagogy, agile and flexible working, changing identities, and parental engagement.

The focus of Maurer et al. was on students with special educational needs (SEN). They investigated how students with SEN coped with the sudden distance learning, and whether teachers of students with SEN faced greater hurdles in handling this switch. The results revealed no significant differences between teachers of special schools and teachers of inclusive schools regarding the use of digital learning. All teachers reported being dissatisfied with more digital learning hours. A large part of distance learning was conducted off-line with worksheets, and books. Teachers' self-efficacy for distance learning was rather low for all teachers of students with SEN.

Paetsch and Drechsel examined teacher training and, in particular, how the first online semester in a German university

contributed to pre-service teachers' intentions to use digital learning materials in the future. The quality of online instruction and self-reported improvements in digital skills were important factors in predicting students' intentions to use digital learning materials in the future. Different results were found for pre-service teachers training to work in elementary school vs. secondary school.

Pöysä et al. investigated latent profiles of Finnish primary school teachers' well-being and found four groups based on their occupational stress and work engagement. During the first few months of the COVID-19 pandemic many teachers experienced occupational stress as well as some increase in stress due to the pandemic. The findings provided new insights concerning how teachers' work engagement was, for some, not severely affected during the first few months of the pandemic, and on how different teaching styles were associated with different aspects of occupational well-being.

ON THE SITUATION OF UNIVERSITY STUDENTS

Several contributions were dedicated to the experiences of university students and how they viewed the switch to distance learning (Goppert and Pfost; Guse et al.; Kovacs et al.; Mohr et al.). Other articles focused on the needs of these students to cope with this challenging time (Hopp et al.; Naujoks et al.; Teuber et al.). Teacher-student interactions, in particular warm relationships, were investigated as important factors in distance-learning (Capon-Sieber et al.; Sun et al.). Other articles developed a framework for online teaching (Wang et al.) or investigated synchronous vs. asynchronous settings of online teaching (Fabriz et al.). Variables explaining digital literacy (Hoss et al.), procrastination (Lim and Javadpour), or attitudes (e.g., usefulness) toward distance learning (Drueke et al.) and the emotional stress caused by conflicting information on the pandemic (Mayweg-Paus et al.) were also examined.

Kovacs et al. investigated the use of digital learning tools of Austrian university students before and during the first lockdown. The results showed that their use of classic digital media such as e-mail or chats did not change whereas the use of certain tools such as videos and web conferencing systems increased considerably. As students saw advantages as well as disadvantages of online learning vs. face-to-face-learning, the authors recommended a balanced combination of both approaches in future university teaching.

The effects of synchronous vs. asynchronous online teaching and learning settings in university were explored by Fabriz et al. They reported that students in predominantly synchronous online settings voiced greater satisfaction of their basic psychological needs for competence support and connectedness, as well as greater overall satisfaction with the online semester compared to students in predominantly asynchronous online settings.

Naujoks et al. addressed the important issue of self-regulated learning in a sample of university students in Germany. More specifically, they investigated students' digital readiness to cope with online learning as well as their intended and actual use of external resource management strategies. While students seemed to be prepared to study online, they were not able to manage their resources during the course as often as intended.

Teuber et al. examined students' psychological needs (i.e., autonomy or competence satisfaction) during the COVID-19 lockdown, their academic engagement or intention to drop out, and the relationship with institutional strategies (i.e., communication of the institution staff about the procedure of examinations and courses). The results emphasized the importance of timely information to students about the universities' strategies for examinations and courses as important institutional tasks during a crisis.

Mohr et al. addressed the requirements in medical studies in respect to their extensive practical components. This included benefits associated with digital learning such as flexibility for students with childcare or jobs and perceived disadvantages such as the lack of interactions with peers, professionals, and patients in practice. The study also explored term-specific effects as well as gender- and age-specific differences in students' satisfaction with the digital study program.

With a focus on the same target group, Guse et al. examined mental burden and study worries among undergraduate medical students. The study showed that a large proportion of medical students experienced significant levels of distress and mental burden during the COVID-19 pandemic. It also highlighted the need for ongoing psychological and educational support for this group of university students during the pandemic.

Goppert and Pfost explored the stress levels of German psychology students in summer 2020 compared to students in preceding academic terms. While a high or medium level of stress is common for university students, the change to e-learning seemed not to be stressful. Contrary to the assumptions, the results indicated that the students experienced fewer worries and more joy in their studies, although they had more workload on average.

The association between students' close social networks, digital information-sharing behavior, and their experiences of social and emotional loneliness during COVID-19 was investigated by Hopp et al. While digital information-sharing behavior, number of close online contacts, and interconnectedness and heterogeneity of contacts were associated with students' experiences of social loneliness, only the heterogeneity of close contacts was associated with students' experiences of emotional loneliness. The authors recommended universities offer training and support in easy-to-use communication software.

Sun et al. investigated the influence of teacher-student interactions on learning during online education in China, based on self-report questionnaires. The level of interaction between teachers and university students was positively related to learning, and the mechanism of this effect could be characterized *via* a chain-mediating effect such that teacher-student interactions affected psychological atmosphere, which affected learning engagement, which in turn affected academic performance. Given the foothold maintained by online teaching and learning even after lockdowns have been lifted,

understanding such mechanisms is of critical importance globally, and in the long term.

Also set in China, Wang et al. drew on existing theory to develop a framework for measuring teaching presence in online teaching. Results showed good support for a five-factor model of teaching presence, including design and organization, facilitating discourse, direct instruction, assessment, and technological support.

Capon-Sieber et al. similarly considered the move from face-to-face to online courses in universities necessitated by the pandemic, and tested whether lecturers' support for relatedness drove student satisfaction with relatedness and, in turn, student motivation and vitality, with a moderating effect of affiliative motive (where a high affiliative motive reflects a wish for positive/warm relationships). The proposed mediation effect was evident but the moderating effect was not. Forms of communication (e.g., video chat) and class format (lecture/seminar) were both relevant to students' experiences of online learning.

Drueke et al. investigated the effect of the pandemic on online university education in Germany drawing on an extended version of the technology acceptance model. The authors showed that perceived usefulness and, to a lesser degree, perceived ease of use were the main predictors of attitudes toward distance learning. Moreover, the latter was associated with data security worries and the organization of online teaching, while the former was associated with general media affinity and pandemic-related worries.

In a sample of German master- and bachelor students, Hoss et al. found that learning opportunities and higher digital literacy depended on study progress and student characteristics. General self-efficacy, a private working space, anxiety, affect, age, and the perceived preparedness of lecturers for remote learning were identified as relevant variables explaining students' perceived probability of remote study success. The authors suggested that university students' digital literacy should be promoted early on.

In an online experiment, Mayweg-Paus et al. investigated the emotional stress caused by conflicting information on the pandemic. During discussions of textual information, participants in collaborative groups more often discussed the pandemic in general and less often engaged emotionally, as compared to individual responses. All participants reported higher perceived information overload, lower self-efficacy, and higher active coping strategies after the reflection task compared to before reading the information, with no significant differences between the collaborative groups and individuals. The authors stressed the importance of peer interaction and reflective skills when dealing with potentially stressful information.

Lim and Javadpour investigated effects on procrastination of university students across two semesters. They found that uncertainty and procrastination did not differ between prior to COVID-19 and the following semester. Uncertainty predicted procrastination, and students' life history strategy mediated the relation between uncertainty and procrastination. Uncertainty during the pandemic prompted students to psychologically shift their life history strategy such that it focused on present gains, which predicted procrastination.

METHODOLOGICAL APPROACHES

A variety of approaches were evident in terms of methodology. Most of the research for this special issue was cross-sectional and emerged from researchers' rapid responses to the extreme changes. Some articles used an experimental (Mayweg-Paus et al.), qualitative, or mixed methods approach, or conducted in-depth interviews (e.g., Mohr et al.; Simm et al.). A few surveys relied on existing large longitudinal studies, for example longitudinal data from the German Socio-Economic Panel (SOEP) (Zinn and Bayer) or NEPS (Haller and Novita; Lockl et al.; Vogelbacher and Attig). However, most studies were set up in direct response to the lockdowns of education institutions and used online questionnaires, gathering information from around hundred participants to several thousands.

SUMMARY

As we can read in this special issue people have employed a myriad of coping strategies, but various psychological burdens have also been reported in relation to the COVID-19 pandemic. The special issue demonstrates how differently this international crisis has been dealt with, how it has affected different parts of society differently, but it has also brought to our attention a range of coping mechanisms. We thank all 145 authors and the around 100 reviewers for their great commitment to this important and timely topic. We hope that beyond the COVID-19 crisis, this special issue will be useful to practitioners as well as researchers, as it offers important insights based on rigorous academic research.

AUTHOR CONTRIBUTIONS

KG, SF, TG, and KL contributed to conception and design of the special issue and the editorial. SF wrote the first draft of the introduction of the editorial. KG, SF, KS, TG, AL, and KL wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

BRIEF RESEARCH REPORT
published: 02 June 2021
doi: 10.3389/fpsyg.2021.672783

Undergraduate Students' Perceived Stress Levels in Summer Term 2020 – A Comparison to Preceding Academic Terms

Simone Antje Goppert and Maximilian Pfost*

Department of Educational Research, Institute of Education, University of Bamberg, Bamberg, Germany

The COVID-19 pandemic tremendously affected teaching and learning in both schools and higher education settings. In Germany, university students had to shift from in-person group learning in lectures and seminars to new forms of e-learning and distance teaching. Even before COVID-19, stress was a common experience among university students, and these changes have reinforced students' stress levels. Based on a sample of $n = 110$ German university students, this study explores whether students' perceived stress levels in summer term 2020 differed from their perceived stress levels in preceding academic terms. The results show that students experienced lower levels of stress and higher levels of joy in summer term 2020 compared to preceding academic terms. Despite limitations in the interpretation of these findings, possible explanations, such as changes in academic and non-academic workload or decreased demands in university exams, are discussed.

Keywords: perceived stress, higher education, e-learning, distance teaching, COVID-19

OPEN ACCESS

Edited by:
Sina Fackler,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Alberto Crescentini,
University of Applied Sciences and Arts of Southern Switzerland (SUPSI), Switzerland
Vanda Sieber,
University of Zurich, Switzerland

****Correspondence:***
Simone Antje Goppert
simone.goppert@uni-bamberg.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *26 February 2021*
Accepted: *06 May 2021*
Published: *02 June 2021*

Citation:
Goppert SA and Pfost M (2021) Undergraduate Students' Perceived Stress Levels in Summer Term 2020 – A Comparison to Preceding Academic Terms. Front. Psychol. 12:672783. doi: 10.3389/fpsyg.2021.672783

INTRODUCTION

University students often report substantial levels of perceived stress, especially during particularly challenging periods, such as the transition from school to university, which requires them to adapt to different forms of learning or develop a new identity as a university student (e.g., Perry et al., 2001; Denovan and Macaskill, 2017). The COVID-19 pandemic represents another such challenge for university teachers and students, as new forms of e-learning had to be established in a short period of time. Due to the need to adapt to these new forms of learning, it is likely that students' perceived stress has changed. Therefore, this study aims to explore university students' perceived stress levels in summer term 2020, which was strongly affected by the COVID-19 pandemic, in comparison with students in preceding academic terms.

THEORETICAL FRAMEWORK

Stress Experience and Higher Education

Stress arises from an interaction between a person and the environment (see, for example, the transactional stress model; Lazarus and Folkman, 1984). A situation is perceived as stressful if it "is appraised by the person as taxing or exceeding his or her resources and endangering his

or her wellbeing" (Lazarus and Folkman, 1984, p. 19). This means that experiencing stress is at least partially individual and subjective (Lazarus and Folkman, 1984; Lazarus, 1999; Fliege et al., 2001). Therefore, some people experience stress in a given situation, while others do not because they perceive and evaluate the same situation differently. It can be concluded that all kinds of changes in people's lives, including changes and transitions in the learning environment, can lead to an increased level of stress (e.g., Clinciu, 2013; Sohail, 2013; Denovan and Macaskill, 2017). This assumption is also transferable to the summer term 2020 under COVID-19 and its change from classroom teaching to distance teaching and online learning.

Overall, stress is a common experience for university students: In Germany, 53.1% of students report a high level of stress during their studies and 41.6% report a medium level. Only 5.3% report a low stress level (Herbst et al., 2016; see Hudd et al., 2000, for comparable data on US college students). Therefore, students in Germany report higher levels of stress than working adults (Herbst et al., 2016). This may be explained by the high number of stressors students faces at university, such as a high workload due to a large amount of learning material, frequent exams, and/or worries about their future (Zeidner, 1992; Bedewy and Gabriel, 2015; Herbst et al., 2016). Furthermore, difficulties in time management can also lead to stress for students (e.g., balancing time for learning with time for other activities, including paid work; Herbst et al., 2016). Finally, stress can have detrimental consequences for university students, such as poor academic performance (Sohail, 2013), mental or psychosomatic symptoms, such as dissatisfaction, restlessness, search for distraction, sleeplessness, difficulty concentrating, or listlessness (Herbst et al., 2016). Thus, if even a normal term can cause a lot of stress for university students, what happens in a pandemic situation like COVID-19?

Distance Learning During the COVID-19 Pandemic – A Stressful Challenge?

The COVID-19 pandemic led to enormous changes in learning conditions for school and university students worldwide within a short amount of time (e.g., Mishra et al., 2020). Universities had to digitalize their courses in order to continue to offer them to their students (Sahu, 2020). Studies on distance teaching and e-learning conducted ahead of COVID-19 show that distance teaching is a unique type of teaching and learning that is associated with different challenges than classroom teaching (Furlonger and Gencic, 2014), such as less face-to-face interaction with instructors and peers, technical difficulties, and less knowledge about course objectives (Furlonger and Gencic, 2014). In addition, 71% of students who regularly used an e-learning format reported dissatisfaction with the lack of connections to their fellow students (Song et al., 2004).

However, COVID-19 not only changed students' learning but also changed their private life as a result of governmental action to handle the pandemic (e.g., contact restrictions and travel restrictions). Some students may also have lost their part-time jobs, whereas other students may have moved house in order to study from their parents' home. Taken together, the shift from classroom teaching to distance teaching coupled with the challenges students faced in their private lives constitutes a process of change for students, which might therefore have had an impact on the students' stress experience.

THE PRESENT RESEARCH

The present study aims to explore differences in university students' perceived stress in summer term 2020 in comparison with preceding academic terms. The study was conducted with undergraduate students from the University of Bamberg, Germany. The University of Bamberg is a public university with four faculties and more than twelve thousand students enrolled in academic year 2019/2020 (Ruppert, 2020). Prior to COVID-19, most courses in the field of education sciences were held in-person. However, in summer term 2020, during the COVID-19 pandemic, most courses switched to online/distance teaching. In addition to these changes in university learning, students faced many challenges in their daily lives in summer term 2020 due to the pandemic-related regulations and restrictions. Consequently, these may have led to changes in their psychological wellbeing (e.g., Zacher and Rudolph, 2021) and stress. Furthermore, university workload may have changed and had an impact on stress, but due to a lack of prior assumptions, all studies were exploratory.

MATERIALS AND METHODS

Procedure

Data were collected as part of a broader evaluation of university students' learning at the University of Bamberg, Germany. This evaluation project aims to analyze the learning conditions and learning outcomes of university students within education sciences, with a particular emphasis on self-regulated learning. In this paper, we focus on education students enrolled in an introductory psychology lecture. This course was evaluated every semester since the winter term 2018/19. In the second half of the semester, students were invited to respond to a questionnaire that included a question on their perceived stress level. The introductory lecture has two parts, one offered in the winter and one in the summer term. Students are free to decide whether to begin the lecture in the winter or summer term. Consequently, some students participated in the study twice. In order to avoid dependencies within the data and consider every student just once, we conducted a random selection procedure. Therefore, just one of the two available questionnaires for each student with multiple participation time points were considered in our analyses. In summer term 2020, data collection started on June 23 and ended on July 9 (17 days).

Sample

Eighty-four university students participated once and 26 university students participated twice in our study. This resulted in a total sample of 110 university students, as students who participated twice were only considered once in our analyses (see procedure).

On average, the participating students were 21.64 years old and in their 1.87 semester of studies. Eighty-three percent of the students were female. Within the analyzed sample, 31 (28%) students responded to our questionnaire in winter term 2018/19, 33 (30%) students in summer term 2019, 26 (24%) students in winter term 2019/2020, and 20 (18%) students in summer term 2020. As the study focused on differences between students participating in the study in summer term 2020 compared to preceding terms, we checked for differences in age (preceding terms/summer term 2020: M = 21.45/22.45), semester (M = 1.83/2.05), and proportion of female students (82%/85%) between these two groups. None of the differences were significant.

Measures

Perceived Stress

Students' subjectively experienced stress was assessed with 20 items from the German short version of the *Perceived Stress Questionnaire* (PSQ, Fliege et al., 2001). Using four scales with five items per scale, the PSQ focuses on current subjectively perceived stress on a cognitive and affective level. In the scale introduction, students were asked to indicate how often these statements apply to their lives in general during the (online) lecture period. Each item consisted of a statement that had to be rated on a four-point Likert scale (1 = hardly ever, 2 = sometimes, 3 = frequently, and 4 = most of the time). Current sorrows and fear about the future (for example, "I have fears about the future") are summarized in the *worries* scale (Cronbach's α = 0.86). The *tension* scale encompasses difficulty relaxing or feelings of exhaustion (e.g., "I have difficulty relaxing"; Cronbach's α = 0.82). Perceived external *demands*, such as time pressure or having too much to do, are summarized in the demands scale (e.g., "I have too many things to do"; Cronbach's α = 0.77). Contrary to the first three scales, the *joy* scale focuses on positive experiences, such as having fun or feelings of security and protection (e.g., "I have the feeling that I am doing things I really like to do"; Cronbach's α = 0.80). As the items for this scale were formulated in a positive way, low scale scores, representing the absence of joy, indicate higher levels of perceived stress. Scale scores were estimated by calculating the arithmetic mean. There were hardly any missing responses. However, in the case of missing responses to single items, the arithmetic mean of the remaining items was taken.

Time Spent Attending University Courses

In order to estimate the time students typically spent attending university courses, we asked the following question: "How many hours have you spent attending university courses on average in a typical week this semester?" Responses were provided in an open-response format in hours per week. In summer term 2020, the question was changed slightly, as we asked about "online university courses" rather than "university courses."

Additional Questions in Summer Term 2020

Some additional questions concerning specifics of the online learning situation were added to the questionnaire used in summer term 2020. With respect to *changes in stress level*, we asked "In comparison to a semester with in-person teaching, I have the impression that my stress level has … due to online teaching." Responses were provided on a seven-point Likert scale (1 = strongly decreased, 4 = remained equal, and 7 = strongly increased). Using the same response options, we also asked about *changes in individual workload* ("In comparison to a semester with in-person teaching, I have the impression that my workload has … due to online teaching.").

Data Analytic Strategy

First, descriptive statistics and correlations were estimated using IBM SPSS Version 26. In order to analyze differences in perceived stress, a dummy variable distinguishing between semesters with in-person teaching (winter term 2018/19, summer term 2019, and winter term 2019/20; coded as 0) and the semester of online teaching (summer term 2020; coded as 1) was generated. In addition, effect sizes d were estimated based on the standard deviation of all analyzed students, and differences were tested using Welch's t-test.

In order to test for differences in perceived stress, a latent variable based on the manifest stress scales was estimated using Mplus 8.4 (Muthén and Muthén, 1998–2017). The dummy variable for in-person vs. online teaching was used as a predictor variable. In a second model, we tested whether the effect of in-person vs. online teaching was mediated by time spent attending university courses. In the latent models, we used an MLR estimator and treated missing data with FIML. Model fit was evaluated based on recommendations by Schermelleh-Engel et al. (2003).

RESULTS

Descriptive Statistics

Means and standard deviation of the PSQ scales and the time students spent attending university courses are presented in **Table 1**. Correlations are shown in **Table 2**. In comparison with the preceding terms, the descriptive statistics show the lowest perceived stress scores on the worries, tension, and demands scales and the highest scores on the joy scale in summer term 2020, the period of online teaching. These descriptive differences were significant for the worries and joy scales. Furthermore, students spent a lower number of hours attending university courses in summer term 2020 compared to the preceding terms. Strong correlations among the worries, tension, and demands stress scales were found, whereas joy was negatively correlated with these scales. The time students spent attending university courses was not significantly related to the PSQ scales.

Latent Variable Analyses

In order to test for differences in perceived stress while taking measurement error into account, a latent variable approach was followed. First, we estimated a latent stress variable based on manifest scale scores for all four PSQ scales. The joy scale was inverted so that all scales pointed in the same direction. With the exception of the first variable, factor loadings and means were not constrained (τ-congeneric model; Steyer, 2001;

TABLE 1 | Means and standard deviations.

	All terms (n = 110)	Winter term 2018/19 (n = 31)	Summer term 2019 (n = 33)	Winter term 2019/20 (n = 26)	Summer term 2020 (n = 20)	Diff. all terms	Contrast	
	M (*SD*)[1]	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)[1]	Value of *p*	*d*	Value of *p*
PSQ-worries	2.15 (0.71)	2.14 (0.55)	2.36 (0.78)	2.18 (0.78)	1.80 (0.61)	$p < 0.05$	−0.61	$p < 0.01$
PSQ-tension	2.22 (0.60)	2.23 (0.62)	2.41 (0.61)	2.12 (0.58)	2.00 (0.53)	*ns*	−0.43	*ns*
PSQ-demands	2.21 (0.59)	2.29 (0.60)	2.33 (0.60)	2.09 (0.61)	2.06 (0.54)	*ns*	−0.32	*ns*
PSQ-joy	2.69 (0.58)	2.64 (0.58)	2.60 (0.63)	2.64 (0.54)	2.96 (0.48)	*ns*	0.59	$p < 0.01$
Courses (h)	14.39 (5.64)	15.23 (4.67)	12.97 (4.18)	16.92 (5.77)	12.05 (7.58)	$p < 0.05$	−0.50	*ns*

[1]*Transformed PSQ scale scores ((x – 1)/3) to compare with Sieber et al. (2020) are for all terms (row 1): worries: M = 0.38; tension: M = 0.41; demands: M = 0.40; and joy: M = 0.56 and for summer term 2020 (row 5): worries: M = 0.27; tension: M = 0.33; demands: M = 0.35; and joy: M = 0.65. Diff. all terms indicates values of p on robust ANOVA (Welch's t-test) between all terms (four groups). Contrast indicates effect sizes of the difference between summer term 2020 and the mean of the three remaining terms (two groups); estimation of effect size d is based on the standard deviation of all students across all terms; and furthermore, within the last column, values of p on Welch's t-test for this contrast are provided.*

TABLE 2 | Correlations.

S. No.		1	2	3	4	5
1.	PSQ-worries	–				
2.	PSQ-tension	0.65**	–			
3.	PSQ-demands	0.54**	0.68**	–		
4.	PSQ-joy	−0.50**	−0.47**	−0.27**	–	
5.	Courses (h)	−0.11	−0.13	−0.09	−0.05	–

$^{**}p < 0.01$.

Steyer and Eid, 2001). The implied variance-covariance structure did not fit the empirical variance-covariance structure well, resulting in a low model fit (χ^2 = 10.90, df = 2, $p < 0.05$; RMSEA = 0.20; CFI = 0.93). This low model fit was primarily due to the joy scale, which did not correspond well with the other three PSQ scales. Therefore, a latent stress variable based on the three remaining PSQ scales was estimated. In order to ensure model identification, all factor loadings were set to be equal (essential τ-equivalent model; Steyer, 2001; Steyer and Eid, 2001). Model fit was acceptable to good (χ^2 = 3.06, df = 2, *ns*; RMSEA = 0.07; CFI = 0.99).

Next, a dummy variable indicating whether students participated at the study in summer term 2020 (online teaching; coded as 1) or before summer term 2020 (in-person teaching; coded as 0) was added (χ^2 = 6.17, df = 4, *ns*; RMSEA = 0.07; CFI = 0.98). The dummy variable negatively predicted the latent perceived stress variable ($B = -0.27$, SE = 0.12, $p < 0.05$; standardized parameter $\beta = -0.21$). Therefore, students indicated lower perceived stress in summer term 2020 compared to the preceding terms.

Finally, we estimated a model that additionally took students' time spent attending university courses as a possible mediator into account (**Figure 1**). Model fit was satisfactory (χ^2 = 6.59, df = 6, *ns*; RMSEA = 0.03; CFI = 1.00). The results show that the dummy variable indicating participation in summer term 2020 still negatively predicted perceived stress. However, the dummy variable did not predict the time students spent attending university courses. The time students spent attending university courses was negatively related to students' perceived stress. The more hours students spent attending university courses, the less stress these students perceived. Finally, the results do not reveal any indirect effect of the dummy variable indicating participation in summer term 2020 on perceived stress via time spent attending university courses (B_{Ind} = 0.05, SE = 0.04, *ns*; standardized parameter β_{Ind} = 0.03).

Additional Analyses

In order to check the PSQ results, students in summer term 2020 provided a self-rating on perceived differences in their stress level and workload between online and in-person teaching. Concerning stress level, a mean of M = 3.85 (SD = 1.50; 95% CI from 3.24 to 4.50) was found. This is slightly below the scale's theoretical mean. Therefore, despite substantial individual variability, students did not report increased stress due to online teaching on average. For workload, a mean of M = 4.90 (SD = 1.45; 95% CI from 4.25 to 5.50) was found, which slightly exceeded the scale's theoretical mean. Consequently, students indicated having a higher workload on average.

DISCUSSION

Findings and Practical Implications

Contrary to our assumptions, the results showed that students did not report increased stress in summer term 2020 compared to preceding academic terms. Rather, the results indicate that the students experienced fewer worries and more joy in their studies. Our conclusion is further supported by a comparison of the scale means with other studies using the PSQ (e.g., Sieber et al., 2020). Furthermore, our data showed no sign of increasing workload due to increasing hours spent in university courses, and consequently, time spent by students in university courses did not prove to be a significant mediator variable. With respect to these results concerning perceived stress and wellbeing, it is important to note that there were some positive changes to university learning conditions for students during and after the first wave of the COVID-19 pandemic in addition to the negative changes. For example, students no longer needed to get up early to travel to the university for class, and recorded lectures gave students more flexibility in managing their time.

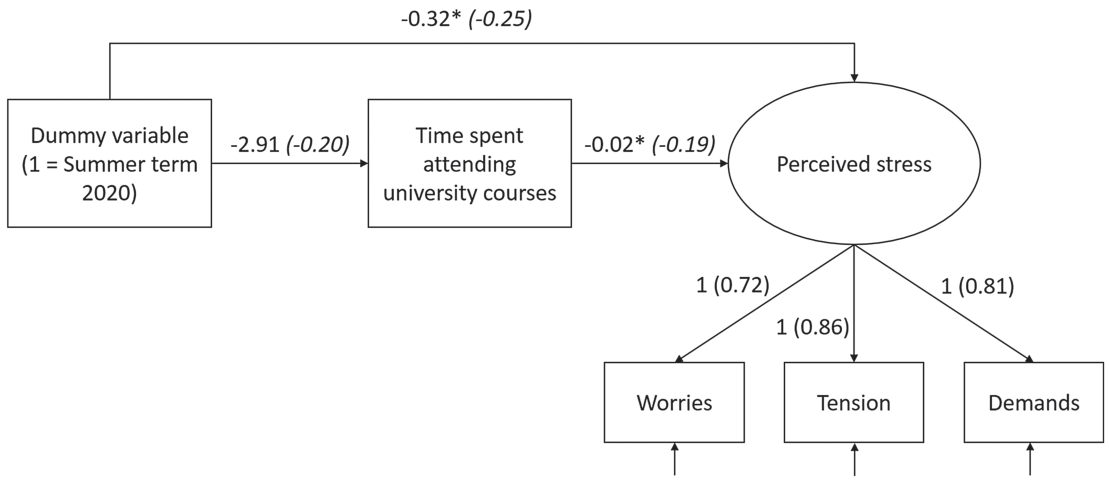

FIGURE 1 | Latent variable model. In addition to the unstandardized coefficients, standardized coefficients are shown in brackets. $^{*}p < 0.05$.

Furthermore, the maximum number of failed exam attempts allowed before expulsion from a study program was suspended (normally there are only two failed attempts), meaning that students faced less pressure to perform. Non-university-related factors could also have had a positive influence on students' stress experience, such as working fewer hours in a part-time job or fewer opportunities for leisure activities, which gave students more time for university and led to less stress in the leisure and work domains. Finally, the time period of data collection coincided with a general trend of decreasing infection rates in Germany (Robert Koch Institute, 2020), which may have had a positive impact on students' psychosocial wellbeing.

All in all, it seems that distance learning and teaching in summer term 2020 did not necessarily negatively influence students' stress experience. However, our findings are merely a one-time snapshot of how COVID-19 changed students' stress experience and psychological wellbeing; further monitoring of students' stress and wellbeing in the forthcoming terms after summer term 2020 still seems worthwhile.

Limitations and Future Directions

A first limitation of our study is the small sample size for summer term 2020. The small and uneven sample leads to inferential statistics with large standard errors and estimates of low precision. Furthermore, as our sample consisted solely of education sciences students, caution is warranted when generalizing the results to other fields of study. Indeed, access to the university environment (e.g., laboratories) is more important for other disciplines (e.g., chemistry and medicine). Finally, our study did not ask students about coping strategies. Thus, it is not possible to provide detailed reasons for our findings.

CONCLUSION

Stress research is an important topic for universities. Based on the previous stress research, we initially assumed that the COVID-19 pandemic and resulting changes in university teaching would have a negative impact on students' stress experience. This was not supported by our data. Instead, it must be assumed that students have the necessary coping strategies to deal with the consequences of changing learning conditions during the pandemic. Going beyond these findings, the changes in teaching and learning necessitated due to COVID-19 can be seen as an opportunity to develop new forms of teaching and learning at universities (e.g., lectures in audio and video podcasts), which can hopefully enrich university education in the long term.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because of privacy restrictions. Requests by qualified researchers to access the minimal set of variables used in the study should be directed to the authors. Requests to access the datasets should be directed to simone.goppert@uni-bamberg.de or maximilian.pfost@uni-bamberg.de.

ETHICS STATEMENT

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors were involved throughout the study, wrote the manuscript, and approved the final manuscript. SG organized data collection. MP performed the statistical analyses presented in the final manuscript.

REFERENCES

Bedewy, D., and Gabriel, A. (2015). Examining perceptions of academic stress and its sources among university students: the perception of Academic Stress Scale. *Health Psychol. Open* 2:2055102915596714. doi: 10.1177/2055102915596714

Clinciu, A. I. (2013). Adaptation and stress for the first year university students. *Procedia. Soc. Behav. Sci.* 78, 718–722. doi: 10.1016/j.sbspro.2013.04.382

Denovan, A., and Macaskill, A. (2017). Stress and subjective well-being among first year UK undergraduate students. *J. Happiness Stud.* 18, 505–525. doi: 10.1007/s10902-016-9736-y

Fliege, H., Rose, M., Arck, P., Levenstein, S., and Klapp, B. F. (2001). Validierung des "perceived stress questionnaire" (PSQ) an einer deutschen Stichprobe [Validation of the "Perceived Stress Questionnaire" (PSQ) in a German sample.]. *Diagnostica* 47, 142–152. doi: 10.1026//0012-1924.47.3.142

Furlonger, B., and Gencic, E. (2014). Comparing satisfaction, life-stress, coping and academic performance of counselling students in on-campus and distance education learning environments. *Aust. J. Guid. Couns.* 24, 76–89. doi: 10.1017/jgc.2014.2

Herbst, U., Voeth, M., Eidhoff, A. T., Müller, M., and Stief, S. (2016). Studierendenstress in Deutschland – eine empirische Untersuchung [Study stress in Germany - an empirical study]. Available at: https://www.ph-ludwigsburg.de/uploads/media/AOK_Studie_Stress.pdf (Accessed February 02, 2021).

Hudd, S. S., Dumlao, J., Erdmann-Sager, D., Murray, D., Phan, E., and Soukas, N., et al. (2000). Stress at college: effects on health habits, health status and self-esteem. *Coll. Stud. J.* 34, 217–227.

Lazarus, R. S. (1999). *Stress and Emotion: A New Synthesis*. New York, NY: Springer Publishing Company.

Lazarus, R. S., and Folkman, S. (1984). *Stress, Appraisal, and Coping*. New York, NY: Springer Publishing Company.

Mishra, L., Gupta, T., and Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *Int. J. Educ. Res.* 1:100012. doi: 10.1016/j.ijedro.2020.100012

Muthén, L. K., and Muthén, B. O. (1998–2017). *Mplus User's Guide. 8th Edn*. Los Angeles, CA: Muthén and Muthén.

Perry, R. P., Hladkyj, S., Pekrun, R. H., and Pelletier, S. T. (2001). Academic control and action control in the achievement of college students: a longitudinal field study. *J. Educ. Psychol.* 93, 776–789. doi: 10.1037/0022-0663.93.4.776

Robert Koch Institute. (2020). Coronavirus Disease 2019 (COVID-19). Daily situation report of the Robert Koch Institute 09/07/2020. Available at: https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Situationsberichte/2020-07-09-en.pdf?__blob=publicationFile (Accessed April 22, 2021).

Ruppert, G. (Ed.) (2020). *Mit klarem Profil durch den Wandel [With a Distinct Profile Through Change]*. Bamberg, Germany: University of Bamberg Press.

Sahu, P. (2020). Closure of universities due to Coronavirus Disease 2019 (COVID-19): impact on education and mental health of students and academic staff. *Cureus* 12:e7541. doi: 10.7759/cureus.7541

Schermelleh-Engel, K., Moosbrugger, H., and Müller, H. (2003). Evaluating the fit of structural equation models: tests of significance and descriptive goodness-of-fit measures. *Methods Psychol. Res. Online* 8, 23–74.

Sieber, V., Hüppi, R., and Praetorius, A.-K. (2020). Teaching, motivation, and well-being during COVID-19 from the perspective of university students and lecturers. *Zenodo* 1–24. doi:10.5281/zenodo.4020377

Sohail, N. (2013). Stress and academic performance among medical students. *J. Coll. Physicians Surg. Pak.* 23, 67–71. doi: 10.2013/JCPSP.6771

Song, L., Singleton, E. S., Hill, J. R., and Koh, M. H. (2004). Improving online learning: student perceptions of useful and challenging characteristics. *Internet High. Educ.* 7, 59–70. doi: 10.1016/j.iheduc.2003.11.003

Steyer, R. (2001). "Classical test theory" in *International Encyclopedia of the Social and Behavioural Sciences. Logic of Inquiry and Research Design*. eds. C. Ragin and T. Cook (Oxford: Pergamon), 481–520.

Steyer, R., and Eid, M. (2001). *Messen und Testen [Measurement and Testing]*. Berlin: Springer.

Zacher, H., and Rudolph, C. W. (2021). Individual differences and changes in subjective wellbeing during the early stages of the COVID-19 pandemic. *Am. Psychol.* 76, 50–62. doi: 10.1037/amp0000702

Zeidner, M. (1992). Sources of academic stress: the case of first year Jewish and Arab college students in Israel. *High. Educ.* 24, 25–40. doi: 10.1007/BF00138616

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 02 June 2021
doi: 10.3389/fpsyg.2021.672741

Self-Regulated Resource Management in Emergency Remote Higher Education: Status Quo and Predictors

Nick Naujoks[1], Svenja Bedenlier[1], Michaela Gläser-Zikuda[1], Rudolf Kammerl[1], Bärbel Kopp[1], Albert Ziegler[2] and Marion Händel[2]**

[1]Department of Education, Friedrich-Alexander University Erlangen-Nuremberg, Erlangen, Germany, [2]Department of Psychology, Friedrich-Alexander University Erlangen-Nuremberg, Erlangen-Nürnberg, Germany

Because of the COVID-19 pandemic in the spring term 2020, students faced a sudden change from on-campus learning to online learning with synchronous and asynchronous online courses (emergency remote teaching). To study successfully, students not only needed to be prepared in terms of digital readiness (workspace, IT equipment, previous online learning experiences, and sharing information online), they also faced challenges that pertained to the self-regulated management of external resources (environment structuring, time management, and help-seeking). In the current study, we investigated students' digital readiness for the sudden switch to online learning; differences between students' intended and actual use of external resource management strategies; and the influence of students' digital readiness on their actual use of resource management strategies. Students enrolled in a full-scale, German university (N = 662) answered two online questionnaires (before and in the middle of the term). Descriptive statistics indicated that students seemed to be ready to study online. However, repeated measures ANOVA showed that students were not able to manage their resources during the term as frequently as intended. Finally, separate regression analyses revealed that availability of workspace and IT equipment predicted the use of environment structuring strategies. Additionally, IT equipment and information sharing behavior predicted students' help-seeking. Based on the current results, we discuss implications for the promotion of student self-regulated learning (SRL) in online emergency remote teaching based on both external resources and digital readiness.

Keywords: emergency remote teaching, resource management strategies, digital readiness, higher education, self-regulated learning

Edited by:
Kathrin Lockl,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Jun Wei,
Tsinghua University, China
Olivia López Martínez,
University of Murcia, Spain

****Correspondence:***
Nick Naujoks
nick.naujoks@fau.de
Marion Händel
marion.haendel@fau.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *26 February 2021*
Accepted: *30 April 2021*
Published: *02 June 2021*

Citation:
Naujoks N, Bedenlier S, Gläser-Zikuda M, Kammerl R, Kopp B, Ziegler A and Händel M (2021) Self-Regulated Resource Management in Emergency Remote Higher Education: Status Quo and Predictors. Front. Psychol. 12:672741. doi: 10.3389/fpsyg.2021.672741

INTRODUCTION

Learning in higher education institutions requires students to manage their learning process, that is, to self-regulate their learning (Dresel et al., 2015). More specifically, online and distance learning settings with high demands on student autonomy require skills to self-regulate one's learning (Barnard et al., 2009; Bol and Garner, 2011). This applies especially to the spring

term 2020, the first online term to deliver all learning material remotely. Due to the COVID-19 pandemic, on-site universities had to switch immediately to online distance education. This so-called emergency remote teaching (Hodges et al., 2020) produced several residual effects. Students' learning material changed from predominantly paper-and-pencil to digital tools and materials. Their learning spaces changed from classrooms or libraries to their homes, and regular in-person higher education courses were either asynchronous or synchronous online courses. These changes placed tremendous demands on students' self-regulated learning (SRL), especially for student application of strategies that regulate their resources.

For example, more so during the COVID-19 pandemic than under regular circumstances, students needed to regulate their physical learning environment. That is, students needed to find a suitable place to study while avoiding possible distractions during at-home study periods. Additionally, students had to keep track of their time management because of the partial absence of regular weekly courses, the mix of synchronous and asynchronous courses, and self-paced processing of asynchronous learning materials. Finally, they had to find new ways to communicate with their peers and lecturers, especially when they were seeking help. For example, it might have been more difficult to start an informal conversation with lecturers or fellow students due to the intermingling of asynchronous and synchronous events.

In the current study, we investigated how students coped with these changing and challenging learning conditions. First, we analyzed students' preconditions (i.e., equipment, skills) to study exclusively online. Second, we investigated students' use of resource management strategies with a focus on structuring the learning environment, time management, and help-seeking. Finally, we analyzed how students' use of resource management strategies was related to their intended use of those strategies, as well as students' preconditions for learning remotely.

Theoretical Background

Demands of Online Learning

Online learning can be distinguished by several characteristics like modality (fully online, blended, and web-enabled face-to-face), pacing (self-paced or class-paced), assumed student roles, or synchronicity (Moore et al., 2011; Means et al., 2014). However, online learning at the beginning of the COVID-19 pandemic cannot be transferred 1:1 to these types of online learning scenarios as students faced a mix of different types of e-learning schemes. Teachers and students did not voluntarily decide to participate in online learning, but the unique circumstances brought about by the COVID-19 pandemic forced them to do so (Means and Neisler, 2020). Accordingly, what transpired during the spring term 2020 can be considered as a new type of online learning, labeled emergency remote teaching, or emergency remote education (Bozkurt et al., 2020; Hodges et al., 2020).

Students had nary any time to prepare for this exceptional situation and as a result, may have embarked on the online learning term with different preconditions (Beaunoyer et al., 2020; Czerniewicz et al., 2020; Händel et al., 2020a). In order to optimally participate in online education, students needed a quiet workspace and appropriate IT equipment, such as computer hard- and software (e.g., notebook and internet access). In addition to technical equipment, students had to depend on computer literacy skills and had to ask for information regarding course content and organizational aspects to cope with the new mode of learning. Hong and Kim (2018) refer to such actions of students as information sharing behavior. In line with Hong and Kim (2018), the European Council (2006) argues that students should be able to use "computers to retrieve, assess, store, produce, present, and exchange information and to communicate [online]" (p. 13). Indeed, to meet educational aims, students needed abilities to participate in courses that exclusively relied on web-based material and web-based interaction (Hong and Kim, 2018; Küsel et al., 2020). For the spring term 2020 in particular, students had to meet these conditions to ensure successful participation in emergency remote teaching. Therefore, and in contrast to regular (on-site) terms, students' digital readiness to participate in emergency remote teaching is displayed by their workspace availability, equipment, previous experiences with online learning, and information sharing behavior.

In general, online learning environments are more self-paced than on-site and in-person learning situations (McBrien et al., 2009; Broadbent, 2017; Bruso et al., 2020). Students have higher autonomy regarding place and time, where and when to study. Accordingly, self-regulation becomes a critical factor for success in online learning (Jansen et al., 2017; Kocdar et al., 2018); for a comprehensive overview, we refer to recent review articles (Hodges, 2005; Broadbent and Poon, 2015; Garcia et al., 2018; Wong et al., 2019; Anthonysamy et al., 2020a; Martin et al., 2020). For example, in a study with students from blended learning courses, students experienced greater possibilities to self-regulate their learning in online learning situations than they did for in-person learning conditions (Lee and Tsai, 2011). However, students with more experience with online courses did not necessarily make more use of online self-regulated learning strategies (Bruso et al., 2020). In essence, emergency remote teaching may force students to face an even greater need to self-regulate their learning resources compared to students who chose to participate in self-paced, distance learning environments (Carter et al., 2020).

Resource Management Strategies in Online Learning Environments

Self-regulated learning means that students plan, monitor, and regulate their learning (Winne and Hadwin, 1998; Panadero, 2017). Models of self-regulated learning usually distinguish three main types of learning strategies – namely cognitive, metacognitive, and resource management strategies (Pintrich et al., 1991; Pintrich, 1999). While cognitive and metacognitive strategies are concerned ways of learning to understand content (e.g., *via* elaborating on the content or *via* monitoring understanding), resource management strategies pertain to the design of individual learning conditions. The current research

focused on resource management strategies toward creating optimal learning conditions (Waldeyer et al., 2019). We argue that under the conditions of a pandemic with physical distancing, restricted access to campus or libraries, and changing formats of learning (shift from traditional learning to online learning), it is of special importance to manage one's internal and external resources for learning.

Resource management strategies are strategies that aim to manage and control one's learning environment (Pintrich, 1999; Vrugt and Oort, 2008). These include regulation of internal resources (effort, motivation) as well as external resources (study environment, time management, and help-seeking). Significant relations with academic achievement (Vrugt and Oort, 2008; Waldeyer et al., 2019), especially in online learning settings (Tsai et al., 2013; Broadbent and Poon, 2015), demonstrate the importance of resource management strategies in higher education. In the following, we focus especially on external resource management strategies.

When learning online and at a distance, students do not have access to a structured learning environment like classrooms, libraries, and learning and computer labs. They need to regulate their physical learning environment; that is, they need to decide where to study – e.g., in which room and ideally with no or limited possibilities for distraction (Lynch and Dembo, 2004). If lectures, rather than being physical live sessions, are recorded and if communication takes place online (either synchronous or asynchronous), timetables will need to be rescheduled and students will need to keep track of their time management (Song et al., 2004; Mahasneh et al., 2012; Kim et al., 2019). If physical isolation leads to low social presence, interactions with peers and lecturers might be hindered and students might remain invisible (Bedenlier et al., 2020). In addition, when students need help, they are required to develop other strategies of help-seeking than they typically would in regular physical interaction. However, online-based help-seeking might also have advantages that lead to more frequent use of help-seeking strategies (Kitsantas and Chow, 2007; Hao et al., 2016). For example, asynchronous communication allows for the posing of questions at any time – with the caveat that answers to those questions might not be immediately provided. With regard to seeking help from persons of higher status (teachers), the lack of social status cues might serve to facilitate help-seeking behavior (Mahasneh et al., 2012). Current research found low levels of interaction, while teacher-student interaction happened more often than student-student interaction (Hamdan et al., 2021).

To gain insights into self-regulated learning and resource management strategies especially in online higher education, existing questionnaire instruments are contextualized to the online or blended learning environment (Barnard et al., 2009; Jansen et al., 2017). Research before emergency remote teaching and learning focused on (the development of) both self-regulated learning within specific online learning environments like massive open online courses or blended learning scenarios and self-regulated learning's relationship with academic achievement (Tabuenca et al., 2015; Kizilcec et al., 2017; Garcia et al., 2018; Jivet et al., 2020). In addition, the use of self-regulated learning strategies between different types of online education like fully online vs. blended or traditional courses is compared (Broadbent, 2017). Results of those studies, however, might not be transferrable to the situation of emergency remote teaching. Before the pandemic, students voluntarily self-selected online or distance education. Usually, students studying in online (distance) courses resemble a different student population than traditional on-site students. Those differences are contingent upon on age, vocational education, work situation, or family situation (Yukselturk and Top, 2012; Broadbent, 2017). That is, it remains unclear how traditional students would cope with the shift from traditional on-site courses to (asynchronous) online courses.

Still, the results of those studies provide interesting insights into self-regulated learning in online education. First, keeping in mind the limitations regarding student characteristics, it seems that strategy application differs between different delivery formats of education. For example, Broadbent (2017) found that students participating in online settings used time management strategies more often compared to students learning in blended learning settings. Regarding help-seeking strategies, the literature provides heterogeneous findings: in the studies by Shea and Bidjerano (2012) and Broadbent (2017), help-seeking strategies were more often implemented in blended compared to online learning. This contrasts with findings by Kitsantas and Chow (2007), both of whom investigated several perspectives of intended help-seeking behavior. It is likely that social presence coupled with the modality of the courses are moderators of help-seeking behavior (Shea and Bidjerano, 2012; Molinillo et al., 2018). According to several empirical studies, there exists a strong connection between self-regulated learning and students' digital readiness. Anthonysamy et al. (2020b) demonstrated a significant and positive link between students' cognitive, technical, and socio-emotional abilities in order to participate in online learning and students' use of resource management strategies. In line with these findings, Greene et al. (2018) found evidence that self-regulated learning strategies play a major role in developing such skills for online learning. Likewise, Kiliç-Çakmak (2010) showed that the use of internal resource management strategies predicted students' abilities to assess and communicate information. However, the study lacks information on external resource management strategies. To sum up, existing research focuses mostly on self-regulated learning strategies as prerequisite for students' ability to develop online learning skills (Hung et al., 2010). In contrast to that focus, Muthupoltotage and Gardner (2018) investigated the interrelationship between the aforementioned skills and self-regulated learning strategies. They found empirical evidence that students' technical and operational skills to participate in online learning predicted their use of strategies to structure their learning environment. In addition, students' abilities to search and communicate information significantly predicted their use of help seeking strategies. However, the cited studies are methodically limited to cross-sectional surveys with one occasion of measurement and used instruments like the Motivated Strategies for Learning Questionnaire (MSLQ) that are not specifically designed to assess strategies in online learning settings.

Considering students' experiences with online courses (number of online courses taken), higher education students in the study by Bruso et al. (2020) did not differ in their use of online self-regulated learning strategies (including resource management strategies). Similarly, a study with freshmen students in their first online term indicates that they did not improve in their use of self-regulated resource management strategies within one study term (Barnard-Brak et al., 2010). These non-significant pre-post comparisons regarding resource management strategies indicate that online courses do not necessarily foster self-regulated learning. In detail, students did not change their strategy use regarding environment structuring, time management, or help-seeking. Again, students in that study were older students who actively self-selected the online learning course and were aware of the required autonomy within the course. In addition, the offered course format was exclusively asynchronous, administered *via* an online learning course management and delivery system. Hence, it remains unclear how those results transfer to students' resource management within a non-voluntary situation of studying remotely.

Aims and Research Questions

The current study took place during an exceptional situation of emergency remote teaching and learning. Students neither actively decided nor were they prepared for a digital semester. Hence, the current study investigated students' readiness for digital learning, students' self-regulated learning, and the relationship between the two. In detail, we posed the following research questions:

First, to gain insights into higher education student readiness for online learning, we investigated students' equipment, prior experiences with online learning, and their information-sharing behavior (ISB).

Q1: How ready are higher education students for online learning?

Second, we investigated students' implementation of external resource management strategies during the term and how this related to students' intentions before they experienced emergency remote teaching.

Q2a: To what extent do students plan and implement different external resource management strategies when experiencing emergency remote teaching?
Q2b: Does students' use of external resource management strategies during the term differ from their intended use of external resource management strategies before entering emergency remote teaching?

Third, we examined whether students' readiness for online learning is relevant to their use of resource management strategies during the term in which they faced emergency remote teaching.

Q3: How do students' availability of equipment, previous experience with online learning, and information sharing behavior influence their self-regulated learning within remote emergency teaching?

MATERIALS AND METHODS

Participants

We recruited students from one large, full-scale German university. Considering only students who completed both the first and second measurement, the number of participants was $N = 662$. Their mean age at the first assessment was 22.9 years ($SD = 4.7$) across all semesters; 66.8% of participants were female students. Across all five faculties of the university, students participated voluntarily in the survey (Faculty of Humanities, Social Sciences, and Theology: $n = 181$; Faculty of Sciences: $n = 93$; Faculty of Business, Economics, and Law: $n = 140$; Faculty of Engineering: $n = 140$; Faculty of Medicine: $n = 108$). Similarly, students from different study programs participated in the online survey (bachelor: $n = 247$; master: $n = 154$; state exam: $n = 235$; doctoral degree: $n = 8$; and others: $n = 11$). About 5% of the students lived with children with on-site childcare. The distribution of students across faculties, study programs, and students with/without children is in accordance with the university's student population.

Procedure

This paper reports on the results of a longitudinal, pre-registered study[1] during the spring term 2020 in Germany. University students participated in an online survey with three measurements. To answer the research question, the current study focuses on the first two of three measurements, namely the measurements in April 2020 and in June 2020 (the middle of the term), directly before the spring term 2020 had started and when students had already completed 7 weeks of online courses, respectively (see **Figure 1**). Students were informed that each online survey would take approximately 20 min and that the survey concerns student learning in the sudden online term. The online survey was administered in the German language and was rolled out *via* the platform Unipark Questback EFS.[2]

We protected participants' privacy in accordance with the institutional commissioner for data protection. Students were not disadvantaged because of non-participation. At the beginning of the questionnaire, the participants gave their informed consent to participate in the study. All data were in pseudonymous form and students yielded an individual password for data matching purposes.

Instruments

The online survey comprised socio-economic information and several standardized scales. First, students provided information on their individual backgrounds and on their current choice of study. We assessed age, gender, children, and study-related factors (current semester, faculty of the study program enrolled in, and intended degree). Next, students answered questionnaire scales to assess digital readiness as prerequisites and management of resources as outcomes of their learning. Students answered

[1]https://osf.io/68aus/
[2]unipark.com

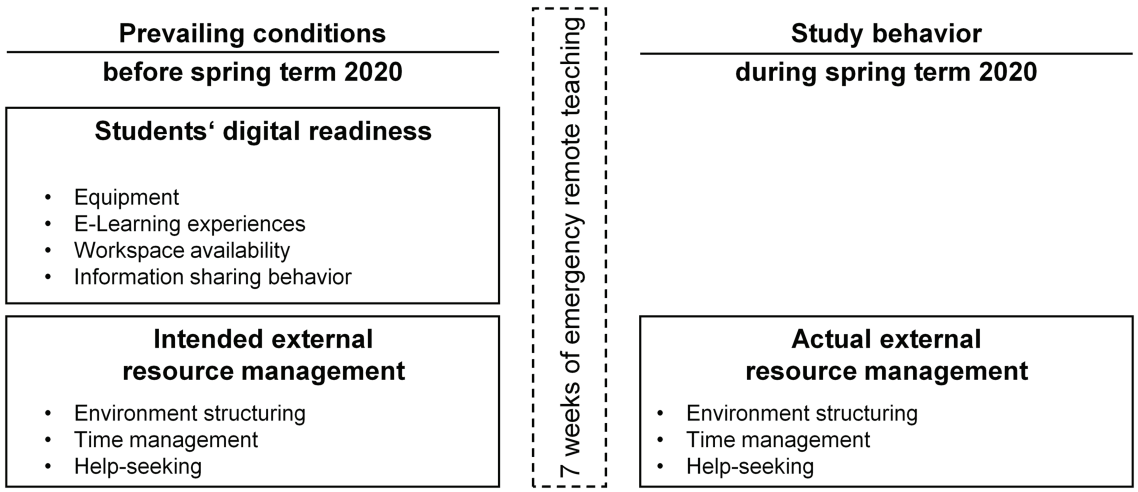

FIGURE 1 | Assessed constructs and variables at both measurement time points.

questions about their technical equipment, previous experiences with online learning tools, availability of a quiet workspace, and about their information sharing behavior. Finally, we assessed students' use of external resource management strategies *via* three subscales (environment structuring, time management, and help-seeking).

Students' Digital Readiness

Students' workspace availability, equipment, previous experiences with online learning, and information sharing behavior were indicators of students' readiness to engage in online learning. These variables represented the prevailing conditions with which students started the emergency remote term and include both external (workspace and equipment) and personal factors (experiences and information sharing behavior).

Workspace Availability

We asked students about the availability of a workspace that offered the possibility to study without disruption. The item was dichotomous (0 "no workspace available," 1 "available workspace").

Equipment

Regarding students' equipment, we assessed whether they had access to certain devices or not, namely desktop PC, notebook, tablet, smartphone, scanner, printer, and internet access. The variable equipment represents the sum score of available devices and ranged from 0 to 7.

E-learning Experiences

We assessed students' previous experiences with online learning in a similar manner. Students rated whether they had been working with one of the following tools of online learning before the spring term of 2020: downloadable scripts, recorded lectures, livestreams of lectures, use of digital live voting or live feedback, online communication and online teamwork, electronic exams, and online self-testing. The variable E-learning reflects the sum score of online learning features, students had experienced before entering the remote emergency term. The score ranged from 0 "no experiences" to 9 "experiences with all tools."

Information-Sharing Behavior

As an additional indicator for students' digital readiness, we focused on the scale for ISB from the digital readiness for academic engagement questionnaire (Hong and Kim, 2018). The scale comprised four items and was internally consistent with Cronbach's $\alpha_1 = 0.82$. An example item was: "I can interact with classmates using real-time communication tools, for example, video conferencing tools or messengers." Students answered the items on a six-point Likert scale, ranging from 1 "not true at all" to 6 "absolutely true."

Online Self-Regulated Learning

The online self-regulated learning questionnaire (OSLQ; Barnard et al., 2009) measures self-regulated learning in the online learning environment as active and volitional behavior for learning successfully. We focused on three subscales addressing strategies used for external resource management according to the theoretical framework by Winne and Hadwin (1998), namely environment structuring, time management[3], and help-seeking. In contrast to other taxonomies of self-regulated learning strategies (e.g., Waldeyer et al., 2019), we included time management as an external resource rather than an internal resource because. Students answered all items of the three subscales: environment structuring, time management, and help-seeking, at both measurements; that is, before as well as

[3]In emergency remote teaching external factors (e.g., deadlines and limited time on task) predetermine the extent to which students have to regulate their study time (Wolters and Brady, 2020). Therefore, in accordance with the model by Winne and Hadwin (1998), we assign time management to the external resource management strategies even though other taxonomies of self-regulated learning strategies consider time management as internal resource (e.g., Waldeyer et al., 2019).

during the term. The only difference was how we introduced the items. Before the courses had started in April 2020, we asked students to think about how they plan to learn in online environments in the upcoming term. During the term, students reported on their actual learning behavior. All items had to be answered on a six-point Likert scale, ranging from 1 "not true at all" to 6 "absolutely true."

First, the *environment structuring* scale focused on strategies regarding the organization and choice of students' learning environment. An example for an item: "I know where I can study most efficiently for online courses." The internal consistency of the four-item scale was satisfying, Cronbach's $\alpha_1 = 0.73$, $\alpha_2 = 0.82$.

Second, the *time management* scale focused on students' strategies for organizing their schedules and managing their times of study considering asynchronous and synchronous online courses. An item that focused on the challenges of synchronous and asynchronous online courses included: "Although we don't have to attend daily classes, I still try to distribute my studying time evenly across days." The internal consistency of the four-item scale was acceptable but low, Cronbach's $\alpha_1 = 0.60$, $\alpha_2 = 0.66$.

Third, the *help-seeking* scale focused on students' tendency to ask peers and instructors for help regarding the content of their online courses. We used the modified help-seeking scale from factor analysis of Jansen et al. (2017). Items of both scales inquired about student communication when faced with problems during study periods. A sample item was: "I share my problems with my classmates in this course online so we know what we are struggling with and how to solve our problems." This scale consisted of five items and its internal consistency was satisfactory, Cronbach's $\alpha_1 = 0.74$, $\alpha_2 = 0.76$.

Data Analysis

Descriptive statistics on students' equipment, their previous experiences with online learning tools, availability of a quiet workspace as well as their score on the scale of information sharing behavior answered the research question concerning students' overall readiness to engage in online learning (Q1). We analyzed the descriptive statistics of the three external resource management strategies on both measurement occasions to answer research question Q2a. To answer the research question Q2b, we conducted a repeated measures multivariate ANOVA (MANOVA) showing differences between students' intended and actual use of resource management strategies during the emergency remote term. The analysis consisted of one independent factor time with two distinctions (before and during emergency remote teaching) and three dependent variables (environment structuring, time management, and help-seeking). Finally, we calculated separate regression analyses to investigate the prediction of students' use of resource management strategies during the term based on their prevailing conditions (Q3). We regressed actual study behavior (i.e., use of resource management strategies in the middle of the study term) on students' workspace availability, equipment, previous e-learning experiences, and information sharing behavior. Additionally, we checked for effects by students' gender and age.

RESULTS

Students' Readiness for Emergency Remote Teaching

Table 1 shows all mean scores concerning indicators of students' readiness to engage in online learning. On average, students had access to many devices (i.e., six out of seven). Only five students either had no internet access or had no access to a desktop PC, notebook, or tablet to participate in online courses. However, all five students owned a smartphone. Students had experienced approximately half of the online learning features provided by the university. In addition, the majority of students had access to a quiet workspace. In consideration of the information sharing behavior, students rated their ability to communicate online as rather high.

Table 2 shows all correlations between indicators of students' digital readiness and their use of resource management strategies during the term. External indicators significantly correlated with students' use of environment structuring strategies. Considering the internal indicators of students' digital readiness, only their information sharing behavior significantly correlated with environment structuring and help-seeking. The correlations between students' intended and actual use of external resource management strategies were significant and of moderate sizes, $r = 0.20–0.64$, $p < 0.01$.

Intended vs. Implemented Resource Management Strategies

Table 3 presents the descriptive statistics concerning resource management. At the first measurement, that is, before online lectures had started, students intended to use all three types of strategies to a moderate degree. Most often, they planned to implement strategies to structure their learning environment. Moreover, students structured their environment most frequently and were least likely to seek help during the term.

The repeated measures MANOVA indicated that students showed lower use of online SRL during the term than they intended to use before entering emergency remote teaching. This difference was statistically significant, $F(3,657) = 36.05$, $p < 0.001$, $\eta_p^2 = 0.14$. **Table 3** indicates that the use of environment structuring strategies did not significantly differ when comparing intended strategy use before the emergency remote teaching and actual study behavior. However, the

TABLE 1 | Descriptive statistics for all aspects of students' digital readiness.

Digital readiness	*M* (*SD*)
External	
Workspace	0.93 (0.26)
Equipment	6.09 (1.17)
Personal	
E-Learning	4.88 (1.97)
Information Sharing Behavior	5.03 (0.88)

TABLE 2 | Correlations between indicators of students' digital readiness and their use of resource management strategies during the term.

	Workspace	Equipment	E-learning	ISB	Environment structuring	Time management	Help-seeking
Workspace	1						
Equipment	0.21**	1					
E-learning	0.09*	0.11**	1				
ISB	0.04	0.16**	0.15**	1			
Environment structuring	0.18**	0.14**	0.07	0.08*	1		
Time management	0.02	0.01	0.04	−0.03	0.49**	1	
Help-seeking	−0.01	−0.07	0.07	0.13**	0.26**	0.26**	1

*ISB, information sharing behavior. *$p < 0.05$; **$p < 0.01$.*

TABLE 3 | Descriptive statistics and results of a repeated measures multivariate ANOVA (MANOVA) comparing intended and actual use of external resource management strategies.

	M_{Before} (*SD*)	M_{During} (*SD*)	*F*	*p*	η_p^2
Environment structuring	4.50 (0.83)	4.50 (0.89)	0.02	0.902	0.00
Time management	4.18 (0.89)	4.10 (1.06)	3.91	0.049	0.01
Help-seeking	3.88 (0.90)	3.52 (1.00)	142.08	0.000	0.18

intended vs. actual use of time management strategies showed a small but significant difference. The difference between intended and actual help-seeking was significant and yielded a large effect. That is, students made less frequent use of help-seeking strategies than they planned to.

Influence of Students' Digital Readiness on Resource Management

Separate regression analyses to analyze potential predictors for the actual use of each resource management strategy showed varying results (see **Table 4**). Overall, gender was a significant predictor for each external resource management strategy. This indicates that women structured their learning environment, managed their time, and asked for help more frequently than males in the current sample. Age, in contrast, was not significantly related to any of the three strategies. The predictors significantly explained 7 % of the variance in the use of environment structuring strategies. The standardized betas showed that the availability of a quiet workspace was the strongest significant predictor followed by students' equipment. Having access to a higher number of electronic devices and being able to use a quiet workspace led to a more frequent use of strategies to organize the learning environment. Regarding time management, no aspect of students' digital readiness predicted any variance in students' organization of study time significantly. Finally, on students' help-seeking during the term, the predictors significantly explained 2 % of the variance in the use of this strategy. Students' ability to communicate online was the strongest significant predictor followed by students' equipment. While a higher score on the scale of information sharing behavior led to a higher number of strategies used during the term, having a lower number of electronic devices resulted in more help-seeking strategies.

DISCUSSION

In the current study, we investigated students' readiness when facing sudden online learning and their self-regulated use of resources during the remote emergency term in 2020. We assessed student strategy application twice – before online courses had started and in the middle of the term when students already had experienced online teaching and learning. The study revealed that students faced multiple challenges concerning the management of their resources, and they intended to use more regulating activities than were actually employed during the term. In addition, students' digital readiness significantly predicted students' implementation of resource management strategies. In the following, we discuss the results regarding each research question separately.

Summary and Discussion of Results

To answer research question Q1, the present study addressed students' readiness to participate in online learning, which arose through emergency remote teaching in the upcoming term. Students reported adequate access to external indicators of digital readiness. The majority of students had access to a quiet workplace to study for their courses and they reported a relatively high number of available electronic devices. Almost every student owned adequate electronic devices to access online learning platforms and to participate in asynchronous and synchronous online courses. However, the current study used an online questionnaire, which limited study participation to students who had access to the internet, at least while answering the two surveys. Students' devices should have enabled them to stream videotaped lectures, discuss topics with their fellow students online, follow up on online courses, or do their coursework. However, the two personal indicators of student digital readiness varied. Students' experiences with online learning features before the spring term of 2020 were

TABLE 4 | Separate regression analyses to predict strategy use during the term based on students' digital readiness.

Variable	*B*	95% CI for *B*		*SE B*	*β*	R^2
		LL	UL			
Environment structuring						0.07***
Constant	2.35***	1.60	3.11	0.38		
Workspace	0.68***	0.40	0.95	0.14	0.19***	
Equipment	0.08*	0.02	0.14	0.03	0.10*	
E–learning	0.01	–0.02	0.05	0.02	0.03	
ISB	0.07	–0.01	0.16	0.04	0.07	
Age	0.01	–0.01	0.02	0.01	0.03	
Gender	0.30***	0.15	0.46	0.08	0.16***	
Time management						0.04***
Constant	2.99***	2.10	3.88	0.45		
Workspace	0.10	–0.23	0.42	0.17	0.02	
Equipment	0.02	–0.06	0.09	0.04	0.02	
E–learning	0.01	–0.03	0.07	0.02	0.02	
ISB	–0.02	–0.11	0.08	0.05	–0.01	
Age	0.01	–0.01	0.02	0.01	0.03	
Gender	0.47***	0.29	0.65	0.09	0.21***	
Help-seeking						0.03**
Constant	3.14***	2.29	3.99	0.43		
Workspace	–0.02	–0.33	0.29	0.16	–0.01	
Equipment	–0.08*	–0.15	–0.05	0.04	–0.09*	
E–learning	0.03	–0.01	0.07	0.02	0.06	
ISB	0.12**	0.03	0.22	0.05	0.11**	
Age	–0.02	–0.03	0.00	0.01	–0.08	
Gender	0.24**	0.07	0.41	0.09	0.11**	

*ISB, information sharing behavior. Gender 1 = men, 2 = women. *p < 0.05; **p < 0.01; ***p < 0.001.*

limited. On average, students had used slightly more than half of the features listed in the survey. Furthermore, and in accordance with Kim et al. (2019), students were confident that they could communicate online. Lee and Tsai (2011) also demonstrated a rather high-perceived capability among students to communicate online with their peers. Accordingly, German higher education students are ready to enter the remote emergency term regarding their equipment, workspace, and their ability to communicate with their peers and instructors. This is particularly true when considering the short preparation time before the emergency remote teaching.

To investigate the second research question (Q2a, Q2b), we assessed students' management of external resources before entering the emergency remote term as well as within the term. In summary, repeated measures MANOVA demonstrated that students had trouble managing their resources as they intended to for the situation at hand. Two assumptions might explain the results: Students either did not see the relevance of using the strategies or were actually not able to use them. Regarding the first assumption, students might expected the emergency remote teaching to take more time and cause more problems than was actually the case. Using fewer resource management strategies could be sufficient for successful participation in new courses if instructors implemented them with care. Regarding the second assumption, students might know which strategies they wanted to use but lacked the ability to apply these strategies in a novel online learning environment (production deficit, Veenman, 2007). In addition, it is conceivable that emergency remote teaching required other strategies with which students were not familiar (availability deficit, Veenman, 2007). Interestingly, all mean scores of the three implemented scales of resource strategies were lower than students' self-reported scores of information sharing behavior, indicating that the results regarding resource management strategies did not occur because of general answer biases.

It was mostly the case that students intended to implement strategies that structure the learning environment and did in actuality, implemented said strategies. Current research demonstrates significant relations between environment structuring among other resource management activities and academic achievement in offline and online learning (Vrugt and Oort, 2008; Tsai et al., 2013; Broadbent and Poon, 2015; Waldeyer et al., 2019). Students might recognize the importance of this strategy, and therefore intended to use and did, in fact, use it most frequently. Furthermore, a well-structured learning environment is a basic condition for studying that is (ideally) available to students every day.

Although time management strategies in our study were used less often than students' intended, promising results from a study by Zhang et al. (2021) indicate that students still managed to complete their assignments in the first remote emergency term. Additionally, efficient time management is essential to handle procrastination and leads to higher academic achievement (Wolters et al., 2017; Wolters and Brady, 2020). Hong et al. (2021) demonstrated that procrastination predicts students' application of resource

management strategies during the COVID-19 pandemic. Students who engaged in more procrastination notably used fewer time management strategies and rated their learning effectiveness significantly lower.

Regarding help-seeking strategies, the results are comparable to those by Hamdan et al. (2021) who found that interaction between peers especially, was rather low in higher education during the COVID-19 pandemic. However, help-seeking is referring to having a problem (e.g., difficulties in understanding) while interaction is a more broad construct not only encompassing help-seeking but also personal interaction concerning other aims. On the one hand, low help-seeking behavior might imply that students do not need to seek help (Stahl and Bromme, 2009), probably because of low task difficulty (Hao et al., 2016). On the other hand, because of a lack of opportunities for on-site meetings, students might not have developed adequate strategies to seek help during online and distance learning.

Regarding research question Q3, we demonstrated that indicators of students' readiness for online learning significantly predicted their resource management during the emergency remote term. First, students' availability of a quiet workspace predicted a more frequent application of strategies to structure their learning environment. Additionally, students who had more electronic devices available used more strategies to structure their learning environment but implemented less help-seeking strategies. It is possible that those students already had a permanent place for their devices and constantly structured their learning environment in a way that separated their private and academic use of said devices. However, a higher number of accessible devices resulted in significantly lower use of strategies of help-seeking during the term. It is likely that students with more electronic devices available used their devices more frequently and were able to take advantage of every opportunity to search for information on academic courses (e.g., website and chatrooms). Therefore, they might not have needed additional content related assistance from peers or instructors. Students who scored higher regarding their ability to communicate online used more help-seeking strategies to get in contact with their fellow students and instructors during the term. This underlines that students' information sharing behavior in online environments reflects a basic skill that students require to engage in help-seeking (Hong and Kim, 2018; Muthupoltotage and Gardner, 2018).

Students' previous experiences with online learning did not significantly predict the emergence or application of any of the resource management strategies. This is in line with findings of Bruso et al. (2020) indicating that differences in students' previous experiences with online learning do not necessarily correlate with their use of self-regulated learning. Finally, none of the aspects of students' digital readiness predicted their use of time management strategies significantly. Wolters et al. (2017) demonstrated that students' time management correlates with their procrastination. Students who reported a low preference for the organization of their study time as well as for their goal-setting showed a higher tendency to procrastinate. According to Wolters and Brady (2020), students' time management is closely related to each phase of student learning and significantly predicts academic achievement. Thus, there are many possibilities to promote students' time management. Students' digital readiness does not seem to be an effective starting point.

Additionally, the regression analysis showed that women in our sample used more strategies in all three subscales of the assessed external resource management. This is in line with findings by Bidjerano (2005) who showed that female undergraduates reported to use significantly more time management and environment-structuring strategies than their male counterparts did. In addition, our study also revealed gender differences with regard to help seeking strategies (in favor of female students). Our results are first indicators that gender differences are also evident in the context of emergency remote teaching and should be considered by future research on learning strategies in online learning contexts."

Limitations and Prospects for Future Research

The aim of the current study is to provide early insight into students' (intended) behavior before and within the first online term during the COVID-19 pandemic. Results clearly indicated that there is room for improvement regarding students' use of resource management strategies, especially when it comes to their use during the term. In light of previous research that convincingly demonstrated the importance of resource management strategies for academic performance (Tsai et al., 2013; Broadbent and Poon, 2015), and assuming that this applies to the situation of emergency remote teaching as well, the current study results underline the necessity for training student implementation of resource management strategies. A limitation of the current research, however, is that it does not provide empirical evidence regarding the relationship of the application of resource management strategies and academic achievement in the situation of emergency remote teaching. Taking into account that women used significantly more strategies than men did, it would be of special interest if this more frequent use of external resource management strategies leads to higher academic achievement. However, the current study used a broad sampling strategy encompassing students of various disciplines and study programs. Consequently, students' use of resource management strategies was not linked to specific courses or course performance as is the case, for example, in studies with more process-based assessments (Loeffler et al., 2019). Additionally, we assessed learning strategies *via* self-report questionnaires that only contain global information about the use of the listed strategies and that are limited concerning students' true use of these strategies (Rovers et al., 2019). Still, in order to provide an assessment as situation-specific as possible within a large student sample, we used well-established questionnaire scales that refer to the specific situation of online learning in higher education. In addition, we explicitly asked students to provide their answers with regard to their actual use of strategies in the instruction. Assuming that emergency remote teaching leads to a boost of online higher education or at least to more hybrid formats in the near future, current research should inherit more situation-specific perspectives to disentangle which strategies are most important and consequently, would need support. Specifically, despite the current study's use of established scales

in the context of online learning, the results are limited to self-report of strategy use, and the scale time management showed rather low internal consistency for both measurement occasions. In addition, we assessed only a subset of the self-regulated learning strategies used by students when experiencing emergency remote teaching. Nevertheless, we claim the strategies in our study as essential regarding external resource management.

The relatively low mean scores for the use of external resource strategies points to a need to support students' self-regulated resource management in online higher education (Karabenick, 2011; Wong et al., 2019). In general, three approaches seem conceivable to promote students' resource management. First, the regression analyses of this study revealed significant predictions of indicators of students' digital readiness on their actual study behavior. Therefore, an implication would be to promote digital readiness among students to strengthen the use of resource management strategies. However, our results indicate only small significant effects and low proportions of explained variance in the use of resource management strategies. For this reason, the disadvantage could be marginal as long as students fulfill basic conditions (e.g., one electronic device and internet access). Second and third, the training literature on self-regulated learning suggests (a) direct and (b) indirect approaches that have even been shown to have transfer effects for cognitive and metacognitive strategies (Schuster et al., 2018, 2020; Dignath and Veenman, 2020). For example, the university where we conducted this research offers self-regulated learning courses for their students. In these courses, students learn about the conditions and processes of selected learning strategies. van der Beek et al. (2019) demonstrated that such courses promote self-regulated learning whether they take place in-person or online. Restructuring online learning that facilitates students' use of resource management strategies, on the other hand, is one approach to indirect training. A low-threshold and suitable tool with which to support students as they reflect on their learning situation and learning progress includes e-portfolios (Gläser-Zikuda et al., 2011; Händel et al., 2020b). Students reflect on their learning behavior and in doing so, have the possibility to be made aware of their strengths and difficulties. This might help students to regulate their resources. If students are having difficulty asking others for help, prompts might encourage them to ask questions, which could in turn, lower the threat presented by the need to ask for help (Schworm and Gruber, 2012). The establishment of smaller learning groups could very well be an opportunity to encourage students' to interact with one another and/or seek help (e.g., *via* breakout sessions on videoconferencing platforms). Oviedo and Fox Tree's (2021) current study suggests that communication *via* video-chat improves student perception of conversations on coursework and of their efficiency when working together.

Conclusion

Overall, this study offers early insights into how students coped with the situation of emergency remote teaching; that is, how they regulated their resources. It revealed that students were digitally ready for online learning but were not able to apply as many resource regulation strategies as initially intended. In light of the importance of the use of strategies for academic achievement, we discussed several approaches with which to assist students in their regulation of learning resources. We think that low-threshold measures (e.g., small group sizes, prompts, etc.) along with a basic digital readiness are simple, efficient, and direct implementations in online courses. Still, online learning settings significantly differ from regular higher education situations due to physical distancing and fundamentally different forms of communication. Hence, training methods exclusively developed for distance education might be necessary and helpful (van der Beek et al., 2019).

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MH, AZ, MG-Z, BK, RK, and SB designed the study. MH and BK carried out the data collection. NN and MH performed the data analyses and were major contributors in writing the manuscript. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

A preprint of this study is available at https://doi.org/10.31234/osf.io/h62q5. We thank the university governing board for recommending our study. Special thanks to Doris Bender and Nicole Froebus from the central university administration for their support of this time-critical study. Finally, we thank Miguelina Nuñez for proofreading the manuscript.

REFERENCES

Anthonysamy, L., Koo, A.-C., and Hew, S.-H. (2020a). Self-regulated learning strategies and non-academic outcomes in higher education blended learning environments: a one decade review. *Educ. Inf. Technol.* 25, 3677–3704. doi: 10.1007/s10639-020-10134-2

Anthonysamy, L., Koo, A.-C., and Hew, S.-H. (2020b). Self-regulated learning strategies in higher education: fostering digital literacy for sustainable lifelong learning. *Educ. Inf. Technol.* 25, 2393–2414. doi: 10.1007/s10639-020-10201-8

Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O., and Lai, S.-L. (2009). Measuring self-regulation in online and blended learning environments. *Internet High. Educ.* 12, 1–6. doi: 10.1016/j.iheduc.2008.10.005

Barnard-Brak, L., Paton, V. O., and Lan, W. Y. (2010). Self-regulation across time of first-generation online learners. *Res. Learn. Technol.* 18, 61–70. doi: 10.1080/09687761003657572

Beaunoyer, E., Dupere, S., and Guitton, M. J. (2020). COVID-19 and digital inequalities: reciprocal impacts and mitigation strategies. *Comput. Hum. Behav.* 111:106424. doi: 10.1016/j.chb.2020.106424

Bedenlier, S., Wunder, I., Gläser-Zikuda, M., Kammerl, R., Kopp, B., Ziegler, A., et al. (2020). "Generation invisible". Higher education students' (non)use of webcams in synchronous online learning. *PsyArXiv* [Preprint]. doi: 10.31234/osf.io/7brp6

Bidjerano, T. (2005). "Gender differences in self-regulated learning," in *Annual Meeting of the Northeastern Educational Research Association*; October 19–21, 2005; New York, United States: Kerhonkson.

Bol, L., and Garner, J. K. (2011). Challenges in supporting self-regulation in distance education environments. *J. Comput. High. Educ.* 23, 104–123. doi: 10.1007/s12528-011-9046-7

Bozkurt, A., Jung, I., Xiao, J., Vladimirschi, V., Schuwer, R., Egorov, G., et al. (2020). A global outlook to the interruption of education due to COVID-19 pandemic: navigating in a time of uncertainty and crisis. *Asian J. Distance Educ.* 15, 1–126. doi: 10.5281/zenodo.3878572

Broadbent, J. (2017). Comparing online and blended learner's self-regulated learning strategies and academic performance. *Internet High. Educ.* 33, 24–32. doi: 10.1016/j.iheduc.2017.01.004

Broadbent, J., and Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: a systematic review. *Internet High. Educ.* 27, 1–13. doi: 10.1016/j.iheduc.2015.04.007

Bruso, J., Stefaniak, J., and Bol, L. (2020). An examination of personality traits as a predictor of the use of self-regulated learning strategies and considerations for online instruction. *Educ. Technol. Res. Dev.* 68, 2659–2683. doi: 10.1007/s11423-020-09797-y

Carter, J. R. A., Rice, M., Yang, S., and Jackson Haidee, A. (2020). Self-regulated learning in online learning environments: strategies for remote learning. *Inf. Learn. Sci.* 121, 321–329. doi: 10.1108/ILS-04-2020-0114

Czerniewicz, L., Agherdien, N., Badenhorst, J., Belluigi, D., Chambers, T., Chili, M., et al. (2020). A wake-up call: equity, inequality and Covid-19 emergency remote teaching and learning. *Postdigital Sci. Educ.* 2, 946–967. doi: 10.1007/s42438-020-00187-4

Dignath, C., and Veenman, M. V. J. (2020). The role of direct strategy instruction and indirect activation of self-regulated learning—Evidence from classroom observation studies. *Educ. Psychol. Rev.* 33, 489–533. doi: 10.1007/s10648-020-09534-0

Dresel, M., Schmitz, B., Schober, B., Spiel, C., Ziegler, A., Engelschalk, T., et al. (2015). Competencies for successful self-regulated learning in higher education: structural model and indications drawn from expert interviews. *Stud. High. Educ.* 40, 454–470. doi: 10.1080/03075079.2015.1004236

European Council (2006). Recommendation of the European Parliament and the Council on key competencies for lifelong learning. *Off. J. Eur. Union.* 49, 10–18.

Garcia, R., Falkner, K., and Vivian, R. (2018). Systematic literature review: self-regulated learning strategies using e-learning tools for computer science. *Comput. Educ.* 123, 150–163. doi: 10.1016/j.compedu.2018.05.006

Gläser-Zikuda, M., Fendler, J., Noack, J., and Ziegelbauer, S. (2011). Fostering self-regulated learning with portfolios in schools and higher education. *Orbis Scholae* 5, 67–78. doi: 10.14712/23363177.2018.101

Greene, J. A., Copeland, D. Z., Deekens, V. M., and Yu, S. B. (2018). Beyond knowledge: examining digital literacy's role in the acquisition of understanding in science. *Comput. Educ.* 117, 141–159. doi: 10.1016/j.compedu.2017.10.003

Hamdan, K. M., Al-Bashaireh, A. M., Zahran, Z., Al-Daghestani, A., AL-Habashneh, S., and Shaheen, A. M. (2021). University students' interaction, Internet self-efficacy, self-regulation and satisfaction with online education during pandemic crises of COVID-19 (SARS-CoV-2). *Int. J. Educ. Manag.*. doi: 10.1108/IJEM-11-2020-0513 [Epub ahead of print]

Händel, M., Stephan, M., Gläser-Zikuda, M., Kopp, B., Bedenlier, S., and Ziegler, A. (2020a). Digital readiness and its effects on higher education students' socio-emotional perceptions in the context of the COVID-19 pandemic. *J. Res. Technol. Educ.* doi: 10.1080/15391523.2020.1846147

Händel, M., Wimmer, B., and Ziegler, A. (2020b). E-portfolio use and its effects on exam performance—a field study. *Stud. High. Educ.* 45, 258–270. doi: 10.1080/03075079.2018.1510388

Hao, Q., Wright, E., Barnes, B., and Branch, R. M. (2016). What are the most important predictors of computer science students' online help-seeking behaviors? *Comput. Hum. Behav.* 62, 467–474. doi: 10.1016/j.chb.2016.04.016

Hodges, C. B. (2005). Self-regulation in web-based courses: a review and the need for research. *Q. Rev. Dist. Learn.* 6, 375–383.

Hodges, C. B., Moore, S., Lockee, B. B., Trust, T., and Bond, A. (2020). The difference between emergency remote teaching and online learning. Educause Review. Available at: https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning (Accessed April 20, 2021).

Hong, A. J., and Kim, H. J. (2018). College students' digital readiness for academic engagement (DRAE) scale: scale development and validation. *Asia Pac. Educ. Res.* 27, 303–312. doi: 10.1007/s40299-018-0387-0

Hong, J.-C., Lee, Y.-F., and Ye, J.-H. (2021). Procrastination predicts online self-regulated learning and online learning ineffectiveness during the coronavirus lockdown. *Personal. Individ. Differ.* 174:110673. doi: 10.1016/j.paid.2021.110673

Hung, M.-L., Chou, C., Chen, C.-H., and Own, Z.-Y. (2010). Learner readiness for online learning: Scale development and student perceptions. *Comput. Educ.* 55, 1080–1090. doi: 10.1016/j.compedu.2010.05.004

Jansen, R. S., van Leeuwen, A., Janssen, J., Kester, L., and Kalz, M. (2017). Validation of the self-regulated online learning questionnaire. *J. Comput. High. Educ.* 29, 6–27. doi: 10.1007/s12528-016-9125-x

Jivet, I., Scheffel, M., Schmitz, M., Robbers, S., Specht, M., and Drachsler, H. (2020). From students with love: an empirical study on learner goals, self-regulated learning and sense-making of learning analytics in higher education. *Internet High. Educ.* 47:100758. doi: 10.1016/j.iheduc.2020.100758

Karabenick, S. A. (2011). Classroom and technology-supported help seeking: the need for converging research paradigms. *Learn. Instr.* 21, 290–296. doi: 10.1016/j.learninstruc.2010.07.007

Kiliç-Çakmak, E. (2010). Learning strategies and motivational factors predicting information literacy selfefficacy of e-learners. *Australas. J. Educ. Technol.* 26, 192–208. doi: 10.14742/ajet.1090

Kim, H. J., Hong, A. J., and Song, H.-D. (2019). The roles of academic engagement and digital readiness in students' achievements in university e-learning environments. *Int. J. Educ. Technol. High. Educ.* 16:21. doi: 10.1186/s41239-019-0152-3

Kitsantas, A., and Chow, A. (2007). College students' perceived threat and preference for seeking help in traditional, distributed, and distance learning environments. *Comput. Educ.* 48, 383–395. doi: 10.1016/j.compedu.2005.01.008

Kizilcec, R. F., Pérez-Sanagustín, M., and Maldonado, J. J. (2017). Self-regulated learning strategies predict learner behavior and goal attainment in massive open online courses. *Comput. Educ.* 104, 18–33. doi: 10.1016/j.compedu.2016.10.001

Kocdar, S., Karadeniz, A., Bozkurt, A., and Buyuk, K. (2018). Measuring self-regulation in self-paced open and distance learning environments. *Int. Rev. Res. Open Dis. Learn.* 19, 25–43. doi: 10.19173/irrodl.v19i1.3255

Küsel, J., Martin, F., and Markic, S. (2020). University students' teadiness for using digital media and online learning—Comparison between Germany and the USA. *Educ. Sci.* 10:313. doi: 10.3390/educsci10110313

Lee, S. W.-Y., and Tsai, C.-C. (2011). Students' perceptions of collaboration, self-regulated learning, and information seeking in the context of Internet-based learning and traditional learning. *Comput. Hum. Behav.* 27, 905–914. doi: 10.1016/j.chb.2010.11.016

Loeffler, S. N., Bohner, A., Stumpp, J., Limberger, M. F., and Gidion, G. (2019). Investigating and fostering self-regulated learning in higher education using interactive ambulatory assessment. *Learn. Individ. Differ.* 71, 43–57. doi: 10.1016/j.lindif.2019.03.006

Lynch, R., and Dembo, M. (2004). The relationship between self-regulation and online learning in a blended learning context. *Int. Rev. Res. Open Dis. Learn.* 5, 1–16. doi: 10.19173/irrodl.v5i2.189

Mahasneh, R. A., Sowan, A. K., and Nassar, Y. H. (2012). Academic help-seeking in online and face-to-face learning environments. *E-Lear. Dig. Med.* 9, 196–210. doi: 10.2304/elea.2012.9.2.196

Martin, F., Sun, T., and Westine, C. D. (2020). A systematic review of research on online teaching and learning from 2009 to 2018. *Comput. Educ.* 159:104009. doi: 10.1016/j.compedu.2020.104009

McBrien, J. L., Cheng, R., and Jones, P. (2009). Virtual spaces: employing a synchronous online classroom to facilitate student engagement in online

learning. *Int. Rev. Res. Open Dis. Learn.* 10, 1–17. doi: 10.19173/irrodl.v10i3.605

Means, B., Bakia, M., and Murphy, R. (2014). *Learning Online: What Research Tells us About Whether, When and How*. London: Routledge.

Means, B., and Neisler, J. (2020). Unmasking Inequality: STEM Course Experience During the COVID-19 Pandemic. Digital Promise.

Molinillo, S., Aguilar-Illescas, R., Anaya-Sánchez, R., and Vallespín-Arán, M. (2018). Exploring the impacts of interactions, social presence and emotional engagement on active collaborative learning in a social web-based environment. *Comput. Educ.* 123, 41–52. doi: 10.1016/j.compedu.2018.04.012

Moore, J. L., Dickson-Deane, C., and Galyen, K. (2011). e-Learning, online learning, and distance learning environments: are they the same? *Internet High. Educ.* 14, 129–135. doi: 10.1016/j.iheduc.2010.10.001

Muthupoltotage, U. P., and Gardner, L. (2018). "Analysing the relationships between digital literacy and self-regulated learning of undergraduates—a preliminary investigation," in *Advances in Information Systems Development: Methods, Tools and Management*. eds. N. Paspallis, M. Raspopoulos, C. Barry, M. Lang, H. Linger and C. Schneider (Cham: Springer).

Oviedo, V. Y., and Fox Tree, J. E. (2021). Meeting by text or video-chat: effects on confidence and performance. *Comput. Human Behav. Rep.* 3:100054. doi: 10.1016/j.chbr.2021.100054

Panadero, E. (2017). A review of self-regulated learning: six models and four directions for research. *Front. Psychol.* 8:422. doi: 10.3389/fpsyg.2017.00422

Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *Int. J. Educ. Res.* 31, 459–470. doi: 10.1016/S0883-0355(99)00015-4

Pintrich, P. R., Smith, D. A. F., Garcia, T., and McKeachie, W. J. (1991). A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ). The University of Michigan.

Rovers, S. F. E., Clarebout, G., Savelberg, H. H. C. M., de Bruin, A. B. H., and van Merriënboer, J. J. G. (2019). Granularity matters: comparing different ways of measuring self-regulated learning. *Metacogn. Learn.* 14, 1–19. doi: 10.1007/s11409-019-09188-6

Schuster, C., Stebner, F., Leutner, D., and Wirth, J. (2020). Transfer of metacognitive skills in self-regulated learning: an experimental training study. *Metacogn. Learn.* 15, 455–477. doi: 10.1007/s11409-020-09237-5

Schuster, C., Stebner, F., Wirth, J., and Leutner, D. (2018). Förderung des Transfers metakognitiver Lernstrategien durch direktes und indirektes Training [Fostering transfer of metacognitive learning strategies by direct and indirect training]. *Unterrichtswissenschaft* 46, 409–435. doi: 10.1007/s42010-018-0028-6

Schworm, S., and Gruber, H. (2012). e-Learning in universities: supporting help-seeking processes by instructional prompts. *Br. J. Educ. Technol.* 43, 272–281. doi: 10.1111/j.1467-8535.2011.01176.x

Shea, P., and Bidjerano, T. (2012). Learning presence as a moderator in the community of inquiry model. *Comput. Educ.* 59, 316–326. doi: 10.1016/j.compedu.2012.01.011

Song, L., Singleton, E. S., Hill, J. R., and Koh, M. H. (2004). Improving online learning: student perceptions of useful and challenging characteristics. *Internet High. Educ.* 7, 59–70. doi: 10.1016/j.iheduc.2003.11.003

Stahl, E., and Bromme, R. (2009). Not everybody needs help to seek help: surprising effects of metacognitive instructions to foster help-seeking in an online-learning environment. *Comput. Educ.* 53, 1020–1028. doi: 10.1016/j.compedu.2008.10.004

Tabuenca, B., Kalz, M., Drachsler, H., and Specht, M. (2015). Time will tell: the role of mobile learning analytics in self-regulated learning. *Comput. Educ.* 89, 53–74. doi: 10.1016/j.compedu.2015.08.004

Tsai, C.-W., Shen, P.-D., and Fan, Y.-T. (2013). Research trends in self-regulated learning research in online learning environments: a review of studies published in selected journals from 2003 to 2012. *Br. J. Educ. Technol.* 44, E107–E110. doi: 10.1111/bjet.12017

van der Beek, S., Bellhäuser, H., Karlen, Y., and Hertel, S. (2019). New ways in fostering self-regulated learning at university: how effective are web-based courses when compared to regular attendance-based courses? *Z. Entwicklungspsychol. Padagog. Psychol.* 34, 117–129. doi: 10.1024/1010-0652/a000254

Veenman, M. V. J. (2007). The assessment and instruction of self-regulation in computer-based environments: a discussion. *Metacogn. Learn.* 2, 177–183. doi: 10.1007/s11409-007-9017-6

Vrugt, A., and Oort, F. J. (2008). Metacognition, achievement goals, study strategies and academic achievement: pathways to achievement. *Metacogn. Learn.* 3, 123–146. doi: 10.1007/s11409-008-9022-4

Waldeyer, J., Fleischer, J., Wirth, J., and Leutner, D. (2019). Validating the resource-management inventory (ReMI). *Eur. J. Psychol. Assess.* 36, 777–786. doi: 10.1027/1015-5759/a000557

Winne, P. H., and Hadwin, A. F. (1998). "Studying as self-regulated engagement in learning," in *Metacognition in Educational Theory and Practice*. eds. D. Hacker, J. Dunlosky and A. Graesser (Hillsdale, NJ: Erlbaum), 277–304.

Wolters, C. A., and Brady, A. C. (2020). College students' time management: a self-regulated learning perspective. *Educ. Psychol. Rev.* doi: 10.1007/s10648-020-09519-z

Wolters, C. A., Won, S., and Hussain, M. (2017). Examining the relations of time management and procrastination within a model of self-regulated learning. *Metacogn. Learn.* 12, 381–399. doi: 10.1007/s11409-017-9174-1

Wong, J., Baars, M., Davis, D., Van Der Zee, T., Houben, G.-J., and Paas, F. (2019). Supporting self-regulated learning in online learning environments and MOOCs: a systematic review. *Int. J. Hum. Comput. Interact.* 35, 356–373. doi: 10.1080/10447318.2018.1543084

Yukselturk, E., and Top, E. (2012). Exploring the link among entry characteristics, participation behaviors and course outcomes of online learners: an examination of learner profile using cluster analysis. *Br. J. Educ. Technol.* 44, 716–728. doi: 10.1111/j.1467-8535.2012.01339.x

Zhang, T., Taub, M., and Chen, Z. (2021). Measuring the impact of COVID-19 induced campus closure on student self-regulated learning in physics online learning modules. arXiv [Preprint]. Available at: https://arxiv.org/abs/2101.05872v1 (Accessed April 25, 2021).

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 07 June 2021
doi: 10.3389/feduc.2021.679695

Satisfying Students' Psychological Needs During the COVID-19 Outbreak in German Higher Education Institutions

Ziwen Teuber[1]*, *Hao Jia*[2] and *Thomas Niewöhner*[1]

[1]Educational Psychology, Department of Psychology, Bielefeld University, Bielefeld, Germany, [2]Department of Educational Psychology, University of Minnesota, St. Paul, MN, United States

The COVID-19 outbreak has been a worldwide challenge for the higher education community. Under lockdown measures, meeting students' needs and encouraging their engagement in academic work have never been more urgent and challenging. In this study, we investigated the relationship between students' satisfaction with institutional strategies, students' optimism and pessimism, satisfaction with basic psychological needs, engagement in academic work, intention to drop out from studies, depression, and well-being. We conducted an online self-report study on $N = 477$ German college and university students (77.25% females, mean age = 23.96 years, $SD = 4.78$). The results of structural equation models showed that students' satisfaction with institutional strategies was positively related to their basic psychological need satisfaction and engagement. Students' optimism was positively associated with need satisfaction and engagement, whereas pessimism was negatively associated with them. Furthermore, students' academic engagement was negatively linked to dropout intentions, whereas psychological need satisfaction was linked to depression and well-being. The findings of this study suggest that acknowledging students timely about the institutional strategies of examinations and courses and supporting students to engage academic activities are important institutional tasks during crisis.

Keywords: stress and coping, self-determination, depression, dropout intentions, optimism and pessimism

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Hiroko Oe, Bournemouth University, United Kingdom
Joni Tzuchen Tang, National Taiwan University of Science and Technology, Taiwan

***Correspondence:**
Ziwen Teuber
zteuber@uni-bielefeld.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *12 March 2021*
Accepted: *25 May 2021*
Published: *07 June 2021*

Citation:
Teuber Z, Jia H and Niewöhner T (2021) Satisfying Students' Psychological Needs During the COVID-19 Outbreak in German Higher Education Institutions. Front. Educ. 6:679695. doi: 10.3389/feduc.2021.679695

INTRODUCTION

Since March 2020, the COVID-19 outbreak has appeared to turn our world upside down. To slow down the spread, social activities have been minimized in numerous countries. The undertaken restrictions usually include social distancing and the closure of many public places such as restaurants, libraries, and educational institutions. A large number of empirical studies have emerged to investigate the psychological impact of lockdown restrictions and quarantine on people's mental health, and findings indicate that these methods are linked to a higher prevalence of isolation, depression, stress reactions, post-traumatic stress symptoms, negative emotions (e.g., anger, fear, and confusion), and insomnia (see Serafini et al., 2020, for an overview).

The psychologically debilitating effect of lockdown restrictions can be explained by, for example, the theory of Self-Determination (Deci and Ryan, 2000), which postulates that human beings strive for autonomy, competence, and relatedness. Satisfying these needs is vital to individuals'

psychological well-being and can fuel motivation and behaviors. Recent empirical work provides evidence implying that through lockdown restrictions, these basic psychological needs cannot be adequately met (e.g., Schwinger et al., 2020), and in turn, it increases the risk of mental health problems.

In Germany, one of the countries with the most infected cases in Europe, tertiary educational institutions have been closed since the first lockdown in March 2020. Higher education institutions have been adopting (mostly) unprecedented instructional strategies trying to transit smoothly and maintain a beneficial educational environment for students. Such strategies include using interactive online teaching, communicating with students concerning further proceeding of examinations, and providing students with flexible forms of consulting. However, it is still unclear whether those strategies are useful in creating an environment in alignment with students' psychological needs and whether they can facilitate student engagement, minimize their intentions to drop out, and lower the risk of mental health problems.

In this study, we investigated the relationship between student's satisfaction with institutional strategies during the COVID-19 outbreak, students' optimism and pessimism, satisfaction with basic psychological needs, engagement with academic work, intention to drop out from studies, as well as psychological well-being and ill-being. In this way, we aim to provide practical implications for higher education institutions to better help students manage this challenge. We used the well-established Job Demands-Resources Theory and Tinto's Student Departure Model as guiding framework models.

Psychological Need Satisfaction

Within Self-Determination Theory (SDT; 2000), Ryan and Deci proposed the concept of basic psychological needs, namely, needs for autonomy, needs for competence, and needs for relatedness. Autonomy donates the experience of volition and self-initiation. When satisfied, individuals perceive a sense of ownership of their own behavior and a sense of psychological liberty and freedom of internal will. Competence refers to the experience of mastery and effectiveness. It can be satisfied if individuals capably engage in activities to utilize and extend their knowledge and skills. Finally, the need for relatedness concerns the experience of warmth, bonding, care, or sense of belonging to groups. This need can be met if individuals feel connected to and appreciated by significant others (Vansteenkiste et al., 2020). Satisfying these psychological needs is essential for individual growth, adjustment, integrity, and well-being (Ryan and Deci, 2000).

Across Eastern and Western research communities, meeting students' basic psychological needs has been generally acknowledged as a relevant aspect in promoting students' emotion and motivation (e.g., Milyavskaya and Koestner, 2011; Vansteenkiste et al., 2020), academic success (e.g., Wang et al., 2019), psychological well-being (see meta-analysis, Yu et al., 2018), beneficial parenting style (e.g., Schiffrin et al., 2014; Cordeiro et al., 2018), and instructional quality (e.g., Wilson et al., 2012). Thus, many prominent theories in developmental and educational psychology are developed with the consideration of students' basic psychological need satisfaction.

Prior to the COVID-19 outbreak, students had more opportunities to receive direct feedback from their lecturers (the need for competence), to discuss and learn with their peers within and after courses (the need for relatedness), to choose the way how and where they wanted to learn (e.g., the use of libraries, learning with friends at home; the need for autonomy), and to engage in university and social activities (the need for relatedness), etc. Since the social restrictions were implemented, students have been taking online courses instead. In addition, students have very limited access to social and university activities. In a recent study, Schwinger et al. (2020) investigated the effect of lockdown methods on citizens' basic psychological need satisfaction in Germany and found that there were significant declines in the fulfillment of the need for autonomy. The study also showed that autonomy satisfaction was most strongly affected by the lockdown measures and thus associated with the reduction in well-being and the increase in mental health problems such as anxiety and depression.

In the current study, we focus on German college and university students' basic psychological needs and investigate whether institutional strategies can foster students' need satisfaction and ultimately contribute to their academic and psychological adjustment during the COVID-19 crisis.

Job/Student Demands-Resources Theory

As previously mentioned, several prominent theories contribute to research on students' academic and psychological adjustment, with the consideration of the concept of basic psychological needs. One of them is the theory of Job Demands-Resources (Bakker and Demerouti, 2014). Using this model, personal characteristics and environmental protective and risk factors can be identified.

The Job Demands-Resources theory is a popular and heuristic model for the investigation of the condition and prerequisite of strain and work engagement as well as the associated occupational and psychological outcomes. In the heart of the Job Demands-Resources theory lies the assumption that although job demands are health-impairing, personal and job resources are functional in dealing with these demands, reducing job demands and their associated psychological costs, and stimulating one's personal growth and development. Hence, there is a so-called *motivational process* in which resources foster one's commitment to the work task at hand. In the long term, engagement fuels occupational performance and success. The authors rationalized the motivational effect of resources by arguing that resources fulfill basic psychological needs (i.e., needs for autonomy, needs for relatedness, and needs for competence; Bakker, 2011; Deci and Ryan, 2000). Previous findings in occupational contexts show that satisfaction with basic psychological needs is one of the most powerful protective factors in the occupational context (meta-analysis: Nahrgang et al., 2011). In other words, the fulfillment of psychological needs can buffer the detrimental effect of work stressors and facilitate work commitment. In the long term, it

contributes to psychological well-being and job performance (Bakker and Demerouti, 2014).

Recently, the Job Demands-Resources Model has been successfully adapted to school (Salmela-Aro and Upadyaya, 2014; Teuber et al., 2020; Teuber et al., 2021a; Teuber et al., 2021b) and higher educational (Gusy et al., 2016; Niewöhner et al., 2021) contexts, which was also renamed as Student Demands-Resources Model (for an overview, see Teuber, 2021). Previous findings show that across Eastern and Western education systems, students' personal strengths such as optimism (Teuber, 2021), self-efficacy (Salmela-Aro and Upadyaya, 2014; Teuber et al., 2020; Teuber, 2021), and grit (Teuber et al., 2021b; Tang et al., 2021) decrease negative emotional responses to academic stressors and foster students' engagement in academic work (i.e., the state of energy, dedication, and absorption; (Schaufeli et al., 2002; Salmela-Aro and Upadaya, 2012) and ultimately contribute to academic success and decrease the risk of school dropout (e.g., Bask and Salmela-Aro, 2013).

In the present study, we focus on optimism and pessimism (Carver and Scheier, 2014) as personality traits that may affect students' adaption to the current challenging situation. According to Carver and Scheier (Scheier and Carver, 1987; Scheier et al., 1994; Carver and Scheier, 2014), optimism is defined as global positive outcome expectations and can be understood as a bias in perceptions and expectations in favor of the positive features of life positive outcome expectations. On the contrary, pessimism represents global negative outcome expectations and can be seen as a bias in perceptions and expectations in favor of the negative features of life. A large body of research demonstrates that optimism positively affects students' dedication, learning behaviors, and persistence in higher education (e.g., Gallagher et al., 2017; Icekson et al., 2020; Rand et al., 2020), whereas pessimism is prognostic of impaired psychological functioning, disengagement, and dropout of higher education (e.g., Roso-Bas et al., 2016; Shields et al., 2016; Boileau et al., 2020).

Across Eastern and Western cultures, various authors suggest that although optimism and pessimism are strongly correlated, they cannot be seen as two opposites of a continuum but two distinct factors (Dember et al., 1989; Chang et al., 1997; Nicholls et al., 2008; Hinz et al., 2017; Jovančević and Milićević, 2020). We assumed that optimism and pessimism both influence students' perception of their learning environment in either positive or negative direction and affect their experience of self-determination as well as learning behavior in the adversity.

Tinto's Framework of Student Departure

Preventing students' dropout from studies and maximizing their academic retention are of high priority for higher education institutions because dropout is usually associated with high individual, institutional, and societal costs. To predict students' intention of dropping out and to understand their decision to depart, Tinto's (1975), Tinto's (2006) Framework of Student Departure has been well-established and widely employed.

Similar to Student Demands-Resources Model, Tinto's model also incorporates individual characteristics and environment. The central idea of Tinto's framework is that given students' pre-entry attributes (e.g., family background, skills and abilities, and prior experiences) and their initial commitment to the institution and its academic goals, students' integration into academic and social systems of the higher education institution is in direct relation to their decisions to remain in or depart from the institution at which they study. In other words, the more students are academically and socially committed, the more likely are they to persist. Academic integration includes engagement in various academic activities such as attending courses and discussing with peers about projects within and outside courses. Social integration involves interactions with peers or other faculty members that enhance the bond between students and their institutions. From Tinto's perspective (2006), on the one hand, students' capacity to academically and socially integrate is crucial for academic success, on the other hand, education institutions have the responsibility to provide students with a supportive and beneficial environment that aids students' integration and success. Empirical evidence underlines the importance of the fit between students and their institution in reducing the probability of academic dropout (for an overview, see Lotkowski et al., 2014).

The idea of Tinto can also be linked to the fulfillment of basic psychological needs (Hagenauer et al., 2018). For example, interacting with other faculty members reflects the fulfillment of the need for competence and the need for relatedness, whereas identifying with institutional norms reflects the fulfillment of the need for autonomy. Tinto's model has been applied particularly among first-year college and university students (e.g., Alexandros et al., 2017) because the first year is a critical stage of transition due to the change of environment (Tinto, 2006). From our point of view, the current pandemic situation is also a critical stage in higher education. In line with Tinto's perspective, we believe that higher education institutions' strategies need to match students' psychological needs during the COVID-19 outbreak.

Whereas Tinto's framework focuses on departure decisions, in the current study, we consider students' dropout intention as a more proximate outcome. One reason for doing so is that intentions reflect the motivations that drive and motivate actual behavior (Ajzen, 1991; Ajzen, 2001). Thus, many scholars regard intentions as the best single predictor of planned human behaviors (e.g., Vallerand et al., 1997; Souitaris et al., 2007). In higher educational contexts, dropout intentions are understood as withdrawal cognitions such as thoughts of departing from the current study and seeking an alternative major (Mashburn, 2000). This construct has been found to be a significant predictor of actual dropout in the research literature (e.g., Mashburn, 2000; Litalien and Guay, 2015). Moreover, it is empirically difficult to reach students who have dropped out of studies (e.g., Heublein and Wolter, 2011). Both aspects can rationalize the choice of dropout intentions instead of the actual dropout.

Studying in the Time of COVID-19

Recently, several empirical studies have emerged to investigate the impact of the COVID-19 outbreak in German higher educational contexts. Findings from several studies (Hajek and Kernecker, 2020; Lörz et al., 2020; Seyfeli and ElsnerWannemacher, 2020;

Hahn et al., 2021; Rahman et al., 2021) revealed that students were experiencing more academic and psychological difficulties during "digital" semesters. They were concerned about the quality of online course delivery, unsure about the courses' contents, and untrusted the guidance received from lecturers distantly. Furthermore, many students reported technical difficulties, financial problems, social isolation, and motivation and concentration problems, which are associated with a higher risk of delaying studies or even dropping out of studies. For example, one of two students thought about extending their studies, and one-fifth of students worried that they would not be able to complete their studies under the current conditions (Traus et al., 2020). While studies by Studitemps GmbH and Maastricht University (2021) found no decrease in satisfaction with the study situation since the beginning of the pandemic, Marczuk et al. (2021) found a significant decrease in study satisfaction due to diminished social integration. The authors of both studies expected a long-term increase in dropouts due to the COVID-19 pandemic, although neither study found an increased actual dropout in the 2020 summer and winter semesters.

As previously mentioned, German higher educational institutions have put many efforts to transit their courses and other support offers to ensure students' study progress. Although several studies have addressed students' academic and financial stressors during the COVID-19 and their relationships with their academic and psychological outcomes, little is known about what role do institutional strategies play during online semesters in students' fulfillment of basic psychological needs, academic engagement, dropout intentions, mental health problems (e.g., depression), and well-being (e.g., life satisfaction). According to Student Demands-Resources Model and Tinto's Framework of Student Departure, students' academic and psychological outcomes are affected by the interplay between individual characteristics and study environment. Hence, by taking the potential influence of individual characteristics (e.g., optimism and pessimism) on students' adjustment into consideration, this study may be able to identify students at a higher risk of maladjustment during the critical time and provide some guidance for institutional strategies that can target desired outcomes effectively.

The Present Study

The present study addresses students' perception of higher education institutional strategies and their personality as well as their relationship with psychological need satisfaction, academic engagement, intentions to drop out from studies, depression, and life satisfaction. We seek to contribute to the literature on students' academic and psychological adjustment within German higher education contexts and to provide practical implications for higher education institutions in crisis situations. Based on the theoretical and empirical foundation, we hypothesized that

H1: Students' satisfaction with institutional strategies is positively correlated to satisfaction with basic psychological needs (i.e., needs for autonomy, needs for relatedness, and needs for competence) as well as students' academic engagement.

H2: Students' optimism is positively related to need satisfaction and engagement, whereas students' pessimism is negatively related to need satisfaction and engagement.

H3: Students' need satisfaction and engagement are positively related to well-being and negatively related to ill-being (i.e., depression in our study) and intention to drop out from higher education.

H4: (explorative hypothesis): Students' need satisfaction and academic engagement mediate the relationship between satisfaction with institutional strategies/personality and academic and psychological outcomes. We will explore this hypothesis based on cross-sectional data admitting that mediation hypotheses cannot be tested relying on non-experimental cross-sectional data and that the results cannot be causally interpreted.

METHODS

Data Collection and Participants

Between June 2020 and February 2021, we conducted an online survey. Participants were asked to report their satisfaction with institutional strategies, satisfaction with their basic psychological needs, academic engagement, dropout intentions, life satisfaction, and depression, as well as demographic information. The participants were informed about the aim and the nature of this study. The participation was voluntary. Before starting with the survey, participants were asked to provide their informed consents. Ethical considerations were addressed by obtaining formal approval from the ethical committee of Bielefeld University.

Totally, 543 students participated in this online survey. After data cleaning, the sample consisted of $N = 477$ (78.25% females) German university and college students. Their mean age was 23.96 years ($SD = 4.78$). Among them, 257 students were pursuing a bachelor's degree, 159 a master's degree, and 10 a doctoral degree. The majority ($n = 372$) of the participants were university students. Around 80% of the participants ($n = 400$) had German citizenship. The participants were students from a variety of disciplines (90 human sciences; 72 sports; 83 mathematics or nature sciences; 63 medicine; four agricultural-, forest-, and nutrition sciences; 37 engineering; one arts or art science; 70 else; 57 no response). About 55% of the sample studied in North Rhine-Westphalia and 22% in Schleswig-Holstein.

Measures

Satisfaction With Institutional Strategies

In a psychological class, we interviewed 30 university students about the most important aspects/concerns regarding their studies during the COVID-19 pandemic. All students cared about their study progress and stated that information about courses and exams was most important to them. Although many supports were offered such as online consulting, the majority of interviewed students reported that such support was too time-consuming to use. Based on these reports, we summarized and operationalized satisfaction with institutional strategies into four items: 1) "My university/college informs me timely about further proceedings regarding courses"; 2) "My university/college informs me timely about the further procedure regarding the exams"; 3) "Overall, I feel that the measures are appropriate at my

university/college"; and 4) "Overall, I am satisfied with the measure in my university/college". Ratings were made on a 4-point rating scale ranging from 1 = *not satisfied at all* to 4 = *very satisfied*. We tested its factorial structure using confirmatory factor analysis (CFA) and found a one-factor model fitted the data very well [χ^2= 0.69, *df* = 1, *p* = 0.41, CFI = 1.00, SRMR = 0.00, RMSEA = 0.00, 90% CI for RMSEA (0.00, 0.11)]. McDonald's Omega was 0.80 in this study.

Satisfaction With Basic Psychological Needs

Satisfaction with needs for autonomy, relatedness, and competence was measured using the German version (Heissel et al., 2018) of the corresponding subscales of the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS; Chen et al., 2015). Each of the three basic needs was measured by four items. Example items are "I feel a sense of choice and freedom in the things I undertake" for autonomy satisfaction, "I feel that the people I care about also care about me" for relatedness satisfaction, and "I feel confident that I can do things well" for competence satisfaction. Responses were made on a 5-point Likert scale (1 = *completely disagree*, 5 = *completely agree*). The result of CFA showed that a three-factor model fitted the data well [χ^2= 119.36, *df* = 51, *p* < 0.001, CFI = 0.97, SRMR = 0.04, RMSEA = 0.06, 90% CI for RMSEA (0.04, 0.07)]. In the present study, McDonald's Omega was 0.75 for autonomy, 0.89 for competence, and 0.84 for relatedness.

Academic Engagement

We used the German ultra-short version (UWES-3-SF; Gusy et al., 2019) of the Utrecht Work Engagement Inventory Student Form (UWES-SF; Schaufeli et al., 2002) to assess students' academic engagement. The original UWES-SF contains 14 items representing vigor, dedication, and absorption. The UWES-3-SF selects the most characteristic item of each facet and was validated in a large German university student sample (Gusy et al., 2019). These items are "I feel strong and vigorous when I'm studying or going to class" for vigor, "My study inspires me" for dedication, and "I feel happy when I am studying intensely" for absorption. All items were scored as 0 = *never* to 6 = *always*. In the current study, a unidimensional factorial structure fitted the data well [χ^2= 1.08, *df* = 1, *p* = 0.30, CFI = 1.00, SRMR = 0.03, RMSEA = 0.01, 90% CI for RMSEA (0.00, 0.13)]. McDonald's Omega was 0.78.

Optimism and Pessimism

Optimism and pessimism were measured using the German version (Glaesmer et al., 2008) of the revised Life-Orientation Tests (LOT-R; Scheier et al., 1994). An example item for optimism is "In uncertain times, I usually expect the best", and an example item for pessimism is "I hardly ever expect things to go my way." Responses were made on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*). In line with previous findings, optimism and pessimism were strongly correlated (*r* = −0.75) but still distinct [χ^2 = 26.21, *df* = 8, *p* < 0.01, CFI = 0.97, SRMR = 0.04, RMSEA = 0.07, 90% CI for RMSEA (0.04, 0.10)] in the present study. As suggested by previous scholars (e.g., Hinz et al., 2017; Jovančević and Milićević, 2020), we included optimism and pessimism as two correlated first-order factors in the further analysis. McDonald's Omega was 0.80 for optimism and 0.72 for pessimism.

Intention to Drop Out

Students' intention to drop out of studies was measured using a scale by Rump et al. (2017). This scale contained four items (e.g., "I sometimes think about dropping out of my studies"). Among them, one item was reversed-worded (i.e., "It is very unlikely that I will drop out of my studies"). All items were coded on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*). In this study, a one-factor CFA model showed excellent fit indices [χ^2 = 3.44, *df* = 2, *p* = 0.18, CFI = 0.99, SRMR = 0.01, RMSEA = 0.04, 90% CI for RMSEA (0.00, 0.11)]. In this study, the internal consistency estimate of this scale was high (McDonald's Omega = 0.87).

Depression

We considered depression as an indicator of impaired mental health in the present study. We used the validated German version (Löwe et al., 2004) of the widely used nine-item depression module from the Patient Health Questionnaire (PHQ-9; Kroenke and Spitzer, 2002) to assess depression. The PHQ-9 is a clinical diagnostic questionnaire. The participants were asked to evaluate the frequency of depressive symptoms in the past two weeks (e.g., "Trouble falling or staying asleep, or sleeping too much"). The items were rated on a 4-point scale ranging from 0 = *not at all* to 3 = *nearly every day*. The sum score of this scale represents the risk or severity of depression. We used the sum score in the further data analysis.

Satisfaction With Life

For the assessment of well-being, we used the validated German version (Janke and Glöckner-Rist, 2012) of the Satisfaction with Life Scale (SWLS; Diener et al., 1985), which was developed to quantify one's affective and cognitive judgment of his or her overall well-being. The SWLS consisted of five items (e.g., "In most ways, my life is close to my ideal"). All items were coded on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*). In the present study, this scale showed a one-factor structure [χ^2 = 16.89, *df* = 5, *p* < 0.01, CFI = 0.99, SRMR = 0.02, RMSEA = 0.07, 90% CI for RMSEA (0.04, 0.11)]. McDonald's Omega was 0.89.

Control Variables

We controlled for participants' gender and desired degree. Gender was dummy coded (0 = cursive, 1 = cursive). Desired degree was coded as 1 = *bachelor's degree*, 2 = *master's degree*, and 3 = *doctoral degree*.

Analytical Strategy

Data analyses were conducted in *M*plus 8 (Muthén and Muthén, 2019). We examined the item distribution and multivariate outliners. Skewness and Kurtosis of all variables were between −1.16 and 1.95. Hence, all variables were approximately normal-distributed. Descriptive analyses included means, standard deviations, and latent intercorrelations. Missing data analysis indicated that for all variables, data were missing between 1.7 and 8% of the cases. Furthermore, the result of Little's test suggested that the data had a missing completely at random mechanism.

Before testing the hypotheses, we ran a global CFA model including all constructs of interest. Despite of depression (sum score, manifest variable), all other constructs were measured using

TABLE 1 | Mean values, standardized deviations, and latent intercorrelations.

	Scale	*M* (*SD*)	Latent intercorrelations								
			1	2	3	4	5	6	7	8	9
1	IN.STR	2.93 (0.63)									
2	AUT	3.30 (0.70)	0.29**								
3	COM	3.58 (0.80)	0.27**	0.82**							
4	REL	4.10 (0.70)	0.18*	0.53**	0.50**						
5	OPT	3.69 (0.88)	0.25**	0.57**	0.59**	0.55**					
6	PES	2.43 (0.81)	−0.23**	−0.53**	−0.54**	−0.56**	−0.74**				
7	ENG	2.87 (1.06)	0.38**	0.60**	0.61**	0.33**	0.39**	−0.35**			
8	DROP	1.84 (0.97)	−0.17*	−0.44**	−0.50**	−0.21**	−0.33**	0.33**	−0.60**		
9	SWLS	4.96 (1.27)	0.16*	0.59**	0.59**	0.58**	0.64**	−0.68**	0.37**	−0.47**	
10	PHQ	7.93 (5.87)	−0.28**	−0.54**	−0.5**	−0.49**	−0.53**	0.55**	−0.41**	0.36**	−0.54**

Note. p < .01. p < .001. M, *mean values;* SD, *standardized deviation; IN.STR, satisfaction with institutional strategies; AUT, needs for autonomy; COM, needs for competence; REL, needs for relatedness; OPT, optimism; PES, pessimism; ENG, academic engagement; DROP, intention to drop out of studies; SWLS, satisfaction with life; PHQ, depression.*

multiple indicators (latent factors). After the global CFA model was established, we tested our assumptions using structural equation modeling (SEM) techniques. The robust maximum likelihood–full information estimator was used to deal with non-normality and missing values. In SEM models, we used multiple indicators for all factors except for depression (the sum score was used instead) and control variables. In all models, we controlled for gender and desired academic degree.

For testing the mediating hypotheses, we added multiple mediators to the SEM. Bootstrapping procedure in *M*plus was used to test the significance of the mediation effects. In the current study, 5,000 bootstrapping samples were generated from the original data set by random sampling.

For the evaluation of the model fit, we oriented on the recommendation by Hu and Benlter (1999). Good model fit can be assumed if chi-square value is not significant, comparative fit index (CFI) is above 0.95, root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) under 0.05. Acceptable model fit can be assumed if CFI is above 0.90, RMESA and SRMR are close to or under 0.08.

RESULTS

Descriptive Statistics

Table 1 presents scale mean values and standardized deviations of all variables as well as latent correlations (based on the results of the global CFA model). The global CFA model showed good fit indices: $\chi^2 = 894.78$, $df = 515$, $p < 0.001$, CFI = 0.95, SRMR = 0.05, RMSEA = 0.04, 90% CI for RMSEA (0.03, 0.04).

Testing the Hypotheses

Figure 1 illustrates the SEM model showing good fit indices [$\chi^2 = 1{,}025.14$, $df = 577$, $p < 0.001$, CFI = 0.94, SRMR = 0.05, RMSEA = 0.04, 90% CI for RMSEA (0.04, 0.05)]. The results indicated that satisfaction with institutional strategies was positively related to satisfaction with the need for autonomy ($\beta = 0.18$, $p < 0.01$) and the need for competence ($\beta = 0.16$, $p < 0.01$) as well as student engagement ($\beta = 0.31$, $p < 0.001$). No significant relationship between satisfaction with institutional strategies and satisfaction with the need for relatedness was found ($\beta = 0.04$, $p = 0.41$). Whereas optimism was positively related to all three components of basic psychological need satisfaction ($\beta = 0.30–0.38$, all ps < 0.01), pessimism was negatively associated with the fulfillment of all basic psychological needs ($\beta = -0.30$ to -0.24, all ps < 0.05) but not significantly associated with engagement ($\beta = -0.13$, $p = 0.22$). Students who reported higher values on academic engagement ($\beta = -0.48$, $p < 0.001$) and higher values on the fulfillment of the need for competence ($\beta = -0.23$, $p < 0.05$) reported lower values on intentions to drop out from studies. Unexpectedly, there was a positive association between the fulfillment of the need for relatedness and dropout intentions ($\beta = 0.14$, $p < 0.05$). The regression coefficient between autonomy need satisfaction and dropout intentions did not reach significance ($\beta = 0.01$, $p = 0.96$). Among all three psychological needs, only the fulfillment of the need for competence ($\beta = -0.34$, $p < 0.01$) was associated with lower levels of depression, whereas only the fulfillment of the need for relatedness was positively associated with life satisfaction ($\beta = 0.18$, $p < 0.01$). Furthermore, higher levels of pessimism were related to higher levels of depression ($\beta = 0.24$, $p < 0.01$) and lower levels of life satisfaction ($\beta = -0.34$, $p < 0.001$).

To test the presumed mediating effects, academic engagement, autonomy, competence, and relatedness were added as multiple mediators to the SEM. We found only one significant indirect effect [B = −0.15, SE = 0.05, $p < 0.01$, 95% CI (−0.254, −0.081)]. Namely, students' satisfaction with institutional strategies was positively linked to their academic engagement, which in turn was negatively related to dropout intentions. Other presumed mediating effects did not reach significance.

Overall, 42.4% variance in autonomy, 33.8% in relatedness, 45% in competence, 25.9% in academic engagement, 57.5% in satisfaction with life, and 40% in dropout intention could be explained by the presumed factors.

DISCUSSION

The purpose of the present study was to examine the relationship between students' satisfaction with institutional strategies during the COVID-19 pandemic, personality (i.e., optimism and

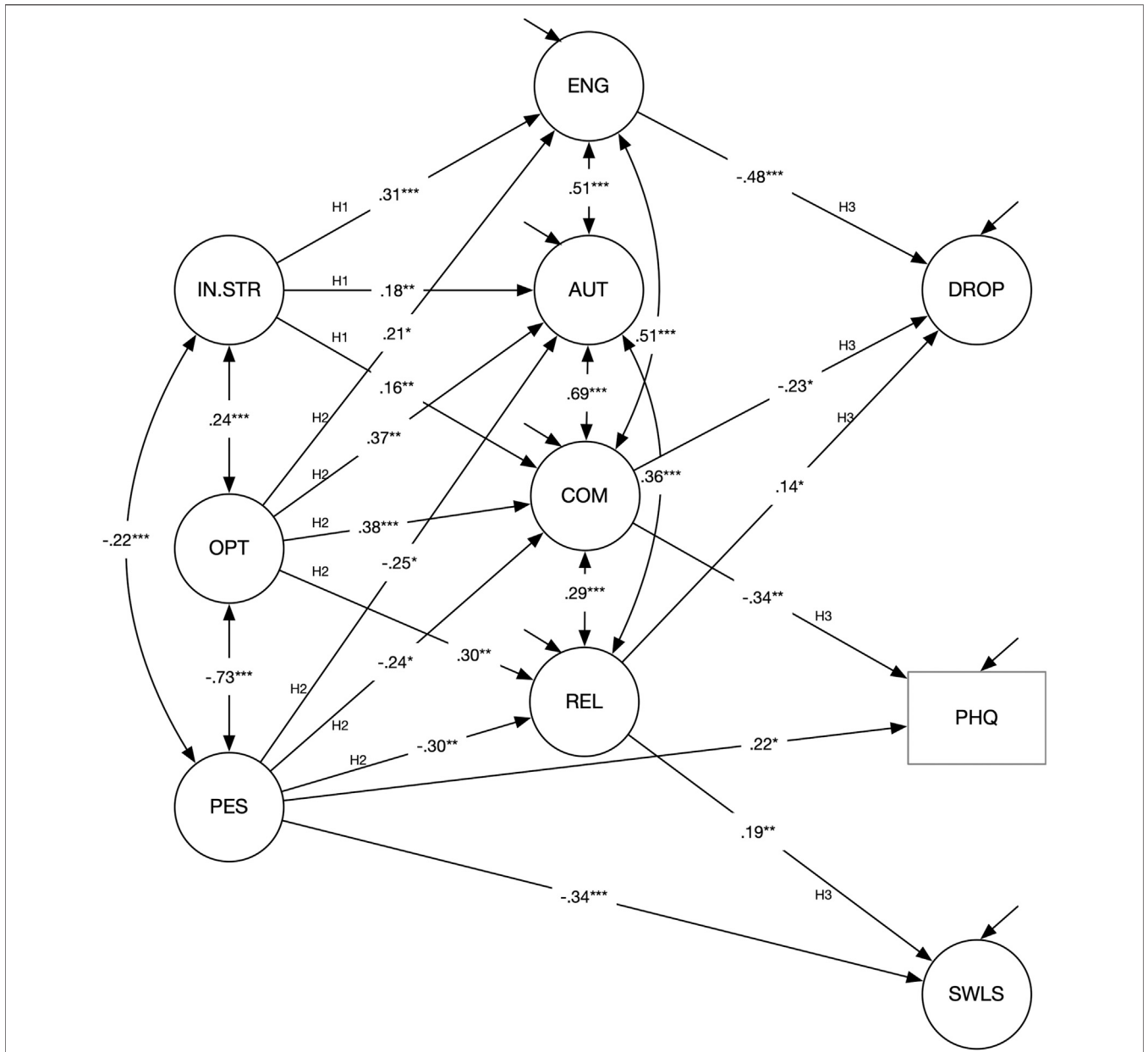

FIGURE 1 | *The final SEM model. Note.* $^{*}p < 0.05$. $^{**}p < 0.01$. $^{***}p < 0.001$. IN.STR, satisfaction with institutional strategies; AUT, needs for autonomy; COM, needs for competence; REL, needs for relatedness; OPT, optimism; PES, pessimism; ENG, academic engagement; DROP, intention to drop out of studies; SWLS, satisfaction with life; PHQ, depression. For sake of simplicity, control variables and their path coefficients as well as non-significant path coefficients are not depicted but estimated in the model.

pessimism), the fulfillment of basic psychological needs, academic engagement, dropout intentions, ill-being, and well-being. Data analyses were based on a sample of 477 German higher education students.

In line with our assumptions, students' satisfaction with institutional strategies was positively related to their satisfaction with needs for autonomy and needs for competence. The regression coefficient from satisfaction with institutional strategies on the fulfillment of needs for relatedness was not significant after controlling for students' optimism and pessimism. This may be due to the way we operationalized satisfaction with institutional strategies. The items focused on the communication of the institution staff about the procedure of examinations and courses. Thus, there were no aspects related on the emotional support of lecturers or peers.

Regarding optimism and pessimism, students who reported higher levels of optimism also reported higher levels of satisfaction with all three basic psychological needs as well as higher levels of academic engagement, whereas students who reported higher levels of pessimism reported lower levels of basic

psychological need satisfaction. This is in line with Student Demands-Resources assumptions (Salmela-Aro and Upadyaya, 2014; Teuber, 2021) as well as recent empirical findings (e.g., Teuber et al., 2021a; Teuber et al., 2021b) indicating that personality traits (e.g., optimism and pessimism) play an important role in academic and psychological adjustment also in critical situations such as the COVID-19 outbreak (e.g., Martin-Krumm et al., 2020). Our findings suggest that optimistic students are more resistant to social distancing and its associated consequences. In comparison, pessimistic students are more likely to suffer from affective problems and tend to be less satisfied with their life. These students may profit more from institutional support programs such as online psychological consulting during the pandemic.

With respect to the relationship between psychological need satisfaction and dropout intentions, we found that among the three basic psychological needs, only the fulfillment of the need for competence was negatively related to students' intention to drop out of studies. An explanation for this result is that we assessed general psychological need satisfaction. The relationships may be more likely to be revealed if domain-specific psychological needs were estimated, such as psychological need satisfaction in the educational context.

As hypothesized by Student Demands-Resources Model, students who reported higher levels of academic engagement reported lower levels of dropout intentions. Under lockdown measures, being actively engaged in academic work and learning may be a significant contributor to students' academic success and may lower the probability of dropping out of studies.

Against our assumption and previous findings, there was a significant positive relationship between the fulfillment of relatedness and dropout intentions. Hence, the fulfillment of the need for relatedness appears to play a different role. Previous studies (Lörz et al., 2020; Seyfeli and ElsnerWannemacher, 2020; Winde et al., 2020) suggest lower levels of students' motivation and engagement in German higher educational contexts in the time of COVID-19. Yet, based on descriptive statistics, the average value on relatedness fulfillment was relatively high ($M = 4.1$ on a 5-point scale) in the present study. According to that question, it is possible that we did not estimate one's relatedness to his or her institutional members but to family members. Due to social restrictions, relatedness to fellow students and other faculty members may decrease, while relatedness to family members (e.g., parents, partners, and other relatives) may increase in a compensating manner. According to the results found in a study conducted by Elmer et al. (2020), university students in Switzerland were worried about their health and family members. As aforementioned, Germany is one of the countries with the most infected cases in Europe, and the death rate is continuously increasing. Against this background, we speculate that in German higher education contexts, the significance of study and relationships to family members may have changed for students in higher education after witnessing increasing cases of death due to the coronavirus. It would be worthwhile to assess this factor in different contexts or using different questionnaires.

Among the presumed mediating effects, only the relationship from satisfaction with institutional strategies through academic engagement to dropout intentions reached significance. While applying Student Demands-Resources Theory to higher educational contexts, several authors (Gusy et al., 2016; Teuber et al., 2020) found that supportive aspects in the learning environment can foster one's academic engagement and contributes to positive academic outcomes. Our results suggest that during the pandemic, supportive institutional strategies may encourage students' engagement in academic work and reduce intentions to drop out of their studies.

Practical Implications

The findings of the present study provide several important implications for practice. The findings of this study indicate that during the COVID-19 pandemic, students' optimism is a significant personal strength in the coping process, whereas pessimism may be a risk factor that has a detrimental effect on students' adaption. According to Tinto's Framework of Student Departure (1975), academic and social integrations of students play an important role in students' decision on dropping out of college. Although academic and social activities are limited under COVID measures, higher educational institutions may be able to effectively encourage their students' academic engagement and contribute to their psychological need satisfaction through informing students timely about further proceedings regarding courses and examinations.

Limitations

Despite these strengths, several limitations of this study should be taken into consideration. Firstly, this study had a cross-sectional design. Theoretically, individuals' traits such as optimism and pessimism can also be affected by the satisfaction with psychological needs and academic commitment. Hence, with our cross-sectional data, we were not able to examine the possible reciprocal relationships between these variables. Although our hypotheses were theoretical founded and empirically supported, longitudinal studies should be conducted to draw causal conclusions. Experience sampling methods can be another good alternative. Secondly, data analyses were based on self-report data. Common method variance may partly explain some of the results. We suggest including different informants such as other faculty members. Thirdly, the data was conducted through an online survey, and we were not able to identify whether the data had a clustered structure (e.g., students from the same institution). Furthermore, the large number of the sample consisted of university students and students who were pursuing a bachelor's degree. Although we controlled these variables, we were not able to examine the effect of different institutional types and target academic degrees. In the future, it may be beneficial to conduct data more systematically.

CONCLUSION

In this study, we examined the relationship between students' satisfaction with institutional strategies, personality traits,

satisfaction with basic psychological needs, academic engagement, dropout intentions, depression, and life satisfaction in German higher education institutions. The findings highlight the importance of satisfying students' basic psychological needs during the COVID-19 outbreak. The results of this study suggest that students' optimism is a personal resource. Furthermore, meeting students' competence needs and encouraging their academic engagement may reduce dropout intentions.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Bielefeld University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ZT conceptually designed the study, carried out analyses, interpreted the results, and drafted and revised the manuscript. HJ contributed to data analyses and interpretation of the results and reviewed and revised drafts of the manuscript. TN reviewed and revised drafts of the manuscript.

REFERENCES

Ajzen, I. (2001). Nature and Operation of Attitudes. *Annu. Rev. Psychol.* 52 (1), 27–58. doi:10.1146/annurev.psych.52.1.27

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behav. Hum. Decis. Process.* 50 (2), 179–211. doi:10.1016/0749-5978(91)90020-t

Alexandros, C., Ahmed, E., and Rupert, W. (2017). Analysis of Tinto's Student Integration Theory in First-Year Undergraduate Computing Students of a UK Higher Education Institution. *Int. J. Comp. Edu. Dev.* 19 (2/3), 97–121. doi:10.1108/IJCED-10-2016-0019

Bakker, A. B. (2011). An Evidence-Based Model of Work Engagement. *Curr. Dir. Psychol. Sci.* 20 (4), 265–269. doi:10.1177/0963721411414534

Bakker, A. B., and Demerouti, E. (2014). "Job Demands-Resources Theory," in *Wellbeing*. Editor C. L. Cooper (Chichester, UK: John Wiley & Sons), 11–28. doi:10.1002/9781118539415.wbwell019

Bask, M., and Salmela-Aro, K. (2013). Burned Out to Drop Out: Exploring the Relationship between School Burnout and School Dropout. *Eur. J. Psychol. Educ.* 28 (2), 511–528. doi:10.1007/s10212-012-0126-5

Boileau, L., Gaudreau, P., Gareau, A., and Chamandy, M. (2020). Some Days Are More Satisfying Than Others: A Daily-Diary Study on Optimism, Pessimism, Coping, and Academic Satisfaction: Some Days Are More Satisfying. *Br. J. Educ. Psychol.* 91, 42–46. doi:10.1111/bjep.12346

Carver, C. S., and Scheier, M. F. (2014). Dispositional Optimism. *Trends Cogn. Sci.* 18 (6), 293–299. doi:10.1016/j.tics.2014.02.003

Chang, E. C., Maydeu-Olivares, A., and D'Zurilla, T. J. (1997). Optimism and Pessimism as Partially Independent Constructs: Relationship to Positive and Negative Affectivity and Psychological Well-Being. *Personal. Individual Differences* 23 (3), 433–440. doi:10.1016/s0191-8869(97)80009-8

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Van der Kaap-Deeder, J., et al. (2015). Basic Psychological Need Satisfaction, Need Frustration, and Need Strength across Four Cultures. *Motiv. Emot.* 39 (2), 216–236. doi:10.1007/s11031-014-9450-1

Cordeiro, P. M. G., Paixão, M. P., Lens, W., Lacante, M., and Luyckx, K. (2018). Parenting Styles, Identity Development, and Adjustment in Career Transitions. *J. Career Dev.* 45 (1), 83–97. doi:10.1177/0894845316672742

Deci, E. L., and Ryan, R. M. (2000). The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychol. Inq.* 11 (4), 227–268. doi:10.1207/s15327965pli1104_01

Dember, W. N., Martin, S. H., Hummer, M. K., Howe, S. R., and Melton, R. S. (1989). The Measurement of Optimism and Pessimism. *Curr. Psychol.* 8 (2), 102–119. doi:10.1007/bf02686675

Diener, E., Emmons, R. A., Larsen, R. J., and Griffin, S. (1985). The Satisfaction with Life Scale. *J. Personal. Assess.* 49 (1), 71–75. doi:10.1207/s15327752jpa4901_13

Elmer, T., Mepham, K., and Stadtfeld, C. (2020). Students under Lockdown: Comparisons of Students' Social Networks and Mental Health before and during the COVID-19 Crisis in Switzerland. *PLoS ONE* 15 (7), e0236337. doi:10.1371/journal.pone.0236337

Gallagher, M. W., Marques, S. C., and Lopez, S. J. (2017). Hope and the Academic Trajectory of College Students. *J. Happiness Stud.* 18 (2), 341–352. doi:10.1007/s10902-016-9727-z

Glaesmer, H., Hoyer, J., Klotsche, J., and Herzberg, P. Y. (2008). Die deutsche Version des Life-Orientation-Tests (LOT-R) zum dispositionellen Optimismus und Pessimismus. *Z. für Gesundheitspsychologie* 16 (1), 26–31. doi:10.1026/0943-8149.16.1.26

Gusy, B., Lesener, T., and Wolter, C. (2019). Measuring Well-Being with the Utrecht Work Engagement Scale - Student Form. *Eur. J. Health Psychol.* 26 (2), 31–38. doi:10.1027/2512-8442/a000027

Gusy, B., Wörfel, F., and Lohmann, K. (2016). Erschöpfung und Engagement im Studium. *Z. für Gesundheitspsychologie* 24 (1), 41–53. doi:10.1026/0943-8149/a000153

Hagenauer, G., Gläser-Zikuda, M., and Moschner, B. (2018). University Students' Emotions, Life-Satisfaction and Study Commitment: a Self-Determination Theoretical Perspective. *J. Further Higher Edu.* 42 (6), 808–826. doi:10.1080/0309877x.2017.1323189

Hahn, E., Kuhlee, D., and Porsch, R. (2021). "Institutionelle und individuelle Einflussfaktoren des Belastungserlebens von Lehramtsstudierenden in der Corona-Pandemie [Institutional and individual factors influencing student teachers' experience of stress in the Corona pandemic," in *Das Bildungssystem in Zeiten der Krise. Empirische Befunde, Konsequenzen und Potenziale Fur das Lehren und Lernen [The Education System in Times of Crisis. Empirical Findings, Consequences and Potentials for Teaching and Learning]*. Editors C. Reintjes, R. Porsch, and G. im Brahm (Münster: Waxmann), 221–237.

Hajek, P., and Kernecker, T. (2020). CoV19-Maßnahmen. Online-Befragung Studierende. Peter Hajek Public Opinion Strategies. Available at: https://www.bmbwf.gv.at/dam/jcr:71063eaf-86d1–4d80–8d31-d023cdbbcd0e/Pr%C3%A4sentation_Studierende_Corona_Krise.pdf (Accessed May 27, 2021).

Heissel, A., Pietrek, A., Flunger, B., Fydrich, T., Rapp, M. A., Heinzel, S., et al. (2018). The Validation of the German Basic Psychological Need Satisfaction and Frustration Scale in the Context of Mental Health. *Eur. J. Health Psychol.* 25 (4), 119–132. doi:10.1027/2512-8442/a000017

Heublein, U., and Wolter, A. (2011). Studienabbruch in Deutschland. Definition, Häufigkeit, Ursachen, Maßnahmen. *Z. Für Pädagogik* 57 (2), 214–236.

Hinz, A., Sander, C., Glaesmer, H., Brähler, E., Zenger, M., Hilbert, A., et al. (2017). Optimism and Pessimism in the General Population: Psychometric Properties of the Life Orientation Test (LOT-R). *Int. J. Clin. Health Psychol.* 17 (2), 161–170. doi:10.1016/j.ijchp.2017.02.003

Hu, L. t., and Bentler, P. M. (1999). Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria versus New Alternatives. *Struct. Equation Model. A Multidisciplinary J.* 6 (1), 1–55. doi:10.1080/10705519909540118

Icekson, T., Kaplan, O., and Slobodin, O. (2020). Does Optimism Predict Academic Performance? Exploring the Moderating Roles of Conscientiousness and Gender. *Stud. Higher Edu.* 45 (3), 635–647. doi:10.1080/03075079.2018.1564257

Janke, S., and Glöckner-Rist, A. (2012). Deutsche version der satisfaction with life scale (SWLS) [The German version of the satisfaction with life scale]. *Zusammenstellung Sozialwissenschaftlicher Items Und Skalen (ZIS)*. doi:10.6102/zis147

Jovančević, A., and Milićević, N. (2020). Optimism-pessimism, Conspiracy Theories and General Trust as Factors Contributing to COVID-19 Related Behavior - A Cross-Cultural Study. *Pers Individ Dif* 167, 110216. doi:10.1016/j.paid.2020.110216

Kroenke, K., and Spitzer, R. L. (2002). The PHQ-9: A New Depression Diagnostic and Severity Measure. *Psychiatr. Ann.* 32 (9), 509–515. doi:10.3928/0048-5713-20020901-06

Litalien, D., and Guay, F. (2015). Dropout Intentions in PhD Studies: A Comprehensive Model Based on Interpersonal Relationships and Motivational Resources. *Contemp. Educ. Psychol.* 41, 218–231. doi:10.1016/j.cedpsych.2015.03.004

Lörz, M., Marczuk, A., Zimmer, L., Multrus, F., and Buchholz, S. (2020). Studieren unter Corona-Bedingungen: Studierende bewerten das erste Digitalsemester. *DZHW Brief 5|2020*, 1–8. doi:10.34878/2020.05.dzhw_brief10.1628/978-3-16-157969-1

Lotkowski, V. A., Robbins, S. B., and Noeth, R. J. (2014). The Role of Academic and Non-academic Factors in Improving College Retention. ACT policy report. Availabe at: https://www.act.org/content/dam/act/unsecured/documents/college_retention.pdf (Accessed May 27, 2021) American College Testing ACT Inc.

Löwe, B., Kroenke, K., Herzog, W., and Gräfe, K. (2004). Measuring Depression Outcome with a Brief Self-Report Instrument: Sensitivity to Change of the Patient Health Questionnaire (PHQ-9). *J. Affective Disord.* 81 (1), 61–66. doi:10.1016/S0165-0327(03)00198-8

Marczuk, A., Multrus, F., and Lörz, M. (2021). *Die Studiensituation in der Corona-Pandemie. Auswirkungen der Digitalisierung auf die Lern- und Kontaktsituation von Studierenden*. Hannover: DZHW Brief. doi:10.34878/2021.01.dzhw_brief

Martin-Krumm, C., Tarquinio, C., and Tarquinio, C. (2020). L'optimisme et COVID-19 : une ressource pour soutenir les personnes en situation de confinement? *Ann. Médico-psychologiques, revue psychiatrique* 178 (7), 728–737. doi:10.1016/j.amp.2020.06.004

Mashburn, A. J. (2000). A Psychological Process of College Student Dropout. *J. Coll. Student Retention: Res. Theor. Pract.* 2 (3), 173–190. doi:10.2190/u2qb-52j9-ghgp-6lee

Milyavskaya, M., and Koestner, R. (2011). Psychological Needs, Motivation, and Well-Being: A Test of Self-Determination Theory across Multiple Domains. *Personal. Individual Differences* 50 (3), 387–391. doi:10.1016/j.paid.2010.10.029

Muthén, L. K., and Muthén, B. O. (2019). *Mplus 8*. Los Angeles, CA: Muthén & Muthén.

Nahrgang, J. D., Morgeson, F. P., and Hofmann, D. A. (2011). Safety at Work: A Meta-Analytic Investigation of the Link between Job Demands, Job Resources, Burnout, Engagement, and Safety Outcomes. *J. Appl. Psychol.* 96 (1), 71–94. doi:10.1037/a0021484

Nicholls, A. R., Polman, R. C. J., Levy, A. R., and Backhouse, S. H. (2008). Mental Toughness, Optimism, Pessimism, and Coping Among Athletes. *Personal. Individual Differences* 44 (5), 1182–1192. doi:10.1016/j.paid.2007.11.011

Niewöhner, T., Hoerdler, L., Roxel, A., Meindl, M., and Teuber, Z. (2021). Zielorientierung, Burnout und Engagement im Hochschulkontext: Integration von Zielorientierung in das Study Demands-Resources-Modell. *Präv Gesundheitsf*, 1–6. doi:10.1007/s11553-021-00840-1

Rahman, M. H. A., Uddin, M. S., and Dey, A. (2021). Investigating the Mediating Role of Online Learning Motivation in the COVID-19 Pandemic Situation in Bangladesh. *J. Comput. Assist. Learn.* doi:10.1111/jcal.12535

Rand, K. L., Shanahan, M. L., Fischer, I. C., and Fortney, S. K. (2020). Hope and Optimism as Predictors of Academic Performance and Subjective Well-Being in College Students. *Learn. Individual Differences* 81, 101906. doi:10.1016/j.lindif.2020.101906

Roso-Bas, F., Pades Jiménez, A., and García-Buades, E. (2016). Emotional Variables, Dropout and Academic Performance in Spanish Nursing Students. *Nurse Edu. Today* 37, 53–58. doi:10.1016/j.nedt.2015.11.021

Rump, M., Esdar, W., and Wild, E. (2017). Individual Differences in the Effects of Academic Motivation on Higher Education Students' Intention to Drop Out. *Eur. J. Higher Edu.* 7 (4), 341–355. doi:10.1080/21568235.2017.1357481

Ryan, R. M., and Deci, E. L. (2000). The Darker and Brighter Sides of Human Existence: Basic Psychological Needs as a Unifying Concept. *Psychol. Inq.* 11 (4), 319–338. doi:10.1207/s15327965pli1104_03

Salmela-Aro, K., and Upadyaya, K. (2014). School Burnout and Engagement in the Context of Demands–Resources Model. *Br. J. Educ. Psychol.* 84 (1), 137–151. doi:10.1111/bjep.12018

Salmela-Aro, K., and Upadaya, K. (2012). The Schoolwork Engagement Inventory. *Eur. J. Psychol. Assess.* 28 (1), 60–67. doi:10.1027/1015-5759/a000091

Schaufeli, W. B., Martínez, I. M., Pinto, A. M., Salanova, M., and Bakker, A. B. (2002). Burnout and Engagement in University Students. *J. Cross-Cultural Psychol.* 33 (5), 464–481. doi:10.1177/0022022102033005003

Scheier, M. E., and Carver, C. S. (1987). Dispositional Optimism and Physical Well-Being: The Influence of Generalized Outcome Expectancies on Health. *J. Personal.* 55 (2), 169–210. doi:10.1111/j.1467-6494.1987.tb00434.x

Scheier, M. F., Carver, C. S., and Bridges, M. W. (1994). Distinguishing Optimism from Neuroticism (And Trait Anxiety, Self-Mastery, and Self-Esteem): A Reevaluation of the Life Orientation Test. *J. Personal. Soc. Psychol.* 67 (6), 1063–1078. doi:10.1037/0022-3514.67.6.1063

Schiffrin, H. H., Liss, M., Miles-McLean, H., Geary, K. A., Erchull, M. J., and Tashner, T. (2014). Helping or Hovering? the Effects of Helicopter Parenting on College Students' Well-Being. *J. Child. Fam. Stud.* 23 (3), 548–557. doi:10.1007/s10826-013-9716-3

Schwinger, M., Trautner, M., Kärchner, H., and Otterpohl, N. (2020). Psychological Impact of corona Lockdown in Germany: Changes in Need Satisfaction, Well-Being, Anxiety, and Depression. *Int. J. Environ. Res. Public. Health.* 17 (23), 9083. doi:10.3390/ijerph17239083

Serafini, G., Parmigiani, B., Amerio, A., Aguglia, A., Sher, L., and Amore, M. (2020). The Psychological Impact of COVID-19 on the Mental Health in the General Population. *QJM: Int. J. Med.* 113 (8), 531–537. doi:10.1093/qjmed/hcaa201

Seyfeli, F., Elsner, L., and Wannemacher, K. (2020). Vom Corona-Shutdown zur Blended University? *Expertinnenbefragung Digitales Sommersemster* (Baden: Tectum Verlag). doi:10.5771/9783828876484

Shields, G. S., Toussaint, L. L., and Slavich, G. M. (2016). Stress-related Changes in Personality: A Longitudinal Study of Perceived Stress and Trait Pessimism. *J. Res. Personal.* 64, 61–68. doi:10.1016/j.jrp.2016.07.008

Souitaris, V., Zerbinati, S., and Al-Laham, A. (2007). Do entrepreneurship Programmes Raise Entrepreneurial Intention of Science and Engineering Students? the Effect of Learning, Inspiration and Resources. *J. Business Venturing* 22 (4), 566–591. doi:10.1016/j.jbusvent.2006.05.002

Studitemps GmbH, and Maastricht University (2021). Studieren und Geldverdienen unter Pandemiebedingungen - Analyse zur Jobsituation und finanziellen Ausstattung der Hochschülerinnen und Hochschüler in DeutschlandVergleich Sommersemester 2019 und Sommersemester 2020 - Sonderauswertung der Studienreihe "Fachkraft 2030. Available at: https://studitemps.de/wp-content/uploads/2020/11/studitemps-whitepaper-jobwelt.pdf (Accessed May 28, 2021).

Tang, X., Upadyaya, K., and Salmela-Aro, K. (2021). School Burnout and Psychosocial Problems Among Adolescents: Grit as a Resilience Factor. *J. Adolescence* 86, 77–89. doi:10.1016/j.adolescence.2020.12.002

Teuber, Z. (2021). *Academic And Psychological Adjustment in Chinese Students: The Role of Student Resources*. Bielefeld, Germany: Bielefeld University. Doctoral dissertation. doi:10.4119/unibi/2951455

Teuber, Z., Möer, J., Webel, L., and Seifert, A. (2020). Burnout und Engagement: Eine Pilotstudie zum Transfer des Job-Demands-Resources-Modells in den deutschen Schulkontext. *Präv Gesundheitsf* 15 (3), 269–274. doi:10.1007/s11553-019-00752-1

Teuber, Z., Nussbeck, F. W., and Wild, E. (2021a). School Burnout Among Chinese High School Students: the Role of Teacher-Student Relationships and Personal Resources. *Educ. Psychol.* 1–18. doi:10.1080/01443410.2021.1917521

Teuber, Z., Nussbeck, F. W., and Wild, E. (2021b). The Bright Side of Grit in Burnout-Prevention: Exploring Grit in the Context of Demands-Resources Model Among Chinese High School Students. *Child. Psychiatry Hum. Dev.* 52, 464–476. doi:10.1007/s10578-020-01031-3

Tinto, V. (1975). Dropout from Higher Education: A Theoretical Synthesis of Recent Research. *Rev. Educ. Res.* 45 (1), 89–125. doi:10.3102/00346543045001089

Tinto, V. (2006). Research and Practice of Student Retention: What Next? *J. Coll. Student Retention: Res. Theor. Pract.* 8 (1), 1–19. doi:10.2190/4ynu-4tmb-22dj-an4w

Traus, A., Höffken, K., Thomas, S., Mangold, K., and Schröer, W. (2020). *Stu.diCo. - Studierenden digital in Zeiten von Corona: Erste Ergebnisse der bundesweiten Studie Stu.diCo*. Hildesheim: Universitätsverlag Hildesheim.

Vallerand, R. J., Fortier, M. S., and Guay, F. (1997). Self-determination and Persistence in a Real-Life Setting: Toward a Motivational Model of High School Dropout. *J. Personal. Soc. Psychol.* 72 (5), 1161–1176. doi:10.1037/0022-3514.72.5.1161

Vansteenkiste, M., Ryan, R. M., and Soenens, B. (2020). Basic Psychological Need Theory: Advancements, Critical Themes, and Future Directions. *Motiv. Emot.* 44 (1), 1–31. doi:10.1007/s11031-019-09818-1

Wang, Y., Tian, L., and Scott Huebner, E. (2019). Basic Psychological Needs Satisfaction at School, Behavioral School Engagement, and Academic Achievement: Longitudinal Reciprocal Relations Among Elementary School Students. *Contemp. Educ. Psychol.* 56, 130–139. doi:10.1016/j.cedpsych.2019.01.003

Wilson, A. J., Liu, Y., Keith, S. E., Wilson, A. H., Kermer, L. E., Zumbo, B. D., et al. (2012). Transformational Teaching and Child Psychological Needs Satisfaction, Motivation, and Engagement in Elementary School Physical Education. *Sport Exerc. Perform. Psychol.* 1 (4), 215–230. doi:10.1037/a0028635

Winde, M., Werner, S. D., Gumbmann, B., and Hieronimus, S. (2020). Hochschulen, Corona und jetzt? Future Skills – Diskussionspapier. 4, , 2020 Available at: https://www.stifterverband.org/download/file/fid/9313.

Yu, S., Levesque-Bristol, C., and Maeda, Y. (2018). General Need for Autonomy and Subjective Well-Being: A Meta-Analysis of Studies in the US and East Asia. *J. Happiness Stud.* 19 (6), 1863–1882. doi:10.1007/s10902-017-9898-2

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 02 July 2021
doi: 10.3389/feduc.2021.699785

Patterns of Teachers' Occupational Well-Being During the COVID-19 Pandemic: Relations to Experiences of Exhaustion, Recovery, and Interactional Styles of Teaching

Sanni Pöysä[1]*, *Eija Pakarinen*[1] and *Marja-Kristiina Lerkkanen*[1,2]

[1]Department of Teacher Education, University of Jyväskylä, Jyväskylä, Finland, [2]Norwegian Centre for Learning Environment and Behavioural Research in Education, University of Stavanger, Stavanger, Norway

This study examined profiles of teachers' occupational well-being during the COVID-19 pandemic. The data were collected from 279 Finnish primary school teachers during the spring of 2020. Four groups of teachers were identified by using Latent Profile Analysis: 1) teachers with mediocre stress and work engagement (34.4%); 2) teachers with mediocre stress and lowest work engagement (11.5%); 3) teachers with highest stress and work engagement (26.5%); and 4) teachers with lowest stress and highest work engagement (27.6%). The findings indicated that teachers' occupational well-being was individually constructed, and there was a diversity with ways how negative and positive aspects of occupational well-being were drawn into patterns. The profile groups were further analyzed with respect to teachers' experiences of emotional exhaustion, recovery from work, and interactional styles of teaching. The results revealed that during the first few months of the COVID-19 pandemic many teachers experienced occupational stress as well as some increase in stress due to the pandemic. In addition, the findings provided new insights concerning how teachers' work engagement was perhaps not severely affected during the first few months of the pandemic, and on how different teaching styles were associated specifically with different aspects of occupational well-being.

Keywords: teachers' occupational well-being, COVID-19, stress, vigor, dedication, interactional styles of teaching, exhaustion, recovery

OPEN ACCESS

Edited by:
Sina Fackler,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Xiaoyu Lan,
University of Padua, Italy
María Isabel de Vicente-Yagüe Jara,
University of Murcia, Spain

***Correspondence:**
Sanni Pöysä
sanni.poysa@jyu.fi

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *24 April 2021*
Accepted: *21 June 2021*
Published: *02 July 2021*

Citation:
Pöysä S, Pakarinen E and Lerkkanen M-K (2021) Patterns of Teachers' Occupational Well-Being During the COVID-19 Pandemic: Relations to Experiences of Exhaustion, Recovery, and Interactional Styles of Teaching. Front. Educ. 6:699785. doi: 10.3389/feduc.2021.699785

INTRODUCTION

When teachers around the globe faced new challenges and unexpected changes in their work due to the outbreak of the COVID-19 pandemic in the Spring of 2020, the field of education shared their concerns about the well-being of teachers. The concern was reasonable, as a considerable body of literature indicates that teachers' occupational well-being is crucial for the sake of themselves as well as for their students (e.g., Skaalvik and Skaalvik, 2016; Madigan and Kim, 2020). The negative aspects of occupational well-being, such as experiences of work-related stress or emotional exhaustion are, indeed, burden for teachers (Chaplain, 2008; Ferguson et al., 2012). Previous studies have also suggested that teachers' higher work-related stress is associated with students' lower educational outcomes (Herman et al., 2018), and that experiences of stress and exhaustion are connected with decreased job satisfaction and increased motivation to leave the teaching profession (Klassen and

Chiu, 2010; Skaalvik and Skaalvik, 2014; Skaalvik and Skaalvik, 2016). The positive aspects of occupational well-being may, however, provide protection against the elements that are harming the well-being (Bermejo-Toro et al., 2016). Experiences of work engagement and professional competence, for example, have been associated with increased job satisfaction and commitment with work (Hakanen et al., 2006; Klassen and Chiu, 2010) as well as better job performance (Bakker and Bal, 2010).

In March 2020, the World Health Organization declared that COVID-19 was a global pandemic. To ensure the safety of teachers and their students, different types of remote learning were quickly adapted into use; for example, many governments in Europe chose to proceed with curriculum-based learning by utilizing online approaches (UNESCO, UNICEF, and the World Bank, 2020; United Nations, 2020). Recent studies have demonstrated that during the time of school closures, teachers had to cope with several stressors, such as experiences of uncertainty or increased workload (Kim and Asbury, 2020; MacIntyre et al., 2020), and teachers experienced substantial levels of stress (MacIntyre et al., 2020). At the same time, however, teachers also found some benefits from the situation. It has been suggested, for example, that teachers felt that the time of school closures increased the trust between parents and teachers, which may also prove beneficial when the pandemic is over (Kim and Asbury, 2020).

The present study focused on the positive as well as negative aspects of teachers' occupational well-being during the COVID-19 pandemic. To reach some novel insights on teachers' occupational well-being, a person-oriented approach was utilized to identify subgroups of teachers based on their experiences of work-related stress and experiences of increased stress due to the COVID-19 pandemic along with their work engagement. The subgroups were subsequently analyzed in order to examine whether the subgroups would differ in their emotional exhaustion, recovery from work, as well as interactional styles of teaching.

Teachers' Occupational Well-Being

Teachers' occupational well-being is a complex phenomenon, which can be approached from several different points of views (see Cumming, 2017). On one hand, the field of education has learned about teachers' occupational well-being by focusing on experiences that diminish well-being, such as work-related stress, emotional exhaustion, or burnout (e.g., Montgomery and Rupp, 2005; Foley and Murphy, 2015). On the other hand, valuable knowledge has been obtained by examining experiences that may strengthen well-being, such as work engagement (Bakker et al., 2007; Granziera and Perera, 2019), coping strategies (Parker and Martin, 2009), or recovery from work (Virtanen et al., 2020). However, an increasing number of studies have approached occupational well-being by also focusing on different negative and positive aspects simultaneously (e.g., Bermejo-Toro et al., 2016; Parker et al., 2012), because this provides an opportunity to obtain versatile knowledge of this complex phenomenon. This decision was made in the present study as well by examining work-related stress and increase of stress due to the COVID-19 pandemic along with core aspects of work engagement, vigor and dedication as features of occupational well-being.

Teachers' occupational stress can be defined as unpleasant and negative emotions (e.g., tension, restlessness, anxiety, frustration, or nervousness) resulting from some aspect of their work as a teacher (Kyriacou, 2001; Elo et al., 2003; Eddy et al., 2019). The existing literature indicates that teachers typically report high levels of occupational stress (Kyriacou, 2001), and teaching is actually recognized as a profession with higher than average stress when comparing the levels of work-related stress across occupations (Johnson et al., 2005). Previous literature have named several stressors, such as time pressure and workload or lack of administrative support that may hinder teachers' occupational well-being (e.g., Ferguson et al., 2012; Skaalvik and Skaalvik, 2009; Skaalvik and Skaalvik, 2016).

A wide range of research has suggested that stress may have an effect on teachers' well-being in numerous ways (see McIntyre et al., 2017). In addition, teachers' occupational stress may act as a strain for their students as well. In previous literature, teachers' higher stress has been associated with, for example, students' lower educational outcomes (Herman et al., 2018) and poorer quality of teacher-student relationships (Whitaker et al., 2015). Moreover, there is widespread agreement that teachers' prolonged stress may lead to experiences of emotional exhaustion, which is also one of the critical components of burnout syndrome (e.g., Maslach et al., 2001; Schaufeli and Salanova, 2014; Skaalvik and Skaalvik, 2016). Therefore, acknowledging teacher's experiences of work-related stress is particularly important.

Work engagement, which represents a positive aspect of teachers' occupational well-being, is defined as "a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption" (Schaufeli et al., 2002, p. 74). Teachers experiencing high levels of *vigor* have high levels of energy and mental resilience while working. They are also willing to invest effort in their work, and they are persistent when facing the difficulties. Moreover, previous literature has suggested that vigor can be seen as the opposite of exhaustion (Schaufeli et al., 2002; Schaufeli and Bakker, 2010). *Dedication*, in turn, is related to teachers' involvement with work as well as with their sense of significance, enthusiasm, inspiration, pride, and challenge with respect to their working. *Absorption*, by contrast, refers to being fully concentrated and deeply engrossed in work. According to Gonzales-Roma et al. (2006), vigor and dedication are considered the core dimensions of work engagement, and were therefore included in the current study.

The extent to which employees experience work engagement can be observed to be drawn from job-related and personal resources along with demands related to work (Bakker and Demerouti, 2007). This view is highlighted in the Job Demands-Resources model (e.g., Demerouti et al., 2001), which posits that employees' occupational well-being may be produced by demands and resources that determine the working conditions typical for specific occupations (Bakker and Demerouti, 2007; Bakker et al., 2007). Studies conducted among educators have recognized that the stressors, such as workload and students' misbehavior, are somewhat typical

work-related demands (Hakanen et al., 2006). Conversely, work-related resources are more affirmative experiences, such as experiences of supervisory support, job control, a supportive climate, and appreciation (Hakanen et al., 2006; Bakker et al., 2007). Ways of recovering from work (Virtanen et al., 2020), the coping strategies the teacher uses (Aulén et al., 2021), and experiences of relatedness and emotional closeness with students (Spilt et al., 2011; Klassen et al., 2012), in turn, can represent personal resources. The different resources are particularly relevant under stressful conditions, as they are positively related to teachers' work engagement (e.g., Bermejo-Toro et al., 2016), and they may even act as a buffer against the negative impacts of work-related demands (Bakker et al., 2007).

In previous literature, several positive consequences of work engagement have been identified both at the individual and organizational levels. Teachers' work engagement has been positively associated, for example, with their satisfaction with work (Perera et al., 2018; Granziera and Perera, 2019), their organizational commitment (Hakanen et al., 2006), as well as higher relatedness with their students (Klassen et al., 2012). In addition, engaged teachers typically have better job performance (Bakker and Bal, 2010), and use more heterogeneous array of teaching practices (Addimando, 2019). It is also possible that teachers' work engagement is reflected in their interactional styles of teaching, that is, adjusting the levels of affection and control toward their students (for more about teaching styles, see Kuntsche et al., 2006; Walker, 2008). According to Bakker and Demerouti (2008), better job performance being associated with work engagement might be partly due to experiences of better psychological and physical health as well as more positive emotions typical for engaged workers. Thus, work engagement can be seen as crucial element of teachers' occupational well-being, and attention should be given on work-related resources, particularly when there is increase in work-related demands.

The COVID-19 Pandemic and Teachers' Occupational Well-Being

According to United Nations (2020), by mid-April of 2020, 94% of the world's student population were affected by the COVID-19 pandemic through school closures. In most countries, students' learning continued via various remote learning options, based on usage of online platforms, television, take-home packages, and radio (UNESCO, UNICEF, and the World Bank, 2020). In Finland, where the current study took place, the shift to remote learning was sudden. The Finnish Government (2020a) established that during school closures, schools would operate under "exceptional arrangements". Usage of online platforms was presented as an example, but not as a requirement. Thus, schools and teachers were autonomous with respect to how the remote teaching was executed. In comprehensive education, different combinations of real-time teaching via online platforms and provision of assignments along with focused feedback were widely used (Vuorio et al., 2021).

From the perspective of teachers' occupational well-being, it should be noted that the sudden shift to remote teaching as well as teaching itself during the COVID-19 pandemic may have caused some changes in the demands teachers faced in their work. Not all teachers were provided with support during the sudden changes nor with requirements that the situation created for the teachers (cf. UNESCO, UNICEF, and the World Bank, 2020). In addition, UNESCO (2021) has stated that confusion and stress for teachers was one of the adverse consequences of school closures. Recent findings support this view, such as MacIntyre et al. (2020), who found that teachers experienced substantial levels of stress during school closures (see also Salmela-Aro et al., 2020; Collie, 2021). Li et al. (2020) found that the prevalence of anxiety among teachers was almost three times more common during the COVID-19 pandemic than had been reported previously.

Studies examining teacher well-being during the COVID-19 pandemic have identified different stressors as well as work-related demands and resources from the time of school closures. For instance, results obtained by Collie (2021) indicate that during school closures, autonomy-thwarting leadership was related to teachers' increased experiences of emotional exhaustion, while autonomy-supportive leadership increased workplace buoyancy, which in turn decreased teachers' somatic burden, stress, and emotional exhaustion. Moreover, Kim and Asbury (2020) concluded that teachers' experiences of uncertainty about the situation and worry they had for vulnerable students were the central stressors during the first six weeks of the lockdown. MacIntyre et al. (2020) reported, instead, that teachers' experiences of workload, worry about their familys' health, and loss of control over work were the three most significant stressors. Nevertheless, occupational well-being of teachers during the COVID-19 pandemic should be examined further by the focusing on different patterns of their well-being (i.e., by utilizing person-oriented approach). While the traditional variable-oriented approach provides valuable information on the associations between measured variables, it does not consider that populations are heterogenous regarding the associations between predictive and outcome variables (Laursen and Hoff, 2006; Eye et al., 2006). To examine teachers' occupational well-being in a more nuanced manner, a person-oriented approach can be adopted, first, to identify subgroups of individuals who share similarities in their occupational well-being, and, second, to examine associations between predictive and outcome variables within each identified subgroup (Bergman and Trost, 2006; Laursen and Hoff, 2006).

At this point, the existing literature provides only a few studies in where the person-oriented approach has been utilized to examine teachers' occupational well-being during the COVID-19 pandemic. A recent study by Salmela-Aro et al. (2020) utilized a person-oriented approach to examine teachers' and principals' occupational well-being during school closures. By focusing on burnout as a negative aspect of well-being and work engagement as a positive aspect of well-being, they identified four well-being profiles among teachers. The results demonstrated that up to 21% of teachers belonged to groups in where well-being was somewhat dominated by burnout. They also found that teachers' risk for burnout increased due to stress related to the COVID-19 pandemic. In the present study, teachers' occupational well-being was assessed with work engagement and experiences of occupational stress instead of work engagement and burnout.

This decision was made because when stress is seen as a precursor of burnout (e.g., Schaufeli and Salanova, 2014), it is possible that some teachers might have experienced severe stress during school closures without yet reaching a burnout syndrome. Therefore, stress was seen as a central feature of the occupational well-being during the first months of when the COVID-19 pandemic caused changes into teachers' work. In addition, the present study sought out to provide a unique view on how teacher occupational well-being during school closures would be related to teachers' recovery from work and interactional styles of teaching.

The Present Study

As teaching is a highly stressful occupation (Kyriacou, 2001; Johnson et al., 2005), and substantial levels of stress have been associated with the COVID-19 pandemic (MacIntyre et al., 2020), the present study was designed to reach a more comprehensive understanding on teachers' occupational well-being during the first few months of the COVID-19 pandemic. By appreciating the view that occupational well-being simultaneously consists of negative as well as positive experiences, the present study examined work-related stress and the increase in stress due to the COVID-19 pandemic along with vigor and dedication (i.e., the core dimensions of work engagement). A person-oriented approach was utilized in order to obtain novel insights on teachers' diverse experiences on occupational well-being. Thus, the following research questions and hypotheses were formulated:

1. What kind of subgroups can be identified based on teachers' occupational well-being assessed through self-reported work-related stress, experiences of increased stress due the COVID-19 pandemic, as well as vigor, and dedication? Based on previous findings describing different well-being profiles among teachers (Herman et al., 2018; Salmela-Aro et al., 2020), it was expected that several distinct subgroups would be identified (Hypothesis 1).
2. To what extent do the identified subgroups differ in teachers' self-reported emotional exhaustion, recovery from work, and interactional styles of teaching? First, as vigor has been seen as an opposite of exhaustion (Schaufeli and Bakker, 2010) and previous literature have indicated positive relations between teachers' stress and exhaustion (e.g., Skaalvik and Skaalvik, 2016), it was expected that subgroups would differ with respect to teachers' experiences of emotional exhaustion (Hypothesis 2a). Second, based on prior findings suggesting that recovery from work is associated well-being (Virtanen et al., 2020), it was expected that subgroups would differ with respect to teachers' recovery from work (Hypothesis 2b). Finally, while the lack of similar studies hampers setting a specific hypothesis concerning the differences between profile groups with respect to interactional styles of teaching, based on prior findings suggesting that different aspects of teachers' occupational well-being are generally associated with ways in which the teachers teach (Addimando, 2019; Bakker and Bal, 2010; Whitaker et al., 2015) and experiences of relatedness with their students (Klassen et al., 2012), it was expected that subgroups would differ with respect to interactional styles of teaching as well (Hypothesis 2c).

MATERIALS AND METHODS

Participants and Procedure

The data for the present study were collected as part of the larger The Effects of Teacher-Student Interactions on Child Outcomes: Behavioral and Psychophysiological Mechanisms (ETSIC) study (Lerkkanen and Pakarinen, 2016-2021) in the Spring of 2020. The ethical approval provided by the ethical committee of the University of Jyväskylä was received prior to commencing the study, and the permits to execute data collection in three municipalities located in different parts of Finland were asked and granted from local education authorities before contacting the teachers. Teachers in these three municipalities were approached via e-mail by asking whether they would agree to answer a questionnaire concerning their occupational well-being and teaching practices. Within the same e-mail, the privacy notices of the study were delivered as attached. Participation was voluntary and anonymous, and none of the contacting with the teachers were done via school administrative staff.

The participants were 279 teachers (77.8 female; 22.2% male) working as class teachers for grades 1–6 of primary school during the 2019–2020 academic year, including during national school closures due to the COVID-19 pandemic. The vast majority (98.2%) of the teachers had a masters' degree and were qualified class teachers. Participants' age ranged between 24 and 65 years (M = 42.52 years; SD = 9.85; Md = 36), and work experience ranged between 0 and 37 years (M = 14.75 years; SD = 10.23 years; Md = 13 years).

Measures

Teachers' Occupational Stress

Two separate single-item questions were utilized to measure teachers' occupational stress. First, to measure the extent of teachers' occupational stress, teachers were asked to answer the following question on a scale from 1 (*not at all*) to 6 (*very much*): "Stress means a situation in which a person feels tense, restless, nervous, or anxious, or is unable to sleep at night because his/her mind is troubled all the time. Do you feel this kind of stress these days?" (Elo et al., 2003). The previous literature has verified that this single-item stress measure drawn from the Occupational Stress Questionnaire is a valid to identify occupational wellness (Elo et al., 2003; see also; Eddy et al., 2019). Second, teachers' occupational stress due to the COVID-19 pandemic was measured with a single item composed for the present study. Teachers were asked to answer the following item on a scale from 1 (*not at all*) to 4 (*entirely*): "To what extent has the increase in your occupational stress been due to the COVID-19 situation?".

Work Engagement

Teachers' work engagement was measured using the Utrecht Work Engagement Scale (UWES; Schaufeli et al., 2002; Seppälä et al., 2009). Six items of the UWES were utilized to measure the

two core dimensions of work engagement: vigor (3 items, α = 0.81; e.g., "At my work, I feel bursting with energy"), and dedication (3 items, α = 0.86; e.g., "I am enthusiastic about my job"). Teachers were asked to answer based on a 7-point Likert scale (1 = *never*; 7 = *daily*). Based on norm scores drawn across occupations (Schaufeli and Bakker, 2004), vigor is considered high when the average value for the dimension is between 5.81 and 6.65, and dedication is considered high when the average value for the dimension is between 5.71 and 6.69.

Emotional Exhaustion

Teachers' emotional exhaustion was measured with a shortened Finnish version of the Bergen Burnout Inventory (Salmela-Aro et al., 2011). In the present study, three items which constitute the sub-scale of emotional exhaustion were used (α = 0.78; e.g., "I am snowed under with work"). Teachers were asked to answer on a scale from 1 (*completely disagree*) to 6 (*strongly agree*).

Recovery From Work

Teachers' recovery experiences were measured using the Recovery Experience Questionnaire (Sonnentag and Fritz, 2007, see also; Siltaloppi et al., 2011). Teachers were asked to respond to 15 items with respect to their off-job time. The scale included four sub-scales: psychological detachment (four items, α = 0.86; e.g., "I don't think about work at all"), relaxation (three items, α = 0.80; e.g., "I do relaxing things"), mastery (four items, α = 0.89; e.g., "I seek out intellectual challenges"), and control (four items, α = 0.83; e.g., "I take care of things the way that I want them done"). Teachers' answers ranged from 1 (*totally agree*) to 5 (*totally disagree*).

Teacher Interactional Styles

Teachers' interactional styles of teaching were measured utilizing the Teachers Interactional Style Scale (Aunola et al., 2005; see also; Pakarinen et al., 2010). Teachers were asked to rate items comprising their affection (eight items, α = 0.84; e.g., "I respect the opinion of the students in my group"), behavioral control (three items, α = 0.76; e.g., "Students have to learn that rules are important in our group"), and psychological control (four items, α = 0.77; e.g., "Students in my class should know how much I sacrifice for them") towards their students. Teachers answers ranged from 1 (*does not fit me at all*) to 5 (*fits me very well*).

Statistical Analyses

A person-oriented approach with a latent profile analysis (LPA) (Vermunt and Magison, 2002; Lubke and Muthen, 2005) was applied in the present study. LPA is a model-based variant of traditional cluster analysis, in which the aim is to identify clusters of individuals (i.e., subgroups) based on observed continuous variables (Nylund-Gibson and Masyn, 2016). The advantage of this kind of analytical approach is that the data can be approached by recognizing that populations are not necessarily heterogeneous in terms of how the measured variables are related to possible outcomes (Bergman and Trost, 2006; Laursen and Hoff, 2006).

During the enumeration process, a series of LPAs are performed to examine different profile solutions with different number of profiles in order to conclude the best fitting solution based on the fit indices as well as theoretical and practical considerations. The fit indices used in the present study were log-likelihood (log L), Akaike information criterion (AIC), Bayesian information criterion (BIC), and adjusted Bayesian information criterion (ABIC), as well as Vuong-Lo-Mendell-Rubin (VLMR) likelihood ratio test and adjusted Lo-Mendell-Rubin (LMR) test. The LPA with the lowest log L, AIC, BIC, and ABIC values is considered to provide a good fit to the data (e.g., Nylund et al., 2007). With VLMR and LMR tests, $p > 0.05$ indicates that the model with one less profile should be rejected in favor of the estimated model (Lo et al., 2001).

In the present study, LPAs were conducted by utilizing teachers' self-ratings on their work-related stress and experiences of increased stress due the COVID-19 situation as well as vigor and dedication (i.e., the core dimensions of work engagement) in order to identify subgroups of teachers with similar patterns of their occupational well-being. The LPAs were executed using the Mplus statistical package (version 7.4; Muthén and Muthén, 1998–2017). With the Auxiliary function and the three-step procedure, analyses comparing teachers' emotional exhaustion, recovery from work, and teachers' interactional styles between the identified profile groups were carried out using multinomial regression analyses and pairwise comparisons along with LPAs. In addition, to validate the chosen profile solution, one-way analyses of variance (ANOVAs) and pairwise comparisons were conducted using the SPSS package in terms of the criterion variables.

RESULTS

Descriptive Statistics

Descriptive statistics of the criterion variables (**Table 1**) suggested that participating teachers experienced, on average, occupational stress to some extent or quite a lot, and they reported that the COVID-19 situation was to some extent the reason for their increased stress. In addition, based on norm scores drawn across occupations (Schaufeli and Bakker, 2004), teachers reported, on average, high and average levels of work engagement. Correlations calculated for the criterion variables (**Table 1**) suggested, first, a moderate positive correlation between the two negative aspects of occupational well-being (i.e., occupational stress and occupational stress due to the COVID-19 pandemic). Second, a strong positive correlation was found between the two positive aspects of occupational well-being (i.e., vigor and dedication). Positive and negative aspects of occupational well-being were not statistically significantly correlated or correlations were very weak.

Profile Groups Based on Teachers' Occupational Well-Being

Following the first research question, LPAs were conducted to examine what kind of subgroups based on teachers' occupational

TABLE 1 | Descriptive statistics and correlation matrix for aspects of teachers' occupational well-being (n = 279).

	M (SD)	Min	Max	1	2	3	4
1. Occupational stress	3.56 (1.29)	1	6		0.43*	–0.22*	–0.11
2. Occupational stress due to the COVID-19 pandemic	2.29 (0.85)	1	4			0.07	0.21*
3. Vigor	5.69 (0.99)	2	7				0.86*
4. Dedication	5.89 (0.99)	2	7				

*Occupational stress: 1 (*not at all*) to 6 (*very much*); Occupational stress due to the COVID-19 pandemic: 1 (*not at all*) to 4 (*entirely*); Vigor and Dedication (the core dimensions of Work engagement): 1 (*never*) to 7 (*daily*).*
*p = 01.

TABLE 2 | Fit indices for the series of latent profile analyses (LPAs).

Number of profiles	Log L	AIC	BIC	ABIC	*p*VLMR	*p*LMR	n
1	–1,601.92	3,219.83	3,248.88	3,223.52			279
2	–1,486.80	2,999.60	3,046.80	3,005.58	0.011	0.012	71/208
3	–1,420.20	2,876.39	2,941.76	2,884.68	0.001	0.001	141/33/105
4	**–1,394.75**	**2,835.50**	**2,919.02**	**2,846.09**	**0.020**	**0.023**	**96/32/74/77**
5	–1,374.16	2,804.33	2,906.00	2,817.21	0.199	0.210	53/32/55/79/60
6	–1,354.90	2,775.80	2,895.63	2,790.99	0.202	0.210	5/74/59/29/55/57
7	–1,332.45	2,740.90	2,878.89	2,758.39	0.057	0.061	5/55/38/47/27/46/60

log L, log-likelihood; AIC, akaike information criterion; BIC, bayesian information criterion; ABIC, adjusted bayesian information criterion; VLMR, vuong-lo-mendell-rubin likelihood ratio test; LMR, adjusted lo-mendell-rubin test.

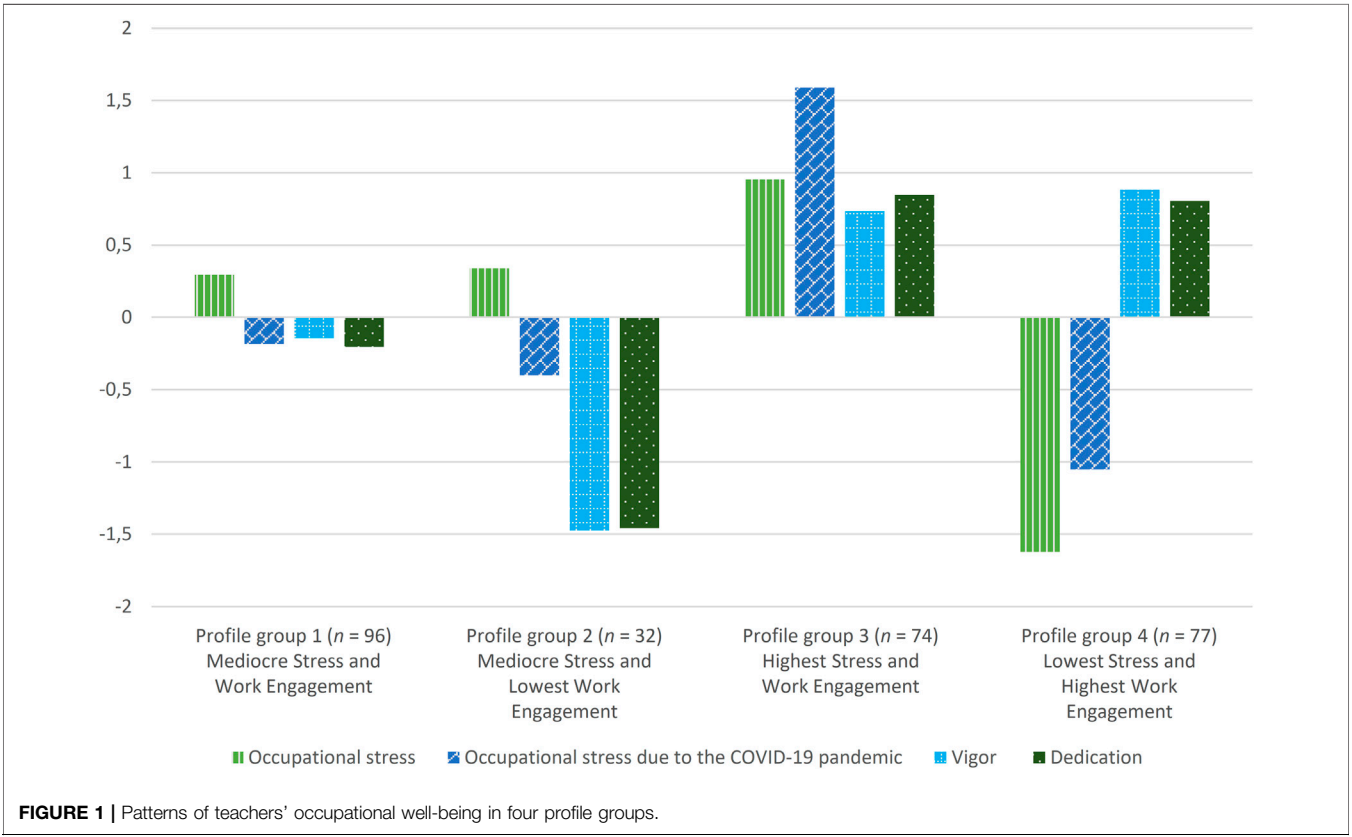

FIGURE 1 | Patterns of teachers' occupational well-being in four profile groups.

well-being can be identified. The features of occupational well-being included in the LPAs were the teachers' work-related stress and increase in stress due to the COVID-19 pandemic along with vigor and dedication (i.e., the core dimensions of work engagement). The LPAs demonstrated that fit indices of log L, BIC, ABIC, and AIC decreased when number of profiles

TABLE 3 | Differences in teachers' occupational well-being between the profile groups.

	Profile group 1	Profile group 2	Profile group 3	Profile group 4		Pairwise comparison
	Mediocre stress and work engagement (n = 96)	Mediocre stress and lowest work engagement (n = 32)	Highest stress and work engagement (n = 74)	Lowest stress and highest work engagement (n = 77)	ANOVA	
	M(SD)	*M(SD)*	*M(SD)*	*M(SD)*	$F_{(3,275)}$	
Occupational stress	3.81 (1.12)	3.84 (1.11)	4.27 (1.21)	2.47 (0.70)	39.68***	1, 2, 3 > 4
Occupational stress due to the COVID-19 pandemic	2.18 (0.74)	2.06 (0.76)	3.16 (0.55)	1.70 (0.54)	69.00***	1, 2, 4 < 3 / 1 > 4
Vigor	5.27 (0.48)	3.75 (0.65)	6.27 (0.49)	6.45 (0.47)	271.55***	1, 3, 4 > 2 / 1 < 3, 4
Dedication	5.41 (0.47)	3.96 (0.62)	6.63 (0.99)	6.59 (0.42)	349.43***	1, 3, 4 > 2 / 1 < 3, 4

*Occupational stress: 1 (*not at all*) to 6 (*very much*); Occupational stress due to the COVID-19 pandemic: 1 (*not at all*) to 4 (*entirely*); Vigor and Dedication (the core dimensions of work engagement): 1 (*never*) to 7 (*daily*); Pairwise comparisons reported between groups in which differences are statistically significant at* p < *0.001 with ANOVA post hoc Dunnett correction.* ***p < *.001.*

increased without providing a point of elbowing (**Table 2**). With VLMR and LMR tests, the *p*-values lower than 0.05 suggested that up to four-profile solution, the model with one less profile could be rejected in favor of the estimated model. Therefore, as the four-profile solution was also theoretically and practically reasonable, it was determined to provide the most optimal fit with the data.

In the four-profile solution (**Figure 1**; **Table 3**), profile group 1 was the largest and it applied to 34.4% of teachers (n = 96). This profile group was composed of teachers experiencing mediocre levels of occupational stress as well as work engagement, leading the profile to be named *Mediocre Stress and Work Engagement*. Profile group 2 was the smallest group and it applied to 11.5% of teachers (n = 32). This group was comprised of teachers experiencing somewhat mediocre levels of occupational stress along with lowest self-ratings concerning their work engagement. Therefore, profile group 2 was named *Mediocre Stress and Lowest Work Engagement*. With respect to size of the groups, the last two profile groups, profile group 3 and profile group 4, were quite similar to each other. Profile group 3 applied to 26.5% of teachers (n = 74), and it was composed of teachers experiencing highest level of occupational stress and highest increase in their stress due to COVID-19 pandemic along with highest vigor and dedication. Based on that, profile group 3 was named *Highest Stress and Work Engagement*. The last profile group, profile group 4, applied to 27.6% of teachers (n = 77). It was composed of teachers experiencing the lowest levels of occupational stress while sharing the highest levels of work engagement with profile group 3. Therefore, profile group 4 was named *Lowest Stress and Highest Work Engagement*.

The results of one-way analyses of variance (ANOVAs) suggested that within the four-profile solution, the profile groups differed from each other with respect to the criterion variables on which the LPAs were based on (**Table 3**). The results of pairwise comparisons disclosed unique and distinctive features within each profile (**Figure 1**; **Table 3**). For example, while profile groups 3 and 4 shared highest values in teachers' work engagement, teachers in these two groups differed significantly in their occupational stress (**Table 3**). Therefore, patterns of occupational well-being were not identical to each other between different profile groups.

Differences in Teachers' Emotional Exhaustion Between the Profile Groups

Multinomial regression analysis with pairwise comparisons suggested differences in teachers' emotional exhaustion between the profile groups (**Table 4**). Teachers identified as having the highest levels of stress and increase in stress due to the COVID-19 situation along with the highest levels of vigor and dedication (i.e., profile group 3) reported significantly higher levels of emotional exhaustion than teachers in the other profile groups. On the contrary, teachers identified as having the lowest levels of stress along with the highest levels of vigor and dedication (i.e., profile group 4), reported significantly lower levels of emotional exhaustion than teachers in other profile groups. Conversely, teachers identified as having similar levels of occupational stress but different levels in their work engagement (i.e., profile groups 1 and 2) did not differ significantly in their emotional exhaustion.

Differences in Teachers' Recovery From Work Between the Profile Groups

Differences in teachers' recovery experiences were examined with the multinomial regression analysis and pairwise comparisons. The results indicated that with respect to three out of four subscales of teachers' recovery from work (i.e., psychological detachment, relaxation, and mastery), the identified subgroups did not significantly differ from each other. With respect to the sub-scale of control, teachers identified as having lowest occupational stress and highest work engagement (i.e., profile group 4), reported significantly higher level of control than teachers in profile group 1 (i.e., *Mediocre Stress and Work Engagement*; β = 1.08, p = 0.026) or in profile group 2 (i.e., *Mediocre Stress and Lowest Work Engagement*; β = 1.11, p = 0.006).

TABLE 4 | Mean levels of emotional exhaustion and estimates of pairwise comparison analyses between the groups.

		Estimates based on paired group comparisons		
	M(SD)	**Profile group 2**	**Profile group 3**	**Profile group 4**
Mediocre stress and work engagement (Profile group 1; *n* = 96)	3.92 (1.09)	ns	–0.94**	0.68**
Mediocre stress and lowest work engagement (Profile group 2; *n* = 32)	3.89 (1.29)		–0.99**	0.64*
Highest stress and work engagement (Profile group 3; *n* = 74)	4.40 (1.01)			1.62***
Lowest stress and highest work engagement (Profile group 4; *n* = 77)	2.91 (1.01)			

Range from 1 (completely disagree) to 6 (strongly agree).
***p < .001.*
**p < .005.*
p = .029.
Ns, non-significant.

Differences in Teachers' Interactional Styles of Teaching Between the Profile Groups

The results of multinomial regression analysis and pairwise comparisons suggested some differences between profile groups with respect to teachers' self-reported interactional styles. Statistically significant differences were found concerning subscales of affection and behavioral control, but not for the psychological control.

With respect to the sub-scale of affection, the results indicated that profile groups 1 and 2 (i.e., *Mediocre Stress and Work Engagement*, and *Mediocre Stress and Lowest Work Engagement*, respectively) did not differ from each other, nor did the Profile groups 3 and 4 (*Highest Stress and Work Engagement*, and *Lowest Stress and Highest Work Engagement*, respectively). However, teachers experiencing mediocre stress along with mediocre or lowest levels of work engagement (i.e., profile groups 1 and 2) reported significantly lower affection with their students than teachers in profile group 3 (*Highest Stress and Work Engagement;* $\beta = -2.44$, $p = 0.006$; $\beta = -3.28$, $p < 0.001$, respectively) or in profile group 4 (*Lowest Stress and Highest Work Engagement*; $\beta = -2.19$, $p = 0.004$; $\beta = -3.03$, $p = 0.001$, respectively) did. In other words, teachers experiencing highest work engagement along with either highest stress (i.e., profile group 3) or lowest stress (i.e., profile group 4) reported the highest levels of affection with their students.

The results also indicated that teachers identified as having the highest stress and work engagement (i.e., profile group 3) reported higher behavioral control than teachers in profile groups 1, 2, and 4 did ($\beta = 1.30$, $p = 0.022$; $\beta = 1.33$, $p = 0.040$; $\beta = 1.783$, $p = 0.005$, respectively). No other differences between profile groups were found with respect to the behavioral control.

DISCUSSION

The present study examined teachers' occupational well-being during the first few months of the COVID-19 pandemic. The study contributes to the literature by utilizing person-oriented approach to identify subgroups of teachers with different profiles of occupational well-being during an exceptional time when the teachers around the globe faced new challenges and unexpected changes in their work. In order to appreciate the complexity of the reality, both negative and positive aspects of occupational well-being were simultaneously examined through teachers' self-ratings of work-related stress and increase of stress due to the COVID-19 pandemic as well as the core dimensions of work engagement (i.e., vigor and dedication). Along with identifying subgroups based on the occupational well-being, the findings contribute to the literature also by providing a unique view on how these identified subgroups differed with respect to teachers' emotional exhaustion, recovery from work, and interactional styles of teaching.

First, as expected (Hypothesis 1), several distinct subgroups based on teachers' occupational well-being during the COVID-19 pandemic were identified. Within the present four-profile solution, 34.4% of teachers were identified with *Mediocre Stress and Work Engagement* (profile group 1), 11.5% of teachers were identified with *Mediocre Stress and Lowest Work Engagement* (profile group 2), 26.5% of teachers were identified with *Highest Stress and Work engagement* (profile group 3), and 27.6% of teachers were identified with *Lowest Stress and Highest Work Engagement* (profile group 4). In other words, there were some teachers who displayed a pattern where higher levels of work engagement (representing the positive aspect of occupational well-being) were accompanied by lower levels of stress (representing the negative aspect of occupational well-being); however, some teachers also displayed a pattern in which work engagement and occupational stress both remained at relatively high or average levels.

The presence of different patterns for teachers' occupational well-being can be seen to concur with the complexity of the phenomenon. While there are no prior studies with exactly the same set of factors from which the present profile analysis was drawn from, somewhat similarly formed patterns of teachers' occupational well-being have been found previously in studies focusing on well-being with respect to experiences of stress and coping with stress before the COVID-19 pandemic (Herman et al., 2018) and with respect to work burnout and engagement before (Salmela-Aro et al., 2019) and during (Salmela-Aro et al., 2020) the COVID-19 pandemic. It seems that while negative and

positive aspects of occupational well-being may be reciprocally connected to each other, the level of occupational stress does not necessarily determine the level of work engagement or vice versa. This could perhaps be due to individual differences in ways how teachers' job-related and personal resources can outweigh the work-related demands (e.g., Bakker and Demerouti, 2007; Berjemo-Toro et al., 2016).

It is common that teachers report high levels of occupational stress (Kyriacou, 2001; Travers, 2017), and recent studies indicate that during the time of school closures following the COVID-19 pandemic, teachers were also stressed because of the situation (MacIntyre et al., 2020; Collie, 2021). The results indicate that the increase in stress due to the COVID-19 pandemic was particularly high among the teachers identified with highest stress and work engagement (i.e., profile group 3). Only less than one third of the teachers were identified with a profile in which the level of occupational stress was somewhat low, and the teachers had reported that the COVID-19 pandemic had resulted less than some increase in their stress (i.e., profile group 4). Thus, the rest of the teachers (72.4% in total) belonged to profiles in which occupational stress was higher than average (i.e., profile groups 1, 2, and 3). Therefore, the present findings can be seen to compliment previous literature by concurring that the first few months of the COVID-19 pandemic may have been stressful time for the teachers (MacIntyre et al., 2020; Collie, 2021). However, while many teachers reported being quite stressed, the findings also complemented the previous literature by illustrating that there was also more than one quarter of teachers who did not experience high levels of occupational stress nor more than somewhat minor increase in their stress due to the COVID-19 pandemic. Thus, it should be noted that occupational stress remains as an individual experience during exceptional times, such as during a global pandemic. Acknowledging these individual experiences is central to providing administrative and personal support for occupational well-being.

Interestingly, the present findings also indicated that during the first few months of the COVID-19 pandemic, most of the teachers reported of being, on average, relatively highly engaged with their work. Based on the norm scores suggested for the UWES measure (Schaufeli and Bakker, 2004), teachers identified with highest work engagement (i.e., profile groups 3 and 4) assessed their experiences of vigor and dedication with values that can be interpreted as high. Teachers identified with mediocre work engagement (i.e., profile group 1), in turn, reported average levels of vigor and dedication, while teachers identified with lowest work engagement (i.e., profile group 2) experienced only low levels.

Second, as expected (Hypothesis 2a), most of the subgroups differed with respect to teachers' experiences of emotional exhaustion. Teachers identified with lowest stress and highest work engagement (i.e., profile group 4) manifested also lowest levels of emotional exhaustion, which aligns nicely with previous literature suggesting that experience of exhaustion is an opposite of vigor (Schaufeli et al., 2002; Schaufeli and Bakker, 2010). However, the highest levels of emotional exhaustion were evidenced among teachers who had highest levels of stress along with highest levels of work engagement (i.e., profile group 3). In addition, two profile groups with similar levels of occupational stress yet different levels of vigor (i.e., Profile groups 1 and 2), did not differ significantly with respect to their experiences of emotional exhaustion. Therefore, it seems that at least during the first few months of the COVID-19 pandemic, experiences of vigor and exhaustion were not exactly opposite experiences for many teachers (cf. Schaufeli and Bakker, 2010). Some relatively similar findings have been reported before the COVID-19 pandemic as well (Salmela-Aro et al., 2019). This result calls attention to the need to more closely examine the individual experiences of teachers rather than talking about teachers as a homogenous group.

With respect to findings of the present study, it is possible to speculate whether teachers' experiences of emotional exhaustion were more determined by the level of their occupational stress and increase of stress due to the COVID-19 pandemic than by the level of vigor or dedication. This would also be in line with the speculation that perhaps some teachers' work engagement was not severely affected by the COVID-19 pandemic during the Spring of 2020. Nevertheless, the present findings highlight the importance of providing support for those teachers who are experiencing occupational stress or increase of stress due to the COVID-19 situation. Recently, Salmela-Aro et al. (2020) identified that during the first few months of the COVID-19 pandemic, 11% of teachers were "engaged but burned out". In the present study, 26.5% of the teachers were somewhat similarly "engaged but stressed" (i.e., Profile group 3). It would be crucially important to recognize those teachers who are experiencing high occupational stress while functioning well due to their high work engagement so they could be supported before their stress evolves into burnout. It is likely that this concern would be real even when the COVID-19 pandemic has been overcome.

Third, in contrast to what was expected (Hypothesis 2b), subgroups did not clearly differ with respect to teachers' recovery from work. From four major recovery experiences examined, differences were found only in experiences of control (i.e., in ways on how the teachers experienced of being able to decide schedules and activities of their leisure time; Sonnentag and Fritz, 2007). In the previous literature, there are some examples showing that from different recovery experiences related to teachers' life satisfaction, control plays the most significant role (e.g., Virtanen et al., 2020). This could perhaps explain to some extent the results of the present study indicating that it was teachers identified with lowest occupational stress and highest work engagement (i.e., profile groups 4) who experienced higher control over their leisure time than those who were identified with mediocre stress along with mediocre or lowest work engagement (i.e., profile groups 1 and 2). However, it does not provide a solid reason why the identified subgroups did not differ with respect to psychological detachment, relaxation, or mastery. Perhaps the absence of clear differences could be related to changes that the COVID-19 pandemic made into teachers' leisure time as well. Similar to many other countries, Finnish government (2020b)

recommended social distance and many leisure activities were put on hold in the Spring 2020. Therefore, it is possible that during the first few months of the COVID-19 pandemic, teachers were still updating their ways to recover from work as well.

Finally, in line with what was expected (Hypothesis 2c), there were differences between identified subgroups with respect to teachers' interactional styles of teaching. First, the findings indicated that the teachers who experienced highest work engagement along with either highest stress (i.e., profile group 3) or lowest stress (i.e., profile group 4), reported highest affection with their students. This means that regardless of differences in the levels of occupational stress, teachers with very high levels of vigor and dedication, valued the most the relatedness with students, that is, of being warm and caring with students, and being responsive to students' needs (see also, Kuntsche et al., 2006; Pakarinen et al., 2010; Walker, 2008). However, the current study cannot be used to determine the causalities. It is impossible to determine whether teachers valued affective interactional style because of their very high levels of vigor and dedication, whether they experienced very high vigor and dedication due to their interactional style, or whether those were somewhat reciprocally linked to one another. Nevertheless, to some extent the present findings can be seen to support previous literature suggesting that teacher-student relationship is associated with teachers' occupational well-being (e.g., Spilt et al., 2011; Klassen et al., 2012), and importance of caring relationships remained to be present during the time of school closures followed from the COVID-19 pandemic as well (Kim and Asbury, 2020).

Along with differences found with respect to affection, teachers' interactional styles of teaching differed between profile groups also with respect to behavioral control. Teachers with highest stress and work engagement (i.e., profile group 3), reported higher behavioral control than teachers in any other profile groups did. It should be particularly noted that the difference was evidenced also between the two profile groups in where vigor and dedication were at equal levels (i.e., Profile groups 3 and 4). Thus, it was teachers with the highest levels of occupational stress and greatest increase of stress due to the COVID-19 situation, who highlighted the importance of rules and structures defining students' good behavior more than the others (see also, Kuntsche et al., 2006; Pakarinen et al., 2010; Wentzel, 2002). While causalities cannot be determined, it might be reasonable to wonder whether changes that teachers faced during the first few months of the COVID-19 pandemic (see UNESCO, UNICEF, and the World Bank, 2020; Vuorio et al., 2021) could have been particularly straining for the teachers who valued behavioral control in their interactional style. That would be somewhat in line with previous finding suggesting that loss of control over work was the third highest stressor for teachers during the first few months of the COVID-19 pandemic (MacIntyre et al., 2020).

In sum, the findings of the present study contribute to the literature by providing a stance for teachers' occupational well-being during the time of when the COVID-19 pandemic was recently begun. The findings concurred that occupational well-being is a complex phenomenon, and there are individual differences in teachers' occupational well-being. Patterns found during the COVID-19 pandemic were somewhat similar to those found before. The findings indicated also that during the first few months of the COVID-19 pandemic many teachers experienced occupational stress as well as at least some increase of stress due to the pandemic. The experiences of stress were related to experiences of emotional exhaustion, and the teachers experiencing the highest levels of occupational stress were also the ones who valued behavioral control in their interactional style the most. However, somewhat surprisingly, the findings did not provide a reason to assume that the COVID-19 pandemic or school closures would have clearly affected on teachers' work engagement during the first few months of the pandemic. Moreover, the findings related to teachers' interactional styles of teaching suggested that the teachers with highest vigor and dedication reported the most of being warm and caring when interacting with students.

Limitations and Suggestions for Further Research

The present study has some limitations. First, this study did not focus on possible differences in teachers' occupational well-being based on participants' background factors (e.g., gender, age, and work experience) or include them as covariates. To understand how teachers from different backgrounds have experienced the COVID-19 pandemic, future studies should be undertaken. Second, teachers' occupational stress was measured with two single-item questions. While the usage of first single-item question has been previously validated to identify occupational wellness (Elo et al., 2003; see also; Eddy et al., 2019), the question used to assess the teachers' experiences of change in their occupational stress due to the COVID-19 pandemic, was used for the first time. In addition, it should be noted that the data were cross-sectional and collected during the first few months of the COVID-19 pandemic. That should be kept in mind when trying to generalize the findings into time when the COVID-19 pandemic does not dictate teachers' daily functions in work or during leisure time. Moreover, due to being cross-sectional, no causal inferences can be made. In the future, longitudinal research focusing on relations between occupational well-being during and after the COVID-19 pandemic is necessary. This would provide deeper knowledge of the ways in which teachers' occupational well-being has been evolving during the pandemic and what will happen afterwards. Particularly interesting would be to examine whether there has been changes in teachers' vigor and dedication as the COVID-19 pandemic has continued, and the ways on how that would be associated with teachers' occupational stress. With respect to the Job Demands-Resources model, the present findings raise the question of how long the experiences of stress or even exhaustion should last before imbalance between demands and resources would have decreasing effects on work engagement. This is something that would be important to understand even when sources of demands would not be as substantial as the COVID-19 pandemic or some other crisis. Crucially important would also be to find ways to recognize the teachers who are experiencing occupational stress or emotional exhaustion while being also

highly engaged in work, and find ways to support them during the COVID-19 pandemic, but also later on. In addition, research revealing the causalities between teachers' interactional styles of teaching and different negative and positive aspects of occupational well-being could enhance the understanding of the role that teacher-student interactions have in teachers' occupational well-being.

CONCLUSION

The present study reveals that teachers' occupational well-being is individually constructed. The findings indicate that many teachers experienced occupational stress during the first few months of the COVID-19 pandemic, but somewhat surprisingly teachers' work engagement was perhaps not severely affected by the pandemic at that point. However, the diversity in ways on how these different negative and positive aspects of well-being are drawn into patterns, highlights the importance of acknowledging the individual experiences of teachers rather than talking about teachers as certain group. This is central when examining teachers' occupational well-being during the time of the global pandemic and beyond.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because of the ongoing research. Requests to access the datasets should be directed to sanni.poysa@jyu.fi.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The ethical committee of the University of Jyväskylä. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

SP was responsible for the research questions and statistical analyses of the present manuscript, and she act as a corresponding author. EP was the Responsible Researcher and M-KL was the Principal Investigator of the larger study projects The Effects of Teacher-Student Interactions on Child Outcomes: Behavioral and Psychophysiological Mechanisms (ETSIC), and The effect of coronavirus epidemic on education: Teacher stress and remote teaching practices as mechanisms for student outcomes (CONE), under which the current study has been conducted. They were responsible on study design, data collection, publishing plan, and they supported with analyzing the data and by co-authoring the current manuscript.

FUNDING

This study was funded by grants from the Academy of Finland (No. 335635; 317610), and by the grant from The Trade Union of Education in Finland.

REFERENCES

Addimando, L. (2019). The Effect of Positive Working Conditions on Work Engagement and Teaching Classroom Practices: A Large Cross-Sectional Study in Switzerland. *Front. Psychol.* 10, 2129. doi:10.3389/fpsyg.2019.02129

Aulén, A.-M., Pakarinen, E., Feldt, T., and Lerkkanen, M.-K. (2021). Teacher Coping Profiles in Relation to Teacher Well-Being: a Mixed Method Approach. *Teach. Teach. Education*. 102, 103323. doi:10.1016/j.tate.2021.103323

Aunola, K., Lerkkanen, M-K., Poikkeus, A-M., and Nurmi, J-E. (2005). *Teacher Interactional Style Scale*. Jyväskylä, Finland: University of Jyväskylä

Bakker, A. B., and Bal, M. P. (2010). Weekly Work Engagement and Performance: A Study Among Starting Teachers. *J. Occup. Organ. Psychol.* 83 (1), 189–206. doi:10.1348/096317909X402596

Bakker, A. B., and Demerouti, E. (2007). The Job Demands-Resources Model: State of the Art. *J. Managerial Psych* 22 (3), 309–328. doi:10.1108/02683940710733115

Bakker, A. B., and Demerouti, E. (2008). Towards a Model of Work Engagement. *Career Dev. Int.* 13 (3), 209–223. doi:10.1108/13620430810870476

Bakker, A. B., Hakanen, J. J., Demerouti, E., and Xanthopoulou, D. (2007). Job Resources Boost Work Engagement, Particularly when Job Demands Are High. *J. Educ. Psychol.* 99 (2), 274–284. doi:10.1037/0022-0663.99.2.274

Bergman, L. R., and Trost, K. (2006). The Person-Oriented versus the Variable-Oriented Approach: Are They Complementary, Opposites, or Exploring Different Worlds? *Merrill-Palmer Q.* 52 (3), 601–632. doi:10.1353/mpq.2006.0023

Bermejo-Toro, L., Prieto-Ursúa, M., and Hernández, V. (2016). Towards a Model of Teacher Well-Being: Personal and Job Resources Involved in Teacher Burnout and Engagement. *Educ. Psychol.* 36 (3), 481–501. doi:10.1080/01443410.2015.1005006

Chaplain, R. P. (2008). Stress and Psychological Distress Among Trainee Secondary Teachers in England. *Educ. Psychol.* 28 (2), 195–209. doi:10.1080/01443410701491858

Collie, R. J. (2021). COVID-19 and Teachers' Somatic Burden, Stress, and Emotional Exhaustion: Examining the Role of Principal Leadership and Workplace Buoyancy. *AERA Open.* 7, 233285842098618. doi:10.3886/E127641V1

Cumming, T. (2017). Early Childhood Educators' Well-Being: An Updated Review of the Literature. *Early Child. Educ J.* 45 (5), 583–593. doi:10.1007/s10643-016-0818-6

Demerouti, E., Bakker, A. B., Nachreiner, F., and Schaufeli, W. B. (2001). The Job Demands-Resources Model of Burnout. *J. Appl. Psychol.* 86 (3), 499–512. doi:10.1037/0021-9010.86.3.499

Eddy, C. L., Herman, K. C., and Reinke, W. M. (2019). Single-Item Teacher Stress and Coping Measures: Concurrent and Predictive Validity and Sensitivity to Change. *J. Sch. Psychol.* 76, 17–32. doi:10.1016/j.jsp.2019.05.001

Elo, A.-L., Leppänen, A., and Jahkola, A. (2003). Validity of a Single-Item Measure of Stress Symptoms. *Scand. J. Work Environ. Health.* 29 (6), 444–451. doi:10.5271/sjweh.752

Eye, A. v., Bogat, G. A., and Rhodes, J. E. (2006). Person-oriented and Variable-Oriented Research: Concepts, Results, and Development. *Merrill-Palmer Q.* 52 (3), 390–420. doi:10.1353/mpq.2006.0032

Ferguson, K., Frost, L., and Hall, D. (2012). Predicting Teacher Anxiety, Depression, and Job Satisfaction. *J. Teach. Learn.* 8 (1), 27–42. doi:10.22329/jtl.v8i1.2896

Finnish Government (2020a). VALTIONEUVOSTON SUOSITUKSET Yliopistoille, Ammattikorkeakouluille, Lukiokoulutuksen ja Ammatillisen Koulutuksen, vapaan Sivistystyön, Taiteen Perusopetuksen, Perusopetuksen, Esiopetuksen Sekä Varhaiskasvatuksen Järjestäjille Koronaviruspandemian

aikana [Government Policy for Universities, Universities of Applied Sciences, General Upper Secondary Education, Vocational Education, Liberal Education, Basic Art Education, Primary and Lower Secondary Education and Early Childhood Education and Care during the Coronavirus Pandemic of 16 March]. Available at: https://minedu.fi/documents/1410845/4449678/Suositukset+16.3.2020/cc750ec2-9603-c2fd-79a7-ebc56c71a4b7/Suositukset+16.3.2020.pdf (Accessed March 21, 2021)

Finnish Government (2020b). Government, in Cooperation with the President of the Republic, Declares a State of Emergency in Finland over Coronavirus Outbreak. [Press release.]. Available at: https://valtioneuvosto.fi/en/-/10616/hallitus-totesi-suomen-olevan-poikkeusoloissa-koronavirustilanteen-vuoksi (Accessed April 3, 2021)

Foley, C., and Murphy, M. (2015). Burnout in Irish Teachers: Investigating the Role of Individual Differences, Work Environment and Coping Factors. *Teach. Teach. Education*. 50, 46–55. doi:10.1016/j.tate.2015.05.001

González-Romá, V., Schaufeli, W. B., Bakker, A. B., and Lloret, S. (2006). Burnout and Work Engagement: Independent Factors or Opposite Poles? *J. Vocat. Behavior* 68 (1), 165–174. doi:10.1016/j.jvb.2005.01.003

Granziera, H., and Perera, H. N. (2019). Relations Among Teachers' Self-Efficacy Beliefs, Engagement, and Work Satisfaction: A Social Cognitive View. *Contemp. Educ. Psychol.* 58, 75–84. doi:10.1016/j.cedpsych.2019.02.003

Hakanen, J. J., Bakker, A. B., and Schaufeli, W. B. (2006). Burnout and Work Engagement Among Teachers. *J. Sch. Psychol.* 43 (6), 495–513. doi:10.1016/j.jsp.2005.11.001

Herman, K. C., Hickmon-Rosa, J. e., and Reinke, W. M. (2018). Empirically Derived Profiles of Teacher Stress, Burnout, Self-Efficacy, and Coping and Associated Student Outcomes. *J. Positive Behav. Interventions*. 20 (2), 90–100. doi:10.1177/1098300717732066

Johnson, S., Cooper, C., Cartwright, S., Donald, I., Taylor, P., and Millet, C. (2005). The Experience of Work-related Stress across Occupations. *J. Managerial Psych.* 20 (2), 178–187. doi:10.1108/02683940510579803

Kim, L. E., and Asbury, K. (2020). 'Like a Rug Had Been Pulled from under You': The Impact of COVID-19 on Teachers in England during the First Six Weeks of the UK Lockdown. *Br. J. Educ. Psychol.* 90 (4), 1062–1083. doi:10.1111/bjep.12381

Klassen, R. M., and Chiu, M. M. (2010). Effects on Teachers' Self-Efficacy and Job Satisfaction: Teacher Gender, Years of Experience, and Job Stress. *J. Educ. Psychol.* 102 (3), 741–756. doi:10.1037/a0019237

Klassen, R. M., Perry, N. E., and Frenzel, A. C. (2012). Teachers' Relatedness with Students: An Underemphasized Component of Teachers' Basic Psychological Needs. *J. Educ. Psychol.* 104 (1), 150–165. doi:10.1037/a0026253

Kuntsche, E., Gmel, G., and Rehm, J. (2006). The Swiss Teaching Style Questionnaire (STSQ) and Adolescent Problem Behaviors. *Swiss J. Psychol.* 65 (3), 147–155. doi:10.1024/1421-0185.65.3.147

Kyriacou, C. (2001). Teacher Stress: Directions for Future Research. *Educ. Rev.* 53 (1), 27–35. doi:10.1080/00131910120033628

Laursen, B. P., and Hoff, E. (2006). Person-Centered and Variable-Centered Approaches to Longitudinal Data. *Merrill-Palmer Q.* 52 (3), 377–389. doi:10.1353/mpq.2006.0029

Lerkkanen, M-K., and Pakarinen, E. (2016-2021). *The Effects of Teacher-Student Interactions on Child Outcomes: Behavioral and Psychophysiological Mechanisms (ETSIC) Study*. Finland: Jyväskylä, University of Jyväskylä. Available at: http://www.jyu.fi/tessi

Li, Q., Miao, Y., Zeng, X., Tarimo, C. S., Wu, C., and Wu, J. (2020). Prevalence and Factors for Anxiety during the Coronavirus Disease 2019 (COVID-19) Epidemic Among the Teachers in China. *J. Affective Disord.* 277, 153–158. doi:10.1016/j.jad.2020.08.017

Lo, Y., Mendel, N. R., and Rubin, D. B. (2001). Testing the Number of Components in a normal Mixture. *Biometrika*. 88, 767–778. doi:10.1093/biomet/88.3.767

Lubke, G. H., and Muthén, B. (2005). Investigating Population Heterogeneity with Factor Mixture Models. *Psychol. Methods*. 10 (1), 21–39. doi:10.1037/1082-989X.10.1.21

MacIntyre, P. D., Gregersen, T., and Mercer, S. (2020). Language Teachers' Coping Strategies during the Covid-19 Conversion to Online Teaching: Correlations with Stress, Wellbeing and Negative Emotions. *System*. 94, 102352. doi:10.1016/j.system.2020.102352

Madigan, D. J., and Kim, L. E. (2021). Does Teacher Burnout Affect Students? A Systematic Review of its Association with Academic Achievement and Student-Reported Outcomes. *Int. J. Educ. Res.* 105, 101714. doi:10.1016/j.ijer.2020.101714

Maslach, C., Schaufeli, W. B., and Leiter, M. P. (2001). Job Burnout. *Annu. Rev. Psychol.* 52 (1), 397–422. doi:10.1146/annurev.psych.52.1.397

McIntyre, T. M., McIntyre, S. E., and Francis, D., J. (2017). *Educator Stress. An Occupational Health Perspective*. Cham: Springer Intrernational Publishing. doi:10.1007/978-3-319-53053-6

Montgomery, C., and Rupp, A. A. (2005). A Meta-Analysis for Exploring the Diverse Causes and Effects of Stress in Teachers. *Can. J. Education / Revue canadienne de l'éducation*. 28, 458–488. doi:10.2307/4126479

Muthén, L. K., and Muthén, B. O. (1998–2017). *Mplus User's Guide*. Seventh edition. Los Angeles, CA: Muthén & Muthén.

Nylund, K. L., Asparouhov, T., and Muthén, B. O. (2007). Deciding on the Number of Classes in Latent Class Analysis and Growth Mixture Modeling: A Monte Carlo Simulation Study. *Struct. Equation Model. A Multidisciplinary J.* 14 (4), 535–569. doi:10.1080/10705510701575396

Nylund-Gibson, K., and Masyn, K. E. (2016). Covariates and Mixture Modeling: Results of a Simulation Study Exploring the Impact of Misspecified Effects on Class Enumeration. *Struct. Equation Model. A Multidisciplinary J.* 23, 782–797. doi:10.1080/10705511.2016.1221313

Pakarinen, E., Lerkkanen, M.-K., Poikkeus, A.-M., Kiuru, N., Siekkinen, M., Rasku-Puttonen, H., et al. (2010). A Validation of the Classroom Assessment Scoring System in Finnish Kindergartens. *Early Education Development*. 21 (1), 95–124. doi:10.1080/10409280902858764

Parker, P. D., Martin, A. J., Colmar, S., and Liem, G. A. (2012). Teachers' Workplace Well-Being: Exploring a Process Model of Goal Orientation, Coping Behavior, Engagement, and Burnout. *Teach. Teach. Education*. 28 (4), 503–513. doi:10.1016/j.tate.2012.01.001

Parker, P. D., and Martin, A. J. (2009). Coping and Buoyancy in the Workplace: Understanding Their Effects on Teachers' Work-Related Well-Being and Engagement. *Teach. Teach. Education*. 25, 68–75. doi:10.1016/j.tate.2008.06.009

Perera, H. N., Vosicka, L., Granziera, H., and McIlveen, P. (2018). Towards an Integrative Perspective on the Structure of Teacher Work Engagement. *J. Vocational Behav.* 108, 28–41. doi:10.1016/j.jvb.2018.05.006

Salmela-Aro, K., Hietajärvi, L., and Lonka, K. (2019). Work Burnout and Engagement Profiles Among Teachers. *Front. Psychol.* 10, 2254. doi:10.3389/fpsyg.2019.02254

Salmela-Aro, K., Rantanen, J., Hyvönen, K., Tilleman, K., and Feldt, T. (2011). Bergen Burnout Inventory: Reliability and Validity Among Finnish and Estonian Managers. *Int. Arch. Occup. Environ. Health*. 84 (6), 635–645. doi:10.1007/s00420-010-0594-3

Salmela-Aro, K., Upadyaya, K., and Hietajärvi, L. (2020). Suomalaisten Rehtorien Ja Opettajien Työhyvinvointiprofiilit Koronakeväänä [Work-RelatedWell-Being Profiles Amon Finnish School Teachers and Principals during the spring of Covid-19]. *Psykologia*. 55 (6), 426–443.

Schaufeli, W., and Bakker, A. (2004). *Utrecth Work Engagement Scale. Preliminary Manual*. Utrecht: Utrech University. Available at: https://www.wilmarschaufeli.nl/publications/Schaufeli/Test%20Manual/Test_manual_UWES_English.pdf (Accessed March 30, 2021)

Schaufeli, W. B., and Bakker, A. B. (2010). "Defining and Measuring Work Engagement: Bringing Clarity to the Concept," in *In Work Engagement: A Handbook of Essential Theory and Research*. Editors A. B. Bakker and M. P. Leiter (England: Psychology Press), 10–24.

Schaufeli, W. B., Salanova, M., González-romá, V., and Bakker, A. B. (2002). The Measurement of Engagement and Burnout: A Two Sample Confirmatory Factor Analytic Approach. *J. Happiness Stud.* 3, 71–92. doi:10.1023/A:1015630930326

Schaufeli, W., and Salanova, M. (2014). "Burnout, Boredom and Engagement at the Workplace," in *In an Introduction to Contemporary Work Psychology*. Editors M. C. Peeters, J. de Jonge, and T. W. Taris (England: Wiley-Blackwell), 293–320.

Seppälä, P., Mauno, S., Feldt, T., Hakanen, J., Kinnunen, U., Tolvanen, A., et al. (2009). The Construct Validity of the Utrecht Work Engagement Scale: Multisample and Longitudinal Evidence. *J. Happiness Stud.* 10 (4), 459–481. doi:10.1007/s10902-008-9100-y

Siltaloppi, M., Kinnunen, U., Feldt, T., and Tolvanen, A. (2011). Identifying Patterns of Recovery Experiences and Their Links to Psychological

Outcomes across One Year. *Int. Arch. Occup. Environ. Health*. 84 (8), 877–888. doi:10.1007/s00420-011-0672-1

Skaalvik, E. M., and Skaalvik, S. (2009). Does School Context Matter? Relations with Teacher Burnout and Job Satisfaction. *Teach. Teach. Education*. 25, 518–524. doi:10.1016/j.tate.2008.12.006

Skaalvik, E. M., and Skaalvik, S. (2014). Teacher Self-Efficacy and Perceived Autonomy: Relations with Teacher Engagement, Job Satisfaction, and Emotional Exhaustion. *Psychol. Rep.* 114 (1), 68–77. doi:10.2466/14.02.PR0.114k14w0

Skaalvik, E. M., and Skaalvik, S. (2016). Teacher Stress and Teacher Self-Efficacy as Predictors of Engagement, Emotional Exhaustion, and Motivation to Leave the Teaching Profession. *Creative Education*. 07, 1785–1799. doi:10.4236/ce.2016.713182

Sonnentag, S., and Fritz, C. (2007). The Recovery Experience Questionnaire: Development and Validation of a Measure for Assessing Recuperation and Unwinding from Work. *J. Occup. Health Psychol.* 12 (3), 204–221. doi:10.1037/1076-8998.12.3.204

Spilt, J. L., Koomen, H. M. Y., and Thijs, J. T. (2011). Teacher Wellbeing: The Importance of Teacher-Student Relationships. *Educ. Psychol. Rev.* 23, 457–477. doi:10.1007/s10648-011-9170-y

Travers, C. (2017). "Current Knowledge on the Nature, Prevalence, Sources and Potential Impact of Teacher Stress," in *In Educator Stress: An Occupational Health Perspective*. Editors T. M. McIntyre, S. E. McIntyre, and D. J. Francis (Cham: Springer International Publishing AG), 23–54. doi:10.1007/978-3-319-53053-6_2

UNESCO (2021). Covid-19: Adverse Consequences of School Closures. Available at: https://en.unesco.org/covid19/educationresponse/consequences (Accessed March 20, 2021).

UNESCO, UNICEF, and the World Bank (2020). *What Have We Learnt?: Overview of Findings from a Survey of Ministries of Education on National Responses to COVID-19*. Paris, New York, Washington D.C: UNESCO, UNICEF, World Bank. © World Bank. Available at: https://openknowledge.worldbank.org/handle/10986/34700 License: CC BY-SA 3.0 IGO (Accessed March 20, 2021).

United Nations (2020). Policy Brief: Education during COVID-19 and beyond. August 2020. Available at: https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/08/sg_policy_brief_covid-19_and_education_august_2020.pdf (Accessed March 20, 2021)

Vermunt, J. K., and Magidson, J. (2002). "Latent Class Cluster Analysis," in *"Latent Class Cluster Analysis," in Applied Latent Class Analysis*. Editors J. A. Hagenaars and A. L. McCutcheon (Cambridge: Cambridge University Press), 89–106. doi:10.1017/CBO9780511499531.004

Virtanen, A., De Bloom, J., and Kinnunen, U. (2020). Relationships between Recovery Experiences and Well-Being Among Younger and Older Teachers. *Int. Arch. Occup. Environ. Health*. 93, 213–227. doi:10.1007/s00420-019-01475-8

Vuorio, J., Ranta, M., Korksinen, K., Nevalainen-Sumkin, T., Helminen, J., and Miettunen, A. (2021). Etäopetuksen Tilannekuva Koronapandemiassa Vuonna 2020. [Report of Remote Taching during the Covid-19 Pandemic in Year 2020.] Raportit Ja Selvitykset 2021:4. Available at: https://www.oph.fi/fi/tilastot-ja-julkaisut/julkaisut/etaopetuksen-tilannekuva-koronapandemiassa-vuonna-2020 (Accessed April 3, 2021)

Walker, J. M. (2008). Looking at Teacher Practices Through the Lens Of Parenting Style. *J. Exp. Educ.* 76 (2), 218–240. doi:10.3200/JEXE.76.2.218-240

Wentzel, K. R. (2002). Are Effective Teachers Like Good Parents? Teaching Styles and Student Adjustment in Early Adolescence. *Child Dev.* 73 (1), 287–301. doi:10.1111/1467-8624.00406

Whitaker, R. C., Dearth-Wesley, T., and Gooze, R. A. (2015). Workplace Stress and the Quality of Teacher-Children Relationships in Head Start. *Early Child. Res. Q.* 30 (A), 57–69. doi:10.1016/j.ecresq.2014.08.008

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

CORRECTION
published: 27 September 2021
doi: 10.3389/feduc.2021.772114

Corrigendum: Patterns of Teachers' Occupational Well-Being During the COVID-19 Pandemic: Relations to Experiences of Exhaustion, Recovery, and Interactional Styles of Teaching

Sanni Pöysä[1]*, *Eija Pakarinen*[1] and *Marja-Kristiina Lerkkanen*[1,2]

[1]Department of Teacher Education, University of Jyväskylä, Jyväskylä, Finland, [2]Norwegian Centre for Learning Environment and Behavioural Research in Education, University of Stavanger, Stavanger, Norway

Keywords: teachers' occupational well-being, COVID-19, stress, vigor, dedication, interactional styles of teaching, exhaustion, recovery

OPEN ACCESS

Edited and reviewed by:
Sina Fackler,
Leibniz Institute for Educational Trajectories (LG), Germany

***Correspondence:**
Sanni Pöysä
sanni.poysa@jyu.fi

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *07 September 2021*
Accepted: *13 September 2021*
Published: *27 September 2021*

Citation:
Pöysä S, Pakarinen E and Lerkkanen M-K (2021) Corrigendum: Patterns of Teachers' Occupational Well-Being During the COVID-19 Pandemic: Relations to Experiences of Exhaustion, Recovery, and Interactional Styles of Teaching. Front. Educ. 6:772114. doi: 10.3389/feduc.2021.772114

A Corrigendum on

Patterns of Teachers' Occupational Well-Being During the COVID-19 Pandemic: Relations to Experiences of Exhaustion, Recovery, and Interactional Styles of Teaching
by Pöysä, S., Pakarinen, E., and Lerkkanen, M.-K. (2021). Front. Educ. 6:699785. doi: 10.3389/feduc.2021.699785

In the original article, there was a mistake concerning the expressed norm values of the UWES measure. The original norm values are drawn with scale 0–6 whereas our study has used the same measure with scale 1–7. While this unfortunate misinterpretation does not jeopardize the integrity of the study in general, we do find it reasonable to request a possibility to make the corrections to the published article.

The corrections have been made into three places:

1) The last sentence of chapter *Work Engagement* (under **Measures**):

Based on norm scores drawn across occupations (Schaufeli and Bakker, 2004), vigor is considered high when the average value for the dimension is between 5.81 and 6.65, and dedication is considered high when the average value for the dimension is between 5.71 and 6.69.

2) The second sentence of *Descriptive Statistics* (under **Results**)

In addition, based on norm scores drawn across occupations (Schaufeli and Bakker, 2004), teachers reported, on average, high and average levels of work engagement.

3) The first three sentences in the fifth paragraph of the **Discussion**

Interestingly, the present findings also indicated that during the first few months of the COVID-19 pandemic, most of the teachers reported of being, on average, relatively highly engaged with their work. Based on the norm scores suggested for the UWES measure (Schaufeli and Bakker, 2004),

teachers identified with highest work engagement (i.e., profile groups 3 and 4) assessed their experiences of vigor and dedication with values that can be interpreted as high. Teachers identified with mediocre work engagement (i.e., profile group 1), in turn, reported average levels of vigor and dedication, while teachers identified with lowest work engagement (i.e., profile group 2) experienced only low levels.

The authors apologize for this error and state that this does not change the scientific conclusions of the article in any way. The original article has been updated.

REFERENCE

Schaufeli, W., and Bakker, A. (2004). Utrecth Work Engagement Scale. Preliminary Manual. Utrecht: Utrech University. Available at: https://www.wilmarschaufeli.nl/publications/Schaufeli/Test%20Manual/Test_manual_UWES_English.pdf (Accessed March 30, 2021).

frontiers in Psychology

ORIGINAL RESEARCH
published: 29 July 2021
doi: 10.3389/fpsyg.2021.682540

Changes in Parents' Home Learning Activities With Their Children During the COVID-19 Lockdown – The Role of Parental Stress, Parents' Self-Efficacy and Social Support

Elisa Oppermann[1], Franziska Cohen[2], Katrin Wolf[1], Lars Burghardt[1] and Yvonne Anders[1]*

[1] Chair of Early Childhood Education, University of Bamberg, Bamberg, Germany, [2] Department of Early Childhood Education, University of Education Freiburg, Freiburg, Germany

As a result of the abrupt closures of daycare centers in Germany due to the COVID-19 pandemic, parents' ability to provide learning opportunities at home became all the more important. Building on the family stress model, the study investigates how parental stress affected changes in parents' provision of home learning activities (HLA) during the lockdown, compared to before the lockdown. In addition, the study considers parental self-efficacy and perceived social support as protective factors that may play important roles in disrupting the negative effects of stress. Data stems from a nation-wide survey of 7,837 German parents of children ages 1–6 years, which was conducted in Spring 2020 during the first wave of COVID-19 infections and at a time of strict restrictions in Germany. Results revealed that parental stress was negatively related to changes in the provision of HLA. Parental self-efficacy and an intact social support system were protective of parental stress during the lockdown. Additionally, parental self-efficacy and – to a larger extend – perceived social support interacted with parental stress in the relation to changes in the provision of HLA. Specifically, self-efficacy and perceived social support acted as protective factors that buffered the negative influence of stress on parents' ability to provide educational activities for their children at home. These results have important implications for supporting families with young children during challenging times, such as the COVID-19 pandemic and the temporary closure of daycare centers.

Keywords: COVID-19, home learning environment (HLE), parental stress, family stress model, social support, parental self-efficacy

OPEN ACCESS

Edited by:
Sina Fackler, Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
James Elliot Hall, University of Southampton, United Kingdom
Sandra Martin-Chang, Concordia University, Canada

****Correspondence:***
Elisa Oppermann
elisa.oppermann@uni-bamberg.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *18 March 2021*
Accepted: *30 June 2021*
Published: *29 July 2021*

Citation:
Oppermann E, Cohen F, Wolf K, Burghardt L and Anders Y (2021) Changes in Parents' Home Learning Activities With Their Children During the COVID-19 Lockdown – The Role of Parental Stress, Parents' Self-Efficacy and Social Support. Front. Psychol. 12:682540. doi: 10.3389/fpsyg.2021.682540

INTRODUCTION

As a response to the COVID-19 pandemic, Germany – among many other countries – implemented nation-wide restrictions to slow the spread of the virus in Spring 2020. These restrictions included the closure of daycare centers and schools[1] as well as all other educative supporting services directed to children, the prohibition to visit playgrounds as well as strict social

[1]Emergency childcare was only available to a small number of families in systemically relevant occupations.

distancing measures, e.g., no contact with more than one person from outside one's household[2]. This led to a challenging situation for families with young children (Andresen et al., 2020; Huebener et al., 2021). Children stayed at home all day and parents had to provide early education and care while simultaneously having to meet all other demands, e.g., occupation, household. The availability of stimulating home learning activities (HLA) is crucial for children's development (Melhuish et al., 2008; Anders et al., 2012) – even more so when institutional education is unavailable, and children rely on their parents to support their learning and development at home. For this reason, we were especially interested in the way parents coped with these challenging times and how the lockdown changed the provision of HLA.

Research shows that parents' ability to provide HLA can be impaired by parental stress, which might also apply to stress resulting from the COVID-19 lockdown (Gershoff et al., 2007). Building on the family stress model (Conger et al., 1992; Masarik and Conger, 2017), the present study examines how parental stress during the lockdown was related to changes in parents' provision of HLA. Moreover, extending the family stress model, the study considers parental self-efficacy and perceived social support as protective factors that may play important roles in disrupting the negative effects of stress. A better understanding of the processes linking parental stress and HLA, as well as the potential benefit of protective factors in this relation, is essential to promoting children's learning and development during difficult times, such as a the COVID-19 pandemic.

Home Learning Environment

The home learning environment constitutes the first and most influential developmental context for children (Bronfenbrenner and Morris, 2006), which has greater effects on child outcomes than any other context (Melhuish et al., 2008). The quality of the home learning environment is a broad concept that encompasses the availability of resources (i.e., structural characteristics such as learning materials and family income), parents' beliefs that influence the provision of learning opportunities (such as parental educational aspirations), and the quantity and quality of parent-child interactions that promote learning (Anders et al., 2012; Kluczniok et al., 2013; Lehrl et al., 2020). These parent–child interactions take place during HLA, e.g., joint book reading or solving puzzles together, which are essential for children's learning and development because they provide children with everyday learning opportunities (Kluczniok et al., 2013). The importance of HLA for child development is widely empirically documented (Foster et al., 2005; Melhuish et al., 2008; Anders et al., 2012; Lehrl et al., 2020; Liang et al., 2020). Parents' ability to provide everyday HLA may thus be particularly crucial at times when institutional early childhood education is not available, such as during the closure of daycare centers in Spring 2020. One aim of the present study was to investigate changes in HLA during the COVID-19 lockdown compared to before the lockdown. One may assume that parents increased the amount of HLA during the closure of daycare centers – also because parents spent more time with their children. However, it is important to keep in mind that the abrupt closure of daycare centers created a stressful situation for parents, who still had to meet all other demands, including their occupations, household, and potential care and home-schooling of other children. Thus, even if parents intended to compensate for the missing institutional education, increased parental stress may have impaired their ability to provide more HLA for their children.

Family Stress Model: Relation Between Parental Stress and Changes in HLA

The family stress model illustrates that stressors, such as financial problems and problematic living conditions, increase parental stress and – through that – negatively influence parenting behavior (Conger et al., 1992; Kotchick et al., 2005; McConnell et al., 2011; Masarik and Conger, 2017). The assumed relations of the family stress model have also been applied to the provision of HLA (Gershoff et al., 2007; Raver et al., 2007; Bendickson, 2020). For instance, Gershoff et al. (2007) showed that economic hardship among US parents of 6–7-year-old children was associated with increased parental stress and poorer parenting behavior, including less provision of cognitively stimulating parent–child activities. More recently, a study based on data from nine different European countries showed that material deprivation was negatively associated with parental wellbeing and parents' provision of HLA (Wolf et al., 2019).

In the present study, we focus on parents' perceived stress, which is defined as psychological distress that occurs as a reaction to external risk factors at a given time (Randall and Bodenmann, 2013). Perceived psychological stress thereby reflects individual parents' appraisal of environmental stressors, which they feel are taxing or exceeding their resources for coping (Lazarus and Folkman, 1984). It is important to distinguish psychological stress from related concepts, such as burnout or depression, which are more long-term clinical conditions. Parental stress can be caused by a number of stressors (Masarik and Conger, 2017), such as financial strain, as proposed by the family stress model (Gershoff et al., 2007; Green et al., 2007; Scaramella et al., 2008; Stewart and Cooper, 2013). Although many studies referring to the family stress model focused on financial problems as a main stressor, there is evidence that other factors may also cause parental stress, including problematic housing conditions, e.g., living in problematic neighborhoods (Ross, 2000; Scaramella et al., 2008), or in houses that are too small for the family (Ross, 2000), and work-related problems, e.g., unemployment (Algarvio et al., 2018). In addition, environmental influences and hazardous events could act as stressors, such as the COVID-19 pandemic (Ravens-Sieberer et al., 2021). However, a recent study showed that health concern was not a significant predictor of perceived stress among parents of children aged 2–14 years in northern Italy, which was one of the European regions most affected by the first wave of COVID-19 infections (Spinelli et al., 2020).

[2]In this article, we refer to this time of strict restrictions in Germany between March and May as "lockdown." Although the restrictions in Germany were – strictly speaking – not a lockdown in the literal sense because curfews were only implemented in some states, the restrictions limited individuals' lives severely and are typically referred to as "lockdown" in the media as well as in previous publications (e.g., Huebener et al., 2021).

Instead, those parents who reported to have difficulty meeting all their demands were most stressed (Spinelli et al., 2020). This suggests that the increase in parental stress in Spring 2020, which has also been documented among German parents by Huebener et al. (2021), was not mainly due to health concerns but rather a consequence of the lockdown. There are two ways through which the lockdown may have increased stress for parents: first, the lockdown may have intensified existing stressors, such as the stress caused by living in inadequate housing, e.g., apartments/houses that are too small for the family size, which is likely to increase conflict at home when more family members stay at home and outside activities, like the use of playgrounds, are prohibited. Second, it may have led to additional stressors, such as unemployment or short-time leave, leading to increasing financial problems; or working from home while having to care for small children. These (additional) stressors during the COVID-19 lockdown likely increased parental stress – which, based on the assumptions of the family stress model, should lead to less HLA. In this regard, one may assume that HLA decreases linearly with increasing parental stress: The more parents are stressed, the less cognitive and emotional resources they may have to offer stimulating HLA for their children. Alternatively, one may argue that parents can deal with some stress until a certain threshold is reached, at which point parents feel overwhelmed by the stress, leading to a non-linear decrease in HLA (threshold hypothesis). A non-linear relation between stress and behavioral outcomes has been documented for stress and depression (Rudolph and Flynn, 2007) as well as for cumulative risk and child development (Evans et al., 2013), but the threshold idea has rarely been applied to parents and it has not been investigated among parents during the COVID-19 pandemic.

Protective Factors

The theoretical and empirical research literature suggests that external stressors result in parental stress (Ross, 2000; Scaramella et al., 2008; Masarik and Conger, 2017), which results in non-optimal parenting behavior, including HLA (Gershoff et al., 2007; Wolf et al., 2019; Bendickson, 2020). Yet, this is not the case for every household. Some parents seem to be more "resilient" than others, which suggests that there may be internal and external protective factors that disrupt this negative circle. In fact, the family stress model proposes that protective factors may interact with parental stress and reduce the negative impact of stress on parenting practices (Masarik and Conger, 2017). The present study focuses on two factors that have been demonstrated to reduce stress and improve parenting behavior, namely parental self-efficacy beliefs (Bojczyk et al., 2018) and social support (McConnell et al., 2011).

Parental Self-Efficacy Beliefs

Parental self-efficacy beliefs are defined as parents' beliefs that they can promote their child's development and their environment toward positive child outcomes (Ardelt and Eccles, 2001). The construct is based on Bandura's (1977) social cognitive theory, describing self-efficacy as a primary source of human motivation and action. In line with this, empirical findings show that higher parental self-efficacy beliefs are associated with more HLA (Jones and Prinz, 2005; Peacock-Chambers et al., 2017; Bojczyk et al., 2018) and better child outcomes, such as child adjustment (Bojczyk et al., 2018) and lower problem behavior (Bandura, 1997; Jones and Prinz, 2005). Moreover, previous findings show that parents with higher parenting self-efficacy beliefs cope better with difficult parenting situations (Bojczyk et al., 2018) and report lower parental stress (Bloomfield and Kendall, 2012; Albanese et al., 2019 for an overview). This may be because parents who are confident in their ability to support their children's learning and development may see difficult parenting situations as challenges rather than problems and face these challenges with lower negative emotional arousal or stress (Jerusalem and Mittag, 1995). In addition to its influence on perceived stress and parenting practices, parental self-efficacy has been discussed as a moderator of the relation between parental stress and parenting practices (Albanese et al., 2019). Specifically, parents' confidence in their ability to handle even difficult parenting situations may help them cope with the stress and promote their child's learning, thus buffering the negative influence of stress on HLA. Previous studies have documented the moderating function of parental self-efficacy in the relation between marital stress and infant-mother attachment quality (Cassé et al., 2016) and in the relation between parental distress and parenting style and consistency (Rominov et al., 2016). The potential moderating role of parental self-efficacy in the relation between parental stress and changes in HLA, however, has not been examined yet.

Perceived Social Support

Social support is the perception that one is part of a social network that provides psychological and material resources intended to benefit a person's ability to deal with stress (Cohen, 2004). Social support may take different forms, including emotional support (e.g., empathy, caring, concern, affection, and reassurance), informational support (e.g., advice, guidance, and suggestions), and instrumental support (e.g., provision of material goods or services, such as helping with the household, caring for the children). Parents' perceived social support has been shown to help parents cope with stress (Östberg and Hagekull, 2000; McConnell et al., 2011; Parkes et al., 2015; Masarik and Conger, 2017). As it can be assumed that the COVID-19 lockdown resulted in higher stress for parents, perceived social support may have acted as a central protective factor for parents' perceived stress. At the same time, keeping social contacts during the lockdown may have been increasingly challenging due to social distancing measures. Thus, parents' perception of the support that they can rely upon during the lockdown may have been particularly relevant for their wellbeing – even more so during the lockdown than during 'normal' times.

In addition, perceived social support has been linked to parenting practices (McConnell et al., 2011), including HLA (Green et al., 2007; Bendickson, 2020). For instance, parents with more social support showed a higher frequency of positive parent–child activities (Green et al., 2007), higher parental warmth (Izzo et al., 2000), and less ineffective parenting (McConnell et al., 2011). Moreover, previous studies documented that perceived social support functions as a moderator of the

relation between parenting stress and parenting practices by enhancing parents' resilience in difficult situations (Kotchick et al., 2005; McConnell et al., 2011). The COVID-19 lockdown can be considered as a particularly difficult situation and perceived social support may thus have played a similar role: Parents with higher perceived social support may have been better able to cope with the stress they experienced, which might have buffered the assumed negative effect of stress on changes in HLA during the COVID-19 lockdown.

This Study

Based on the assumptions of the family stress model (Masarik and Conger, 2017), the present study examined the influence of parental stress on changes in HLA during the COVID-19 lockdown. Moreover, extending the family stress model, we investigated the role of parental self-efficacy and perceived social support as potential protective factors. We controlled for covariates that are typically associated with HLA and parental stress, specifically parents age, gender, parental education (McConnell et al., 2011; Parkes et al., 2015; Wolf et al., 2019) as well as characteristics that may also affect parental stress during the COVID-19 lockdown (e.g., working from home, being a single parent).

We investigated the following research questions:

(1) How do stressors and perceived parental stress influence changes in HLA during the lockdown?
   (a) We expect that stressors are positively associated with perceived parental stress during the lockdown (H1a).
   (b) We hypothesize that parental stress is negatively associated with changes in HLA (H1b).
   (c) We test for a non-linear relation between stress and changes in HLA (threshold hypothesis). As there are too few previous findings, we explore the nature of the relation between stress and changes in HLA.

(2) How are parental self-efficacy and perceived social support related to parental stress and changes in HLA?
   (a) Parental self-efficacy and perceived social support are negatively associated with perceived stress (H2a).
   (b) Parental self-efficacy and perceived social support are positively associated with changes in HLA (H2b).
   (c) Parental self-efficacy and perceived social support interact with perceived stress in predicting changes in HLA (H2c).

MATERIALS AND METHODS

Sample

Data for this study stems from in a nation-wide cross-sectional online survey in Germany, which was specifically designed to examine the effects of the abrupt closures of daycare centers and the strict regulations due to the COVID-19 pandemic on German families with young children (Cohen et al., 2020). To our knowledge, this was one of the first studies to assess the situation of families with children ages 1–6 years during the first wave of COVID-19 infections and at a time of strict restrictions in Germany in Spring 2020. Parents of children who attended daycare before the closures were invited to participate in the study between April 9th and May 24th 2020. Participants were recruited using convenience sampling starting with personal contacts, online blogs, social media and mailing lists of large non-profit organizations, foundations, and daycare providers. Altogether 9,343 parents participated in the survey. As the present study investigates the effects of the closures of daycare centers on parental stress and HLA, we excluded those cases where children did not attend daycare at all before the pandemic (n = 779) and those cases where children did attend daycare at the time of data collection despite the nation-wide closures (n = 727)[3]. The final dataset for our analyses consisted of N = 7,837 parents of children ages 1–6 years (M = 4.20, SD = 1.38) from all 16 federal states of Germany. The participants were on average 37.10 years old (SD = 4.50), 88.3% were female. Parental education was coded into three levels: *low* which corresponds to ISCED levels 0–2 (lower secondary school education and below; see International Standard Classification of Education; UNESCO, 2011), *medium* which corresponds to ISCED levels 3–5 (upper secondary school education to short-cycle tertiary education) and *high* which corresponds to ISCED levels 6 and 7 (Bachelor degree or above). In the sample, 74.2% of parents had a high educational level, 25.0% had a medium educational level and 0.8% had a low educational level. At the time of data collection, 72.5% of the parents were employed (20.6% in full time, 43.6% in part time and 8.4% in short-time work with temporarily reduced hours), compared to 78.3% who were employed before the COVID-19 pandemic.

Written informed consent was given by the participants. Participants were informed that they could stop the survey at any time without any disadvantage. The study abided APA ethical guidelines on conducting studies with human participants. No formal approval from a governing or institutional review board was required for the study (see guidelines provided by the German Research Foundation for the social sciences[4]).

Measures

Central Variables

Stressors

The following potential stressors were assessed through single items: financial problems, problematic housing situations, work-related problems, COVID-related health worries, conflict with partner, and conflict with family. Parents were asked whether these stressors occurred in the last weeks and if so, how burdensome they perceived them, ranging 1 (*did not occur*), 2 (*a bit burdensome*) to 5 (*very burdensome*).

Parental stress

Parental stress was assessed with four items where parents indicated their agreement with different statements of psychological distress ranging 1 (*totally disagree*) to 4 (*totally*

[3]In Germany, parents with system relevant occupations were eligible to emergency childcare, often for a reduced number of hours.

[4]www.dfg.de/en/research_funding/faq/faq_humanities_social_science/index.html

agree). Sample item: "I feel overwhelmed with all the demands I have to meet." Reliability was good (α = 0.85).

Changes in home learning activities (HLA)

Changes in parent–child-activities in the home were measured with reference to the time before the lockdown. Specifically, parents were asked to indicate if they do a certain activity *much less* (1), *less* (2), *slightly less* (3), *same* (4), *slightly more* (5), *more* (6), or *much more* (7) than before the lockdown. The scale consists of nine items, representing activities in the domains numeracy, reading, creative and practical activities (see **Supplementary Appendix Table A1**). The items were adapted from HLA items used in the German National Educational Panel Study (NEPS) (Blossfeld et al., 2011). Such global HLA measures were used in several German and European studies (e.g., EPPSE, see Sylva et al., 2014) and findings confirmed that these measures are predictive of child development (NEPS: Relikowski et al., 2015; EPPSE: Melhuish et al., 2008; Sylva et al., 2014). Reliability was good (α = 0.84).

Parental self-efficacy

Parental self-efficacy was measured using a five-item scale ranging from 1 (*totally disagree*) to 4 (*totally agree*). The measure focused on parents' general confidence in supporting their children's development and was thus appropriate for a range of child ages. The scale was developed by Schünke et al. (in preparation) based on an established instrument by Kliem et al. (2014). Sample item: "I have all the skills necessary to be a good mother/father." Reliability was acceptable (α = 0.79).

Perceived social support

Perceived social support was assessed with regard to parents' report on how often they can rely upon someone to give them emotional and informational support. The scale consisted of four items ranging 1 (*never*) to 5 (*always*), sample item: "Can you rely upon someone to give you advice with problems?" (see **Supplementary Appendix Table A2** for the item wordings of the entire scale). Reliability was good (α = 0.89).

Covariates and Family Characteristics

All covariates were assessed through parental report. These included (1) children's age; (2) the number of children living in the household that are 1–6 years old; (3) single parent; (4) private childcare (non-institutional), i.e., anyone outside the household taking care of their child/children for any number of hours, such as grandparents, friends, babysitters; (5) working from home, i.e., whether parents who were employed at the time of data collection currently worked from home and (6) whether both partners were working (part-time or full-time).

Statistical Analyses

First, descriptive results and bivariate correlations between the observed variables were computed. To analyze whether data on our variables of interest were systematically missing, we conducted missing data analyses with all cases using Little (1998) test of missing completely at random (MCAR). MCAR test results showed no systematic missingness in our continuous variables of interest (i.e., financial problems, problematic housing situation, work related problems, perceived stress, perceived social support, parental self-efficacy and HLA); χ^2 = 251.53, *df* = 244, *p* = 0.357. To make full use of the data, we applied the full information likelihood method in all our analyses to answer our research questions (FIML). FIML in conjunction with the robust maximum likelihood estimator (MLR), has been found to result in unbiased parameter estimates even with a high percentage of missing data (Enders, 2001; Shin et al., 2009).

The first research question regarding the relation between stressors, perceived parental stress and changes in HLA was investigated using multivariate regression analyses in Mplus (Version 8.3; Muthén and Muthén, 1998–2012). To test for a non-linear relation between parental stress and changes in HLA (threshold hypothesis), we visually examined this relation using locally estimated scatterplot smoothing (LOESS) in ggplot in R (Wickham, 2016; RStudio Team, 2020). Our second research question regarding the role of protective factors in the relation between stress and changes in HLA was investigated using path analyses. This was the most parsimonious approach and it also allowed us to directly compare the effects of self-efficacy and perceived social support on stress and changes in HLA. Model fit was assessed with reference to the Yuan–Bentler scaled χ^2 (YB χ^2, mean-adjusted test-statistic robust to non-normality), the root mean square of approximation (RMSEA), the comparative fit index (CFI), the Tucker and Lewis index (TLI), and the standardized root mean residual (SRMR) values using the criteria suggested by Hu and Bentler (1999). CFI and TLI values greater than.95, RMSEA values lower than 0.06, and SRMR lower than 0.08 were accepted as indicators of a good model fit (Hu and Bentler, 1999). As the method to test statistical interaction effects (hypothesis 2c) depends on the nature of the relation between stress and changes in HLA (RQ1), we report the exact analyses to test hypothesis 2c below.

RESULTS

Descriptive Statistics and Changes in HLA

Descriptive results revealed that parental stress scores were slightly above the theoretical mean of 2.5, indicating that parents were rather stressed (*M* = 2.70, *SD* = 0.72). With regard to HLA, parents, on average, reported to provide more HLA compared to before the lockdown: The mean of 4.96 was closest to the response format "slightly more" (see **Table 1** for descriptive results of the study variables). More detailed examination of the item-specific frequencies showed that the largest increases could be documented in activities related to crafting and arts (e.g., painting), followed by motion play (e.g., running, playing tag, hide, and seek) and music/dancing (see **Supplementary Appendix Table A1**). A smaller increase in the frequency of activities was found for the domains literacy (e.g., reading, learning rhymes or poems) and math/numeracy (e.g., sorting and classifying objects or construction games). However, there was considerable variance across all items, indicating that – although the average score showed an increase in HLA – some parents reported to do (much) less and some parents (much) more activities than before the lockdown.

TABLE 1 | Descriptive statistics.

	N	*M*/%	*SD*	Min	Max
Age of child in years	7034	4.20	1.38	1.00	6.00
No. of children ages 1–6	7801	1.53	0.60	1.00	4.00
Single parent in %	7828	4.2%		0.00	1.00
Private childcare in %	4456	22.1%		0.00	1.00
Working from home in %	5644	73.0%		0.00	1.00
Both partners working in %	7482	65.8%		0.00	1.00
Financial problems	7007	2.17	1.19	1.00	5.00
Problematic housing	6997	2.15	1.14	1.00	5.00
Work-related problems	6992	3.03	1.28	1.00	5.00
COVID-related health worries	6999	2.62	1.22	1.00	5.00
Conflict with partner	6981	2.60	1.14	1.00	5.00
Conflict with family	6994	2.29	1.11	1.00	5.00
Parental stress	7412	2.70	0.72	1.00	4.00
Changes in HLA	6903	4.96	0.84	1.00	7.00
Parental self-efficacy	7412	3.23	0.44	1.00	4.00
Perceived social support	7020	3.33	1.02	1.00	5.00

The sample size for parents' reports on whether they were working from home was comparatively small because this information was only obtained from parents who were employed at the time of data collection. Please note that private childcare refers to non-institutional care, i.e., anyone outside the household taking care of the child/children for any number of hours, including grandparents, friends, babysitters.

TABLE 2 | Regression results for stressors predicting perceived stress.

	Model 1			Model 2		
	β	*SE*	*p*	β	*SE*	*p*
Covariates						
Gender (0 = female)	− 0.02	0.01	0.093	− 0.02	0.01	0.097
Age in years	0.02	0.01	0.152	0.01	0.01	0.203
Education level	− 0.02	0.01	0.151	−0.02	0.01	0.188
Age of child in years	− 0.06	0.01	0.000	− 0.04	0.01	0.001
No. of children ages 1–6	0.08	0.01	0.000	0.07	0.01	0.000
Single parent (0 = no)	0.01	0.01	0.348	0.03	0.01	0.025
Private childcare (0 = no)	− 0.03	0.02	0.033	− 0.03	0.01	0.049
Working from home (0 = no)	0.15	0.02	0.000	0.12	0.01	0.000
Both partners working (0 = no)	0.07	0.01	0.000	0.06	0.01	0.000
Stressors						
Financial problems				0.01	0.01	0.268
Problematic housing				0.14	0.01	0.000
Work-related problems				0.22	0.01	0.000
COVID-related health worries				0.03	0.01	0.002
Conflict with partner				0.18	0.01	0.000
Conflict with family				0.20	0.01	0.000
R^2	0.03	0.01	0.000	0.31	0.01	0.000

N = 7,837.

As the sample included a wide range of children's ages (1–6 years), we additionally examined whether the descriptive statistics differed between children's age groups (ages 1–2, 3–4, and 5–6). Descriptive results showed several differences between the age groups on our covariates and stressors, such as fewer children and lower percentages of single parents among parents of 1–2-year-olds but also more work-related problems (see **Supplementary Appendix Table A3**). Parents of older children reported slightly fewer problems with their housing situation, but more conflict with the partner and family. The descriptive statistics of our main variables of interest, namely parental perceived stress, changes in HLA, parental self-efficacy and perceived social support, were very similar in the three age groups. The only two notable differences were that parents of children ages 5–6 years reported a lower increase in HLA compared to parents of children ages 1–2 years and parents of children in the youngest age group felt slightly more self-efficacious than parents of children in the other two age groups.

Bivariate correlations between the study variables are displayed in **Supplementary Appendix Table A4**. Results showed that all stressors were significantly correlated with parental stress. There was a small negative correlation between some of the stressors and changes in HLA, indicating that stressors relate to a lower increase in activities. The correlation between parental stress and changes in HLA was also negative and slightly larger. Parental self-efficacy and perceived social support were negatively related to the stressors as well as to parental stress. Both, self-efficacy beliefs and perceived social support positively correlated with changes in HLA: the parent-reported change in HLA compared to before the lockdown was positively related to parents' self-efficacy beliefs and perceived social support.

RQ1: Associations Between Stressors, Perceived Parental Stress and Changes in HLA

We investigated the associations between the stressors and perceived parental stress during COVID-19 using hierarchical linear regression analyses. The first regression model, which included only covariates predicting parental stress (see **Table 2**, Model 1), showed that the effects were small and the model only explained 3% of the variance in parental stress. The stressors were added in Model 2, which explained considerably more variance in parental stress than Model 1 ($\Delta R^2 = 0.28$). Results largely supported our hypothesis 1a, stating that stressors are positively related to perceived parental stress. The strongest predictors of parental stress were work-related problems, conflict with the family, and conflict with the partner. Financial problems and COVID-19 related health worries did not significantly predict parental stress when other stressors were accounted for.

To test hypothesis 1b, we investigated the relation between parental stress and changes in HLA using hierarchical regression analyses. The first regression model included only covariates and stressors predicting changes in HLA (see **Table 3**, Model 1). Results showed that some of the covariates and stressors were negatively related to changes in HLA, however, the effect sizes were small, and the model only explained 3% of the variance in changes in HLA. In a second step, we included perceived parental stress as a predictor of changes in HLA. Supporting our hypothesis 1b, parental stress was negatively related to changes in HLA: The more stress parents reported, the lower the increase in HLA (see **Table 3**, Model 2). Perceived parental stress was the strongest predictor of changes in HLA and the

TABLE 3 | Regression results for stressors and perceived stress predicting changes in HLA.

	Model 1			Model 2			Model 3		
	β	*SE*	*p*	β	*SE*	*p*	β	*SE*	*p*
Covariates									
Gender (0 = female)	0.02	0.01	0.091	0.02	0.01	0.135	0.02	0.01	0.177
Age in years	– 0.06	0.01	0.000	– 0.05	0.01	0.000	– 0.05	0.01	0.000
Education level	0.04	0.01	0.001	0.04	0.01	0.002	0.04	0.01	0.003
Age of child in years	– 0.07	0.02	0.000	– 0.08	0.02	0.000	– 0.08	0.02	0.000
No. of children ages 1–6	– 0.05	0.02	0.001	– 0.04	0.01	0.016	– 0.03	0.01	0.025
Single parent (0 = no)	0.00	0.01	0.867	0.01	0.01	0.622	0.01	0.01	0.472
Private childcare (0 = no)	– 0.05	0.02	0.005	– 0.05	0.02	0.002	– 0.05	0.02	0.002
Working from home (0 = no)	– 0.00	0.02	0.955	0.02	0.02	0.212	0.02	0.02	0.200
Both partners working (0 = no)	– 0.03	0.01	0.024	– 0.02	0.01	0.116	– 0.02	0.01	0.205
Stressors									
Financial problems	– 0.05	0.02	0.001	– 0.05	0.02	0.001	– 0.05	0.02	0.001
Problematic housing	– 0.01	0.01	0.565	0.02	0.01	0.267	0.02	0.01	0.231
Work-related problems	– 0.03	0.01	0.022	0.00	0.01	0.768	0.00	0.01	0.773
COVID-related health worries	0.08	0.01	0.000	0.08	0.01	0.000	0.08	0.01	0.000
Conflict with partner	– 0.01	0.01	0.459	0.02	0.01	0.176	0.02	0.01	0.178
Conflict with family	– 0.04	0.01	0.003	– 0.01	0.02	0.480	– 0.01	0.02	0.665
Stress									
Parental stress				– 0.16	0.01	0.000	0.05	0.04	0.128
Exp(parental stress)							– 0.23	0.04	0.000
R^2	0.03	0.01	0.000	0.05	0.01	0.000	0.06	0.01	0.000

N = 7,837. exp(parental stress), exponentiated parental stress term.

amount of explained variance increased to 5%. Moreover, some of the stressors' direct effects on changes in HLA became non-significant when perceived parental stress was accounted for, indicating that parental stress may mediate the relations between stressors and changes in HLA. Additional tests for indirect effects confirmed this: Those stressors that had a significant effect on parental stress also showed small but significant indirect effects on changes in HLA via parental stress. The indirect effects were as follows: $\beta_{ind} = -0.00$ ($SE = 0.00$, $p = 0.269$) for financial problems, $\beta_{ind} = -0.02$ ($SE = 0.00$, $p = 0.000$) for problematic housing, $\beta_{ind} = -0.04$ ($SE = 0.00$, $p = 0.001$) for work-related problems, $\beta_{ind} = -0.01$ ($SE = 0.00$, $p = 0.002$) for health worries, $\beta_{ind} = -0.03$ ($SE = 0.00$, $p = 0.000$) for conflict with partner and $\beta_{ind} = -0.03$ ($SE = 0.00$, $p = 0.000$) for conflict with family.

In the third step, we tested the threshold hypothesis stating that stress is non-linearly related to changes in HLA (H1c). We started by visually examining the relation between perceived parental stress and HLA using locally estimated scatterplot smoothing (LOESS), see **Figure 1**. The LOESS curve revealed that HLA remained relatively unaffected by parental stress until a tipping point is reached around a stress score of about three on the original scale, ranging from 1 (*totally disagree*) to 4 (*totally agree*). Above this tipping point, changes in HLA decreased with increasing stress. The shape of the LOESS curve suggested an exponential negative relation between stress and changes in HLA. Based on this finding, we included an exponentiated stress score in the hierarchical regression model (see **Table 3**, Model 3). Results showed a significant negative effect of the exponentiated stress term and a small increase in the amount of explained variance compared to Model 2 ($\Delta R^2 = 0.01$)[5]. Taken together, the LOESS plot and the results of the hierarchical regression analyses showed that HLA exponentially decreased with increasing stress. Although the average HLA score remained above four (=same HLA as before the lockdown), there was particularly high variance in HLA among the very stressed parents (see distribution of cases, indicated by dots in **Figure 1**). Thus, some of the very stressed parents reported to offer less HLA than before the lockdown – which was not the case among parents who were not stressed.

RQ2: Role of Protective Factors Parental Self-Efficacy and Perceived Social Support

Our second research question tackled the role of parental self-efficacy and perceived social support in the relation between parental stress and changes in HLA. Our hypotheses stated that parental self-efficacy and perceived social support are negatively related to parental stress (H2a) and positively related to changes in HLA (H2b). We tested these assumptions using path analyses. We controlled for all covariates in the model. The overall model fit was excellent ($\chi^2 = 56.05$, $df = 6$, RMSEA = 0.03, CFI = 0.99,

[5]Additional multigroup analyses in Mplus were conducted to examine whether the strength of the exponential relation between parental stress and changes in HLA differed between children's age groups (1–2-year-olds, 3–4-year-olds, and 5–6-year-olds). Although the relation between parental stress and changes in HLA was slightly lower among parents of 1–2-year-olds than among parents of 3–4-year-olds and 5–6-year-olds (see **Supplementary Appendix Table A5**), these small differences were not significant ($p > 0.05$).

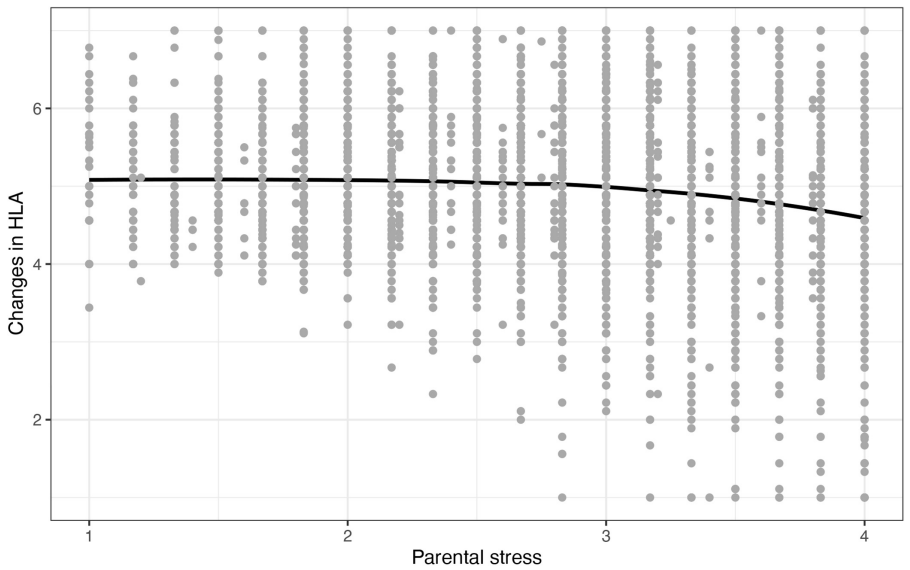

FIGURE 1 | LOESS curve showing the relation between perceived parental stress and changes in HLA.

TLI = 0.98, SRMR = 0.01). Results are displayed in **Table 4**. In line with our hypothesis 2a, parental self-efficacy and perceived social support were negatively related to perceived stress, i.e., the higher parents' self-efficacy beliefs and the more they felt supported, the lower their stress level. The model explained more variance in parental stress than the regression model without parental self-efficacy and perceived social support (ΔR^2 = 0.08, see **Table 2**). Our hypothesis 2b could partly be supported: Perceived social support, but not parental self-efficacy beliefs, was positively related to changes in HLA: The higher parents' perceived social support, the more HLA they offered compared to before the lockdown.

Although parental self-efficacy and perceived social support were not strong predictors of changes in HLA, they may nevertheless buffer the negative influence of stress on changes in HLA (hypothesis 2c). We first visually examined whether the relation between stress and changes in HLA varied for parents with low versus high self-efficacy (**Figure 2A**) or low versus high perceived social support (**Figure 2B**). Median-split was used to compare low (0) and high (1) parental self-efficacy/perceived social support groups in their LOESS-curves in R (Wickham, 2016; RStudio Team, 2020). The LOESS curves for parents with low versus high parental self-efficacy were very similar, indicating only a small interaction (see **Figure 2A**). The LOESS curves for low versus high perceived social support differed more strongly: parents with low perceived social support showed a steeper decrease in HLA with increased stress than parents with high perceived social support.

Based on this finding, we tested for statistical interaction in a multivariate regression model. The model included (a) main effects of parental stress, parental self-efficacy, and perceived social support predicting changes in HLA as well as (b) the interaction terms of parental self-efficacy × parental stress, and perceived social support × parental stress. Because the relation between stress and changes in HLA was exponential, we report average marginal effects (AME) (Mize, 2019), which refer to the average change in HLA for one unit (*SD*) change

TABLE 4 | Relation between parental self-efficacy, perceived support, perceived stress, and changes in HLA.

	Parental stress			Changes in HLA		
	β	*SE*	*p*	β	*SE*	*p*
Covariates						
Gender (0 = female)	− 0.04	0.01	0.000	0.02	0.01	0.048
Age in years	0.00	0.01	0.928	− 0.05	0.01	0.001
Education level	− 0.01	0.01	0.621	0.04	0.01	0.001
Age of child in years	− 0.05	0.01	0.000	− 0.08	0.02	0.000
No. of children ages 1–6	0.07	0.01	0.000	− 0.04	0.01	0.010
Single parent (0 = no)	0.01	0.01	0.322	0.01	0.01	0.576
Private childcare (0 = no)	− 0.01	0.02	0.559	− 0.06	0.02	0.000
Working from home (0 = no)	0.12	0.01	0.000	0.02	0.01	0.099
Both partners working (0 = no)	0.06	0.01	0.000	− 0.02	0.01	0.097
Stressors						
Financial problems	0.00	0.01	0.702			
Problematic housing	0.11	0.01	0.000			
Work-related problems	0.19	0.01	0.000			
COVID-related health worries	0.03	0.01	0.002			
Conflict with partner	0.13	0.01	0.000			
Conflict with family	0.16	0.01	0.000			
Predictors						
Parental stress				0.10	0.03	0.004
Exp(parental stress)				− 0.23	0.04	0.000
Parental self-efficacy	− 0.20	0.01	0.000	0.02	0.01	0.094
Perceived support	− 0.19	0.01	0.000	0.07	0.01	0.000
R^2	0.39	0.01	0.000	0.05	0.01	0.000

N = 7,837.

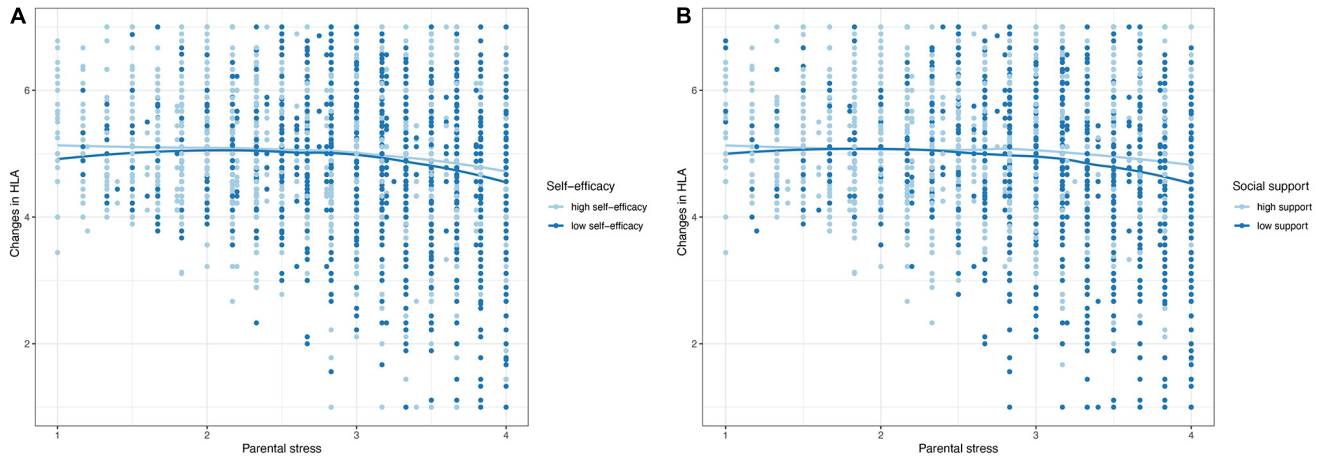

FIGURE 2 | LOESS plots for the relation between perceived parental stress and changes in HLA moderated by **(A)** parental self-efficacy and **(B)** perceived support.

in stress, at different values of self-efficacy/perceived social support. We chose to examine the AME of stress on changes in HLA at the 0–100% quartiles of self-efficacy/perceived social support, in order to determine whether the AME of stress on HLA varies depending on parents' self-efficacy and/or social support score. The results are displayed in **Table 5**. The negative AME of stress on changes in HLA continuously decreased with increasing self-efficacy, indicating that parental self-efficacy partly buffered the negative effect of stress on HLA. However, the negative AME for the 100% self-efficacy percentile indicated that even high parental self-efficacy beliefs could not completely buffer the negative effect of stress on HLA (indicated by the significant negative relation between stress and changes in HLA at the 100% self-efficacy percentile). For perceived social support, results showed a similar but stronger trend: The negative effect of stress on changes in HLA became weaker with increasing perceived social support. For parents with very high perceived social support values (100% percentile), the negative effect of stress even became non-significant, indicating that perceived social support could completely buffer the negative effect of stress on changes in HLA. Thus, parental self-efficacy and – to a larger extend – perceived social support interacted with parental stress in relation to changes in HLA.

DISCUSSION

The present study was one of the first in Germany to examine parental stress and changes in parents' HLA during the COVID-19 lockdown in Spring 2020. In addition, we considered the role of potential protective factors in the relation between parental stress and changes in HLA. Our key findings can be summarized as follows: Parents engaged, on average, in more HLA with their children compared to before the lockdown. Parental stress predicted self-reported changes in HLA: The lower parents' stress, the higher the increase in HLA. This relation, however, was non-linear and showed an exponential decline in HLA starting at an above-average stress score. Thus, whereas most parents offered more HLA, some of the very stressed parents offered less HLA than before the lockdown. Parental self-efficacy and perceived social support were protective of parental stress, i.e., parents with higher parental self-efficacy and an intact social support system experienced less stress during the lockdown. In addition, we found significant interaction effects of self-efficacy and perceived social support with stress in relation to changes in HLA. In the following, we discuss these findings as well as the implications for research and practice.

Changes in Home Learning Activities During the COVID-19 Lockdown

The cognitively stimulating HLA that parents provide are crucial for child development (Tietze et al., 1998; NICHD ECCRN, 2003; Anders et al., 2012; Kluczniok et al., 2013). The temporary closure of daycare centers during the COVID-19 lockdown amplified the importance of HLA: Children were deprived of all other forms of early childhood education and other play opportunities, including institutional education in preschools, educational programs or extracurricular activities. Thus, more than ever, children relied on parents' ability to provide a stimulating learning environment at home. The results of our study showed that parents, on average, reported to do *slightly more* HLA compared to before the lockdown on a 7-point scale ranging *much less* to *much more*. However, there was a lot a variance in HLA, indicating that not all parents offered more HLA. These changes of HLA during the COVID-19 lockdown in comparison to before the lockdown could be explained by a number of COVID-19-related influences, one of which may be increased perceived stress. Specifically, the COVID-19 lockdown likely created a particularly challenging situation for parents, which increased their stress and may have undermined some parents' ability to offer HLA.

TABLE 5 | Average marginal effects of stress on changes in HLA at different percentiles of parental self-efficacy and perceived social support.

	AME	*SE*	*p*	95% CI
AME of stress on changes in HLA at self-efficacy percentiles (associated self-efficacy raw scores):				
0% percentile (1.00)	–0.29	0.07	0.000	[–0.43; –0.15]
25% percentile (2.25)	–0.17	0.02	0.000	[–0.20; –0.14]
50% percentile (2.75)	–0.16	0.01	0.001	[–0.19; –0.13]
75% percentile (3.25)	–0.13	0.02	0.000	[–0.17; –0.10]
100% percentile (4.00)	–0.11	0.03	0.000	[–0.16; –0.06]
AME of stress on changes in HLA at support percentiles (associated social support raw scores):				
0% percentile (1.00)	–0.30	0.04	0.000	[–0.37; –0.23]
25% percentile (2.50)	–0.20	0.01	0.000	[–0.24; –0.16]
50% percentile (3.25)	–0.15	0.01	0.000	[–0.18; –0.12]
75% percentile (4.00)	–0.10	0.02	0.000	[–0.13; –0.06]
100% percentile (5.00)	–0.03	0.03	0.266	[–0.08; 0.02]

N = 7,837. AME, average marginal effect; SE, standard error; 95% CI, 95% Confidence intervals.

Relation Between Stressors, Parental Stress, and Changes in HLA

The family stress model proposes that stressors increase parental stress, which undermines supportive parenting, including parents' ability to offer HLA (Gershoff et al., 2007; Raver et al., 2007). In line with these assumption, results of the present study revealed that stressors, including work-related problems, conflict with family, and conflict with partner, were positively related to perceived parental stress during the COVID-19 lockdown: The more the parents rated these stressors as burdensome, the more stress they reported. Parental stress was – in turn – negatively related to changes in parents' provision of HLA. This finding is in line with previous research documenting a negative relation between parental stress and parenting practices, including HLA (Gershoff et al., 2007; Wolf et al., 2019; Bendickson, 2020). Importantly, these relations were found after accounting for a number of relevant family characteristics, including parents' gender, age and education, the age and number of children, single parents and parents' occupational status. Moreover, the results were controlled for the influence of parents' financial status, which may have been associated with perceived stress and/or parents' financial resources for home learning materials. Similarly, we controlled for private childcare and whether parents were working from home because these covariates may have been associated with perceived stress and/or time available for HLA. The associations found between stress and changes in HLA were thus independent of child and family background characteristics (including financial problems) as well as distal indicators of the time available to spend with their children (e.g., private childcare and working from home).

Analyses further showed that the relation between parental stress and changes in HLA was non-linear: there was no relation between perceived parental stress and changes in HLA among parents with a stress score below three on the original scale, ranging from 1 (*totally disagree*) to 4 (*totally agree*). Past this tipping point, HLA exponentially decreased with increasing stress. To our knowledge, this was the first study to test for and reveal a non-linear relation between parental stress and one aspect of parenting behavior, namely changes in parents' provision of HLA. This finding has important theoretical implications for the family stress model (Conger et al., 1992; Masarik and Conger, 2017), which assumes a linear relation between parental stress and parenting practices. Based on our results we argue that it is necessary to question this assumption and test for a potential non-linear association between parental stress and parenting practices in future research.

Another interesting result of our study was the high variance in changes of HLA among parents with higher stress scores. In fact, although most parents – on average – reported to offer slightly more HLA than before the lockdown, there were a number of parents who reported to offer (much) less HLA than before the lockdown, which did not occur among parents who were less stressed. Based on these findings, we considered additional protective factors that may help explain why some parents were able to offer more HLA than before the lockdown despite their high stress scores whereas others were not.

Role of Protective Factors: Parental Self-Efficacy and Perceived Social Support

It has been proposed that the negative associations between stress and parenting behavior can be disrupted by protective factors (Masarik and Conger, 2017). Previous studies have shown that high parental self-efficacy beliefs and a supportive social network can reduce parental stress and improve parenting behavior (Green et al., 2007; McConnell et al., 2011; Bojczyk et al., 2018). In line with previous findings (Östberg and Hagekull, 2000; McConnell et al., 2011), results of the present study showed that self-efficacy beliefs and perceived social support were both protective of parental stress. In addition, results showed significant interaction effects of parental self-efficacy and perceived social support with stress in the relation to changes in HLA. Our finding of main and interaction effects of the two protective factors is in accordance with the assumptions of the adapted family stress model by Masarik and Conger (2017). Specifically, high parental self-efficacy and an intact social support system seemed to buffer the negative influence

of existing stress on changes in HLA. This buffering effect was stronger for perceived social support: Whereas high parental self-efficacy beliefs were only able to *reduce* the negative influence of stress on changes in HLA, high perceived social support *eliminated* the negative relation between stress and changes in HLA. Thus, parental self-efficacy and – to a larger degree – perceived social support seemed to help parents to provide more HLA during the COVID-19 lockdown despite their stress. The mechanisms behind this finding may be that parents who are more confident in their ability to support their children's development even in challenging times and parents who can rely upon emotional and informational support from their social network, are better at coping with challenging situations, such as the COVID-19 lockdown, and consequently offer more HLA despite their stress.

Limitations

There are several limitations to the present study that should be noted. First, recruitment of study participants was based on convenience sampling and participation in the study was optional. Thus, although the sample was very large and drawn from all states of Germany, it was not a random selection, resulting in selection bias. For instance, parents with low educational levels and single parents were underrepresented in our sample compared to the German average (Statistisches Bundesamt, 2020). In order to minimize the influence of these potential biases, we controlled for a number of family's background characteristics in our analyses (e.g., parents' age, gender and education, single parent, children's age, number of children ages 1–6, single or dual earner households).

Second, we were unable to infer causal relations from the cross-sectionally examined variables. As previous research has suggested bi-directional relations between some of the study variables, e.g., parental stress and self-efficacy (Crnic and Ross, 2017), future longitudinal studies should test the directionality of the effects. Moreover, due to the cross-sectional nature of the study, we could only test for statistical interaction effects as testing for unidirectional moderation requires longitudinal data (Hall et al., 2020).

Third, due to the cross-sectional data, changes in HLA could not be directly tested. As we anticipated this limitation, we directly asked parents to indicate the extent to which HLA has changed compared to before the lockdown. This allowed us to investigate how parents' provision of HLA at home changed as a result of the COVID-19 lockdown – and to examine the role of parental stress, self-efficacy, and perceived social support for these reported changes in HLA. However, this approach also meant that we do not have any information about parents' baseline frequency of HLA. Thus, our study results can be interpreted in terms of how parental stress, self-efficacy, and perceived social support affected changes in HLA, but we cannot generalize these findings to absolute HLA frequencies. Related to this limitation, it is also important to note that our HLA measure captures changes in HLA that parents engaged in with their children, compared to before the lockdown. It does not, however, represent changes in children's overall learning opportunities at home and at preschool, which were likely much lower due to the closure of institutional daycare.

Lastly, the HLA measure relied on parental self-report which may be biased. Although we cannot exclude that social desirability influenced parents' self-reported changes in HLA, it seems unlikely given the high variance of self-reported changes in HLA. Moreover, social desirability bias would only affect the generalizability of the central tendencies of our HLA measure but not the generalizability of the found associations.

CONCLUSION AND IMPLICATIONS

The results of the present study showed that parents, on average, provided more HLA than before the lockdown. Thus, stressful situations, such as the COVID-19 lockdown, do not seem to automatically translate into a decrease of HLA for young children, which is good news for practice and policy. Instead, the amount of parental stress seemed to matter for parents' provision of HLA: while little stress had no effect on changes in HLA, once parents reached a certain stress level, changes in HLA exponentially decreased with increasing stress. The implications for research and practice are that more attention should be paid to these parents who were very stressed. In this regard, the present study provides the important insights that the harmful effects of parental stress on changes in HLA could be buffered by high parental self-efficacy and perceived social support. Thus, measures should be undertaken to promote parental self-efficacy and provide social support particularly during stressful times, such as the COVID-19 lockdown. This could be achieved through (digital) family support initiatives, e.g., digital play groups to foster exchange among parents, platforms that enable exchange among parents and preschool staff as well as the provision of ideas and materials for HLA. In addition, existing family support programs could be extended to be accessed digitally. These family support initiatives could reduce parental stress and help parents provide HLA for their children despite the challenging circumstances. However, it is important to keep in mind that this cannot compensate for the lack of institutional education and care. Closing daycare centers are extreme measures that deprive children of the education and the social contact that they need while putting parents under immense stress. This can be particularly harmful for families living in disadvantageous circumstances. Thus, the closure of institutional education and care should be a last resort and only be implemented for short times, since these measures take the largest toll on families with young children.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data are currently reserved for scientific qualifications (Ph.D. and masters' theses). Requests to access the datasets should be directed to EO, elisa.oppermann@uni-bamberg.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EO: conceptualization, data collection, methodology, formal analysis, writing – original draft, and visualization. FC: conceptualization, data collection, and writing – review and editing. KW and LB: conceptualization, methodology, and writing – review and editing. YA: conceptualization, writing – review and editing, supervision, and resources. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.682540/full#supplementary-material

REFERENCES

Albanese, A. M., Russo, G. R., and Geller, P. A. (2019). The role of parental self-efficacy in parent and child well-being: A systematic review of associated outcomes. *Child Care Health Dev.* 45, 333–363. doi: 10.1111/cch.12661

Algarvio, S., Leal, I., and Maroco, J. (2018). Parental stress scale: validation study with a Portuguese population of parents of children from 3 to 10 years old. *J. Child Health Care* 22, 563–576. doi: 10.1177/1367493518764337

Anders, Y., Rossbach, H. G., Weinert, S., Ebert, S., Kuger, S., Lehrl, S., et al. (2012). Home and preschool learning environments and their relationship to the development of numeracy skills. *Early Childhood Res. Q.* 27, 231–244.

Andresen, S., Lipps, A., Möller, R., Rusack, T., Schröer, W., Thomas, S., et al. (2020). *Kinder, Eltern und ihre Erfahrungen während der Corona-Pandemie: JuCo – Erfahrungen und Perspektiven von jungen Menschen während der Corona-Maßnahmen. [Children, Parents and their Experiences during the Corona-Pandemic]*. Available online at: https://hildok.bsz-bw.de/frontdoor/index/index/docid/1081

Ardelt, M., and Eccles, J. S. (2001). Effects of Mothers' parental efficacy beliefs and promotive parenting strategies on inner-city youth. *J. Family Issues* 22, 944–972.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychol. Rev.* 84, 191–215.

Bandura, A. (1997). *Self-efficacy: The Exercise of Control*. New York, NY: Freeman.

Bendickson, L. (2020). *Poverty, parental depression, parental self-efficacy, social support, and the home learning environment of toddlers: an application of the family stress model*. Doctoral dissertation. Vancouver, BC: University of British Columbia.

Bloomfield, L., and Kendall, S. (2012). Parenting self-efficacy, parenting stress and child behaviour before and after a parenting programme. *Prim. Health Care Res. Dev.* 13, 364–372. doi: 10.1017/S1463423612000060

Blossfeld, H., Rossbach, H.-G., and von Maurice, J. (2011). "Education as a Lifelong Process," in *The German National Educational Panel Study (NEPS)*, eds H. Blossfeld and H.-G. Rossbach (Wiesbaden: Springer Fachmedien Wiesbaden), 383.

Bojczyk, K. E., Haverback, H. R., and Pae, H. K. (2018). Investigating maternal self-efficacy and home learning environment of families enrolled in head start. *Early Childhood Educ. J.* 46, 169–178. doi: 10.1007/s10643-017-0853-y

Bronfenbrenner, U., and Morris, P. A. (2006). "The bioecological model of human development," in *Handbook of child psychology: Theoretical models of human development*, 6 Edn, Vol. Volume 1, ed. R. M. Lerner (Hoboken, NJ: Wiley), 793–828.

Cassé, J. F. H., Oosterman, M., and Schuengel, C. (2016). Parenting self-efficacy moderates linkage between partner relationship dissatisfaction and avoidant infant–mother attachment: A Dutch study. *J. Family Psychol.* 30, 935–943. doi: 10.1037/fam0000247

Cohen, F., Oppermann, E., and Anders, Y. (2020). *Familien & Kitas in der Corona-Zeit. Zusammenfassung der Ergebnisse. [Families and preschool centres during the COVID-19 lockdown in Germany. Summary of main results.]*. Available Online at: https://www.uni-bamberg.de/fileadmin/efp/forschung/Corona/Ergebnisbericht_Corona-Studie_2020.pdf

Cohen, S. (2004). Social relationships and health. *Am. Psychol.* 59, 676–684.

Conger, R. D., Conger, K. J., Elder, G. H. Jr., Lorenz, F. O., Simons, R. L., and Whitbeck, L. B. (1992). A family process model of economic hardship and adjustment of early adolescent boys. *Child Dev.* 63, 526–541. doi: 10.1111/j.1467-8624.1992.tb01644.x

Crnic, K., and Ross, E. (2017). "Parenting Stress and Parental Efficacy," in *Parental Stress and Early Child Development. Adaptive and Maladaptive Outcomes*, eds K. Deater-Deckard and R. Panneton (New York: Springer), 263–285.

Enders, C. K. (2001). The impact of nonnormality on full information maximum-likelihood estimation for structural equation models with missing data. *Psychol. Methods* 6, 352–370.

Evans, G. W., Li, D., and Whipple, S. S. (2013). Cumulative risk and child development. *Psychol. Bull.* 139, 1342–1396.

Foster, M., Lambert, R., Abbott-Shim, M., McCarty, F. A., and Franze, S. (2005). A model of the home learning environment and social risk factors in relation to children's literacy and social outcomes. *Early Childhood Res. Q.* 20, 13–36. doi: 10.1016/j.ecresq.2005.01.006

Gershoff, E. T., Aber, J. L., Raver, C. C., and Lennon, M. C. (2007). Income is not enough: incorporating material hardship into models of income associations with parenting and child development. *Child Dev.* 78, 70–95. doi: 10.1111/j.1467-8624.2007.00986.x

Green, B., Furrer, C., and McAllister, C. (2007). How do relationships support parenting? effects of attachment style and social support on parenting behavior in an at-risk population. *Am. J. Commun. Psychol.* 40, 96–108. doi: 10.1007/s10464-007-9127-y

Hall, J., Malmberg, L.-E., Lindorff, A., Baumann, N., and Sammons, P. (2020). Airbag moderation: the definition and statistical implementation of a new methodological model. *Int. J. Res. Method Educ.* 43, 379–394. doi: 10.1080/1743727X.2020.1735334

Hu, L., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct. Equat. Model.* 6, 1–55.

Huebener, M., Waights, S., Spieß, C., Siegel, N., and Wagner, G. (2021). Parental well-being in times of Covid-19 in Germany. *Rev. Eco. Household* 19, 91–122. doi: 10.1007/s11150-020-09529-4

Izzo, C., Weiss, L., Shanahan, T., and Rodriguez-Brown, F. (2000). Parental self-efficacy and social support as predictors of parenting practices and Children's Socioemotional adjustment in Mexican immigrant families. *J. Preven. Interv. Communit.* 20, 197–213. doi: 10.1300/J005v20n01_13

Jerusalem, M., and Mittag, W. (1995). "Self-efficacy in stressful life transitions," in *Self-efficacy in changing societies*, ed. A. Bandura (Cambridge: Cambridge University Press), 177–201.

Jones, T. L., and Prinz, R. J. (2005). Potential roles of parental self-efficacy in parent and child adjustment: a review. *Clin. Psychol. Rev.* 25, 341–363. doi: 10.1016/j.cpr.2004.12.004

Kliem, S., Kessemeier, Y., Heinrichs, N., Döpfner, M., and Hahlweg, K. (2014). Der Fragebogen zur Selbstwirksamkeit in der Erziehung (FSW). *Diagnostica* 60, 35–45. doi: 10.1026/0012-1924/a000107

Kluczniok, K., Lehrl, S., Kuger, S., and Rossbach, H.-G. (2013). Quality of the home learning environment during preschool age – Domains and contextual conditions. *Eur. Early Childhood Educ. Res. J.* 21, 420–438. doi: 10.1080/1350293X.2013.814356

Kotchick, B. A., Dorsey, S., and Heller, L. (2005). Predictors of parenting among African American single mothers: personal and contextual factors. *J. Marriage Family* 67, 448–460. doi: 10.1111/j.0022-2445.2005.00127.x

Lazarus, R. S., and Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.

Lehrl, S., Ebert, S., Blaurock, S., Rossbach, H.-G., and Weinert, S. (2020). Long-term and domain-specific relations between the early years home learning environment and students' academic outcomes in secondary school. *School Effect. School Improv.* 31, 102–124. doi: 10.1080/09243453.2019.1618346

Liang, Y., Cao, H., Zhou, N., Li, J., and Zhang, L. (2020). Early home learning environment predicts early adolescents' adjustment through cognitive abilities in middle childhood. *J. Family Psychol.* 34, 905–917. doi: 10.1037/fam0000675

Little, R. J. A. (1998). A test of missing completely at random for multivariate data with missing values. *J. Am. Stat. Assoc.* 83, 1198–1202.

Masarik, A. S., and Conger, R. D. (2017). Stress and child development: A review of the family stress model. *Curr. Opin. Psychol.* 13, 85–90.

McConnell, D., Breitkreuz, R., and Savage, A. (2011). From financial hardship to child difficulties: main and moderating effects of perceived social support. *Child Care Health Dev.* 37, 679–691. doi: 10.1111/j.1365-2214.2010.01185.x

Melhuish, E., Phan, M., Sylva, K., Sammons, P., Siraj, I., and Taggart, B. (2008). Effects of the home learning environment and preschool center experience upon literacy and numeracy development in early primary school. *J. Soc. Issues* 64, 95–114. doi: 10.1111/j.1540-4560.2008.00550.x

Mize, T. D. (2019). Best practices for estimating, interpreting, and presenting nonlinear interaction effects. *Sociol. Sci.* 6, 81–117.

Muthén, L. K., and Muthén, B. (1998–2012). *Mplus User's Guide*, 6th Edn. Los Angeles, CA: Muthén and Muthén.

NICHD ECCRN. (2003). Does quality of child care affect child outcomes at age 4 1/2? *Dev. Psychol.* 39, 451–469.

Östberg, M., and Hagekull, B. (2000). A structural modeling approach to the understanding of parenting stress. *J. Clin. Child Psychol.* 29, 615–625.

Parkes, A., Sweeting, H., and Wight, D. (2015). Parenting stress and parent support among mothers with high and low education. *J. Family Psychol.* 29, 907–918. doi: 10.1037/fam0000129

Peacock-Chambers, E., Martin, J. T., Necastro, K. A., Cabral, H. J., and Bair-Merritt, M. (2017). The influence of parental self-efficacy and perceived control on the home learning environment of young children. *Acad. Pediatr.* 17, 176–183. doi: 10.1016/j.acap.2016.10.010

Randall, A. K., and Bodenmann, G. (2013). "Family Stress," in *Encyclopedia of Behavioral Medicine*, eds M. D. Gellman and J. R. Turner (Cham: Springer).

Ravens-Sieberer, U., Kaman, A., Erhart, M., Devine, J., Schlack, R., and Otto, C. (2021). Impact of the COVID-19 pandemic on quality of life and mental health in children and adolescents in Germany. *Eur. Child Adoles. Psychiatry* 2021, 1–11. doi: 10.1007/s00787-021-01726-5

Raver, C. C., Gershoff, E. T., and Aber, J. L. (2007). Testing equivalence of mediating models of income, parenting, and school readiness for white, black, and Hispanic children in a national sample. *Child Dev.* 78, 96–115. doi: 10.1111/j.1467-8624.2007.00987.x

Relikowski, I., Schneider, T., and Linberg, T. (2015). Rezeptive Wortschatz- und Grammatikkompetenzen von Fünfjährigen mit und ohne Migrationshintergrund. [Receptive vocabulary and grammar skills among 5-year-olds with and without migration background]. *Frühe Bildung* 4, 135–143. doi: 10.1026/2191-9186/a000218

Rominov, H., Giallo, R., and Whelan, T. A. (2016). Fathers' postnatal distress, parenting self-efficacy, later parenting behavior, and children's emotional-behavioral functioning: A longitudinal study. *J. Family Psychol.* 30, 907–917. doi: 10.1037/fam0000216

Ross, C. E. (2000). Neighborhood disadvantage and adult depression. *J. Health Soc. Behav.* 41, 177–187. doi: 10.2307/2676304

RStudio Team. (2020). *RStudio: Integrated Development for R*. Boston,MA: RStudio PBC.

Rudolph, K. D., and Flynn, M. (2007). Childhood adversity and youth depression: influence of gender and pubertal status. *Dev. Psychopathol.* 19, 497–521. doi: 10.1017/S0954579407070241

Scaramella, L., Sohr-Preston, S., Callahan, K., and Mirabile, S. (2008). A test of the family stress model on toddler-aged Children's adjustment among hurricane katrina impacted and nonimpacted low-income families. *J. Clin. Child Adoles. Psychol.* 37, 530–541. doi: 10.1080/15374410802148202

Shin, T., Davidson, M. L., and Long, J. D. (2009). Effects of missing data methods in structural equations modeling with nonnormal data. *Struct. Equat. Model.* 16, 70–98.

Spinelli, M., Lionetti, F., Pastore, M., and Fasolo, M. (2020). Parents' stress and Children's psychological problems in families facing the COVID-19 outbreak in Italy. *Front. Psychol.* 11:1713. doi: 10.3389/fpsyg.2020.01713

Statistisches Bundesamt. (2020). *Mikrozensus 2019: Haushalte und Familien, Ergebnisse des Mikrozensus. [microcensus results 2019: Households and families]*.

Stewart, K., and Cooper, K. (2013). *Does Money affect children's outcomes? A review of evidence on casual links. Child Poverty Insights. Policy Analysis. UNICEF Policy and Strategy*. York,ENG: Joseph Rowntree Foundation, 1–3.

Sylva, K., Melhuish, E., Sammons, P., Siraj, I., and Taggart, B. (2014). *Effective Preschool, Primary and Secondary Education 3–16 Project (EPPSE 3–16) Students' educational and developmental outcomes at age 16. Department for Education Research. Report RR354*. Available Online at: http://www.ucl.ac.uk/ioe/research/pdf/16--educational~--Developmental--Outcomes--RR.pdf [02.10.2017]

Tietze, W., Meischner, T., Gänsfuß, R., Grenner, K., Schuster, K.-M., Völkel, P., et al. (1998). *Wie Gut Sind Unsere Kindergärten? Eine Untersuchung zur padagogischen Qualität in deutschen Kindergärten [How Good Are our Preschools? A Study of the Educational Quality of German Preschools]*. Neuwied: Luchterhand.

UNESCO. (2011). *International Standard Classification of Education (ISCED) UNESCO-UIS*. Quebec City, Canada: UNESCO.

Wickham, H. (2016). *ggplot2: Elegant Graphics for Data Analysis*. Berlin: Springer-Verlag.

Wolf, K., Anders, Y., Francot, R., Leseman, P., and Isotis Research Team. (2019). "Determinants of informal learning activities in the home for disadvantaged families in Europe," in *Resources, experiences, and support needs of families in disadvantaged communities*, eds L. Broekhuizen, K. Wolf, R. Francot, T. Moser, G. Pastori, L. Nurse, et al. (Dutch: Utrecht University), 31–47.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 03 August 2021
doi: 10.3389/feduc.2021.702406

Teaching in Times of COVID-19: The Evaluation of Distance Teaching in Elementary and Secondary Schools in Germany

Rebecca Schneider, Karoline A. Sachse, Stefan Schipolowski and Florian Enke*

Institute for Educational Quality Improvement (IQB), Berlin, Germany

To depict the situation during the school closures in spring 2020 that were implemented to contain the spread of COVID-19, we conducted a self-constructed online survey on distance teaching among teachers regarding their teaching practices in this new situation, the challenges they experienced, and the prerequisites for successful distance teaching. The sample consisted of voluntarily participating German elementary (n = 857) and secondary school teachers (n = 1,590) from a sample of randomly drawn schools in four federal states in Germany. We describe the main survey findings and examine the importance of different distance teaching aspects for teacher reports of students attaining their learning objectives and students' learning progress during distance teaching. Our results particularly highlight the necessity for students and teachers to remain in contact in all the surveyed school types. In elementary school, regular contact between teachers and parents is similarly important. The key challenges highlighted inadequate digitalization, the participation of all students, and students' motivation. Correspondingly, adequate technical equipment for schools, teachers, and students, together with teachers' and students' competence to use technical devices and digital media as well as students' motivation to participate in distance learning were found to be necessary prerequisites for successful distance teaching. We conclude that efforts should be devoted to enabling teachers and students to better communicate using digital devices, for example, expanding the digital infrastructure in combination with training teachers and students in the use of technical devices and digital media.

Keywords: COVID-19, distance teaching, distance learning, home schooling, elementary school, secondary school

OPEN ACCESS

Edited by:
Kathrin Lockl,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Lianjiang Jiang,
The Education University of Hong Kong, China
Johanna Pöysä-Tarhonen,
University of Jyväskylä, Finland
John Mark R. Asio,
Gordon College, Philippines

****Correspondence:***
Rebecca Schneider
rebecca.schneider@iqb.hu-berlin.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *29 April 2021*
Accepted: *15 July 2021*
Published: *03 August 2021*

Citation:
Schneider R, Sachse KA, Schipolowski S and Enke F (2021) Teaching in Times of COVID-19: The Evaluation of Distance Teaching in Elementary and Secondary Schools in Germany. Front. Educ. 6:702406. doi: 10.3389/feduc.2021.702406

INTRODUCTION

Containing the spread of SARS-CoV-2 was one of the main aims worldwide in 2020 and is still an issue in 2021. Until vaccines are widely available to slow its spread, social distancing strategies are the main requirement for preventing overwhelmed health systems. Therefore, a wide variety of SARS-CoV-2-control policies, for example, restrictions on gatherings, workplace closures, national and international travel controls, testing, and contact tracing, were implemented. Since educational institutions host large numbers of students in enclosed spaces and could therefore potentially produce infection clusters, one additional main policy component was the closing of all educational institutions. More than 1.2 billion students had to deal with the closure of elementary schools, secondary schools, or higher education institutions (United Nations Sustainable Development

Group, 2020). In total, 80 percent of children and young people worldwide were forced into being educated at home (Van Lancker and Parolin, 2020), millions of teachers suddenly faced the challenge of having to reorganize their lessons, and both teachers and students had to adjust to distance teaching[1]. In the sense of *responsible science* and to add empirical evidence to the research scope on distance teaching during the pandemic (see Helm et al., 2021, for a systematic overview of the state of quantitative research on teaching and learning characteristics during school closures due to the coronavirus), our aim was to describe the impact of the necessary school closures on education in Germany from the teachers' perspective. Furthermore, we examined the importance of different teaching practices on students attaining their learning objectives and students' learning progress during distance teaching. Our research findings, together with results from surveys on, for example, school administrators, students, and/or their parents, might be especially beneficial for developing pedagogical plans to better cope with comparable situations in the future.

Pandemic Policy on Education in Germany

The educational system in Germany is decentralized, with the authorities in the federal states being responsible for education quality. In order to contain the spread of SARS-CoV-2 in Germany, in the year 2020 all federal state governments closed educational institutions in mid-March (for a detailed chronology, see Fickermann and Edelstein, 2020) affecting around 9.1 million first to thirteenth graders, 2.6 million students in vocational training schools, and their approximately 830,000 teachers (Statistisches Bundesamt, 2020). The Ministries of Education or senate administrations of the German federal states issued an order for students to continue learning and to receive support while doing so. Therefore, distance teaching was implemented as an alternative to classroom teaching to allow for flexible learning arrangements depending on local infection rates (i.e., full distance teaching in the case of school closures or a combination of learning at school and at home) and flexible learning in terms of time (i.e., independent of educational institution cycles). Legally, distance teaching is defined as the transfer of knowledge and skills where teachers and students are spatially separated from one another and where teachers still monitor the learning success of students (Gesetz zum Schutz der Teilnehmer am Fernunterricht, 2020, §1). In contrast to home schooling (which is prohibited under German law), work assignments are determined by designated teachers in accordance with school curricula, rather than by the parents (Tenorth, 2014). Depending on different governmental decisions in the German federal states, schools either fully opened in May 2020, re-opened only for graduating classes, or implemented a combination of learning at school and at home.

[1]In this paper we use the term "distance teaching." This should be considered equivalent to "distance learning," "distance education," "remote teaching," and "remote learning."

Impact of School Closures on Teaching in Elementary and Secondary Schools

Schools are considered institutions of learning and living. Students are expected to acquire specific learning content and competencies and take part in the social life of a school. Lessons as interactive spaces in which subject-specific and more general content can be taught and explored are at the core of schooling. During the SARS-CoV-2 pandemic, the goal of politics was to continue lessons and thus fulfill the school curricula. Teachers (and students) had to switch from classroom learning to distance learning within a few days, facing many challenges concerning technical equipment, pedagogical changes, governmental guidelines, and students' individual needs. However, no specific instructions in terms of teaching structure were provided, for example, which school subjects should be taught, to what extent teachers should provide learning opportunities, and which forms of support students and their parents should receive. As a consequence, the success of distance teaching mainly depended on how well teachers and students were equipped, prepared, and engaged in distance teaching.

Since then, many scientists have engaged themselves in research on distance teaching in Germany (for an overview see, e.g., Fickermann and Edelstein, 2020) as well as in other countries around the world (e.g., Assunção Flores and Gago, 2020; Ewing and Cooper, 2021; Khlaif et al., 2021). In this study, our aim is to contribute to the empirical evidence on the impact of school closures on education in Germany from the teachers' perspective for both elementary and secondary school education. In this context, we focused on aspects that can be associated with good teaching and the successful development of students' knowledge and skills to answer the following four questions: 1) Did teachers stay in contact with most of their students? 2) Which aspects did teachers focus on during lessons? 3) How did teachers organize their classes against the background of inadequate digitalization? 4) How did teachers factor in achievement differences between students? The significance of each of these questions is outlined in more detail below.

Contact Between Teachers and Students

One fundamental prerequisite for education during school closures is ensuring regular contact between teachers and their students (if necessary, mediated by students' parents) for providing learning opportunities, distributing learning material and work assignments, giving feedback, and providing a platform for exchanging experiences, emotions, or even fears relating to distance learning. Only when students take advantage of this offer to learn, can distance teaching lead to learning progress. Here, the percentage of students that teachers had contact with might indicate how many students were involved in lessons or became increasingly isolated–providing teachers actually offered interaction opportunities. Because elementary school students might be more dependent on parental support during distance teaching, the percentage of teachers having frequent contact with their students might be lower in elementary compared to secondary schools. Conversely, it can be assumed

that more elementary school teachers communicated directly with their students' parents.

Aspects Teachers Focused on During Lessons

In school, teachers are required to provide learning opportunities for students to engage with learning content and develop corresponding competencies. As shown in many studies, opportunities to learn are an important determinant of differences in scholastic achievement (Scheerens, 2017). With regard to distance teaching, Klieme (2020) recommended offering opportunities for learning along the curriculum with tasks varying in difficulty. In terms of quality of instruction, demanding content should not be excluded to avoid specific content being arbitrarily neglected in an uncontrolled manner. In contrast, repeating already learned content and postponing the introduction of new content might be problematic because the rehearsal of previously learned content could be associated with lower aspiration levels and underload, which is related to boredom (e.g., Acee et al., 2010), and, consequently, lower scholastic achievement (Hattie, 2020). Furthermore, Klieme (2020) encouraged teachers to assess the learning progress of their students via curriculum-based diagnostic tests to identify content areas that need further instruction as well as identify students with learning deficits. For this, diagnostic tests would allow for rapid, smooth, and more adaptive teaching. Gaps in knowledge and understanding would otherwise only be discovered coincidentally during lessons, with subsequent time-consuming explanations that interrupt the planned structure of lessons and exclude some students. Overall, teaching new content together with periodic diagnostic tests are desirable aspects that teachers should implement during distance teaching.

Organization of Classes Against the Background of Inadequate Digitalization

With schools being closed and distance teaching implemented, "online learning opportunities have been elevated from a bonus extracurricular facility to a critical lifeline for education" (Organisation for Economic Co-operation and Development [OECD], 2020, p. 1). National and international studies indicate that German schools and teachers were not well prepared for distance teaching using technical devices and digital media. Serious deficits were reported for equipment in schools with Germany being well below the OECD average with regard to the availability of IT equipment, Wi-Fi, learning management systems and internet-based applications for collaborative working, and the supply of teachers with individual technical devices. Consequently, only around 60 percent of secondary school teachers in Germany reported using digital media in school for school-related purposes at least once a week, with around 23 percent using digital media daily (ICILS study; Eickelmann et al., 2019). In elementary school, digital media were used to an even more limited extent than secondary school (Schmid et al., 2017) and the use of digital media in this case depended largely on the commitment (e.g., personal interests, competencies) of teachers and principals (Thom et al., 2017). These findings indicate that a stronger use of digital media for learning during school closures might be a new experience for many German students.

Against the background of the unsatisfactory state of digitalization in German education, it is of particular interest to examine how teachers organized their lessons during school closures. It can be assumed that teachers mainly used presentation modes and distribution methods having low technical requirements, for example, relying on exercises in text books or sending working sheets/feedback to students via e-mail–especially in elementary school where students were even less familiar with technical devices and digital media compared to secondary school students. Besides asking "how," it is also important to examine "how often" teachers used the different presentation modes, sent out work assignments and teaching materials, or gave feedback to their students. As research indicates, giving short work assignments on a regular basis is more effective than giving extensive assignments (Schnyder et al., 2006) and allows for the adaptation of subsequent learning material and work assignments. Furthermore, prompt and regular feedback on these assignments is essential for successful learning (McLaughlin and Yan, 2017) and appears to increase motivation in students (Trautwein et al., 2001; Khlaif et al., 2021).

Handling Achievement Differences Between Students

Because students vary, for example, in their social and cultural backgrounds, learning pace, or scholastic achievements, teachers should give differentiated instructions assuming that "students learn best when their teachers effectively address variance in students' readiness levels, interests, and learning profile preferences" (Tomlinson, 2005, p. 263). During the pandemic, concerns about students' learning progress were widespread among educational management, policy makers, and educational scientists. More specifically, higher learning lags were assumed for students from socially deprived families, students with immigration backgrounds, and students with special needs (e.g., Di Pietro et al., 2020; Hurrelmann and Dohmen, 2020; Leopoldina, 2020; Van Ackeren et al., 2020). For example, students from socially deprived families typically have less available socio-cultural capital and therefore fewer resources that might help them learn at home (e.g., technical devices; Andrew et al., 2020) than students from families with higher incomes. Students with immigration backgrounds (associated with a lower socio-economic status) might additionally have problems understanding the language of instruction (Kempert et al., 2016) and necessary language tuition or additional teacher support might have been dropped. Furthermore, for students from both groups, it is likely that their parents struggle more to help their children learn at home and be an additional audience for feedback. It can be expected that teachers identified these groups of students as being disadvantaged by distance teaching.

To maximize individual learning success, instruction should be individually adjusted depending on the achievement level of the student. For example, Thakur (2014) recommends differentiation by individually adjusting learning content (tasks

should be appropriate to students' individual experience or knowledge level and students should use different resources in accordance with their learning style), processes (varying the presentation mode of instructions), and products (showing gained knowledge through individualized outcomes/products). In conjunction with perceived stress (e.g., Huber et al., 2020; Klapproth et al., 2020) and/or less knowledge when dealing with technical devices and digital media, teachers might have less time and/or lack the necessary competencies to factor in achievement differences between students during distance teaching. Additionally, it might be more difficult to assess learning during distance teaching (less interactions with students, less diagnostic tests) and therefore to adapt learning material and work assignments. However, since teachers typically know their students and their strengths and weaknesses well, it can be assumed that many teachers used differentiated instructions independent of the examined school type.

Challenges of Distance Teaching and Prerequisites for Successful Distance Teaching

In addition to exploring the teaching structure, teacher-reported challenges and prerequisites for successful distance teaching might provide further indications of aspects that should be targeted first due to their particular importance to distance teaching. Consistent with the unsatisfactory state of digitalization in German education described in the ICILS study (Eickelmann et al., 2019), empirical evidence regarding competencies in using technical devices and digital media appears to reinforce concerns about the lack of preparation of teachers and students for distance teaching: According to principals, only half their teachers had the necessary technical and pedagogical skills to integrate technical devices and digital media into instruction. Simultaneously, around only 40 percent of principals reported that effective professional resources for teachers to learn how to use digital devices were available to their staff (Organisation for Economic Co-operation and Development, 2020). On the other hand, nearly all German secondary school teachers reported confidence in finding useful teaching material on the Internet and 80 percent were also confident in preparing lessons for students using digital media. However, only one third of the teachers used learning management systems. In terms of students, around 91 percent of 15-year-old students reported having a computer for working at home and nearly all students (99 percent) reported having access to the Internet (Behrends et al., 2018; Organisation for Economic Co-operation and Development, 2020). In an international comparison of these statistics, Germany is in the leading group of OECD member countries. Nevertheless, it is conceivable that these requirements are inadequate because families with several school-aged children and/or parents working from home could rapidly reach their capacity limit of device availability. Relating to this, only 43 percent of German 12-year-olds and 52 percent of 14-year-olds report having a computer or tablet for their own use. For students in socially deprived families, the corresponding percentages are even lower (Geis-Thöne, 2020). This defies the constitutional right of all students for equal access to high-quality education. However, computer- and information-related competencies of German eighth graders were above the international average in 2018 and Germany was ranked in the middle section for this field in an international comparison. Associated with this, around one third of eighth grade students only have rudimentary or basic computer- and information-related competencies and another quarter of the students are able to use digital media autonomously and critically. Based on these data, it is conceivable that teachers list mainly the same aspects focusing on inadequate digitalization as the researchers and politicians–particularly in elementary schools where teachers and students are less familiar with technical devices and digital media. Thus, prerequisites for successful distance teaching should consequently focus on aspects of digitalization.

Students' Attainment of Learning Objectives and Learning Progress

Beyond describing the impact of school closures on education in Germany from the teachers' perspective, our aim was to examine the importance of different teaching practices for the students' attainment of learning objectives as well as their learning progress during distance teaching. The initial results of empirical studies indicate that students were less engaged in school-related activities in general and learning activities in particular during the first German school closures in spring 2020 (e.g., Grewenig et al., 2020; Wößmann et al., 2020), they were less motivated to learn, and had different and possibly fewer interactions with their teachers (e.g., Di Pietro et al., 2020). Correspondingly, school closures had detrimental effects on learning gains and social disparities during the first wave of the pandemic in Germany (Depping et al., 2021; Schult et al., 2021) and other countries (e.g., Maldonado and De Witte, 2020; Engzell et al., 2021). Which aspects should educational management, policy makers, and others involved in education focus on to ensure that as many students as possible achieve their targeted learning goals and therefore show learning gains? Contact with students and/or parents as well as access to technical devices for both teachers and students are undoubtably fundamental prerequisites for distance teaching. However, new devices might be of less value if teachers and/or students do not know how to use them adequately. In addition, research by Hattie (2020) on 1,400 meta-analyses indicates the substantial impact of, for example, feedback (d = 0.73) on students' academic achievement. The reported relationships and effect sizes can only be applied to traditional classroom teaching. For distance teaching, we do not know of any comparable ranking sequences. Yet these analyses can help highlight important aspects related to successful distance teaching and, therefore, enrich the professional discourse and political debate on future interventions.

The Current Study

In order to inform policy and practice as well as initiate further research on the impact of school closures on education in

Germany, we conducted an online survey on distance teaching among nearly 2,500 teachers. Our aim is to present data describing teaching practices during the first wave of school closures in spring 2020 and summarize the teacher-reported challenges of distance teaching as well as prerequisites for successful distance teaching. Moreover, we examined the importance of different teaching practices for students' attainment of learning objectives and learning progress during distance teaching using data mining supervised machine learning, which is a state-of-the-art method in exploratory data analysis. To gain further insights into potentially differing teaching practices depending on students' age, analyses were conducted separately for elementary and secondary school students and subsequently compared. We then related our findings to corresponding results from other surveys in the discussion.

MATERIALS AND METHODS

Sample and Procedure

Responses were collected from an online survey conducted in June and July 2020 (i.e., at the end of the school year) from teachers in different states in Germany. The original sample comprised answers from elementary school teachers in 15 of the 16 German federal states and responses from secondary school teachers in four states. To ensure the comparability of the results between elementary and secondary schools, we only analyzed data from the four federal states where teachers from both levels of education had participated (for comprehensive descriptive results for elementary schools, see Schneider et al., 2020).

Depending on the state, either all public schools of the state were invited to participate in the survey or only a representative sample that was randomly drawn from a complete list of all schools in the respective state provided by school authorities. Headmasters of the invited schools were asked to distribute the hyperlink for the survey among all teachers currently working as form teachers at the school. The open source software *LimeSurvey*[2] was used to administer the survey. At the beginning of the questionnaire, form teachers were asked to respond to the questions on distance learning with regard to their class; other (i.e., non-form) teachers were also accepted as participants and required to choose a class for which they would answer the questions. All teachers were instructed to consider the last 4 weeks of mere distance learning.

Participation was voluntary and anonymous. Complete questionnaires were submitted by n = 857 elementary school teachers (gender: 88 percent female, 9 percent male, 3 percent diverse or unspecified; age: $M(SD)$ = 44.21 (9.61) years) and n = 1,590 secondary school teachers (gender: 66 percent female, 31 percent male, 2 percent diverse or unspecified; age: $M(SD)$ = 45.01 (10.13) years; school type: 42 percent academic track, 58 percent non-academic track) and these were included in the following analyses. Participation quotas are not available as participants cannot be linked to schools based on the survey data; however, the gender and age distribution in our teacher sample are similar to the respective population statistics reported in large-scale educational monitoring studies (e.g., Rjosk et al., 2017).

[2]https://www.limesurvey.org/

Instrument

The survey consisted of 28 questions, including nine questions concerning the teachers' personal information (e.g., gender, age) and their students/school (e.g., grade level, school type) and 19 questions about distance teaching that were assigned to three general topics: 1) teaching practices, 2) teachers' evaluation of different distance teaching aspects and their improvement, and 3) students' learning progress. The 13 distance teaching-related questions that were used for the analyses in the current paper (**Table 1**) can be categorized as follows in six (sub-)topics:

1a) Teachers' contact with students and parents,
1b) teachers' focus on different aspects during lessons,
1c) the organization of lessons against the background of inadequate digitalization,
1d) how to factor in achievement differences between students as well as the potential disadvantages for certain students due to distance learning,
2) the evaluation of different aspects of distance learning as well as prerequisites for successful distance teaching, and
3) the teacher-estimated learning progress of students.

Due to the unique and novel situation of distance teaching during school closures, we did not use existing questionnaires, but devised the questions specifically for the current study to cover our research questions. Only few results from other studies on distance teaching during the pandemic in Germany were available at the time and were considered during questionnaire development (e.g., forsa, 2020a).

Analyses

Analyses were conducted separately for elementary and secondary school using SPSS and R. For questions with closed response formats, frequencies or percentages were reported. Where appropriate, multiple answers were allowed for these questions. To evaluate the open question with more extensive answers, a categorical system built on the main motives of each response was created: First, a subsample of 300 teachers who answered the question (multiple answers per teacher were possible) was randomly selected. Subsequently, each answer was summarized in accordance with the qualitative content analysis according to Mayring (2015), paraphrasing answers until evaluable and comprehensible main categories were available. Second, trained raters assigned the subsample answers to the main categories independent of each other. If the interrater reliability was unsatisfactory (Cohen's kappa $\kappa < 0.60$; Landis and Koch, 1977), the definition of the respective category was revised, adjusted, reassigned, and rechecked. If the interrater reliability was at least satisfactory (final κ was .83), the resulting category system was applied to the remaining answers.

TABLE 1 | Questionnaire content summary.

Question[a]	Response format	Topic[b]	Figure/ Table
How many students and parents, respectively, did you stay in touch with on a regular basis during school closures?	closed	1a, 3	**Figure 1**
What aspects did you mainly focus on with your teaching material and work assignments during distance teaching in comparison to regular classroom teaching?	closed	1b	**Figure 2**
How often did you use the different presentation modes to present learning content in German?	closed	1c, 3	**Figure 3**
How often did you use the different presentation modes to present learning content in mathematics?	closed	1c	—
How often did you distribute work assignments and learning material to your students via different communication channels?	closed	1c, 3	**Figure 4**
How often did you give feedback to the students *via* different communication channels?	closed	1c, 3	**Figure 5**
Which students do you consider to be especially disadvantaged by distance teaching?	closed	1d	—
How did you handle achievement differences between students during school closures?	closed	1d, 3	**Figure 6**
How good did distance teaching work with regard to the following aspects?	closed	2, 3[c]	**Figure 7**
Which preconditions are most important for successful distance teaching?	open	2	**Table 2**
In your opinion, what percentage of students managed to obtain at least the same learning progress during distance teaching that could have been expected during classroom teaching?	closed	3	**Figure 8**
Which factors impeded the organization of distance teaching for you?	closed	3	—
How was the contact between students and teachers organized during distance teaching?	closed	3	—
Are you female, male, or diverse?	closed	3	—
How old are you?	open	3	—
Which grade level does the class you are answering this questionnaire for belong to?	closed	3	—
What type is the school you are currently working at?	closed	1–3[d]	—

Notes. [a]*Translated from German.*
[b]*Indicates which topic the respective question belongs to (see text, section "*Instrument*").*
[c]*This question's closed items "attainment of learning objectives" and "ensuring the equal participation of all students" were used for analyses concerning topic 3.*
[d]*Results are presented separately for school types (topics 1a to 2: elementary and secondary school; topic 3: elementary school, non-academic track, academic track).*

In order to explore which variables were most important for the teacher-reported attainment of learning objectives and the prediction of learning progress by students perceived by teachers, we used random forests (Breiman, 2001), a well-established data mining supervised machine learning method (e.g., Strobl et al., 2009). Prior to this, we analyzed the correlational structure of the data. Because our data were ordinally scaled we grew random forests consisting of ordinal regression trees (Janitza et al., 2016) using the R package *party* (Hothorn et al., 2021). We ran separate analyses for two different dependent variables (teacher-reported achievement of overall learning objectives and teacher-reported learning progress in comparison to classroom learning) and three subsets of our data that were split according to school type (elementary school, academic track in secondary school, and non-academic track in secondary school) resulting in six random forests. In every subset for both dependent variables we added the same set of self-reported measures as predictors. Each of our random forests consisted of 5,000 ordinal regression trees; robustness checks showed that this was sufficient as further increasing the number of trees yielded the same results. We computed four different variable importance measures (VIM) for each variable in each subset. As recommended by Janitza et al. (2016), our final variable ranking relied on the ranked probability score (RPS) VIM, but in general the ranking of variables was very similar among all VIMs considered. For the construction of the trees, 63.2 percent of the data were sampled without replacement and used as a training set as suggested by Boulesteix et al. (2012). Furthermore, we set the number of input variables sampled as candidates at each node to five.

RESULTS

Impact of School Closures on Teaching in German Elementary and Secondary Schools

The statistics describing the implementation of distance teaching in elementary and secondary schools in Germany following the sequence of aspects outlined in the introduction are reported below.

Figure 1 shows the results for how successfully teachers stayed in contact with their students and parents during distance teaching (topic 1a). A large majority of teachers in both elementary and secondary school had regular contact with most or all of the students in their class. However, there was also a non-negligible proportion of teachers in both school types reporting only regular contact with half or even fewer of their students. Regular contact with parents was much more frequent for elementary schools than for parents of older students.

Another important aspect of distance teaching is how work assignments are designed and communicated (topic 1b). **Figure 2** shows how the content of learning materials used during distance teaching differed in comparison to assignments in regular classroom learning. The results are similar for elementary and secondary schools. Most notably, assignments in distance teaching focused much more often on repetition and practicing already learned content, whereas the introduction of new topics and content was often postponed. For both school types, many teachers reported having rarely or not at all assessed the learning progress of the students.

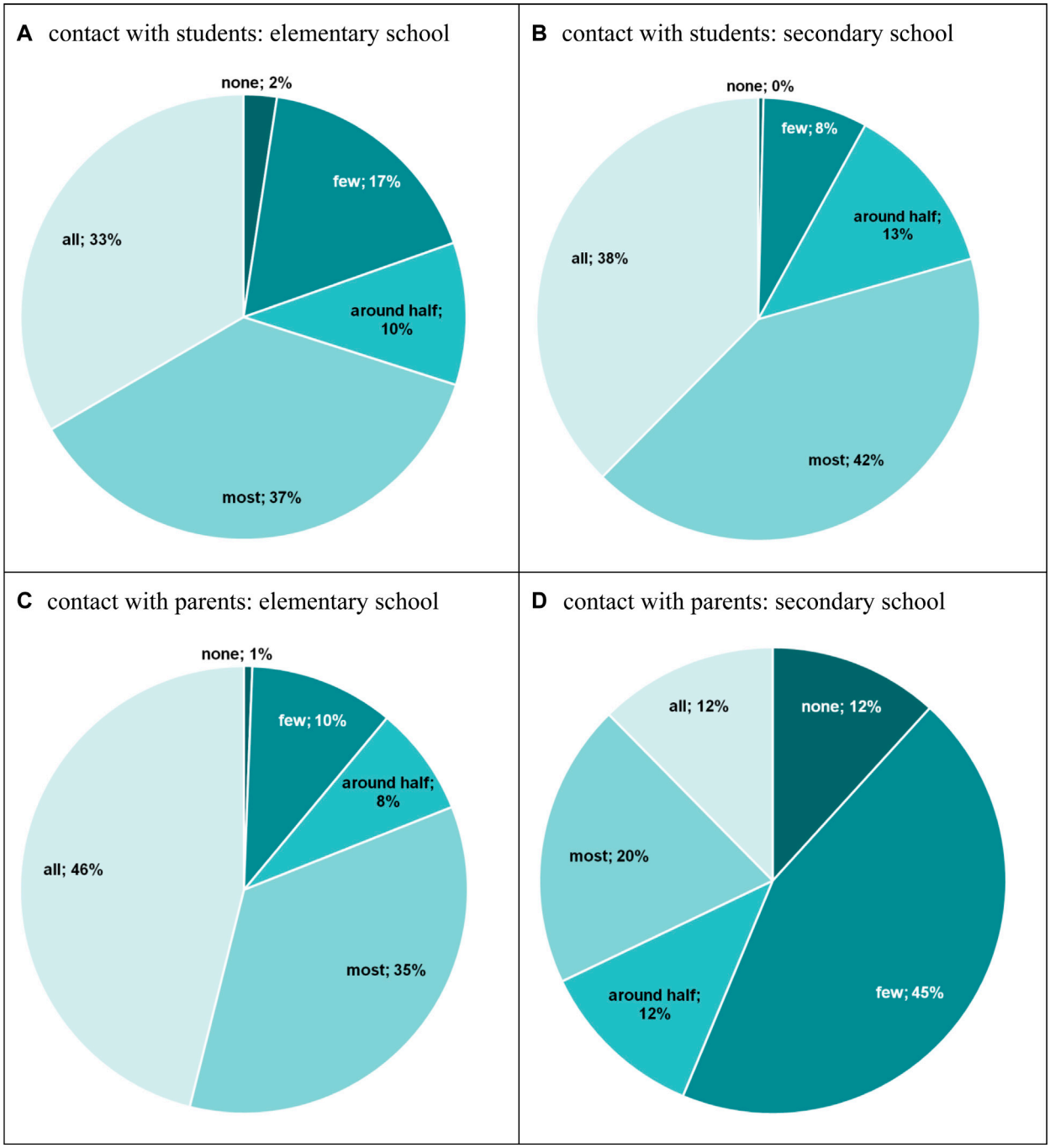

FIGURE 1 | Percentage of teachers giving the indicated responses to the question "How many students and parents, respectively, did you stay in touch with on a regular basis during school closures?" **(A)** contact with students: elementary school. **(B)** contact with students: secondary school. **(C)** contact with parents: elementary school. **(D)** contact with parents: secondary school.

Next, we examined teachers' organization of lessons against the background of inadequate digitalization (topic 1c). **Figures 3**, **4** illustrate how teachers presented learning content to students and which communication channels they used to distribute learning materials and work assignments. In both cases, the percentages shown reflect the proportion of teachers in elementary and secondary schools, respectively, using a presentation mode or means of communication on a regular basis (i.e., at least once a week). The results show that teachers most often used presentation modes and ways to deliver assignments that had low-level technical requirements, such as assignments in textbooks or on worksheets sent *via* e-mail or kept

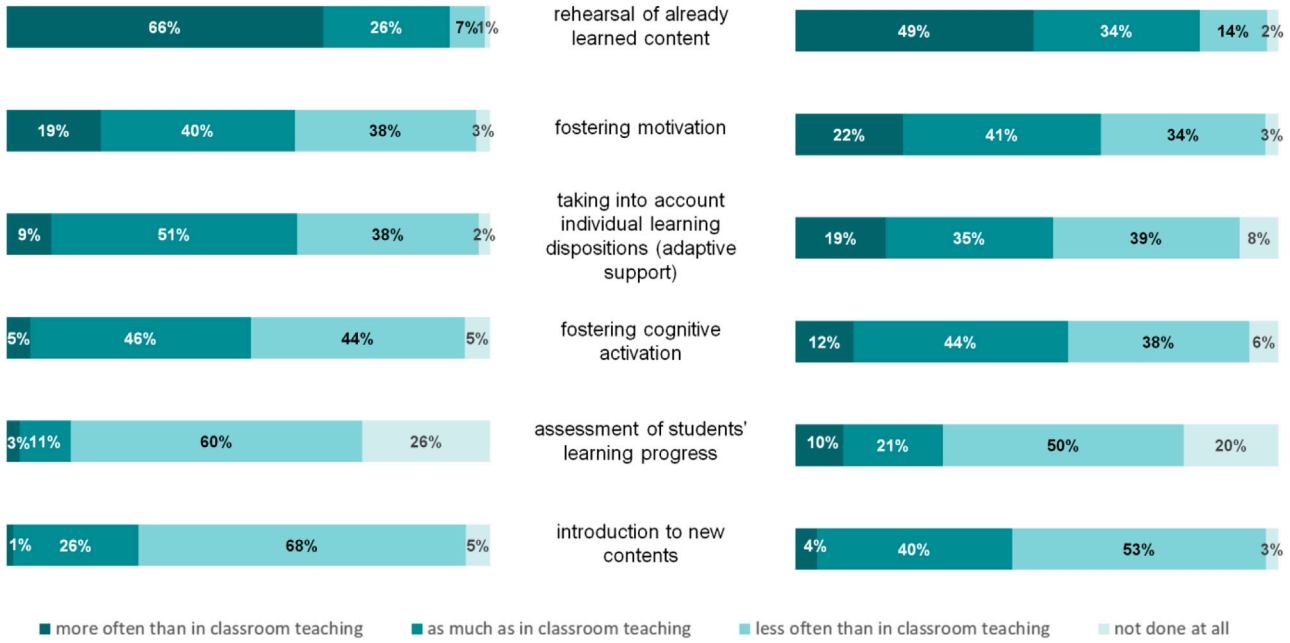

FIGURE 2 | Focus of work assignments and learning materials during distance teaching in comparison to regular classroom teaching.

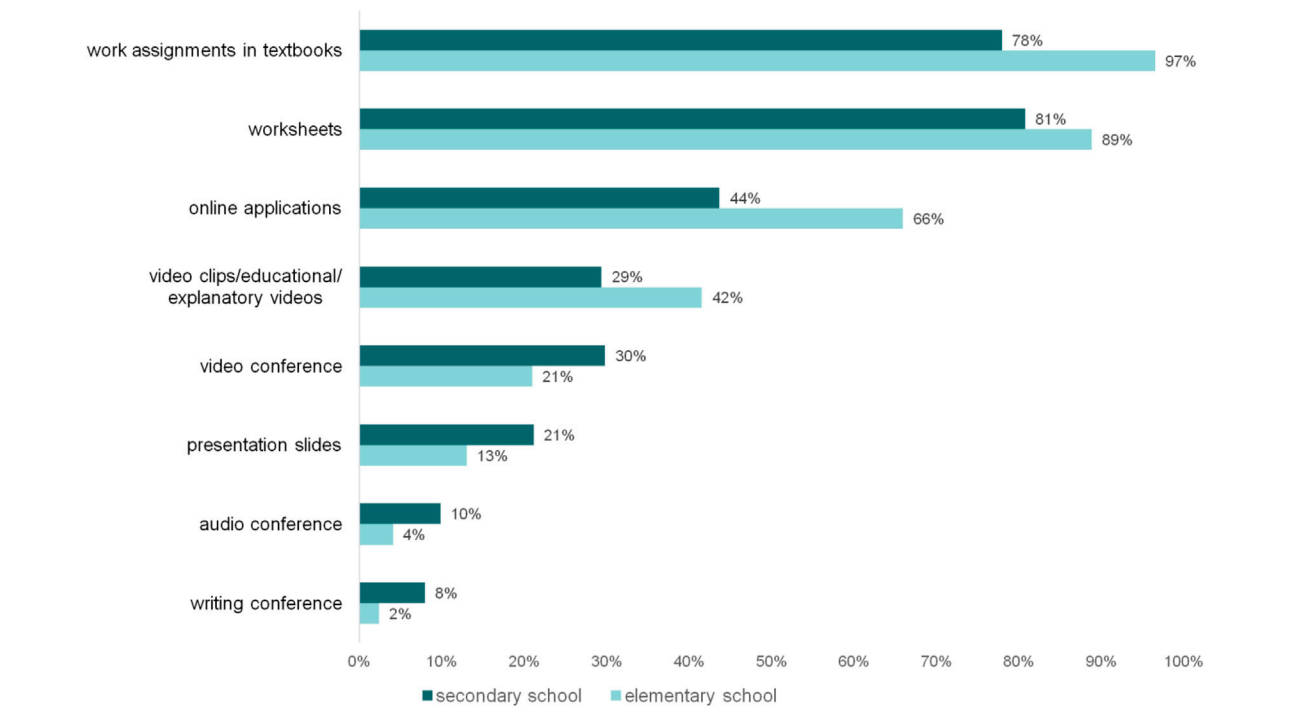

FIGURE 3 | Percentage of teachers using the indicated presentation modes for learning content at least once a week (subject German).

at school for pickup. However, many teachers also regularly used online platforms and apps for distributing assignments (especially in secondary school); about one quarter to 38 percent had video or audio conferences with their students. At secondary schools, the use of technically more advanced ways of communication, such as video or audio conferences,

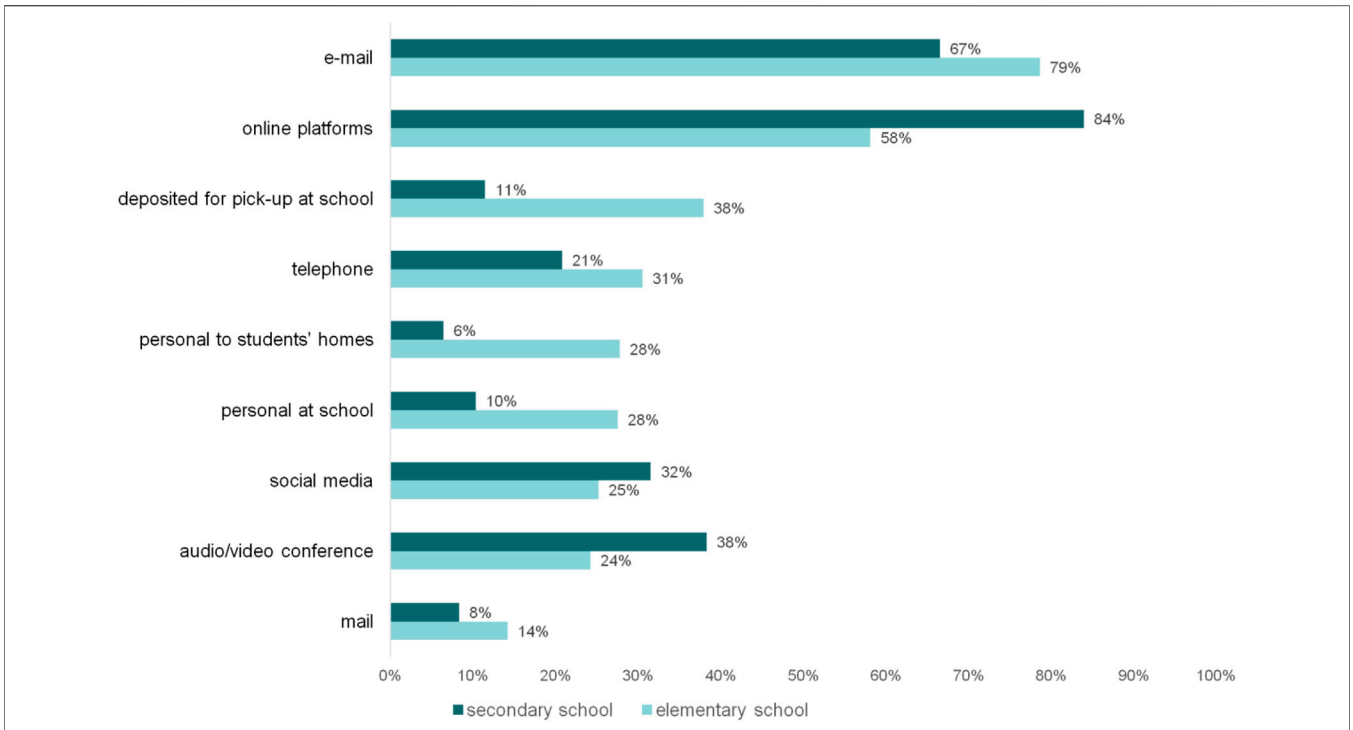

FIGURE 4 | Percentage of teachers using the indicated communication channels to distribute work assignments and learning material at least once a week.

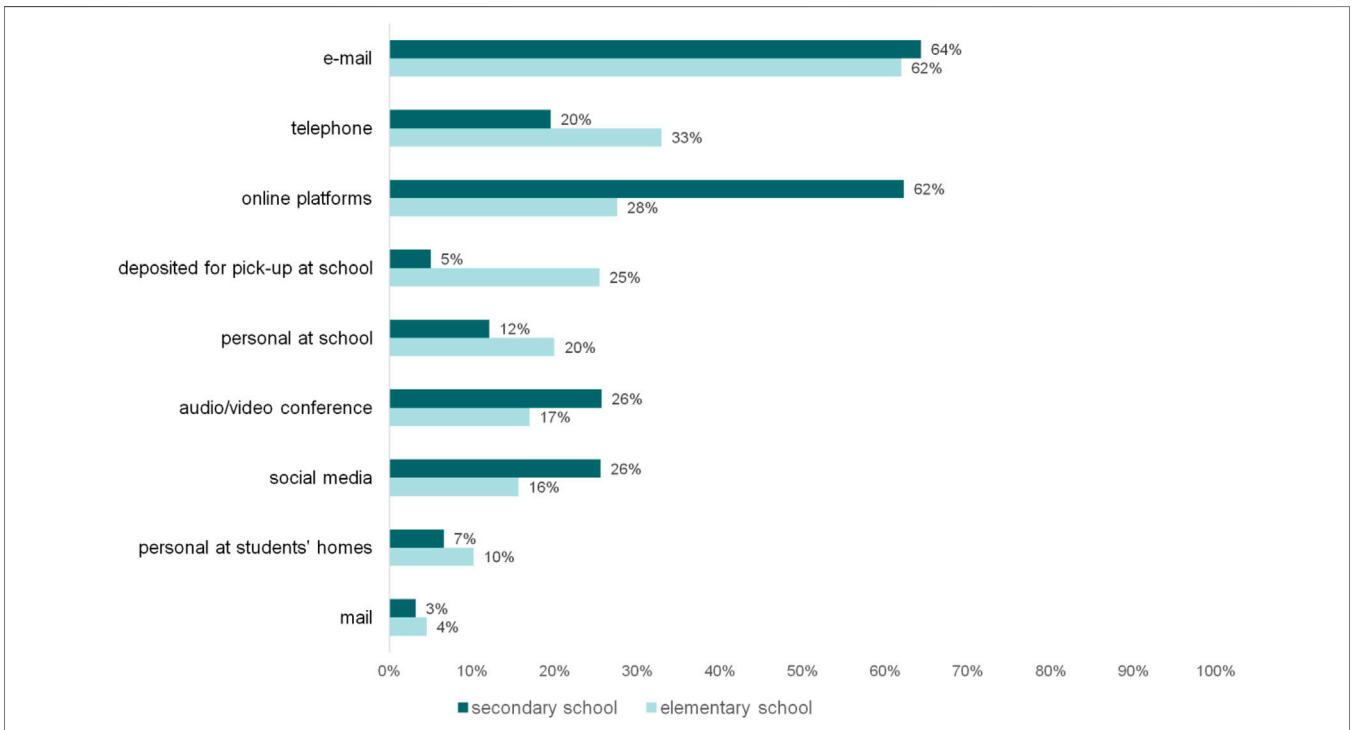

FIGURE 5 | Percentage of teachers giving feedback to their students via different communication channels at least once a week.

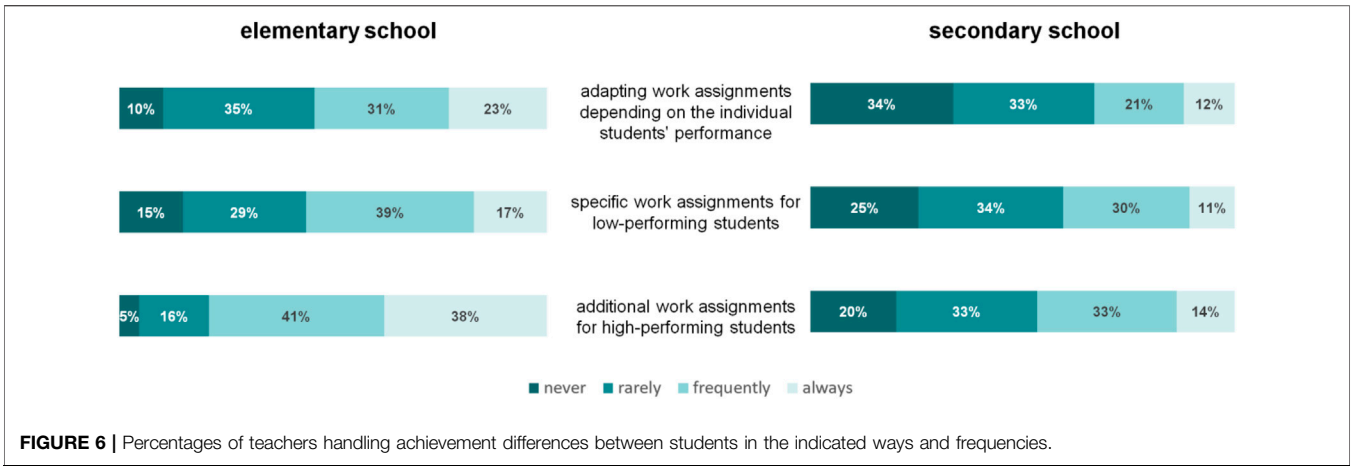

FIGURE 6 | Percentages of teachers handling achievement differences between students in the indicated ways and frequencies.

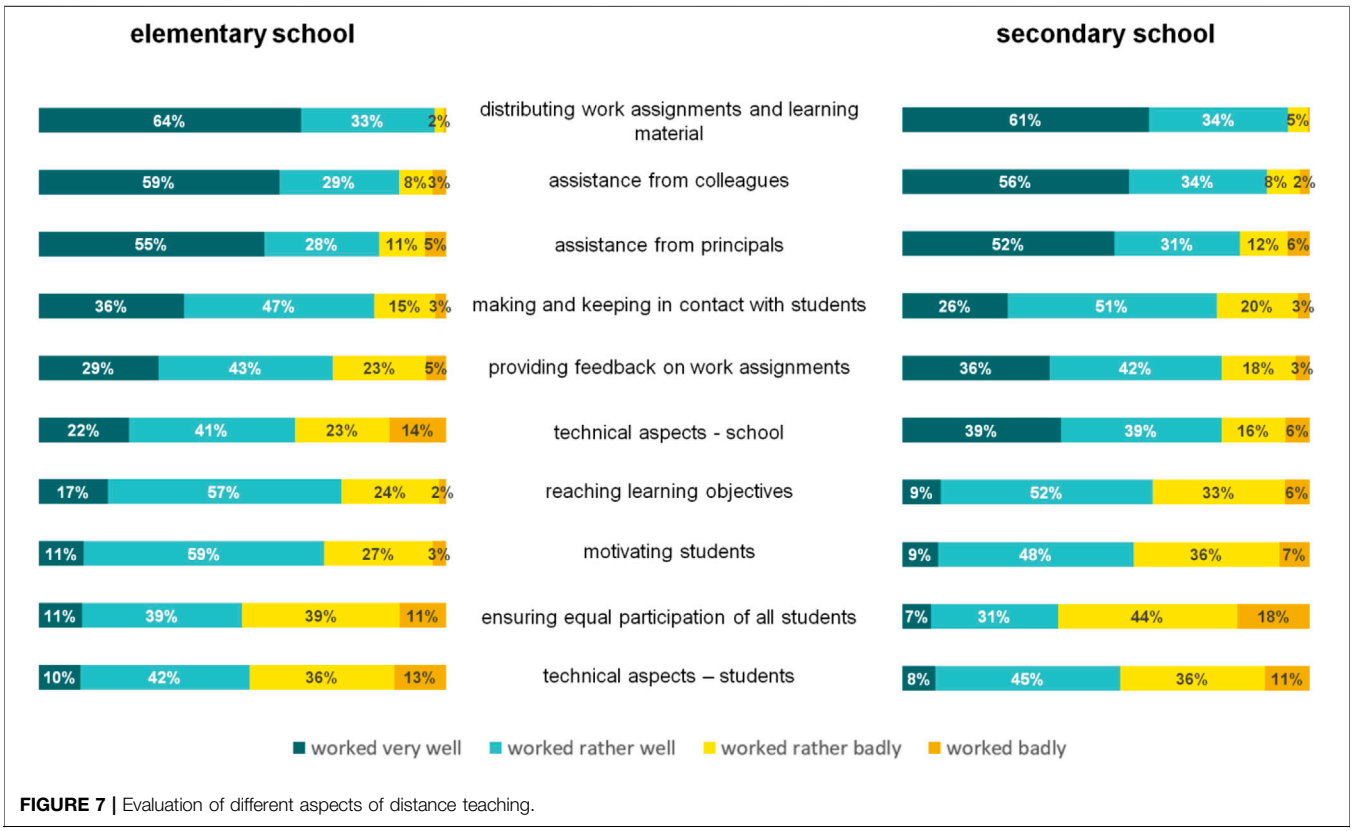

FIGURE 7 | Evaluation of different aspects of distance teaching.

was slightly more frequent than in elementary schools. Results were very similar for mathematics (not shown) and German.

Another important aspect of distance teaching is how often and in which ways students receive feedback from teachers (e.g., concerning the correctness of completed learning assignments). At elementary schools, nearly all teachers (98 percent) gave students feedback at least once a week. Results were similar for teachers at secondary schools (97 percent). For both school types, e-mail was the most important means of communication for feedback (**Figure 5**). At elementary schools, teachers also often used the telephone or offered a pick-up at school. Feedback on a regular basis (i.e., at least once a week) via online platforms was provided by one third of elementary school teachers. However, the regular use of online platforms for feedback was much more frequent at secondary schools.

With regard to the handling of achievement differences between students (topic 1d), our survey showed that more than 85 percent of teachers at elementary and secondary schools considered students from families facing difficult social

TABLE 2 | Frequencies for the categorized responses with regard to the open question asking elementary school (ES) and secondary school (SS) teachers to name the most important preconditions for successful distance learning. The table is sorted in descending order according to ES.

Frequencies in %		Category	Description	Sample examples
ES	SS			
77	75	technical equipment	availability of devices, e.g., tablets or laptops	"all students must have access to appropriate devices," "teachers must be provided with digital devices by their employer"
60	61	IT infrastructure	IT infrastructure improvement	"working internet and wifi", "more IT staff"
30	24	communication	communication with parents, students and between school staff	"regular contact with students and parents," "regular feedback from the teacher on work results"
29	34	digital competence	demand for further training in the area of media/ digital literacy	"training on video conferencing with large groups and working with learning platforms"
26	17	parental support	requests for cooperation of parents	"parents need to better structure their children's daily routine," "clarify that completing assignments is mandatory"
24	29	school/educational software	specific software required for distance teaching	"increased use of learning apps," "make better use of online offerings from publishers/platforms," "easily accessible learning portals"
17	31	general regulations	comments on general regulations such as compulsory education and data protection	"specifications as to which external providers may be used and whether or how achievement monitoring should be used"
7	17	student-related aspects of teaching	students' competencies for successful participation in distance teaching	"foster student motivation and self-organized working"
<5	18	performance evaluation	evaluation/grading of tasks completed by students	"mandatory participation in distance teaching with performance evaluation is required"

Notes. *The sample examples have been translated into English. Multiple responses per teacher were possible.*

circumstances as well as students who rarely speak German at home to be especially disadvantaged by distance teaching. The question of how far teachers adapted their teaching for students with different educational needs during school closures was handled quite heterogeneously in both school types (**Figure 6**). For instance, whereas about 40 percent of secondary school teachers frequently used specific work assignments for low-performing students, this was done only rarely by about one third and not at all by one quarter of secondary school teachers.

Challenges of Distance Teaching and Prerequisites for Successful Distance Teaching

One focus of the survey was to ask teachers to evaluate different aspects of distance teaching to identify challenges that needed to be addressed to improve learning at home during school closures in the future (topic 2, **Figure 7**). The results were similar for elementary and secondary schools: A large percentage of teachers indicated that the distribution of work assignments worked rather well or very well and were satisfied with the support they received from colleagues and school principals. Staying in contact with students was also deemed manageable by most teachers. On the other hand, technical issues and ensuring the equal participation of all students without "losing" anyone were identified as the biggest challenges.

We complemented the closed-format items in **Figure 7** with an open question asking teachers to name the most important "preconditions for successful distance learning." Categorization of the responses (see method section for details) revealed that the two most frequently mentioned requirements were referred to by elementary and secondary school teachers alike (**Table 2**). These requirements referred to technical equipment (mentioned by 77 percent of elementary school teachers and 75 percent of secondary school teachers), e.g., tablets or laptops for students and teachers, and IT infrastructure (60 percent and 61 percent, respectively), e.g., stable internet connections or infrastructure maintenance.

Students' Attainment of Learning Objectives and Learning Progress

Concerning the teacher-reported learning progress of students (topic 3), slightly more than half of the elementary school teachers and only about one third of the secondary school teachers stated that the majority of their students achieved the same learning progress that would have been expected in regular lessons at school (**Figure 8**). Similarly, about one quarter of elementary school teachers and almost 40 percent of secondary school teachers believed that their classes more or less failed in meeting the overall educational objectives during the weeks of distance teaching (**Figure 7**).

Based on six random forest analyses consisting of 5,000 ordinal regression trees each, we derived the relative importance of our predictor variables for explaining these two outcome variables as described in the method section. Of all predictor variables that were included in the analyses, the first seven predictors for each school type and for each dependent variable are displayed in **Figure 9**. We excluded all variables from further exploration and discussion that were negative, zero, or positive, but with a value that lay in the same range as the negative values as suggested by Strobl et al. (2009). These variables are bordered in red in **Figure 9**.

For both outcome variables, the most important predictor in elementary school is regular contact between teachers and their

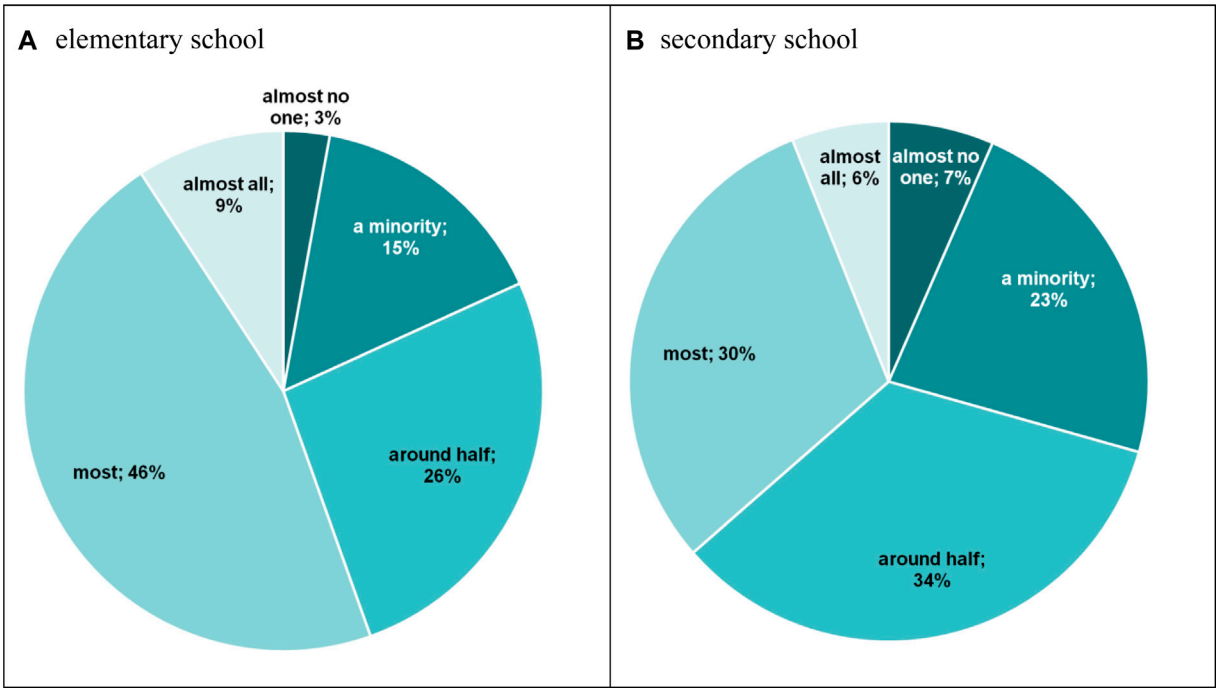

FIGURE 8 | Percentages of teachers giving the indicated responses to the question "In your opinion, what percentage of students managed to obtain at least the same learning progress during distance teaching that could have been expected during classroom teaching?" **(A)** elementary school. **(B)** secondary school.

students' parents, whereas teacher contact with students was slightly less important. In contrast, regular contact with parents was much less important in secondary school, and in secondary schools with academic track it was virtually unimportant. However, contact with the students themselves was the most important predictor variable independent of outcome variable and school track in secondary school.

The correlational structure of the remaining important variables is as follows: Especially in primary school, teachers' gender was associated with the outcome variables in the sense that women tended to report better overall learning goal achievement and better learning progress for students in comparison with regular classroom teaching. Furthermore, in subgroups where the teachers' age variable was fairly important, older teachers reported better learning progress for their students. The association of students' age or grade level, respectively, was inverse in primary versus secondary school: In primary school, teachers reported better learning progress for the younger children, whereas in secondary school, teachers reported better learning progress for students in more advanced grades. Among the factors that hindered teachers' work, lack of access to materials (i.e., due to limited access to the school building), lack of an own PC/laptop, and lack of a separate room for work at home were negatively associated with the outcome variables. However, having to care for their own children at home during distance teaching did not seem to be important.

Of the different communication channels assessed, higher frequencies of communication *via* ordinary mail and deposit and pick-up at school in particular were negatively associated with the outcome variables suggesting that relying on "analog" communication channels tended to fail to contribute to successful distance teaching. In contrast, the more frequent usage of digital communication channels, such as feedback and material distribution *via* e-mail, feedback via online platforms, or feedback *via* audio/video conferencing, was positively associated with the outcome variables. In primary school, the association with feedback *via* e-mail in particular had a relatively high variable importance. Additional factors that were relatively important as predictors for the outcome variables were the adaptation of work assignments depending on the students' individual performance and additional exercises for high performing students, fixed consultation hours for teachers, and fixed availability times for students.

DISCUSSION

The SARS-CoV-2 pandemic has had an undoubtedly tremendous impact on schools, students, and teachers, with teaching and learning processes being temporarily remotely implemented in spring 2020. In this study, our aim was to describe the impact of school closures due to the SARS-CoV-2 pandemic on elementary and secondary school education in Germany from a teacher's perspective. Moreover, we conducted an exploratory examination of the importance of different variables including teaching

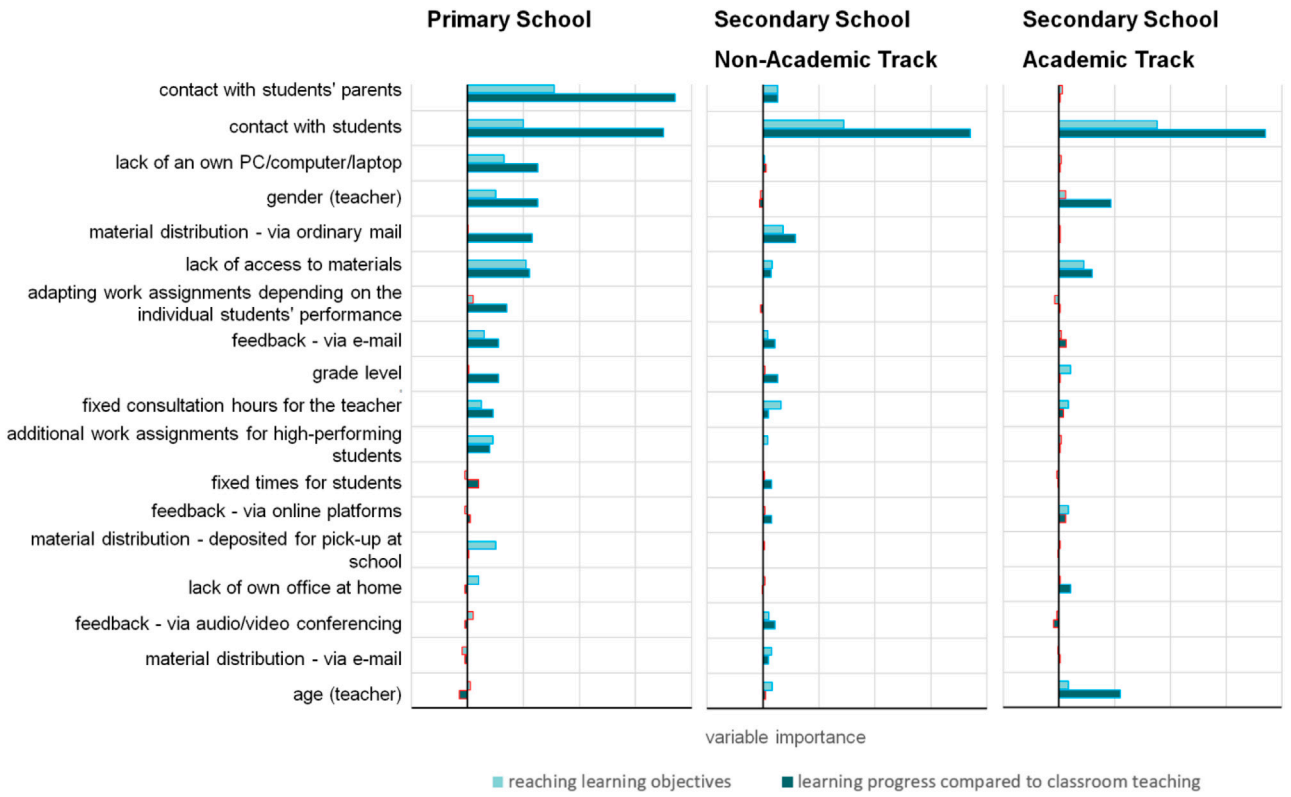

FIGURE 9 | Relative importance of predictor variables for explaining teacher-reported attainment of learning objectives as well as teacher-reported learning progress in comparison to classroom learning. *Note*. Variables that are bordered in red are not discussed in the text.

practices for teacher reports of students' attainment of learning objectives during distance teaching and their learning progress compared to regular classroom teaching. Overall, our results underline the importance of regular contact between teachers and students for the learning progress of students, the demand for faster progress regarding digitalization, and of fostering the corresponding digitalization competencies in teachers and students.

The Most Important Predictor for Successful Distance Teaching: Staying in Contact With Students and Their Parents

In our study, teachers were rather pessimistic about students' learning gains during the school closures. About one quarter of elementary school teachers and almost 40 percent of secondary school teachers believed that their classes more or less failed to meet the overall educational objectives during the weeks of distance teaching. Furthermore, only slightly more than half of the elementary school teachers and only about one third of secondary school teachers stated that the majority of their students made the same learning progress that would have been expected in regular lessons in school. These results are in line with other surveys conducted with teachers (forsa, 2020a; Schwerzmann and Frenzel, 2020; Steiner et al., 2020). Between one third and two thirds of students' parents worry about the potential negative consequences for their children's learning progress (e.g, Huber et al., 2020; Thies and Klein, 2020; Wößmann et al., 2020).

The percentages of teachers who had contact with their students' parents and their students, respectively, on a regular basis were by far the two most important determinants for teacher-reported attainment of learning objectives and learning progress for elementary school students. For secondary school students, only contact with students had a substantial impact. Fortunately, the majority of elementary and secondary school teachers reported maintaining contact with most or all of their students regularly, with a slightly higher percentage for secondary school teachers. In contrast, and as expected, the majority of elementary school teachers maintained contact with most or all of their students' parents, but for secondary school teachers, such contact was rare. Compared to the results of studies that were conducted at the beginning of the school closures in March and April 2020 (forsa, 2020a; Porsch and Porsch, 2020), the percentages reported in our survey are higher, indicating the increased involvement of students and their parents in lessons as distance teaching continued. However, around 29 percent of elementary school teachers and one fifth of secondary school teachers held contact with half or less of their students on a regular basis. There is reason to be concerned that many of these students might come from socially deprived families (e.g., since they lacked the necessary technical devices), have insufficient

German language skills to follow the instructions, and/or are lower academic achievers, i.e., those students that would actually benefit most from regular contact and teacher support.

Further Important Aspects: Digitalization and Students' Motivation

On the basis of our results, another key area concerning distance teaching is digitalization, both in elementary and secondary schools. Although aspects relating to digitalization play a less important role for the teacher-reported attainment of learning objectives and for the learning progress of students (apart from the lack of an own computer/laptop for elementary school teachers), they seemed to be a major issue for teachers during school closures. For example, half of the elementary and secondary school teachers reported technical problems on the side of the students, 37/22 percent of elementary/secondary school teachers had problems with overcoming the technical challenges of distance teaching themselves. Correspondingly, a substantial amount of teachers saw need for improvement in technical requirements and the development/improvement of digital competencies. Comparable results and demands were found/formulated in other national and international studies (e.g., forsa, 2020a; forsa, 2020b; Murat and Bonacini, 2020; Wildemann and Hosenfeld, 2020). Altogether, this is regrettable given that technical devices and digital media have the potential to considerably ease distance teaching. For example, video conferences or chats allow for collaborative learning despite social distancing, thus resulting in cognitive as well as metacognitive activation and, subsequently, better learning outcomes (Spörer et al., 2008; Jeong et al., 2019). Furthermore, technical devices and digital media can support teachers in the timely evaluation of students' learning progress as well as in providing prompt feedback (Van der Kleij et al., 2015; McLaughlin and Yan, 2017), both of which are important for successful learning (McLaughlin and Yan, 2017; Hattie, 2020). Thus, efforts should be intensified to advance digitalization. However, access to technical devices and digital media is no panacea, but rather a precondition for participating in lessons during distance teaching (Ewing and Cooper, 2021).

Motivation to learn is considered to be an important internal learning potential (e.g., according to the *utilization of learning opportunities model* by Helmke and Schrader, 2013) that is also essential for self-determined work on tasks. According to the evaluation of distance teaching by teachers, special attention needs to be given to student motivation: Around 30 percent of elementary school teachers and 43 percent of secondary school teachers reported that motivating students worked (rather) badly. Correspondingly, around half of the N = 4,230 parents of elementary and secondary school students interviewed by Wildemann and Hosenfeld (2020) reported that their children had low motivation or were not motivated at all. Working on tasks remotely requires high self-regulation skills from students, especially if teachers use analogous learning materials and presentation modes that students need to work on without the teachers' supervision. In elementary school in particular, students with low self-regulation skills need to rely on their parents' support. Again, disadvantages for students from socially deprived families, from households where German is rarely spoken, for students with special educational needs, and for low-achieving students are to be expected. Trautwein and Lüdtke (2014) suggest self-regulation training for students that can be held during school breaks or in the afternoon. If not feasible, teachers should at least use tasks or presentation modes that are within the self-regulation limits of their students. For example, video conferences or chats support collaborative learning and thus foster students' self-regulation skills.

Implications and Limitations

Educational management, policy makers, and others involved in education need to bear in mind local conditions to ensure that as many students as possible achieve their targeted learning goals and show learning gains. An overview of policy measures by various countries is provided by the UNESCO (e.g., Chang and Yano, 2020). Because countries vary in their economic and cultural characteristics, educational systems, and even experiences with distance teaching, single results of our study and corresponding implications can more easily be adopted to countries with comparable characteristics and systems. Nevertheless, the key components of our study for successful distance teaching seem to be generally valid (e.g., Daniel, 2020; Nóvoa and Alvim, 2020; Thomas and Rogers, 2020) and indicate a multitude of tasks for teachers: They need to stay in contact with students (and parents, if they teach in elementary school) to provide learning material (online and/or offline), to monitor students' learning process and progress as well as to support their students. They are supposed to adopt their lessons and learning materials, and therewith, factor in students' individual needs. Furthermore, they shall give positive feedback on a regular basis, maintain students' motivation and avoid frustration. Thus, qualifying teachers accordingly might be one key component to minimize the impact of distance teaching on students' learning progress.

Another key component, as outlined above, seems to be an increasing digitalization. According to a meta-analysis by Hillmayr et al. (2020), digital media can enhance students' learning if other instruction methods and digital media are combined and teachers are accordingly qualified. Therefore, increasing digitalization and the corresponding qualification of teachers might not only be helpful in maintaining a high quality of teaching during school closures or cohort teaching, but could also make a positive difference in future classroom teaching (Anger and Plünnecke, 2020). However, an advancing digitalization is linked to countries' economic and cultural characteristics. For example, and with regard to the latter, families in the Middle East seem to be more concerned about their children, especially daughters, using the microphone, webcams or sharing their screen during distance teaching (Khlaif et al., 2021), which may limit these students' possibilities to participate in distance teaching *via* technical devices and digital media. Future research should not only describe potential progress in digitalization and changes in teaching practices resulting from the pandemic, but should also focus on students' actual achievements, including

disparities associated with disadvantaged groups of students, on students' motivation, as well as on the physical and mental health of teachers, students, and parents. A broad and international database would be desirable for examining what has been done and what worked best in order to further learn from other countries and to develop pedagogical plans to better cope with comparable situations in the future.

Concerning the limitations of our study, it needs to be noted that participation in the survey was voluntary, with the risk of under/overrepresenting certain groups of teachers and therefore not being representative of all German elementary and secondary school teachers. Furthermore, the current data is restricted to elementary school teachers from four German federal states to facilitate the comparison of results between elementary and secondary schools. However, the presented results do not differ substantially from those for the full sample of elementary school teachers from nearly all German federal states (see Schneider et al., 2020). Nevertheless, our study contributes to the ongoing debate about the impact of school closures on education by describing teaching practices during the first wave of school closures in spring 2020 and examining the impact of different variables including teaching practices on students' attainment of learning objectives and their learning progress during distance teaching.

CONCLUSION

Overall, our study contributes to the (inter)national data base concerning distance teaching during the 2020 school closures due to the SARS-CoV-2 pandemic. As most important for perceived successful distance teaching we could identify staying in touch with students in secondary school and in addition with parents in primary school. Furthermore, our results underline the demand for faster progress regarding digitalization and for fostering the corresponding digitalization competencies in teachers and students. Technical devices and digital media should not only be used for the distribution of learning materials and feedback, but also for motivating students, probably even more for those living in potentially deprived learning environments.

DATA AVAILABILITY STATEMENT

Data supporting the conclusions of this article will be made available upon request to the first author.

ETHICS STATEMENT

Prior to the participation of teachers, the Ministries of Education and Cultural Affairs of the German Federal States were informed of the general aim of our research and approved the study material and procedures. Participation was voluntarily and participants gave their informed consent to take part in this online study by answering the survey questions.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

ACKNOWLEDGMENTS

We thank the IEA Hamburg for their support in contacting the schools.

REFERENCES

Acee, T. W., Kim, H., Kim, H. J., Kim, J.-I., Chu, H.-N. R., Kim, M., et al. (2010). Academic Boredom in under- and Over-challenging Situations. *Contemp. Educ. Psychol.* 35 (1), 17–27. doi:10.1016/j.cedpsych.2009.08.002

Andrew, A., Cattan, S., Costa-Dias, M., Farquharson, C., Kraftman, L., Krutikova, S., et al. (2020). Learning during the Lockdown: Real-Time Data on Children's Experiences during home Learning. *IFS Briefing Note BN288*. Available at: https://www.ifs.org.uk/uploads/Edited_Final-BN288%20Learning%20during%20the%20lockdown.pdf.

Anger, C., and Plünnecke, A. (2020). Schulische Bildung zu Zeiten der Corona-Krise [School education in times of the coronavirus crisis]. *Perspektiven der Wirtschaftspolitik* 21 (4), 353–360. doi:10.1515/pwp-2020-0055

Assunção Flores, M., and Gago, M. (2020). Teacher Education in Times of COVID-19 Pandemic in Portugal: National, Institutional and Pedagogical Responses. *J. Edu. Teach.* 46 (4), 507–516. doi:10.1080/02607476.2020.1799709

Behrends, S., Engel, W., Kott, K., and Neuhäuser, J. (2018). *Datenreport 2018. Ausstattung privater Haushalte mit Gebrauchsgütern*. [Data report 2018. Consumer goods in private households] (bpb: Bundeszentrale für politische Bildung. Available at: https://www.bpb.de/nachschlagen/datenreport-2018/private-haushalte-einkommen-konsum-wohnen/278199/ausstattung-privater-haushalte-mit-gebrauchsguetern.

Boulesteix, A.-L., Janitza, S., Kruppa, J., and König, I. R. (2012). Overview of Random Forest Methodology and Practical Guidance with Emphasis on Computational Biology and Bioinformatics. *Wires Data Mining Knowl Discov.* 2 (6), 493–507. doi:10.1002/widm.1072

Breiman, L. (2001). Random Forests. *Machine Learn.* 45, 5–32. doi:10.1023/a:1010933404324

Chang, G. C., and Yano, S. (2020). How Are Countries Addressing the Covid-19 Challenges in Education? A Snapshot of Policy Measures. *World Educ. Blog.* doi:10.1023/A:1010933404324

Daniel, S. J. (2020). Education and the COVID-19 Pandemic. *Prospects* 49, 91–96. doi:10.1007/s11125-020-09464-3

Depping, D., Lücken, M., Musekamp, F., and Thonke, F. (2021). Kompetenzstände Hamburger Schüler*innen vor und während der Corona-Pandemie [Alternative pupils' competence measurement in Hamburg during the Corona pandemic]. *DDS – Die Deutsche Schule, Beiheft* 17, 51–79. doi:10.31244/9783830993315.03

Di Pietro, G., Biagi, F., Costa, P., Karpiński, Z., and Mazza, J. (2020). *The Likely Impact of COVID-19 on Education: Reflections Based on the Existing Literature and Recent International Datasets*. JRC Technical Report (Luxembourg: Publications Office of the European Union). doi:10.2760/126686

Eickelmann, B., Bos, W., Gerick, J., Goldhammer, F., Schaumburg, H., Schwippert, K., et al. (2019). *ICILS 2018 #Deutschland. Computer- und informationsbezogene Kompetenzen von Schülerinnen und Schülern im zweiten internationalen Vergleich und Kompetenzen im Bereich Computational Thinking* [ICILS 2018 #Germany. Computer and information-related competencies of students in the second international comparison and competencies in computational thinking]. New York:

Waxmann. Available at: https://www.pedocs.de/volltexte/2019/18166/pdf/Eickelmann_et_al_2019_ICILS_2018_Deutschland.pdf.

Engzell, P., Frey, A., and Verhagen, M. D. (2021). Learning Loss Due to School Closures during the COVID-19 Pandemic. *SocArXiv Papers*. doi:10.31235/osf.io/ve4z7

Ewing, L.-A., and Cooper, H. B. (2021). Technology-enabled Remote Learning during Covid-19: Perspectives of Australian Teachers, Students and Parents. *Technol. Pedagogy Edu.* 30 (1), 41–57. doi:10.1080/1475939X.2020.1868562

Fickermann, D., and Edelstein, B. (2020). "Langsam vermisse ich die Schule ...": Schule während und nach der Corona-Pandemie ["I'm starting to miss school": Schooling during and after the Corona pandemic]. *DDS – Die Deutsche Schule, Beiheft* 16, 9–33. doi:10.31244/9783830992318.01

forsa (2020a). *Das Deutsche Schulbarometer Spezial Corona-Krise* [The German School Barometer – Coronavirus Crisis Special]. Available at: https://deutsches-schulportal.de/unterricht/das-deutsche-schulbarometer-spezial-corona-krise/.

forsa (2020b). *Das Deutsche Schulbarometer Spezial Corona-Krise: Folgebefragung* [The German School Barometer – Coronavirus Crisis Special: Follow-Up Survey]. Available at: https://deutsches-schulportal.de/unterricht/lehrer-umfrage-deutsches-schulbarometer-spezial-corona-krise-folgebefragung/.

Geis-Thöne, W. (2020). Häusliches Umfeld in der Krise: Ein Teil der Kinder braucht mehr Unterstützung. Ergebnisse einer Auswertung des Sozio-ökonomischen Panels (SOEP) [The domestic environment during the crisis: Some children need more support. Results of an analysis of the Socio-Economic Panel (SOEP)], *IW-Report* (15/2020). Available at: https://www.iwkoeln.de/fileadmin/user_upload/Studien/Report/PDF/2020/IW-Report_2020_Haeusliche_Lebenswelten_Kinder.pdf.

Gesetz zum Schutz der Teilnehmer am Fernunterricht (2020). [Law for the protection of the participants of distance learning], BGB I S. 1670, §1 et seq. Available at: https://www.gesetze-im-internet.de/fernusg/.

Grewenig, E., Lergetporer, P., Woessmann, L., and Zierow, L. (2020). COVID-19 and Educational Inequality: How School Closures Affect Low- and High-Achieving Students. *CESifo Working Paper* (8648). doi:10.1016/j.jeconom.2020.03.022

Hattie, J. (2020). *Hattie Ranking: Backup of 195 Effects Related to Student Achievement*. Available at: https://visible-learning.org/hattie-ranking-backup-195-effects/. doi:10.4324/9780367815561

Helm, C., Huber, S., and Loisinger, T. (2021). Was wissen wir über schulische Lehr-Lern-Prozesse im Distanzunterricht während der Corona-Pandemie? - Evidenz aus Deutschland, Österreich und der Schweiz [Meta-Review on findings about teaching and learning in distance education during the Corona pandemic – Evidence from Germany, Austria and Switzerland]. *Zeitschrift für Erziehungswissenschaft*, 1–75. doi:10.1007/s11618-021-01000-z

Helmke, A., and Schrader, F.-W. (2013). Angebots-Nutzungs-Modell der Wirkfaktoren akademischer Leistungen [Utilization of learning opportunities model], in *Dorsch – Lexikon der Psychologie*. Editor M. A. Wirtz (Bern, Switzerland: Huber), 147–148. Available at: https://dorsch.hogrefe.com/stichwort/angebots-nutzungs-modell-der-wirkfaktoren-akademischer-leistungen.

Hillmayr, D., Ziernwald, L., Reinhold, F., Hofer, S. I., and Reiss, K. M. (2020). The Potential of Digital Tools to Enhance Mathematics and Science Learning in Secondary Schools: A Context-specific Meta-Analysis. *Comput. Edu.* 153, 103897. doi:10.1016/j.compedu.2020.103897

Hothorn, T., Hornik, K., and Zeileis, A. (2021). *Party: A Laboratory for Recursive Partytioning*. (*R package version 1.3-7*) [Computer software]. The Comprehensive R Archive Network. Available at: https://cran.r-project.org/web/packages/party/vignettes/party.pdf.

Huber, S. G., Günther, P. S., Schneider, N., Helm, C., Schwander, M., Schneider, J. A., et al. (2020). *COVID-19 und aktuelle Herausforderungen in Schule und Bildung* [COVID-19 and the current challenges in education]. Münster, Germany: Waxmann. doi:10.31244/9783830942160

Hurrelmann, K., and Dohmen, D. (2020). *Coronakrise verstärkt Bildungsungleichheit* [Corona Crisis Reinforces Educational Inequality]. Das Deutsche Schulportal. Available at: https://deutsches-schulportal.de/stimmen/das-deutsche-schulbarometer-hurrelmann-dohmen-corona-krise-verstaerkt-bildungsungleichheit/.

Janitza, S., Tutz, G., and Boulesteix, A.-L. (2016). Random Forest for Ordinal Responses: Prediction and Variable Selection. *Comput. Stat. Data Anal.* 96, 57–73. doi:10.1016/j.csda.2015.10.005

Jeong, H., Hmelo-Silver, C. E., and Jo, K. (2019). Ten Years of Computer-Supported Collaborative Learning: A Meta-Analysis of CSCL in STEM Education during 2005-2014. *Educ. Res. Rev.* 28, 100284. doi:10.1016/j.edurev.2019.100284

Kempert, S., Edele, A., Rauch, D., Wolf, K. M., Paetsch, J., Darsow, A., et al. (2016). Die Rolle der Sprache für zuwanderungsbezogene Ungleichheiten im Bildungserfolg [The Role of Language in Immigration-Related Inequalities in Educational Attainment], in *Ethnische Ungleichheiten im Bildungsverlauf*. Editors C. Diehl, D. Hunkler, and C. Kristen (Springer VS), 157–241. doi:10.1007/978-3-658-04322-3_5

Khlaif, Z. N., Salha, S., Fareed, S., and Rashed, H. (2021). The Hidden Shadow of Coronavirus on Education in Developing Countries. *Olj* 25 (1), 269–285. doi:10.24059/olj.v25i1.2287

Klapproth, F., Federkeil, L., Heinschke, F., and Jungmann, T. (2020). Teachers Experiences of Stress and Their Coping Strategies during COVID - 19 Induced Distance Teaching. *Jpr* 4 (4), 444–452. doi:10.33902/JPR.2020062805

Klieme, E. (2020). Guter Unterricht - auch und besonders unter Einschränkungen der Pandemie? [Teaching quality – also and especially under the constraints of the pandemic?]. *DDS – Die Deutsche Schule, Beiheft* 16, 117–135. doi:10.31244/9783830992318.07

Landis, J. R., and Koch, G. G. (1977). The Measurement of Observer Agreement for Categorical Data. *Biometrics* 33 (1), 159–174. doi:10.2307/2529310

Leopoldina (2020). *Dritte Ad-Hoc-Stellungnahme: Coronavirus-Pandemie – Die Krise Nachhaltig Überwinden* [Third Ad Hoc Statement: Coronavirus Pandemic – Overcoming the Crisis Sustainably]. Available at: https://www.leopoldina.org/uploads/tx_leopublication/2020_04_13_Coronavirus-Pandemie-Die_Krise_nachhaltig_überwinden_final.pdf.

Maldonado, J. E., and De Witte, K. (2020). The Effect of School Closures on Standardised Student Test Outcomes, Discussion Paper Series, DPS20.17. Available at: https://feb.kuleuven.be/research/economics/ces/documents/DPS/2020/dps2017.pdf.

Mayring, P. (2015). Qualitative Content Analysis: Theoretical Background and Procedures, in *Approaches to Qualitative Research in Mathematics Education. Advances in Mathematics Education*. Editors A. Bikner-Ahsbahs, C. Knipping, and N. Presmeg (Springer), 365–380. doi:10.1007/978-94-017-9181-6_13

McLaughlin, T., and Yan, Z. (2017). Diverse Delivery Methods and strong Psychological Benefits: A Review of Online Formative Assessment. *J. Comp. Assist. Learn.* 33 (6), 562–574. doi:10.1111/jcal.12200

Murat, M., and Bonacini, L. (2020). Coronavirus Pandemic, Remote Learning and Education Inequalities, GLO Discussion Paper, 679. Available at: http://hdl.handle.net/10419/224765.

Nóvoa, A., and Alvim, Y. (2020). Nothing Is New, but Everything Has Changed: A Viewpoint on the Future School. *Prospects* 49, 35–41. doi:10.1007/s11125-020-09487-w

Organisation for Economic Co-operation and Development (2020). *Learning Remotely when Schools Close: How Well Are Students and School Prepared? Insights Form PISA*. OECD. Available at: https://www.oecd.org/coronavirus/policy-responses/learning-remotely-when-schools-close-how-well-are-students-and-schools-prepared-insights-from-pisa-3bfda1f7/.

Porsch, R., and Porsch, T. (2020). Fernunterricht Als Ausnahmesituation. Befunde einer bundesweiten Befragung von Eltern mit Kindern in der Grundschule [Home schooling as an exceptional situation. Findings from a nationwide survey of parents with primary school children]. *DDS – Die Deutsche Schule, Beiheft* 16, 61–78. doi:10.31244/9783830992318.03

Rjosk, C., Hoffmann, L., Richter, D., Marx, A., and Gresch, C. (2017). Qualifikation von Lehrkräften und Einschätzungen zum gemeinsamen Unterricht von Kindern mit und Kindern ohne sonderpädagogischen Förderbedarf [Teacher qualification and valuation regarding common instruction of children with and children without special educational needs], in *IQB-bildungstrend 2016 [IQB Trend in Student Assessment 2016*. Editors P. Stanat, S. Schipolowski, C. Rjosk, S. Weirich, and N. Haag (Münster, Germany: Waxmann), pp. 335–353.

Scheerens, J. (2017). *Opportunity to Learn, Curriculum Alignment and Test Preparation. A Research Review*. Springer. doi:10.1007/978-3-319-43110-9

Schmid, U., Goertz, L., and Behrens, J. (2017). *Monitor Digitale Bildung. Die Schulen im digitalen Zeitalter* [Digital education monitor. Schools in the digital age]. Gütersloh, Germany: Bertelsmann Stiftung. Available at: https://www.

bertelsmann-stiftung.de/fileadmin/files/BSt/Publikationen/GrauePublikationen/BSt_MDB3_Schulen_web.pdf.

Schneider, R., Schipolowski, S., Sachse, K. A., Enke, F., and Stanat, P. (2020). *Fernunterricht im Schuljahr 2019/2020: Ergebnisse der Lehrkräftebefragung des IQB* [Distance teaching in the school year 2019/2020: Results of a survey among teachers by the Institute for Educational Quality Improvement]. Berlin, Germany: Institute for Educational Quality Improvement. Available at: https://www.iqb.hu-berlin.de/bt/Fernunterricht/.

Schnyder, I., Niggli, A., Cathomas, R., Trautwein, U., and Lüdtke, O. (2006). Wer lange lernt, lernt noch lange nicht viel mehr: Korrelate der Hausaufgabenzeit im Fach Französisch und Effekte auf die Leistungsentwicklung [Learning for more hours does not imply learning more: Correlating homework time and effects on performance development in French]. *Psychol. Erziehung Unterricht* 53, 107–121.

Schult, J., Mahler, N., Fauth, B., and Lindner, M. A. (2021). Did Students Learn Less during the COVID-19 Pandemic? Reading and Mathematics Competencies before and after the First Pandemic Wave. *PsyArXiv*. doi:10.31234/osf.io/pqtgf

Schwerzmann, M., and Frenzel, S. (2020). *Umfrage zum Fernunterricht. Ergebnisse der Befragung im Juni 2020* [Distance learning survey. Results of the survey in June 2020]. Bildungs- und Kulturdepartement. Available at: https://www.lu.ch/-/media/Kanton/Dokumente/BKD/Aktuelles/BKD_Fernunterricht_Praesentation_Ergebnisse_an_MK_2020_10_14.pdf?la=de-CH.

Spörer, N., Seuring, V., Schünemann, N., and Brunstein, J. C. (2008). Förderung des Leseverständnisses von Schülern der 7. Klasse: Effekte peer-gestützten Lernens in Deutsch und Englisch [Promoting reading comprehension in 7th-grade pupils: Effects of peer-supported learning in German and English]. *Z. für Pädagogische Psychol.* 22 (34), 247–259. doi:10.1024/1010-0652.22.34.247

Statistisches Bundesamt (2020). *Bildung, Forschung und Kultur: Schulen* [Education, Research, and Culture: Schools]. Available at: https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Schulen/_inhalt.html#sprg234476.

Steiner, M., Köpping, M., Leitner, A., and Pessl, G. (2020). *COVID-19 LehrerInnenbefragung – Zwischenergebnisse. Was tun, damit aus der Gesundheitskrise nicht auch eine Bildungskrise wird?* [COVID-19 teaching staff-survey – Intermediate results. What can we do to ensure that the health crisis does not become an educational crisis?]. Institut für Höhere Studien – Institute for Advanced Studies (IHS). Available at: https://www.ihs.ac.at/index.php?id=1176.

Strobl, C., Malley, J., and Tutz, G. (2009). An Introduction to Recursive Partitioning: Rationale, Application, and Characteristics of Classification and Regression Trees, Bagging, and Random Forests. *Psychol. Methods* 14 (4), 323–348. doi:10.1037/a0016973

Tenorth, H.-E. (2014). *Kurze Geschichte der allgemeinen Schulpflicht* [A brief history of compulsory education]. bpb: Bundeszentrale für politische Bildung. Available at: https://www.bpb.de/gesellschaft/bildung/zukunft-bildung/185878/geschichte-der-allgemeinen-schulpflicht.

Thakur, K. (2014). Differentiated Instruction in the Inclusive Classroom. *Res. J. Educ. Sci.* 2 (7), 10–14. Available at: http://isca.in/EDU_SCI/Archive/v2/i7/2.%20ISCA-RJEduS-2014-025.pdf.

Thies, L., and Klein, Y. (2020). *Unter Druck. Die Situation von Eltern und ihren schulpflichtigen Kin-dern während der Schulschließungen* [Under pressure. The situation of parents and their school-age children during the school closures]. Düsseldorf, Germany: Vodafone Stiftung Deutschland. Available at: https://www.vodafone-stiftung.de/wp-content/uploads/2020/04/Vodafone-Stiftung-Deutschland_Studie_Unter_Druck.pdf.

Thom, S., Behrens, J., Schmid, U., and Goertz, L. (2017). *Monitor Digitale Bildung. Digitales Lernen An Grundschulen* [Digital Education Monitor. Digital Learning at Elementary Schools]. Gütersloh, Germany: Bertelsmann Stiftung. Available at: https://www.bertelsmann-stiftung.de/fileadmin/files/BSt/Publikationen/GrauePublikationen/BST_DigiMonitor_Grundschulen.pdf.

Thomas, M. S. C., and Rogers, C. (2020). Education, the Science of Learning, and the COVID-19 Crisis. *Prospects* 49, 87–90. doi:10.1007/s11125-020-09468-z

Tomlinson, C. A. (2005). Grading and Differentiation: Paradox or Good Practice? *Theor. Into Pract.* 44 (3), 262–269. doi:10.1207/s15430421tip4403_11

Trautwein, U., Köller, O., and Baumert, J. (2001). Lieber oft als viel: Hausaufgaben und die Entwicklung von Leistung und Interesse im Mathematik-Unterricht der 7. Jahrgangsstufe [Better often Than a lot: Homework assignments and the development of performance and interest in 7th grade mathematics class]. *Z. für Pädagogik* 47, 703–724. Available at: https://www.pedocs.de/volltexte/2012/4310/pdf/ZfPaed_2001_5_Trautwein_Koeller_Baumert_Lieber_oft_Hausaufgaben_D_A.pdf.

Trautwein, U., and Lüdtke, O. (2014). Die Förderung der Selbstregulation durch Hausaufgaben - Herausforderungen und Chancen [Enhancing self-regulation through homework – Challenges and opportunities], in *Kompetenz-Bildung*. Editors C. Rohlfs, M. Harring, and C. Palentien (Springer), 275–288. doi:10.1007/978-3-658-03441-2_12

United Nations Sustainable Development Group (2020). *Policy Brief: Education during COVID-19 and beyond*. New York, NY, USA: United Nations. Available at: https://unsdg.un.org/sites/default/files/2020-08/sg_policy_brief_covid-19_and_education_august_2020.pdf.

Van Ackeren, I., Endberg, M., and Locker-Grütjen, O. (2020). Chancenausgleich in der Corona-Krise: Die soziale Bildungsschere wieder schließen [Compensation of unequal educational opportunities in the Corona crisis: Closing the social education gap again]. *Dds–Die Deutsche Schule* 112 (2), 245–248. doi:10.31244/dds.2020.02.10

Van der Kleij, F. M., Feskens, R. C. W., and Eggen, T. J. H. M. (2015). Effects of Feedback in a Computer-Based Learning Environment on Students' Learning Outcomes. *Rev. Educ. Res.* 85 (4), 475–511. doi:10.3102/0034654314564881

Van Lancker, W., and Parolin, Z. (2020). COVID-19, School Closures, and Child Poverty: A Social Crisis in the Making. *The Lancet Public Health* 5 (5), 243–244. doi:10.1016/S2468-2667(20)30084-0

Wildemann, A., and Hosenfeld, I. (2020). *Bundesweite Elternbefragung zu Homeschooling während der Covid 19-Pandemie. Erkenntnisse zur Umsetzung des Homeschoolings in Deutschland* [Nationwide parent survey on homeschooling during the COVID-19 pandemic. Findings on the implementation of homeschooling in Germany]. Universität Koblenz-Landau: Institut für Bildung im Kindes- und Jugendalter; Zentrum für empirische Pädagogische Forschung. Available at: http://www.zepf.eu/wp-content/uploads/2020/06/Bericht_HOMEschooling2020.pdf.

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Werner, K., and Zierow, L. (2020). Bildung in der Coronakrise: Wie haben die Schulkinder die Zeit der Schulschließungen verbracht, und welche Bildungsmaßnahmen befürworten die Deutschen? [Education during the coronavirus crisis: How have school children spent the time over the school closures and which educational measures Do Germans prefer?]. *Ifo Schnelldienst* 73 (09), 25–39. Available at: https://www.ifo.de/publikationen/2020/aufsatz-zeitschrift/bildung-der-coronakrise-wie-haben-die-schulkinder-die-zeit.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 11 August 2021
doi: 10.3389/fpsyg.2021.705107

Time Spent on School-Related Activities at Home During the Pandemic: A Longitudinal Analysis of Social Group Inequality Among Secondary School Students

Sabine Zinn[1,2] *and Michael Bayer*[3,4]*

[1] Socio-Economic Panel (SOEP), German Institute for Economic Research (DIW), Berlin, Germany, [2] Departement of Social Sciences, Humboldt University, Berlin, Germany, [3] Leibniz Institute for Educational Trajectories (LIfBi), Bamberg, Germany, [4] Evangelische Hochschule Nürnberg, Nuremberg, Germany

OPEN ACCESS

Edited by:
Karin Sørlie Street, Western Norway University of Applied Sciences, Norway

Reviewed by:
Emil Smith, Aarhus University, Denmark
Frauke Peter, Deutsches Zentrum für Hochschul- und Wissenschaftsforschung, Germany

***Correspondence:**
Michael Bayer
michael.bayer@lifbi.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *04 May 2021*
Accepted: *23 July 2021*
Published: *11 August 2021*

Citation:
Zinn S and Bayer M (2021) Time Spent on School-Related Activities at Home During the Pandemic: A Longitudinal Analysis of Social Group Inequality Among Secondary School Students. Front. Psychol. 12:705107. doi: 10.3389/fpsyg.2021.705107

Substantial educational inequalities have been documented in Germany for decades. In this article, we examine whether educational inequalities among children have increased or remained the same since the school closures of spring 2020 due to the COVID-19 pandemic. Our perspective is longitudinal: We compare the amount of time children in secondary schools spent on school-related activities at home before the pandemic, during school closures, and immediately after returning to in-person learning. We operationalize family socio-economic status using the highest parental educational attainment. Based on the theoretical assumption that the pandemic affected everyone equally, we formulate a hypothesis of equalization during the first period of school closures. For the period thereafter, however, we assume that parents with a low level of education had more difficulties bearing the additional burden of supervising and supporting their children's learning activities. Thus, for that period, we postulate an increase in educational inequality. To study our hypotheses, we use data from the 2019 wave of the SOEP and the SOEP-CoV study, both of which are probability samples. The SOEP-CoV study provides a unique database, as it was conducted during the lockdown of spring 2020 and in the following month. For statistical analysis, we use probit regressions at three measurement points (in 2019, in 2020 during the school closures, and in the month after closures). The comparison of these three time points makes our analysis and findings unique in the research on education during the COVID-19 pandemic, in particular with regard to Germany-wide comparisons. Our results confirm the hypothesis of equalization during the first school closures and the hypothesis of an increase in educational in the subsequent period. Our findings have direct policy implications regarding the need to further expand support systems for children.

Keywords: educational inequalities, school closures, learning time, secondary-age children, parental education

INTRODUCTION

Parents, children, and schools were largely unprepared when the COVID-19 pandemic reached Germany in 2020, leading to school closures in the spring and again in winter of 2020 and again in spring of 2021 in some parts of Germany (depending on the regional regulations related to incidence levels). The complete closure of schools was an entirely new situation, especially for parents, who were suddenly faced with the challenges of managing and monitoring their children's school-related activities.

Overall, the pandemic can be understood as a *collective critical life event*. People worldwide, and thus also in Germany, have been affected, although to different degrees depending on the government measures implemented to contain the pandemic and their effects on distinct population groups. One group that has been uniquely affected by containment measures is that of school-aged children and their families. Since spring 2020, a great deal of research has been done on how social inequality plays out in this context (e.g., Blundell et al., 2020; Reimer et al., 2021). However, there are only a few studies that have used representative data to analyze the effects of school closures and the shift of all school-related activities into the home and family context.

Alongside this emerging body of research, there has been ongoing public discussion about the impact of school closures and distance learning on underprivileged children (whose parents have no education beyond secondary schooling) and children living in precarious circumstances (e.g., whose parents are unemployed). These discussions have raised questions related to broader and long-standing debates about educational justice. The United Nations (2020), for example, expects that learning losses due to the pandemic will be immense and that differences between socio-economic groups will (further) widen.

This paper focuses on the impact of school closures on the school-related activities of children in different socio-economic groups. To distinguish group differences arising directly from the "school closure" event from pre-existing differences, we compare students' school-related activities during the school closures of spring 2020 with their activities in 2019. A further comparison with the period directly following the reopening of schools in spring 2020 provides an impression of the possible persistence of group differences. In our analyses, we focus only on secondary schools. The mechanisms and effects of school closures are likely to be different for children in primary schools and therefore require separate analysis.

BACKGROUND AND THEORY

As one consequence of the sudden school closures, there was a rapid shift from in-person learning in schools to distance learning at home. Some schools were better prepared for this situation than others, especially with respect to computers and digital resources. Early research results (e.g., Huebener et al., 2020) suggest that private schools switched more quickly than public schools from in-person to distance learning. Previous studies have shown that students in private schools are significantly more privileged on average (in terms of socio-economic backgrounds) than students in public schools (Klemm et al., 2018). Their better access to digital educational resources created a kind of Matthew effect (and thus educational inequality): More privileged students are therefore more likely to attend better-equipped schools.

Moreover, it can be assumed that the pandemic has had additional effects that reinforce existing educational inequalities across socio-demographic groups. This assumption results from research on the "summer learning gap" identified in the United States (e.g., Cooper et al., 1996) and on the influence of summer holidays on skills development in school children (e.g., Alexander et al., 2007). Studies have found differences between children of parents with tertiary education and children of parents with secondary education or lower in the amount of time spent on school-related activities (e.g., Lundborg et al., 2014). Andrew et al. (2020) analyzed the amount of time school children in the United Kingdom spent on school-related activities during the lockdown and compared the results with the situation in 2014–15. They found that the children spent an average of 4.15 h per day on school-related activities during lockdown compared to 6.59 h per day in 2014–15. They report that differences in time use on school-related activities between students from different socio-economic groups (measured by annual family gross income) increased in primary schools the longer these schools were closed. This presents a contrast to the situation of children in secondary schools: Here, inequalities persisted during school closures, but did not increase. The results of Grewenig et al. (2020) paint a different picture for Germany. They indicate an average reduction of school-related learning time by about half during the lockdown, with a significant difference between low- and high-performing students, but without significant correlation with parental education. Likewise, Agostinelli et al. (2020) report a dramatic widening of the educational inequality gap between children from poor neighborhoods and children from richer neighborhoods in the United States as a result of the pandemic. They explain their finding by the fact that the former are less likely to benefit from positive peer contacts in the pandemic situation, and their parents are less likely (able) to work from home. Similarly, Haeck and Lefebvre (2020) predict for Canada an increase at about 30% in the socio-economic skills gap (measured using PISA data from 2000 to 2018) caused by the pandemic and the closure of schools during the crisis.[1] In summary, there is as yet no consistent evidence on how school closures during the pandemic affected educational inequality across different socio-economic groups.

There are two main theoretical perspectives explaining educational inequality between socio-economic groups in general. The first one explains differences in school-related activities from a family investment perspective (e.g., Becker, 1981). This resource-based perspective assumes that resource-rich parents invest more time in supporting and monitoring their children's school-related activities to compensate for the

[1]In addition to the studies discussed in detail here, there are a number of other studies that thematically lie in the same thematic field as ours. E.g., Jæger and Blaabæk (2020) examine library borrowing behavior during the period of distance learning with Danish register data and find significant differences with respect to parental educational background.

loss of time caused by school closures. The second theoretical perspective describes educational processes as kind of struggle for relevant cultural capital between different social classes, in which educational investment strategies are an expression of class-specific educational orientations (see Bourdieu, 1984). Both perspectives can be used to explain group- or class-specific differences under normal conditions when the institutional setting is fairly stable and when parents have some idea what to expect from schools and teachers. The pandemic situation is, however, characterized by a high degree of uncertainty around learning, both on the part of schools and teachers and on the part of children and their parents, irrespective of the socio-economic group or social class to which they belong.

These considerations lead to two possible scenarios. The first one refers to the results from studies on the learning gap during long holiday periods, hereafter referred to as *inequality acceleration scenario*. Under this scenario, we expect existing inequalities between groups of secondary school children distinguished according to their socio-demographic characteristics to increase during school closures. Here we adopt a cultural capital perspective, following Ditton et al. (2019) and Sari et al. (2021). Accordingly, we postulate that families' cultural resources relating to education, such as parental educational attainment, are one of the driving forces behind differences in school-related activities. The second scenario, which we call the *equalization scenario*, is based on the idea that in a situation of high uncertainty on the part of parents and students about what school and teachers will do, there is little or only a moderate impact of educational background on learning behavior (since everyone is affected in the same way). Unlike, for example, the summer holiday effect, where families have some expectation of what will happen next, the pandemic confronts all families with a similar situation of uncertainty. While passing to the next grade can be seen as dependent on the cultural resources of the home (e.g., Lee and Bowen, 2006), during the pandemic all parents are in a situation where they cannot predict what exactly the policy or the school will do next.

It is well known that the degree of parental control is lower in older children than in younger ones (Seydlitz, 1991). This fact is likely to remain unaffected by the pandemic situation. It can therefore be assumed that older students reduce the amount of time they spend on learning activities at home more than younger students during school closures.

Up to this point, we have only discussed the comparison of educational inequalities before and during the period of school closures. But what happens when schools reopen? How long can schoolchildren and parents compensate for the lack of in-person learning before negative impacts begin to appear? To answer these questions, it is important to consider not only the educational capital of parents or families but also parents' working conditions. Since individuals with low educational capital (i.e., low educational attainment) are more likely to work in jobs that they cannot do at home (e.g., Möhring et al., 2020), it is plausible that parents in this group are not able to sustain their investment in managing and monitoring their children's school-related learning activities (for an extended period). It is also plausible that once schools reopen, parents with low educational capital will hand more of the responsibility for their children's learning back over to teachers and schools than other parents, leading to a greater decline in their investment in their children's school-related activities at home. This assumption is in line with Lareau's (2000) findings on the relationship between different social classes and schooling, showing that parents with lower levels of education are less able to coordinate their children's learning activities at home with the school curriculum than other parents. This is confirmed by O'Sullivan et al. (2014), who show that the quality of parents' help differs significantly between social groups.

Against this background, we expect different effects of the socio-economic background on the time children spend at home on school-related activities during and after school closures. During the period of school closures, we assume that the concrete support provided by schools is more relevant than the educational capital of the parents for children's learning activities at home. Thus, in this period, we expect that the pandemic works in a more equalizing direction (*equalization scenario*). However, we also expect that the longer the pandemic situation lasts, the more parental investments decrease, especially those of parents with lower educational attainment, so that inequalities existing in combination with inequalities in educational background accelerate further (*inequality acceleration scenario*).

Hypothesis

Based on the aforementioned theoretical considerations and the idea that the collective event of school closures was unprecedented, meaning that no one had any experience with such a situation before the pandemic, we do not expect any additional effects of educational background on learning behavior during the period of school closures (*Hypothesis 1*). Nevertheless, we expect effects after this phase (*Hypothesis 2*): Concretely, we hypothesize that children whose parents had very low educational attainment fell behind their peers when schools reopened. We consider it plausible that support from teachers and schools during school closures and especially the use of digital resources had a high impact on children's school-related activities, since digital technologies ensure effective delivery of learning materials to students (*Hypothesis 3*). Finally, we expect that during the school closures, older students spent less time on learning at home than younger students (*Hypothesis 4*).

DATA AND METHODS

Data

We studied home learning time of students in secondary education by comparing data from three time periods: the period before the COVID-19 pandemic (spring 2019), the period during the first lockdown (April-May 2020), and the period shortly after the first lockdown came to an end (May-June 2020). Data for the pre-pandemic period come from the 2019 annual wave of the German Socio-Economic Panel (SOEP) study. Data for the lockdown period and the period shortly thereafter stem from a special survey (SOEP-CoV) of SOEP respondents on their living conditions during the pandemic, conducted from April 1

to the end of June 2020. The 2019 SOEP wave was conducted mainly in CAPI, meaning that interviewers visited respondents' households and asked all adult household members a variety of questions on socio-economic and psychological topics, such as their own and their household's financial situation, marital status, and personal well-being. Adolescents, children, and their parents completed special questionnaires for these age groups, including questions about school and the learning situation at home. In the SOEP-CoV study, all households with a valid telephone number (except for the refugee samples) were contacted by phone (in CATI), and one adult member of the household was asked to participate in the survey. The SOEP-CoV sample was randomly divided into nine cross-sectional tranches of participants who were contacted at 2–3 week intervals (for details, see Kühne et al., 2020). A question about how much time children spent learning at home was part of the questionnaire that went out to tranches 2 to 9. The periods in which they were surveyed (April 14 to May 24) correspond relatively closely to the time period when the German federal states ordered the closure of schools for the first time. The survey periods for tranches 5–9 (May 25 to June 28) cover the 5 weeks thereafter and thus the period when the schools returned to a regular mode of operation. The SOEP-CoV study is designed such that the first four subsamples comprise approximately 75% of the cases, and the remaining 5 tranches comprise circa 25%. The reason is that the study designers wanted to lay as much statistical power as possible to the period of the early period of the pandemic, see Kühne et al., 2020 To ensure that the working population (or, rather, the people who were not working from home) could also be reached, half of the calls were made in the late afternoon or evening (51% in total, see also Siegers et al., 2021).

Our analytic samples relate to secondary school children, aged 10–18 years. The 2019 SOEP wave contains data on N = 1,433 secondary school children (with a mean age of 14.1, 49.5% girls and 41.3% attending Gymnasium) and the 2020 SOEP-CoV data contain information on N = 1,028 secondary school children (N = 723 in the tranches 2–4 with a mean age of 15.3, 48.3% girls, 48.7% attending Gymnasium; N = 305 in the tranches 5–9 with a mean age of 15.2, 47.2% girls, 42.6% attending Gymnasium).

The outcome variable is a categorical variable for *time spent per day on school-related activities at home*. The categories are "less than 30 min," "between 30 min and 1 h," "between 1 and 2 h," "between 2 and 3 h," "between 3 and 4 h," and "more than 4 h." In 2019, students themselves reported the time they spent on school-related activities at home, while in 2020, this information was given by their parents (about the youngest schoolchild in the household). These two different reporting perspectives constitute a potential measurement error when comparing the amount of time reported in 2019 and 2020. For example, children might think that they spend more time on schoolwork than their parents perceive to be the case. In order to measure the strength of this effect with regard to our study results, we would need comparable measurement points, i.e., statements from parents and children about time spent on learning that refer to the same time periods. Unfortunately, such information is not available to us. However, asking questions about time use in the form of categories mitigates the problem: The difference between parents and children in their allocation to these discrete categories is likely to be negligible compared to the statistical imprecision associated with the sample and sample size.

A central explanatory variable in our study is the educational level of the parents. In our analyses, we include the *highest educational attainment of the parents living in the household* according to the CASMIN classification scheme as an independent variable with the three ordered categories "low education," "medium education," and "high education." Furthermore, we include the *age of the child* (ages 10–14 or 15–18) in our analysis. We measure *school support* during the 2020 spring lockdown by whether children received learning materials through digital channels (i.e., email or cloud) and also whether multiple channels (i.e., email, cloud, conferencing tools, materials distributed prior to the lockdown, or other means such as in-person meetings with teachers) were used to provide students with learning materials. To capture the potential impact of parental time resources, we also considered *parents' employment status*, categorized by "at least one parent works full-time or part-time," "neither parent works," and "parents are in some other type of employment that is not full-time or part-time, or are without work" (e.g., working reduced hours, or on "short-time work"). As possible confounders, we included the children's *gender, type of school*, and *performance level* at school. The *type of school* distinguishes Gymnasium from other types of secondary school. Performance at school was measured by very good or good grades in mathematics and German (average grades 1–2) and moderate to poor grades (average grades 3–6). To capture the differences in in-person versus distance learning immediately after the lockdown in spring 2020, we additionally controlled for the type of learning during this period. Here, we distinguished between in-person learning for all or part of the week and distance learning at home.

For the two periods considered in 2020, the data on parents' employment status, the type of school, and students' performance levels (i.e., school grades) were taken from the 2019 wave of the SOEP. The reason for this is that the SOEP-CoV questionnaire does not provide (complete) information on these characteristics. The time span between the 2019 SOEP wave and the SOEP-CoV survey is less than 1 year. Therefore, we still consider the information from 2019 to be sufficiently reliable for the type of school a child attended in 2020. The same applies to children's performance levels. For a large proportion of the children surveyed in 2020, the 2019 SOEP wave did not contain any information on school type or grades in math or German. This is an issue that has to be taken into account in the statistical analysis.

Table 1 shows the weighted sample statistics for the characteristics considered for the three time points studied, i.e., spring 2019, April 14 to May 24, and May 25 to June 28. Post-stratified survey weights for the households in which the children live were used to obtain these figures (see "Methods" section for more details). Overall, the distribution of the independent variables shows the expected pattern.

Methods

We used a simple descriptive measure: We calculated whether schoolchildren spent more than 2 h per day on school-related

TABLE 1 | Sample composition, column %.

	2019	14.4.–24.5.2020	25.5.–28.6.2020
Time spent on school-related activities at home			
Less than 30 min	0.19	(0.02)	(0.06)
Between 30 min and 1 h	0.38	0.07	0.19
Between 1 h and 2 h	0.31	0.23	0.30
Between 2 h and 3 h	0.08	0.28	0.20
Between 3 h and 4 h	0.02	0.20	0.12
More than 4 h	(0.00)	0.21	0.13
Information missing	(0.02)	(0.01)	(0.01)
Highest parental level of education			
Low (CASMIN 0,1a,1b,2b)	0.09	0.10	(0.11)
Medium (CASMIN 1c,2a,2c)	0.54	0.52	0.52
High (CASMIN 3a,3b)	0.36	0.36	0.35
Information missing	(0.01)	(0.02)	(0.02)
Employment status of parents in 2019†			
At least one parent working full-time	0.74	0.73	0.73
Neither parent working full-time, at least one part-time	0.15	0.20	0.16
Neither of the parents employed	0.08	(0.04)	(0.06)
Other kind of employment	(0.02)	(0.02)	(0.04)
Information missing	(0.01)	(0.01)	(0.01)
Age of school child			
10–14	0.72	0.70	0.70
15–18	0.28	0.30	0.30
Gender of child			
Male	0.49	0.52	0.50
Female	0.51	0.48	0.50
School type			
Gymnasium‡	0.41	0.41	0.43
Other school type	0.58	0.49	0.49
Information missing	(0.01)	0.10	(0.09)
Performance of school child			
Grade 1 or 2	0.26	0.21	0.17
Grade 3 or worse	0.63	0.45	0.35
Information missing	0.11	0.34	0.47
Provision of learning material			
Digital (email, cloud)	–	0.95	–
Not digital	–	0.05	–
School support			
Learning material provided through several channels	–	0.71	–
Only one channel or none	–	0.29	–
In-person versus distance learning			
In-person learning all or part of the week	–	–	0.13
Distance learning at home	–	–	0.87
Sample size (unweighted)	1,433	723	305

Weighted statistics (using post-stratified survey weights on household level). Cells with fewer than 30 observations are given in parentheses. ‡Gymnasium: German upper secondary school providing university entrance qualifications. †Employment status of parents measured in 2019 since information for the lockdown was only available for one adult household member (the CATI respondent).

activities at home (or less). We chose the cut point of 2 h because the category "between 2 and 3 h" constitutes the weighted median (category) during the lockdown and "between 1 and 2 h" the weighted median (category) directly after the lockdown.[2] All descriptive analyses were carried out separately for 2019, the 2020 spring lockdown, and for the period shortly thereafter. For each of these time periods, we also conducted binary response analysis (probit regressions) to gain deeper insight into the impact of our study's focus variables on time use under the specific circumstances (i.e., lockdown or not).

All analyses were weighted using non-response-adjusted and post-stratified survey weights for the households in which the 2019 SOEP and SOEP-CoV respondents live. The weighting strategy used in the annual SOEP survey and the variables considered for related non-response adjustment as well as used for post-stratification are described in great detail in Siegers et al. (2020). The weighting procedure used the SOEP-CoV study is described in detail in Siegers et al. (2021). In the related non-response analyses, we paid particular attention to employment status, income, gender, number of persons in a household, household type, educational level, and migration background. For weighting the SOEP-CoV study, it is crucial to consider whether any adult household member was employed as an essential or frontline worker, as well as the COVID-19 incidence at the NUTS-3 regional level (on the day of the interview). Possible period effects in participation behavior were controlled by interaction terms with the different sample tranches. Post-stratification for the 2019 SOEP wave and the SOEP-CoV survey were based on distributions taken from the 2019 Microzensus for various regional and socio-economic characteristics, including age, gender, household size, citizenship, size of municipality, and federal state. In this study, the weights for the two SOEP-CoV samples (the lockdown sample, i.e., tranches 2–4, and the post-lockdown sample, i.e., tranches 5–9) were further post-stratified to correspond to the proportions of secondary school children in the two age groups "10–14" and "15–18" reported in official school statistics for the school year 2019/2020 (Statistisches Bundesamt, 2020). To assess whether the analytic samples used in this study (i.e., secondary school children in 2019, during the 2020 spring lockdown period, and in the period shortly after) represent random sub-samples of the SOEP and SOEP-CoV sample for which the survey weights were originally derived, we conducted a selectivity analysis. For each analytic sample, we estimated a logistic regression model in which the indicator for membership (or non-membership) in the respective sample was the dependent variable. For this, the entire 2019 SOEP wave formed the base sample for the 2019 sample of secondary school children, and the entire SOEP-CoV sample (all tranches 1–9) formed the base sample for the two 2020 samples. All of the household and individual characteristics described above were the covariates. We found that in all three samples, none of the covariates considered had a significant impact on membership

[2]We chose the median time during lockdown and directly thereafter as a compromise to cope with the issue that learning times before the pandemic and learning times during the pandemic are structurally different and cannot be compared one-to-one. In the period before the pandemic, students used the time for school-related activities at home almost exclusively for homework and re-learning the material taught at school. During lockdown periods, all school-related activities took place at home. Shortly thereafter, students were partly taught on site in the school, partly the schooling still took place at home.

probability in the analytic samples. Therefore, the survey weights derived for the 2019 wave of the SOEP and those derived for the SOEP-CoV sample also fit the analytic samples of this study.

We imputed missing values by using the multivariate imputation by chained equations (mice) algorithm by van Buuren and Groothuis-Oudshoorn (2011), applying classification and regression trees (CART) as the imputation routine. To improve the predictive power of the imputation routine, we used several auxiliary variables in addition to the focal variables of this study (such as the family members' migration background, family status, employment status of the CATI respondent in 2020, regional information, number of children in the household). As suggested by Kim et al. (2006), we entered survey weights into the corresponding imputation models as explanatory variables. We imputed $m = 20$ data sets with 20 iteration steps in the Gibbs sampler of mice. We checked the convergence and meaningfulness of the estimated imputation models by means of the associated mice diagnostics (e.g., trace plots).

We examined the robustness of our results by conducting robustness checks. To see whether besides parental education also the income situation of the household impacted on learning times, we included the monthly net household income in 2019 as an additional explanatory variable in our models (pre-pandemic mean 4450 EUR, SD 2070 EUR, during the 1st lockout mean 4533 EUR, SD 2135 EUR; post 1st lockout mean 4458 EUR, SD 2394 EUR).[3] We also investigated whether home office (48% during the pandemic, 45% directly thereafter) and the employment situation of the respondents in spring 2020 (during lockdown in spring 2020: 77% in full- or parttime, 15% non-employed, 8% other kind of employment; directly thereafter: 72% in full- or parttime, 17% non-employed, 10% other kind of employment) have an influence on students' learning times.

For statistical analysis, we used the software R (version x64 3.6.2). All source code for data preparation, descriptive analysis, and regression analysis is freely available at the GitHub link https://github.com/bieneSchwarze/TimeSpentOnSchoolActivitiesAtHomeDuringPandemic.

RESULTS

Descriptive Results

Table 2 shows the proportion of secondary school children who spent at least 2 h per day on school-related activities at home, according to time period (before the pandemic, during the spring 2020 lockdown, immediately after the lockdown). We find that this proportion increases from 9 to 68% during the lockdown in spring 2020. This means that 7.5 times more children fell into that category during than before the pandemic. In the period immediately after the lockdown in spring 2020, this proportion fell to 46%. We identified the observed increases as statistically significant. Corresponding tests were carried out using t-tests with $p < 0.05$.

Considering the highest parental education attainment in the household as a relevant dimension of educational inequality (see **Table 3**) as well, we see that in 2019, the proportion of secondary school children who spent at least 2 h per day on school-related activities at home ranged from 2% among children whose parents had low educational attainment to 8 and 10% for children whose parents had medium and high educational attainment, respectively.

This suggests that educational inequality (approximated by the amount of time spent on school-related activities at home) was more pronounced between the group of children whose parents had lower levels of education and those with medium or high levels of education than between the medium and high education groups. During school closures, we find no significant differences between the amount of time spent on schoolwork in relation to the higher of the two parents' educational attainment. This descriptive result supports our first hypothesis, positing an equalization during the first phase of school closures in Germany. For the period after the lockdown, however, we find that the pre-pandemic differences in home learning times between lower levels of parental education and medium or higher levels of parental education increased dramatically. Compared to children whose parents had a medium or higher level of education, the proportion of children with parents having low educational attainment who spent at least 2 h per day doing school-related activities at home dropped from 69% during the lockdown to 4% in the immediate post-lockdown period. This result supports our second hypothesis regarding an acceleration of educational inequalities due to the pandemic. **Figure 1** illustrates this alarming result.

Regression Results

Table 4 shows the average partial marginal effects from the weighted probit analysis. The model includes all of the aforementioned covariates, as well as the confounders "gender of child," "school type," "performance level," and "type of schooling" (in-person or distance) for the period after the

TABLE 2 | Proportion of children spending at least 2 h per day on school-related activities at home (95% confidence intervals in parentheses).

Time point	Proportion	95% confidence interval
In 2019	0.09	(0.07,0.12)
During 2020 spring lockdown	0.68	(0.62,0.75)
After 2020 spring lockdown	0.46	(0.36,0.57)

Weighted analysis. Confidence intervals have been derived by basic bootstrap.

TABLE 3 | Proportion of children spending at least 2 h per day on school-related activities at home, according to the highest educational attainment of the parents living in the household (95% confidence intervals in parentheses).

Time point	High education	Medium education	Low education
In 2019	0.08 (0.05,0.11)	0.10 (0.06,0,14)	0.02 (0.00,0,04)
During 2020 spring lockdown	0.70 (0.61,0.81)	0.66 (0.56,0.75)	0.69 (0.51,0.95)
After 2020 spring lockdown	0.49 (0.29,0.67)	0.53 (0.35,0.69)	0.04 (0.00,0.08)

Weighted analysis. Confidence intervals (given in parentheses) have been derived by basic bootstrap.

[3]SOEP data on net household income in 2020 are not yet available at the time of writing this article.

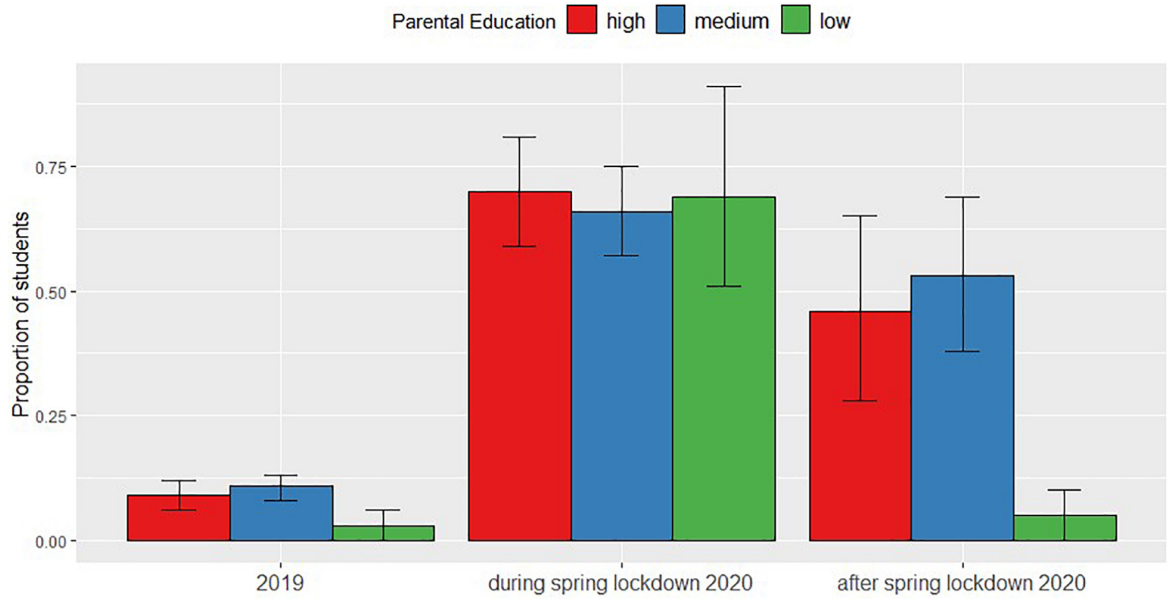

FIGURE 1 | Proportion of children spending more than 2 h per day on school-related activities at home, according to the higher of the parents' educational attainment. Vertical lines mark 95% confidence intervals. Weighted analysis. Confidence intervals have been derived by basic bootstrap.

2020 spring lockdown. These results confirm our descriptive results regarding the influence of parental education levels: During the lockdown, children spent similar amounts of time on schoolwork at home regardless of their parents' education, but after the lockdown period, in the group of children whose parents had a low level of education, the proportion of children who spent more than 2 h per day at home on schoolwork decreased dramatically and was 47% lower than that of children whose parents had a medium or high level of education (with all other covariates held constant). Both of these results support Hypotheses 1 and 2 (equalization during the first lockdown and inequality acceleration after the lockdown). We see that the use of digital channels for the provision of learning materials has a high impact on children's school-related activities during the spring 2020 lockdown: The proportion of children who spent at least 2 h per day on school-related activities at home was 39% higher in the group who received learning materials through digital channels than in the group who did not (holding all other covariates constant). This corroborates Hypothesis 3. We find support for Hypothesis 4 as well: The estimated model suggests that older students (aged 15–18) spent less time on school-related activities than younger students (aged 10–14) during the spring 2020 school closure period.

In addition, we find that it has a positive effect on children's learning time at home if their parents were engaged in another type of employment, such as vocational training or short-time work, during the school closure period. The proportion of children who spent more than 2 h per day on school-related activities at home is 25 per cent higher in this category than among children whose parents were employed full-time or part-time or were unemployed.

Not surprisingly, we see in our results that children who returned to in-person for all or part of the week after lockdown spent less time on school-related activities at home than children who only had distance learning. A nevertheless surprising result is the positive effect on learning time at home in the category "other school type than Gymnasium." Here, however, it must be taken into account that in most of Germany's federal states, the post-lockdown period fell exactly in the final examination period for the intermediate school-leaving certificate and the qualified lower secondary school-leaving certificate. This meant that these groups of students had to spend a great deal of additional time studying at home. The final examinations for the Gymnasium (i.e., the Abitur), on the other hand, had already been completed in most cases by this time. We therefore attribute the positive effect detected for other school types (than the Gymnasium) to the final examination period in these school types.

Including the monthly net household income in 2019 as additional variable into our regression analysis did not impact on the results. The related average marginal effect was zero for all three periods studied. Concerning home-office, we see a small but statistically insignificant effect on students' time use [during 1st lockdown AME = 0.09 with 95% CI (−0.02,0.20); after 1st lockdown AME = 0.09 with 95% CI (−0.09,0.27)]. We also studied whether our results change when including the employment situation of the respondents in spring 2020 instead of their household's employment situation in 2019. This exchange does not impact on our results [during the 1st lockdown: being not employed as compared to fulltime or parttime employment AME = −0.13 CI (−0.31, 0.06), other type of employment AME = 0.02 95% CI (−0.14,0.18); after the 1st lockdown: being not employed as compared to fulltime or parttime employment AME = −0.01 CI (−0.32,0.29), other type of employment

TABLE 4 | Average partial marginal effects from weighted probit regression.

	2019	14.4–24.5.2020	25.5.–28.6.2020
Highest parental level of education			
High (CASMIN 3a,3b)	(Reference category)		
Medium (CASMIN 1c,2a,2c)	0.01	0.03	0.06
Low (CASMIN 0,1a,1b,2b)	−0.07*	0.07	−0.47*
Employment status of parents in 2019[a]			
At least one parent works full-time or part-time	(Reference category)		
Neither of the parents employed	0.14*	−0.01	0.17
Other type of employment (e.g., short-time work)	0.07	0.25*	−0.01
Age of child			
10–14	(Reference category)		
15–18	0.04*	−0.11*	0.12
Gender of child			
Male	(Reference category)		
Female	0.07*	0.00	−0.01
School type			
Gymnasium[b]	(Reference category)		
Other school type	−0.01	−0.09	0.24*
Performance of child			
Grade 1 or 2	(Reference category)		
Grade 3 or worse	−0.02	−0.04	−0.03
Provision of learning materials			
Not digital	(Reference category)		
Digital (email, cloud)	–	0.39*	–
School support			
Only one channel or none	(Reference category)		
Learning materials provided through several channels	–	−0.04	–
In-person versus distance learning			
Remote learning at home only	(Reference category)		
In person learning all or part of the week	–	–	−0.31*
Pseudo-R^2 (McFadden)	0.07	0.05	0.15
Sample size	1,433	723	305

Outcome variable: indicator whether school children in secondary education learned at least 2 h per day at home for school.
*$p < 0.05$.
[a]*Gymnasium: German upper secondary school type providing university entrance qualifications.*
[b]*Employment status of parents measured in 2019 since information for the lockdown was only available for one adult household member (the CATI respondent).*

AME = 0.08 95% CI (−0.18, 0.34)]. In conclusion, our results are robust under the assumed model with respect to household's monthly net income, and the respondents' employment and home office situation in spring 2020.

CONCLUDING REMARKS

In summary, we found a mixed picture in our study regarding the impact of the spring 2020 school closures due to the COVID-19 pandemic on different groups of secondary school children. In the period of closures, we see a picture of equalization regarding time use on school-related activities at home between children with different parental educational backgrounds. During the closures in spring 2020, all groups, regardless of parental educational background, reduced their school-related learning activities, which at this point was the amount of time normally spent both in school and doing homework or engaging in additional learning activities at home. We find that the few small differences found in learning time can be explained mainly by the teachers or the policies of schools and by the parents' professional situation and how this affected their ability to work from home. This result is similar to the results of other studies in other countries (e.g., in the United Kingdom; Cullinane and Montacute, 2020; Pensiero et al., 2020). At this point, the pandemic thus had an equalizing effect. For the period immediately after the school closures in spring 2020, children whose parents had a low level of education reduced their learning activities at home substantially compared to children whose parents had medium or higher education. During the school closures, 70% of children spent an average of at least 2 h per day learning at home, regardless of their parents' education. After this period, this proportion dropped to 4% for children with low-educated parents compared to 53 and 49% for children with medium or highly educated parents. We thus observe an acceleration of inequalities between children of parents with low education and children of parents with medium or high education for the period directly after the closures.

This alarming result undoubtedly has direct policy implications regarding the need to expand support systems for children who are severely affected by educational inequalities. It also raises concerns about the probable massive impact of the second period of school closures in late 2020 and early 2021. If this process of widening learning time gaps continues, the long-term impact on educational inequality could be substantial, if not irreversible. The data we use in our study are not without problems. In particular, we cannot rule out the possibility of measurement error in our dependent variable (students' time use). Different response behavior among different groups of children (in 2019) or parents (in 2020) could have caused such measurement error–a possible problem that we cannot check with the data at hand. However, the respondents in the study are panelists (in the SOEP) who are used to self-reporting time use in different contexts. This circumstance should at least counteract a possible measurement error.

There are several important questions that we cannot answer with our data. First, we cannot analyze the medium- or long-term effects of differences in learning activities at home on competence development. In fact, only a very few preliminary scenario-based studies on this topic exist at all (Kaffenberger, 2021). The reasons clearly lie in the lack of data that can provide information about future developments. For Germany, data from the National Education Panel in particular offer potential for this type of analysis.

Second, the question remains unanswered how long parents, children, and teachers can compensate for the lack of in-person learning, and what the individual and social consequences will be. In this context, digital teaching can also only be seen as a compensatory measure and not as a solution that should be extended at the current scale into the future. The lack of face-to-face interaction between child and teacher is detrimental

first and foremost to children's psychosocial development (e.g., Haleemunnissa et al., 2021) and is certainly also not conducive to teachers' well-being and work (e.g., Klapproth et al., 2020; Collie, 2021). While there are preliminary results on the impact of parents' working conditions during the pandemic on parenting behavior mediated by parental stress (Chung et al., 2020), it is not clear precisely how work-family arrangements and the need to supervise children's school activities actually affect children's distance learning at home. Aznar et al. (2021) provide first results on this question for the United Kingdom, and Verweij et al. (2021) for a rather small sample of parents in the Netherlands; however, both studies use non-random samples and therefore do not provide generalizable results. Finally, we do not have enough information in our data about schools and the differences in school policies during and after the school closures in spring 2020 to shed light on school-related effects in our model. This data gap is further complicated by the fact that there were a variety of different strategies used by schools and teachers to deal with the new situation at that time, which are difficult to categorize and thus quantify in a (regression) model. There is high evidence that the fact that we do not see an increase in inequality during the lockdown and the period of distance learning can be explained on the one hand by the equalization scenario (collective event, with an equally high degree of uncertainty for all). On the other hand, we assume that the differences in students' learning times during the first closure were not significantly caused by the parents' home or student-specific characteristics, but by the school's actions and the teachers' behavior. The different levels of digitalization in the schools probably play a role here, as does the high degree of autonomy of the teachers with regard to planning distance learning.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: The data have been collected as part of a third-funded project. Data usage is therefore restricted. The data will be made available for the scientific community in 2022 with the usual release of the SOEP (German Socio-Economic Panel) annual waves. Requests to access these datasets should be directed to www.diw.de/en/diw_02.c.222516.en/data.html.

AUTHOR CONTRIBUTIONS

SZ contributed 60% to this work. MB contributed 40% to this work. Both authors contributed to the article and approved the submitted version.

FUNDING

SZ acknowledges funding by the German Research Foundation for the project "The consequences of SARS-CoV-2 for societal inequalities" (reference numbers: HO 7021/1-1, RA 889/11-1, SCHR 1498/7-1, and ZI 1535/1-1). Open access funding was provided by Leibniz Institute for Educational Trajectories (LIfBi).

ACKNOWLEDGMENTS

We would like to thank all (other) members of the SOEP-CoV project team: Simon Kühne, Stefan Liebig, Theresa Entringer, Jan Goebel, Markus M. Grabka, Daniel Graeber, Hannes Kröger, Martin Kroh, Johannes Seebauer, Carsten Schröder, and Jürgen Schupp. We thank to Florian Griese for managing the questionnaire design, to the weighting team Rainer Siegers and Hans Walter Steinhauer, and to Gert G. Wagner for his valuable comments on the SOEP-CoV project. For language editing, we are grateful to Deborah Anne Bowen. A previous version of the manuscript is also published as a working paper in the SOEP working paper series (https://www.diw.de/en/diw_01.c.620272.en/publications/soep_survey_papers.html).

REFERENCES

Agostinelli, F., Doepke, M., Sorrenti, G., and Zilibotti, F. (2020). *When the Great Equalizer Shuts Down: Schools, Peers, and Parents in Pandemic Times*. Cambridge, MA: National Bureau of Economic Research.

Alexander, K. L., Entwistle, D. R., and Olson, L. S. (2007). Lasting Consequences of the Summer Learning Gap. *Am. Sociol. Rev.* 72, 167–180. doi: 10.1177/000312240707200202

Andrew, A., Cattan, S., Costa-Dias, M., Farquharson, C., Kraftman, L., Krutikova, S., et al. (2020). Inequalities in Children's Experiences of Home Learning during the COVID-19 Lockdown in England. *Fiscal Stud.* 41, 653–683. doi: 10.1111/1475-5890.12240

Aznar, A., Sowden, P., Bayless, S., Ross, K., Warhurst, A., and Pachi, D. (2021). Home-schooling during COVID-19 lockdown: Effects of coping style, home space, and everyday creativity on stress and home-schooling outcomes. [Preprints]. doi: 10.31234/osf.io/dzh8m

Becker, G. S. (1981). *A Treatise on the Family*. Cambridge, MA: Harvard University Press.

Blundell, R., Costa Dias, M., Joyce, R., and Xu, X. (2020). COVID-19 and Inequalities. *Fiscal Stud.* 41, 291–319.

Bourdieu, P. (1984). *Distinction. A Social Critique of the Judgement of Taste*. Cambridge, MA: Harvard University Press.

Chung, G., Lanier, P., and Wong, P. Y. J. (2020). Mediating Effects of Parental Stress on Harsh Parenting and Parent-Child Relationship during Coronavirus (COVID-19) Pandemic in Singapore. *J. Family Viol.* 2020, 200–201. doi: 10.1007/s10896-020-00200-1

Collie, R. (2021). COVID-19 and Teachers' Somatic Burden, Stress, and Emotional Exhaustion: Examining the Role of Principal Leadership and Workplace Buoyancy. *AERA Open* 7, 1–15. doi: 10.1080/10615806.2021.1903447

Cooper, H., Nye, B., Charlton, K., Lindsay, J., and Greathouse, S. (1996). The Effects of Summer Vacation on Achievement Test Scores: A Narrative and Meta-Analytic Review. *Rev. Educat. Res.* 66, 227–268. doi: 10.3102/00346543066003227

Cullinane, C., and Montacute, R. (2020). *COVID-19 and social mobility impact brief #1: School Shutdown*. London: The Sutton Trust.

Ditton, H., Bayer, M., and Wohlkinger, F. (2019). Structural and motivational mechanisms of academic achievement: a mediation model of social-background effects on academic achievement. *Br. J. Sociol.* 70, 1276–1296. doi: 10.1111/1468-4446.12506

Grewenig, E., Lergetporer, P., Werner, K., Woesmann, L., and Zierow, L. (2020). "COVID-19 and Educational Inequality: How School Closures Affect Low- and High-Achieving Students," in *CRC TRR 190, Discussion Paper No. 260*, (London: CRC TRR).

Haeck, C., and Lefebvre, P. (2020). *Pandemic school closures may increase inequality in test scores*. London: Canadian Public Policy.

Haleemunnissa, S., Didel, S., Swami, M. K., Singh, K., and Vyas, V. (2021). Children and COVID19: Understanding impact on the growth trajectory of an evolving generation. *Childr. Youth Serv. Rev.* 120:105754. doi: 10.1016/j.childyouth.2020.105754

Huebener, M., Spieß, C. K., and Zinn, S. (2020). *SchülerInnen in Corona-Zeiten: Teils deutliche Unterschiede im Zugang zu Lernmaterial nach Schultypen und -trägern [Students in time of Corona: Partly marked differences in access to learning materials among different school types and school authorities]. DIW Wochenbericht No. 47*. Berlin: DIW.

Jæger, M. M., and Blaabæk, E. H. (2020). Inequality in learning opportunities during Covid-19: Evidence from library takeout. *Res. Soc. Stratificat. Mobil.* 68, 1–5. doi: 10.1016/j.rssm.2020.100524

Kaffenberger, M. (2021). Modelling the long-run learning impact of the Covid-19 learning shock: Actions to (more than) mitigate loss. *Int. J. Educat. Dev.* 81, 1–8. doi: 10.1016/j.ijedudev.2020.102326

Kim, J. K., Michael Brick, J., Fuller, W. A., and Kalton, G. (2006). On the bias of the multiple-imputation variance estimator in survey sampling. *J. R. Statist. Soc. Ser. B* 68, 509–521. doi: 10.1111/j.1467-9868.2006.00546.x

Klapproth, F., Federkeil, L., Heische, F., and Jungmann, T. (2020). Teachers' experiences of stress and their coping strategies during COVID-19 induced distance teaching. *J. Pedagogical Res.* 4, 444–452. doi: 10.33902/jpr.2020062805

Klemm, K., Hoffmann, L., Maaz, K., and Stanat, P. (2018). *Privatschulen in Deutschland [Private schools in Germany]*. Berlin: Friedrich-Ebert-Stiftung.

Kühne, S., Kroh, M., Liebig, S., and Zinn, S. (2020). The need for household panel surveys in times of crisis: The case of SOEP-CoV. *Survey Res. Methods* 14, 195–203. doi: 10.18148/srm/2020.v14i2.7748

Lareau, A. (2000). *Home Advantage. Social Class and Parental Intervention in Elementary Education*. Lanham: Rowan & Littlefield.

Lee, J.-S., and Bowen, N. K. (2006). Parent Involvement, Cultural Capital, and the Achievement Gap Among Elementary School Children. *Am. Educat. Res. J.* 43, 193–218. doi: 10.3102/00028312043002193

Lundborg, P., Nilsson, A., and Rooth, D.-O. (2014). Parental Education and Offspring Outcomes: Evidence from the Swedish Compulsory School Reform. *Am. Econom. J. Appl. Econom.* 6, 253–278. doi: 10.1257/app.6.1.253

Möhring, K., Naumann, E., Reifenscheid, M., Blom, A. G., Wenz, A., Rettig, T., et al. (2020). *Die Mannheimer Corona-Studie: Schwerpunktbericht zur Erwerbstätigkeit in Deutschland. [Mannheimer Corona Study: Focus report on employment in Germany]*. Available online at: https://www.uni-mannheim.de/media/Einrichtungen/gip/Corona_Studie/2020-04-16_Schwerpunktbericht_Erwerbstaetigkeit.pdf

O'Sullivan, R. H., Chen, Y. C., and Fish, M. C. (2014). Parental Mathematics Homework Involvement of Low-Income Families with Middle School Students. *School Commun. J.* 24, 165–188.

Pensiero, N., Kelly, A., and Bokhove, C. (2020). *Learning inequalities during the Covid-19 pandemic: how families cope with home-schooling*. Southampton: University of Southampton research, doi: 10.5258/SOTON/P0025

Reimer, D., Smith, E., Andersen, I. G., and Sortkær, B. (2021). What happens when schools shut down? Investigating inequality in students' reading behavior during Covid-19 in Denmark. *Res. Soc. Stratificat. Mobil.* 71, 1–5. doi: 10.1016/j.rssm.2020.100568

Sari, E., Bittmann, F., and Homuth, C. (2021). Explaining Inequalities of Homeschooling in Germany during the first COVID-19 Lockdown. *SocArXiv* [Preprint]. doi: 10.31235/osf.io/vsdq4

Seydlitz, R. (1991). The effects of age and gender on parental control and delinquency. *Youth Soc.* 23, 175–201. doi: 10.1177/0044118x91023002002

Siegers, R., Belcheva, V., and Silbermann, T. (2020). "SOEP-Core v35 Documentation of Sample Sizes and Panel Attrition in the German Socio-Economic Panel (SOEP) (1984 until 2018)," in *SOEP Survey Papers 826*, (Berlin: DIW/SOEP).

Siegers, R., Steinhauer, H. W., and Zinn, S. (2021). *Weighting the SOEP-CoV study 2020. SOEP Survey Papers 989: SOEP Survey Papers : Series C - Data Documentations*. Berlin: DIW/SOEP.

Statistisches Bundesamt (2020). *Fachserie 11 Reihe 1: Bildung und Kultur: Allgemeinbildende Schulen: Schuljahr 2019/20. [Education and culture: General education schools: school year 2019/20]*. Wiesbaden: Statistisches Bundesamt.

United Nations (2020). *Policy Brief: Education during COVID-19 and beyond*. New York, NY: United Nations.

van Buuren, S., and Groothuis-Oudshoorn, K. (2011). mice: multivariate imputation by chained equations in R. *J. Statist. Softw.* 45, 1–67. doi: 10.18637/jss.v045.i03

Verweij, R., Helmerhorst, K., and Keizer, R. (2021). Work-to-family conflict, family-to-work conflict and their relation to perceived parenting and parent-child relationship before and during the Covid-19 lockdown. [Preprints]. doi: 10.31219/osf.io/cfn84

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 17 August 2021
doi: 10.3389/fpsyg.2021.702163

Adaptability and High School Students' Online Learning During COVID-19: A Job Demands-Resources Perspective

Andrew J. Martin, Rebecca J. Collie and Robin P. Nagy*

School of Education, University of New South Wales, Sydney, NSW, Australia

The present study investigated the role of adaptability in helping high school students navigate their online learning during a period of COVID-19 that entailed fully or partially remote online learning. Drawing on Job Demands-Resources theory and data from a sample of 1,548 Australian high school students in nine schools, we examined the role of adaptability in predicting students' online learning self-efficacy in mathematics and their end of year mathematics achievement. It was found that beyond the effects of online learning demands, online and parental learning support, and background attributes, adaptability was significantly associated with higher levels of online learning self-efficacy and with gains in later achievement; online learning self-efficacy was also significantly associated with gains in achievement—and significantly mediated the relationship between adaptability and achievement. These findings confirm the role of adaptability as an important personal resource that can help students in their online learning, including through periods of remote instruction, such as during COVID-19.

Keywords: adaptability, job demands-resources, online learning, remote instruction, COVID-19, achievement

OPEN ACCESS

Edited by:
Sina Fackler,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Fotini Polychroni,
National and Kapodistrian University of Athens, Greece
Hongbiao Yin,
The Chinese University of Hong Kong, China

****Correspondence:***
Andrew J. Martin
andrew.martin@unsw.edu.au

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *29 April 2021*
Accepted: *05 July 2021*
Published: *17 August 2021*

Citation:
Martin AJ, Collie RJ and Nagy RP (2021) Adaptability and High School Students' Online Learning During COVID-19: A Job Demands-Resources Perspective. Front. Psychol. 12:702163. doi: 10.3389/fpsyg.2021.702163

INTRODUCTION

The COVID-19 pandemic led to an unexpected and rapid shift to remote learning for students around the world. In the space of a few weeks, the very nature of learning and instruction was transformed (Australian Academy of Science, 2020). Learning and instruction moved to remote online modes at speed and scale. The extent to which students have successfully responded and adjusted to these disruptions has been key to how they have coped academically (Australian Academy of Science, 2020). This being the case, *adaptability* may be a personal attribute that is highly relevant through times of online remote learning and instruction, such as during COVID-19 and any other future periods of disrupted learning.

Adaptability is the capacity to regulate one's behaviors, thoughts, and feelings in response to novel, variable, uncertain, and unexpected situations and circumstances (Martin et al., 2012, 2013). Adaptability has been identified as an important capacity for students' academic and personal development, including their motivation, engagement, achievement, and social-emotional wellbeing (Martin et al., 2013; Holliman et al., 2018, 2019, 2021). Given adaptability

is specifically aimed at successfully navigating change, uncertainty, and novelty, it is also likely a vital personal attribute to support students during periods of novelty, variability, and uncertainty, such as with COVID-19 restrictions and lockdowns, including periods of online learning through these times. To the extent that adaptability is associated with positive educational processes and outcomes during online learning, it may be an important area of focus for educational interventions.

The aim of this research was to expand current knowledge of adaptability by focusing on its role in students' academic development and online learning during a period of COVID-19 that entailed fully or partially remote online learning. Drawing on Job Demands-Resources theory (JD-R theory; Bakker and Demerouti, 2017, 2018) and focusing on learning and instruction in mathematics, we examined the role of adaptability in predicting students' online learning self-efficacy and their end of year achievement. We were particularly interested in the extent to which adaptability (a personal resource) played a role in students' online learning self-efficacy and achievement beyond the effects of any online learning demands, online and parental learning support, and background attributes. **Figure 1** demonstrates the hypothesized model under examination.

THEORETICAL BACKGROUND AND LITERATURE REVIEW

Adaptability

As described above, adaptability is the capacity to adjust behaviors, thoughts, and feelings in response to novel, variable, uncertain, and unexpected situations and circumstances (Martin et al., 2012, 2013). It is thus a tripartite perspective composed of behavioral, cognitive, and emotional dimensions (Martin et al., 2012, 2013). Research among school students has demonstrated links between adaptability and students' engagement and achievement (Martin et al., 2012, 2013; Collie et al., 2017), identified the role of adaptability in young people's responses to climate change (Liem and Martin, 2015), demonstrated the role of adaptability in reducing students' failure dynamics (Martin et al., 2015), shown links with university students' engagement and longer-term achievement (Holliman et al., 2018), and validated adaptability across diverse international contexts (Martin et al., 2017). There is, then, a strong evidence base for the role of adaptability in students' positive development. The present study is an opportunity to expand on this by investigating the role of adaptability in assisting students' online learning experiences and outcomes during a period of substantial

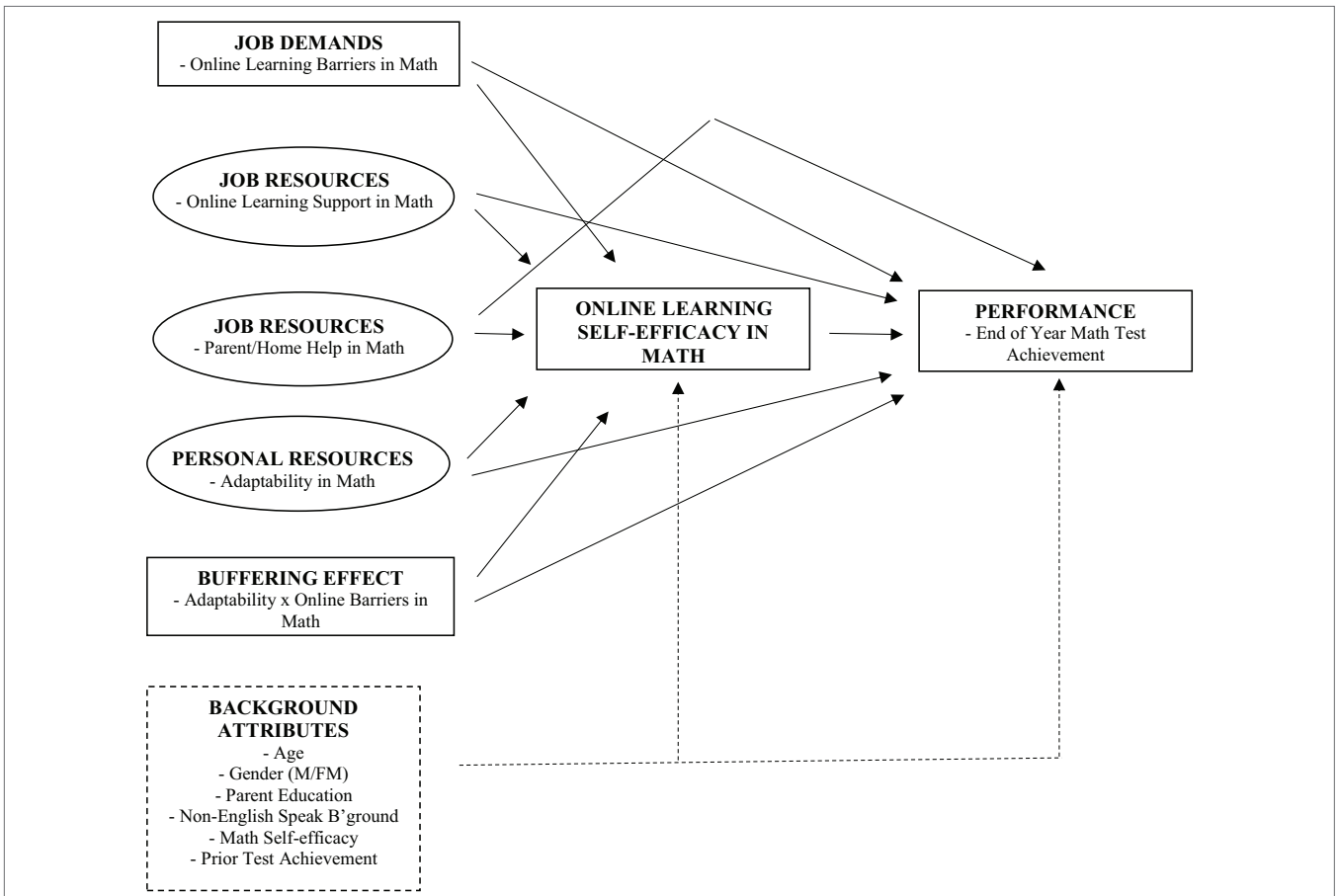

FIGURE 1 | Hypothesized JD-R process in online mathematics.

novelty, variability, and uncertainty—specifically, online learning during the COVID-19 pandemic. Given there is likely to be substantial novelty, variability, and uncertainty ahead due to the evolving nature of the pandemic (Australian Academy of Science, 2020), it is important to identify modifiable psycho-behavioral attributes that may assist students through this and through future periods of disrupted learning. The present study focuses on adaptability as one such attribute.

Online Learning and Instruction

Online learning encompasses the use of desktop computers, laptops, tablets, virtual reality devices, mobile phones, personal digital assistants, and more (Sung et al., 2017). Online learning methods traverse staged programs of instruction, animation, gaming, simulations, video instruction, collaborative documents, chatrooms, etc. There are also many content and learning management systems (e.g., Canvas, Moodle, and Blackboard) that facilitate online learning. Online learning activity predominantly comprises synchronous instruction that is in real-time (such as live video interaction) and asynchronous instruction that may be pre-recorded or a standalone self-paced online program (Thalheimer, 2017).

When appraising the effectiveness of online learning, there is a mixed evidence base. On the positive side, there is meta-analytic evidence demonstrating the effectiveness of various online learning approaches, yielding generally small to moderate effect sizes (Yuwono and Sujono, 2018). There is also meta-analytic evidence that mobile-computer-supported learning can enhance collaborative learning (Sung et al., 2017). On the negative side, there is research suggesting that online learning approaches are not as effective as real-time in-class learning. For example, Clinton (2019); see also Delgado et al. (2018) found that students reading material in paper-based form showed greater comprehension than students reading the same material in digital form. Findings from PISA 2012 (Peña-López, 2015) found that students who used computers very frequently at school performed more poorly than students with other levels of computer use. Moreover, it seems that many teachers are not highly trained in harnessing technology to help students learn (Peña-López, 2015). There is also a line of research demonstrating generally null or minimal effects when comparing online and in-class modes. In an online coaching program for teachers, there were no significant effects for student achievement (Kraft and Hill, 2020). In a study of online distance education, Cavanaugh et al. (2004) found comparable student achievement across online and in-class instructional modes.

One reason why there are such mixed findings is because there are many factors that are implicated in the success of online modes. Factors related to technology access, technology skills, instructional and resource quality, parent/home support, ethnicity, socioeconomic status, and learning support needs have all been identified as influencing the extent to which online learning is effective or not (AITSL, 2020; Australian Academy of Science, 2020). Importantly, however, given the substantial novelty, variability, and uncertainty associated with online learning during COVID-19, it is also likely that various personal psychological attributes have potential to assist students' learning during this time and in future periods of disrupted learning. Adaptability is hypothesized as one such factor and is the focus of our investigation into online learning experiences during a period of COVID-19 in Australia when students were variously engaged in fully or partially remote online learning.

Job Demands-Resources Theory

We draw on JD-R as a means to explore and understand the role of adaptability in students' online learning experiences during COVID-19. Before doing so, we summarize JD-R as traditionally formulated in workplace research. Then, we extrapolate from this to explore its relevance to students' online learning and to frame the present study.

Job Demands-Resources Theory in the Workplace

Job Demands-Resources theory holds that there are specific contextual factors in jobs and work roles that help or hinder employees' outcomes (Schaufeli and Bakker, 2004). Job demands are aspects of work that require psychological or physical exertion (e.g., performing under a heavy workload and addressing mounting deadlines) and that are linked with psychological or physical costs (e.g., poor mental and physical health aspects of burnout; Bakker and Demerouti, 2017; Collie et al., 2020a). Job resources are aspects of work that help employees attain desired work-related goals and growth (e.g., peer support; Demerouti et al., 2001) and are linked with positive outcomes (e.g., motivation and health; Skaalvik and Skaalvik, 2018).

In recent years, JD-R theory has recognized that there are also personal resources that determine employees' work-related functioning (Xanthopoulou et al., 2007; Collie et al., 2020a). Personal resources are modifiable, personal capacities that reflect an individual's potential to influence their working environment; similar to job resources, personal resources are linked with positive outcomes (Schaufeli and Taris, 2014). Collie et al. (2020a); see also Granziera et al. (2021) proposed that adaptability can be considered a personal resource, as it is a modifiable capacity that can help an individual navigate change in the workplace and effect positive outcomes.

In addition to these "main effects" of demands and resources, there is also a buffering possibility suggested by JD-R theory (Bakker and Demerouti, 2017)—and adaptability may be an important part of this. For example, Granziera et al. (2021) proposed that adaptability may buffer the negative effects of job demands such that employees high in adaptability are less likely to experience the negative effects of job demands. Granziera et al. (2021) demonstrated support for this by showing that adaptability offset the negative effect of role conflict on emotional exhaustion in teachers (see also Dicke et al., 2018).

Alongside the need to consider potential buffering effects, we also draw attention to more recent refinements of JD-R theory that speak to how demands and resources may be perceived differently by individuals: A given job demand or job resource may be perceived in different ways by different

people—not all individuals perceive a demand as a hindrance and not all individuals perceive a resource as a help (Bakker and Demerouti, 2017; Yin et al., 2018). This may be the case for numerous reasons, such as the level of control individuals have in their role, the prestige of their role, the extent to which the demand benefits them, etc. (Bakker and Demerouti, 2017). This being the case, we remain open to the possibility that demands and/or resources may have apparently counter-intuitive effects.

JD-R and Learning and Instruction

Although JD-R is centered on workplace processes, it is evident the same factors and processes implicated in workplace functioning are implicated in students' learning. There are specific contextual factors in academic learning that help or hinder students' educational outcomes (Martin and Marsh, 2009). This being the case, job demands in the educational setting refer to aspects of learning that require psychological or physical exertion (e.g., performing under a heavy study load and meeting multiple due dates) and are linked with psychological or physical costs (e.g., stress, dropout, and underachievement). Correspondingly, job resources in the educational setting are aspects of learning that help students attain desired academic goals and growth (e.g., teacher/instructional support) and are linked with positive outcomes (e.g., engagement and achievement). In relation to personal resources, in line with Collie et al. (2020a), adaptability can be considered a modifiable capacity that can help students navigate change and effect positive learning outcomes. Indeed, there may also be a buffering role for adaptability in the learning context such that adaptable students may be less likely to experience the negative effects of job demands.

Thus, although JD-R theory is a well-established approach for understanding employees' workplace functioning (Bakker and Demerouti, 2017), we propose it can also be applied to learning and instruction. Moreover, although there is substantial research harnessing JD-R to investigate teachers' workplace experiences (e.g., Collie et al., 2020a; Granziera et al., 2021), there is significant scope for investigating the same dynamics among school students.

Demands and Resources in the Present Study

In addition to our focus on *adaptability* (as a personal resource), our study comprised one job demand and two job resources. The job demand, *online learning barriers*, refers to the challenges that students experience when learning online at home. It is well documented that factors, such as unreliable internet, difficulties accessing appropriate computing and technology, and distracting home environments, present barriers to students' online learning (Peña-López, 2015; Australian Academy of Science, 2020). In relation to job resources, *online learning support* refers to the quality of the online learning resources and learning opportunities made available to students by their schools (Yukselturk and Bulut, 2007; Means et al., 2009; Escueta et al., 2017; Gregori et al., 2018; AITSL, 2020). The other job resource is *parent/home help*, which refers to the extent to which parents provide help with schoolwork and the necessary routines and resources are available at home to assist learning (Galpin and Taylor, 2018).

Although we hypothesize that online learning barriers (job demand) will yield negative effects and that online learning support and parent/home help (job resources) will yield positive effects, we are open to the possibility that this may not be so—in keeping with recent developments in JD-R theory stating that there is variability between individuals in how they perceive demands and resources (Bakker and Demerouti, 2017; Yin et al., 2018; Han et al., 2020). Indeed, recent research by Martin et al. (2021) showed that students in high school science perceive and experience a difficult task in different ways, some seeing it as a challenge and some seeing it as a threat. In the case of the present study we might ask, at what point does parent/home help move from being supportive (yielding a positive motivational effect) to being controlling (yielding a negative motivational effect; Neubauer et al., 2020)?

In terms of JD-R's contended *buffering* effect, we can model the interaction between adaptability and online learning barriers to ascertain the extent to which adaptability may moderate the negative effects of job demands (Collie et al., 2020a; Granziera et al., 2021). These factors are all demonstrated in **Figure 1** as key predictors of student outcomes that take the forms of online learning self-efficacy and end of year test achievement—links now discussed.

Linking the Resources and Demands With Online Learning Self-Efficacy

Collie et al. (2020a) argued that the nature of individuals' demands and resources impacts their domain-specific efficacy, which in turn impacts important outcomes, such as performance. *Online learning self-efficacy* refers to students' perceived and experienced competence in online learning. A large body of research has demonstrated the importance of perceived efficacy for a range of outcomes, including performance (e.g., Bandura, 1997; Martin, 2007, 2009; Klassen and Chiu, 2010; Marsh and Martin, 2011). In JD-R models, the positioning of efficacy can differ, with some models placing it as a personal resource alongside job demands and resources (e.g., Xanthopoulou et al., 2007), while others having efficacy predicted by demands and resources—but notably still referring to it as a personal resource (Collie et al., 2020a). We adopt the latter position because (in line with Collie et al., 2020a) we wanted to focus on what demands and resources lay a foundation for online learning self-efficacy given it is a desirable outcome in itself (as well as being a means to desirable ends, such as achievement; Collie et al., 2020a). Indeed, other researchers have also identified perceived efficacy as an outcome of job demands, job resources, and other personal resources (e.g., Chang, 2013).

Of particular interest in our research is the role of adaptability in predicting online learning self-efficacy. According to Collie et al. (2020a); see also Collie and Martin (2016), adaptability fosters mastery and efficacy experiences—and their research among teachers demonstrated precisely this. Accordingly, we hypothesize that adaptability during times of such

uncertainty, variability, and novelty (viz. online learning during COVID-19) will be associated with higher levels of online learning self-efficacy. In addition to this, we suggest that the presence of online learning barriers (job demands) will lead to lower online learning self-efficacy, whereas job resources in the forms of online learning support and parent/home help will be associated with higher online learning self-efficacy.

Achievement as an Outcome of Online Learning Self-Efficacy

In most JD-R models, workplace outcomes reflected in diverse forms of performance (e.g., retention and achievement) are the final part of the process (though, the process is cyclical over time; Collie et al., 2020a). Extrapolating to learning and instruction processes under a JD-R framework, academic achievement is contended as an analogous performance outcome (see **Figure 1**). Thus, the final part of the process examined in our hypothesized model considers the association between online learning self-efficacy and subsequent achievement. This component is also supported by conceptualizing from social cognitive theory (Bandura, 1997) and supported by a long line of empirical research in education (Martin, 2007, 2009; Lee et al., 2014; Schunk and DiBenedetto, 2014). We therefore hypothesize a positive link between online learning self-efficacy and achievement. Moreover, given our focus on adaptability as a predictor of online learning self-efficacy, we also explore the indirect association between adaptability and achievement *via* online learning self-efficacy.

Mathematics: The Subject Area for This Investigation

For several reasons, mathematics was our focus for this investigation. There is evidence of declining achievement and participation in high school mathematics in Australia (e.g., Thomson et al., 2016; OECD, 2018). There are also concerns that first-year university STEM students are not sufficiently prepared for the level of mathematics skill required at the tertiary level (Nicholas et al., 2015). It is also the case that students can struggle with online formats in mathematics. For example, when assessing online and paper-based tests, Backes and Cowan (2019) found paper-based tests yielded higher mathematics results than online tests. Hassler Hallstedt et al. (2018) found that engaging with a mathematics program on a tablet yielded a small positive effect size for basic arithmetic, but not for arithmetic transfer and problem solving; they also found the positive effects faded over the course of 6 to 12 months. Notwithstanding this, other research has found more positive evidence for online mathematics learning (e.g., Sung et al., 2017). Taken together, mathematics is an area of national priority and one for which there is mixed evidence for effective instruction in online modes. It is, thus, a potentially illuminating focus for research investigating factors that may assist students' online learning experiences.

The Role of Salient Background Attributes

In assessing the unique effects of demands and resources, it is important to account for the following background attributes (covariates) that are known to be associated with one or more of this study's substantive variables: age, gender, language background, parent education, mathematics self-efficacy, and prior mathematics achievement. Older students seem to achieve more highly in technology-assisted learning (Escueta et al., 2017; Sung et al., 2017). Girls tend to score higher in the self-regulatory attributes (Martin, 2007) important for self-directed/autonomous remote online learning (Kirschner and De Bruyckere, 2017). Ethnicity has been found to moderate the effects of online learning on achievement (Nguyen, 2015). In periods of remote learning during COVID-19, parents have struggled with the motivational and learning demands placed on them (Garbe et al., 2020) and unfamiliarity with these processes may be greater for parents with fewer years of education themselves. Online learning self-efficacy and achievement in mathematics are likely to be associated with self-efficacy in mathematics more generally (not just in its online aspects) and also with prior mathematics achievement (e.g., Hattie, 2009).

AIMS OF THE PRESENT STUDY

Drawing on JD-R theory and set during a period of COVID-19 entailing fully or partially remote online learning, this research investigated the role of adaptability in high school students' online learning self-efficacy in mathematics and their end of year mathematics achievement. Following our review of theory and prior research, we pose numerous hypotheses and a research question. Hypothesis 1: beyond the effects of online learning demands, online and parental learning support, and background attributes, adaptability will be positively associated with students' online learning self-efficacy and gains in end of year achievement. Hypothesis 2: beyond the effects of adaptability, online learning demands, online and parental learning support, and background attributes, online learning self-efficacy will be positively associated with gains in end of year achievement. Hypothesis 3: online learning self-efficacy will significantly mediate the relationship between adaptability and gains in end of year achievement. Research Question 1: what is the role of adaptability in buffering the potentially negative effects of online learning barriers.

MATERIALS AND METHODS

Participants

The sample comprised 1,548 Australian high school students from nine schools. All schools were in the independent school sector and located in or around major urban areas of the state of New South Wales (NSW) on the east coast of Australia. Of the nine schools, four were co-educational, two were single-sex boys' schools, and three were single-sex girls' schools. Just over half (53%) of students were boys.

Students were in Year 7 (21%), Year 8 (34%), Year 9 (17%), and Year 10 (28%)—the first 4 years of high school in Australia. The average age was 13.77 years (*SD* = 1.16 years). Fourteen percent of students spoke a language other than English at home. Students tended to be from educated backgrounds, with parents/carers scoring 5.19 (*SD* = 1.77) on a scale of 1 (no formal education) to 6 (university education).

Procedure

The lead researcher's university provided human ethics approval. School principals then provided approval for their school's participation. Subsequently, parents/carers and participating students provided consent. An online survey and mathematics test were administered during school hours in the second term (of four school terms) of 2020. As described in the introduction, this was during a period of COVID-19 that entailed fully or partially remote online learning. The end of year online mathematics test was administered in the final term of 2020 when all students had returned to school for in-class lessons. Students were asked to complete the survey and tests on their own.

Materials

Our substantive factors included job demands, job resources, personal resources, online learning self-efficacy, and performance. Descriptive, reliability, and factor analytic statistics are presented in **Table 1**. We also assessed background attributes as covariates, comprising age, gender, parent education, and language background.

TABLE 1 | Descriptive and measurement statistics.

	Possible range	*M*	*SD*	Reliability (omega)	CFA loading *M*
Online learning barriers (job demands)	0–3	0.217	0.476	–	–
Online learning support (job resources)	1–5	3.711	0.708	0.795	0.659
Parent/ home help (job resources)	1–5	2.678	0.856	0.751	0.612
Adaptability (personal resources)	1–7	5.471	1.054	0.800	0.749
Online learning self-efficacy	1–4	2.888	0.910	0.700†	0.837
End of year test achievement	0–10	5.745	1.948	–	–

All measures are in relation to mathematics; M, mean; SD, standard deviation; CFA, confirmatory factor analysis; dash, formative score/single-item indicator.†reliability estimated for this single item indicator and used to generate error-adjusted score.

Job Demands, Resources, and Outcomes

JD-R factors comprised job demands (online learning barriers), job resources (online learning support, parent/home help), personal resources (adaptability), a buffering factor (online demands x adaptability), efficacy (online learning self-efficacy), and performance (end of year achievement test)—all in relation to mathematics. Descriptive and measurement statistics are shown in **Table 1**. *Online learning barriers* were a formative sum (from 0 to 3) representing the accumulation of barriers to students' online learning at home, including unreliable Internet, inadequate computing/technology, and little/no access to a quality area for concentration. *Online learning support* comprised five items asking students about the quality of support/resourcing for their online learning (e.g., "How satisfied are you with your online learning platform for mathematics?"), rated on a scale from 1 (very dissatisfied) to 5 (very satisfied). Because the nature of online learning elements (e.g., online learning platforms, such as learning management systems) can be quite variable (Tinmaz and Lee, 2020)—e.g., qualitative responses in the present study revealed more than 20 online learning platforms were used—a given online learning element may not necessarily be a resource per se. Thus, to better ensure we were assessing it as a resource, we asked students to appraise the resource *via* ratings of satisfaction. While we acknowledge resources under JD-R are often assessed in terms of the characteristics or attributes of the resource, we adapted this to assess it in a more nuanced and targeted fashion to establish it more clearly as a resource. In fact, the idea to tap into appraisals of job demands and resources is now being recognized, with researchers suggesting it is only then that the help or hindrance dimension of a job resource/demand can be assessed (Liu and Li, 2018; Ma et al., 2021). *Parent/home help* comprised five items asking about the help they received at home for their learning (e.g., "How often do your parents or someone else in your home help you with your mathematics homework?"), rated on a scale of 1 (never/hardly ever) to 5 (every day/ almost every day). *Adaptability* comprised three items (using the Adaptability Scale—Short; Martin et al., 2016) asking students about the extent to which they could adjust their behavior, thinking, and emotion to effectively navigate novelty, variability, and uncertainty (e.g., "In mathematics, to assist me in a new situation, I am able to change the way I do things"), rated on a scale of 1 (strongly disagree) to 7 (strongly agree). *Buffering* was assessed *via* the interaction of online learning demands and adaptability (an interaction term generated through the cross-product of the two zero-centered main effects; Aiken et al., 1991).

Online learning self-efficacy was a single item asking students about their perceived competence in online learning ("Overall, how confident are you as an online learner in mathematics?"), rated on a 1 (not confident) to 4 (very confident) scale. Given this was a single-item factor, we sought to account for measurement error by creating an error-adjusted score using the following equation: $\sigma_h^2 \times (1 - \omega_h)$, where σ_h^2 is the variance of our online learning self-efficacy variable (0.827) and ω_h was the reliability of the same variable (Cole and Preacher, 2014; Kline, 2016), which we conservatively estimated

at 0.70 in this study. In so doing, unreliability was accounted for in this factor, as would be the case if we had multiple items and estimated a latent factor. This error-adjusted score was used in the confirmatory factor analysis (CFA) and structural equation modeling (SEM; described below). *End of year achievement* was assessed *via* a 10-item mathematics test and operationalized as a formative summed score. Achievement scores were standardized by year level (M = 0; SD = 1). Questions were structured in 4-answer multiple-choice format, graduated in difficulty and designed to assess underlying mathematical competencies (as opposed to knowledge recall) from the Australian National Curriculum (Kindergarten-10), and associated state syllabus outcomes (e.g., addition, subtraction, patterns, algebra, time, fractions, decimals, percentages, ratio, probability, and area). An example question was "Which of the following is correct? (A: 0.0409 > 0.041, B: 0.21 > 0.200, C: 0.00004 > 0.0003, and D: 0.123 > 0.124)," to assess a part of the syllabus material covering decimals, fractions, and percentages.

Background Attributes

In assessing the unique effects of demands and resources, it is important to account for numerous background attributes in modeling. For these background attributes, participants reported age (a continuous measure), gender (0 = male and 1 = female), language background (0 = English speaking and 1 = non-English speaking), and parent education (scale from 1 = no formal education to 6 = university education). Descriptive statistics for these are presented in Participants section, above. We also assessed mathematics self-efficacy (single item from the domain-specific version of the Motivation and Engagement Scale High School Short, Martin, 2020; validated by Martin et al., 2020): "I believe I can do well in mathematics" rated (1 = strongly disagree to 7 = strongly agree; M = 5.40, SD = 1.94) and prior achievement (10-item mathematics test parallel to the end of year test described above; M = 5.52, SD = 1.86).

Data Analysis

Confirmatory factor analysis and SEM were the central analyses, conducted with M*plus* version 8 (Muthén and Muthén, 2017). We used the MLR (maximum likelihood robust to non-normality) estimator that provides parameter estimates with standard errors and a chi-square test statistic that are robust to non-normality (Muthén and Muthén, 2017). To assess model fit, a Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) greater than 0.90, a Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) less than 0.08 indicated acceptable fit (Hu and Bentler, 1999; Kline, 2016). Missing data were dealt with using the M*plus* default, Full Information Maximum Likelihood (FIML; Arbuckle, 1996).

For the CFA, the following factors were included: online learning barriers (formative score), online learning support (latent factor), parent/home help (latent factor), adaptability (latent factor), online learning self-efficacy (error-adjusted score), end of year achievement (formative summed score), and background attributes (each a single indicator, with loading set at 1.00 and residual at 0)—thus, a 12-factor CFA.

The hypothesized structural model (**Figure 1**) was tested using SEM. In this model, (a) online learning demands, online learning support, parent/home help, adaptability, the interaction of online demands and adaptability (buffering effect), and all background attributes predicted online learning self-efficacy and in turn, (b) these factors—including online learning self-efficacy—predicted end of year achievement (thus, a "fully-forward" model). Because we included prior achievement as a predictor in the model, we could interpret paths to end of year achievement in terms of gains (or declines). Our data also enabled tests of indirect (mediation) effects which were conducted in subsidiary analyses. A parametric bootstrapping approach was used to test mediation. Here, we explored the extent to which online learning self-efficacy mediated the relationship between the various demands and resources and students' end of year achievement. Analyses were based on bootstrapped standard errors with 1,000 draws (MacKinnon et al., 2002; Shrout and Bolger, 2002).

RESULTS

Confirmatory Factor Analysis and Correlations

The 12-factor CFA tested the dimensionality and measurement properties underlying the hypothesized model and also generated bivariate correlations that were the first insight into the relationships of interest in **Figure 1**. This CFA yielded an acceptable fit to the data, χ^2 (152) = 453.25, $p < 0.001$, CFI = 0.956, TLI = 0.933, RMSEA = 0.036, and SRMR = 0.033. Factor loading means are shown in **Table 1** and correlations are presented in **Table 2**. Here, we summarize only significant correlations among substantive factors that are key to the hypothesized model (all other significant and non-significant correlations are in **Table 2**). The following were significantly correlated with online learning self-efficacy: online learning barriers ($r = -0.247$, $p < 0.001$), online learning support ($r = 0.689$, $p < 0.001$), parent/home help ($r = 0.153$, $p < 0.001$), and adaptability ($r = 0.529$, $p < 0.001$). Thus, online learning barriers were associated with lower online learning self-efficacy, whereas online learning support, parent/home help, and adaptability were associated with higher online learning self-efficacy. The following were significantly correlated with end of year achievement: online learning self-efficacy ($r = 0.256$, $p < 0.001$), online learning barriers ($r = -0.097$, $p < 0.001$), online learning support ($r = 0.140$, $p < 0.001$), parent/home help ($r = -0.090$, $p < 0.01$), and adaptability ($r = 0.272$, $p < 0.001$). Thus, online learning barriers and parent/home help were associated with lower end of year achievement, whereas online learning self-efficacy, online learning support, and adaptability were associated with higher end of year achievement.

TABLE 2 | Correlations from CFA.

		1	2	3	4	5	6	7	8	9	10	11	12
JD-R factors													
1.	Online learning barriers	–	–0.239***	–0.058	–0.152***	–0.247***	–0.097***	0.038	0.008	–0.044	0.024	–0.149***	–0.114***
2.	Online learning support		–	0.080*	0.408***	0.689***	0.140***	0.050	–0.054	0.031	0.018	0.258***	0.167***
3.	Parent/home help			–	0.230***	0.153***	–0.090**	–0.177***	–0.077**	0.082**	0.040	0.166***	–0.096**
4.	Adaptability				–	0.529***	0.272***	–0.111***	–0.200***	0.063*	0.047	0.556***	0.263***
5.	Online learning self-efficacy					–	0.256***	–0.107**	–0.098**	0.108**	0.047	0.406***	0.235***
6.	End of year achievement						–	–0.029	–0.097***	0.174***	0.144***	0.308***	0.561***
Background attributes													
7.	Age							–	0.074**	–0.019	0.039	–0.066**	–0.012
8.	Gender (M/FM)								–	–0.021	–0.060**	–0.193***	–0.147***
9.	Parent education									–	0.030	0.116***	0.161***
10.	NESB										–	0.061**	0.153***
11.	Math self-efficacy											–	0.309***
12.	Prior achievement												–

*All JD-R factors are in relation to mathematics; NESB, non-English speaking background; M, male; and FM, female. *p < 0.05, **p < 0.01, and ***p < 0.001.*

Structural Equation Modeling

We then tested the model in **Figure 1** using SEM. This yielded an acceptable fit to the data, χ^2 (163) = 509.76, $p < 0.001$, CFI = 0.949, TLI = 0.921, RMSEA = 0.037, and SRMR = 0.036.[1] **Table 3** and **Figure 2** show results. Here, we summarize only significant paths among substantive factors. All other significant and non-significant paths are in **Table 3**. Significant predictors of online learning self-efficacy (beyond the effects of all background attributes) were as follows: online learning demands ($\beta = -0.062$, $p < 0.05$), online learning support ($\beta = 0.562$, $p < 0.001$), and adaptability ($\beta = 0.202$, $p < 0.001$). Thus, online learning demands were predictive of lower online learning self-efficacy, whereas online learning support and adaptability were predictive of higher online learning self-efficacy. In turn, beyond the effects of background attributes, significant predictors of end of year achievement gains were as follows: online learning self-efficacy ($\beta = 0.118$, $p < 0.05$), parent/home help ($\beta = -0.103$, $p < 0.001$), and adaptability ($\beta = 0.079$, $p < 0.05$). Thus, online learning self-efficacy and adaptability were predictive of gains in end of year achievement, whereas parent/home help was predictive of declines in end of year achievement (discussed in further detail below).

Finally, we examined the indirect paths from demands and resources to end of year achievement gains *via* online learning self-efficacy. There were two significant indirect paths: online learning support → online learning self-efficacy → end of year achievement, $\beta = 0.066$, $p < 0.05$; adaptability → online learning self-efficacy → end of year achievement, $\beta = 0.024$, $p < 0.05$. Thus, online learning self-efficacy mediated the relationship between online learning support and end of year achievement gains; it also mediated the relationship between adaptability and end of year achievement gains. **Table 3** also presents total effects, showing that adaptability has the largest net positive effect on achievement gains of all predictors ($\beta = 0.103$, $p < 0.001$), while parent/home help has the largest net negative effect, being significantly associated with achievement declines ($\beta = -0.100$, $p < 0.001$).

TABLE 3 | Standardized direct and indirect effects for JD-R process in online mathematics.

	Online learning self-efficacy	End of year test achievement
	β	*β*
JD-R factors		
Online learning barriers (job demands)	−0.062*	−0.012
Online learning support (job resources)	0.562***	−0.072
Home/parent help (job resources)	0.022	−0.103***
Adaptability (personal resources)	0.202***	0.079*
Adaptability × Barriers (buffering)	−0.008	−0.001
Online learning self-efficacy	–	0.118*
Background attributes		
Age	−0.101	−0.011
Gender (M/FM)	0.011	0.011
Parent education	0.053	0.079***
Non-English speaking background	0.018	0.063**
Math self-efficacy	0.117**	0.095**
Prior achievement	0.039	0.463***
Indirect effects		
Online learning barriers → Online learning self-efficacy → End of year test achievement		−0.007
Online learning support → Online learning self-efficacy → End of year test achievement		0.066*
Home/parent support → Online learning self-efficacy → End of year test achievement		0.003
Adaptability → Online learning self-efficacy → End of year test achievement		0.024*
Adaptability × Barriers → Online learning self-efficacy → End of year test achievement		−0.001
Total effects		
Online learning barriers → Online learning self-efficacy → End of year test achievement		−0.020
Online learning support → Online learning self-efficacy → End of year test achievement		−0.006
Home/parent support → Online learning self-efficacy → End of year test achievement		−0.100***
Adaptability → Online learning self-efficacy → End of year test achievement		0.103***
Adaptability × Barriers → Online learning self-efficacy → End of year test achievement		−0.002

*All JD-R factors are in relation to mathematics. *p < 0.05, **p < 0.01, and ***p < 0.001.*

DISCUSSION

Adaptability is a personal resource that has potential to assist students through times of novelty, variability, and uncertainty—such as what they have experienced during COVID-19. Drawing on JD-R theory and a large sample of Australian high school students, we examined the role of adaptability (a personal resource) in predicting students' online learning self-efficacy and the role of their online learning self-efficacy in predicting their end of year achievement during a period of COVID-19 that entailed fully or partially remote online learning. We found that adaptability was significantly associated with greater online learning self-efficacy and with gains in achievement (supporting Hypothesis 1); online learning self-efficacy was also significantly associated with gains in achievement (supporting Hypothesis 2)—and significantly mediated the relationship between adaptability and achievement (supporting Hypothesis 3).

[1]Because there were diverse modes of online mathematics instruction during this period of COVID-19 (e.g., different combinations of class-based/online learning, small group learning, and solo learning on any given school day), students were not always nested in their mathematics classrooms. Thus, we did not statistically account for clustering/nesting in our analyses. For completeness, however, when we tested the hypothesized model (**Figure 1**) using the M*plus* Type = Complex command (adjusting standard errors for the nesting of students within classrooms), we derived good fit (χ^2 [163] = 493.38, $p < 0.001$, CFI = 0.948, TLI = 0.919, RMSEA = 0.036, and SRMR = 0.036) and the same substantive effects as our unadjusted model, with the minor exception that the online learning barriers → online learning self-efficacy path was significant at $p < 0.10$ ($\beta = -0.062$, $p = 0.067$), not $p < 0.05$.

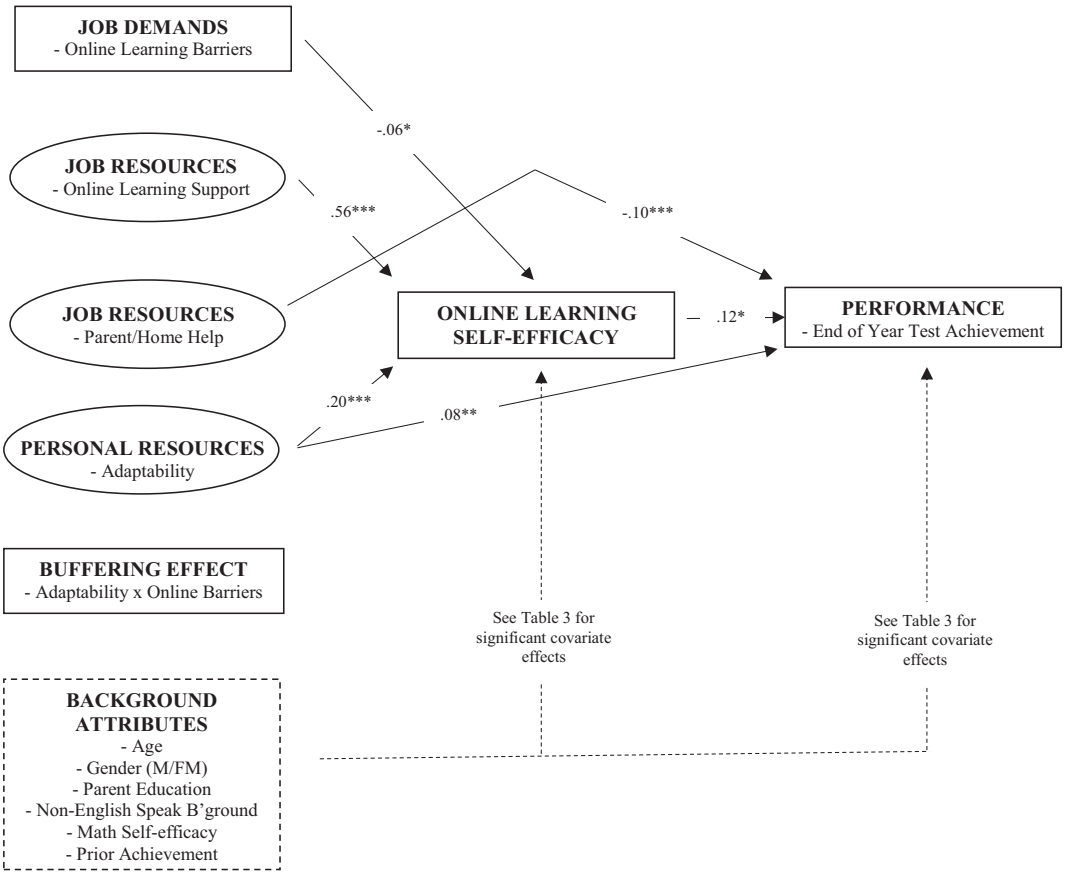

FIGURE 2 | Standardized beta coefficients for JD-R process in online mathematics. All JD-R factors are in relation to mathematics; $^{*}p < 0.05$, $^{**}p < 0.01$, and $^{***}p < 0.001$. See **Table 3** for indirect and covariate effects.

These effects were significant beyond any variance attributable to online learning demands, online learning support, parent/home help, and background attributes. Our findings therefore confirm the hypothesized role of adaptability as an important personal resource and have practical implications for better supporting students in their online learning, including through periods of remote online instruction, such as during COVID-19.

Findings of Particular Note

In line with hypotheses, findings showed that adaptability (a personal resource) was significantly associated with greater online learning self-efficacy—beyond the effects of online learning barriers (job demands), online learning support and parent/home help (job resources), and background attributes. In fact, adaptability not only predicted online learning self-efficacy as hypothesized, but also directly predicted gains in end of year test achievement—and significantly indirectly predicted end of year achievement *via* the mediating role of online learning self-efficacy. Adaptability thus presents as an important factor in how students navigate their online learning during periods of significant novelty, variability, and uncertainty (in this case, during a period of COVID-19 that entailed fully or partially remote online learning). We can infer that the adjustments required by students to navigate these uncertain circumstances were well met by the psychological attribute of adaptability. This expands on the pre-COVID-19 evidence base for the positive effects of adaptability on students' educational outcomes (Martin et al., 2013; Holliman et al., 2018, 2019, 2021). Thus, in line with Collie et al. (2020a); see also Collie and Martin, 2016), it seems that adaptability fosters mastery and efficacy experiences—manifested in our research by online learning self-efficacy.

We can also now add to what we know about factors that may enhance the effectiveness of online learning. As described earlier, there is a mixed evidence base for the effectiveness of online learning modes, representing a diversity of positive effects (Yuwono and Sujono, 2018), negative effects (Peña-López, 2015; Delgado et al., 2018; Clinton, 2019), and null effects (Cavanaugh et al., 2004; Kraft and Hill, 2020). It has been suggested that part of this diversity is due to the variety of factors that influence online learning effectiveness. Research has previously identified factors, such as technology access, technology skills, instructional and resource quality, parent/home support, ethnicity, socioeconomic status, and learning support needs (AITSL, 2020; Australian Academy of Science, 2020). To this, we can now add adaptability which predicted online

learning self-efficacy and also achievement *via* online learning self-efficacy. Indeed, because adaptability is a modifiable psychological attribute (Martin et al., 2013; Granziera et al., 2021), it represents a viable direction for assisting students' online learning experience.

In addition to the positive role of adaptability, online learning self-efficacy was associated with gains in end of year test achievement. Thus, the extent to which students perceived and experienced competence in online learning was important for their subsequent academic performance (beyond prior academic performance). This is consistent with contentions under classic conceptualizing (e.g., social cognitive theory; Bandura, 1997) and research (e.g., Martin, 2007, 2009; Lee et al., 2014; Schunk and DiBenedetto, 2014). Particularly noteworthy is the fact that online learning self-efficacy predicted gains in achievement beyond the effects of general mathematics self-efficacy on achievement—thus, students' efficacy in online mathematics learning itself (net general mathematics self-efficacy) was linked to their later mathematics achievement. These findings demonstrate that achievement is not only a function of subject-specific mathematics self-efficacy (consistent with prior research; Green et al., 2007) but also a function of domain-specific efficacy within the subject: in this case, online learning self-efficacy.

Unexpected Findings of Note

Following prior research among teachers, we modeled the interaction between personal resources (adaptability) and job demands (online learning barriers) to ascertain the extent to which adaptability may buffer the negative effects of job demands (Collie et al., 2020a; Granziera et al., 2021)—to address Research Question 1. This interaction (buffering) effect was not statistically significant; instead, it was the main effects of adaptability (positive effect) and online learning barriers (negative effect) that predicted online learning self-efficacy. This is nonetheless important, as it shows that adaptability yields a positive effect beyond the barriers that students experience in online learning. Thus, adaptability surmounts the negative effects of online learning barriers, even if it does not buffer them.

It was also initially surprising to identify a negative path between parent/home help and end of year test achievement—higher levels of help from parents at home were associated with lower end of year achievement. We suspect this may be explained by the reality that academically struggling students are likely to require more help from their parents—thus, lower achieving students reported higher levels of parent/home help. But how do we reconcile this with other research showing that low parental involvement is associated with lower achievement (e.g., Lara and Saracostti, 2019)? We cannot rule out the possibility that the more intense parental involvement with their adolescent child while at home during COVID-19 may have been perceived by the student as controlling and giving rise to a reduction in autonomy-supportive parenting practices (e.g., Neubauer et al., 2020)—leading to reduced achievement. Further research is needed to understand this better, but it does align with recent developments in JD-R theory and research identifying variability between individuals in how they perceive demands and resources (Bakker and Demerouti, 2017; Yin et al., 2018; Han et al., 2020; Martin et al., 2021), with some seeing resources as more a hindrance than a help. In the case of our study, perhaps there was a controlling role for parent/home help that was perceived as a hindrance, and which evinced a negative effect for achievement. Similar apparently counter-intuitive effects of parental involvement and attitudes on students' academic outcomes have been found in other studies. Murayama et al. (2016) suggested that overly positive parental judgments may be disadvantageous because they are associated with over involvement, controlling behavior, and excessive pressure. Other studies explore parental "intrusive support" of students. For instance, Gunderson et al. (2012) explain how expectations of parents, based on their own anxieties and stereotypical beliefs, can lead to lower achievement, *via* intrusive support during homework. Furthermore, we suggest it is important to better understand the nature and impact of parental involvement as relevant to the COVID-19 pandemic itself. For example, additional research is needed to explore diverse dimensions of parental involvement in their children's schoolwork during the pandemic with particular interest in the factors that determine whether this involvement is perceived as a help or a hindrance.

There were two non-significant main effects also worth noting (but they were not the substantive focus and we did not formulate hypotheses for them): a non-significant predictive path between online learning barriers and achievement and a non-significant predictive path between online learning support and achievement. We suggest this is noteworthy because these two predictors were significantly correlated with achievement (see **Table 2**), but after including the significant predictive roles of adaptability and parent/home help on achievement, online learning barriers and support explained no further variance in achievement. Moreover, because adaptability yielded a unique net positive effect on achievement relative to the net negative effect of parent/home help (see total effects in **Table 3**) and because adaptability shared more variance with online learning barriers and support than did parent/home help (see **Table 2**), we suggest it is the presence of adaptability that played a major role in mitigating the predictive paths from online learning barriers and support to achievement. The two non-significant paths also underscore an important mediating role for self-efficacy, in similar vein to prior research finding that teacher self-efficacy fully mediates the link between teachers' adaptability and students' outcomes (Collie et al., 2020a). These findings, we suggest, further highlight the importance of considering adaptability as a personal resource in JD-R models generally (in line with emerging research: Collie et al., 2020a; Granziera et al., 2021), and in models exploring disruptive circumstances, such as COVID-19 more specifically.

Implications for Theory and Practice

Based on the findings, we believe we have successfully adapted JD-R theory to the (online) learning and instruction setting in high school mathematics. We showed that personal resources by way of adaptability positively impacted students' online learning experiences and outcomes (consistent with research

showing the positive impacts of adaptability among teachers; Collie et al., 2020a; Granziera et al., 2021). We showed that job demands by way of online learning barriers were associated with lower online learning self-efficacy (consistent with research showing such barriers impede online learning; e.g., Peña-López, 2015; Australian Academy of Science, 2020). We also showed that job resources by way of online learning support and parent/home help were associated with higher online learning self-efficacy (consistent with prior research demonstrating a supportive role for these factors; e.g., Yukselturk and Bulut, 2007; Means et al., 2009; Escueta et al., 2017; Galpin and Taylor, 2018; Gregori et al., 2018; AITSL, 2020).

The salient role of adaptability in this study also suggests it as an important point for educational intervention. As adaptability is an emerging area of research, suggested practice directions have drawn on existing related frameworks, such as the resilience research by Rutter (1987) and Morales (2000). For example, Martin et al. (2013); see also Burns and Martin (2014) and Martin and Burns (2014) identified the following steps to boost students' adaptability: (1) teach students how to recognize novelty, variability, and uncertainty, (2) explain to students how they can adjust their behavior, thinking, and/or emotion to navigate the novelty, variability, and uncertainty (strategies are detailed below), (3) encourage students to recognize the benefits of these psycho-behavioral adjustments, and (4) explain to students that continued behavioral, cognitive, and/or emotional responses to novelty, variability, and uncertainty represent the "adaptability cycle" and that this cycle leads to enhanced ongoing positive outcomes in the face of change.

Burns and Martin (2014) and Martin and Burns (2014) propose that the second step of this process (adjusting behavior, cognition, and emotion) is the most critical part of the adaptability cycle. According to Martin (2014); see also Burns and Martin (2014) and Martin and Burns (2014) and extrapolating his guidance to online learning, (a) students can adjust their cognition by thinking about a new online task in a different way (e.g., considering the opportunities the new online option might offer); (b) students can adjust their behavior by seeking out new or more online information and resources, or asking for help (e.g., asking a teacher to help with a new online learning management system); and (c) students can adjust their emotions by minimizing negative feelings (e.g., frustration) when they need to juggle in-class and online learning modes (e.g., choosing not to focus on disappointment if the teacher engages an online learning approach that is not to the student's preference).

Our findings also showed that adaptability is not the only practical implication to take from this study; it is also important to remove barriers to students' online learning and to enhance their online learning resources. Attending to the online learning barriers would entail addressing Internet and connection issues, ensuring students have access to appropriate computing and technology, and identifying places for them to engage with online learning so they can concentrate (Australian Academy of Science, 2020). Attending to online learning support would involve ensuring high quality learning management systems, providing ample opportunity to interact with and receive help from the teacher online, and being provided with the opportunity to engage with peers online but also to work independently as appropriate.

Limitations and Future Directions

There are some limitations in this study that are important to take into account when interpreting the findings and which also have implications for future research into online learning. First, our correlational research data cannot be interpreted as supporting causal conclusions. Experimental work that manipulates adaptability and explores for any subsequent shifts in online learning self-efficacy would better establish (or not) the causal role of adaptability. Indeed, Galpin and Taylor (2018) and others (e.g., Means et al., 2009; Patrick and Powell, 2009; Quesada-Pallarès et al., 2019) recommend more studies that can test causality (including experimental studies) and the factors that may moderate whether online learning is beneficial or not. Second, although our achievement data were based on a mathematics test tapping into diverse aspects of mathematics syllabus, it will be important to expand the outcome measures to assess other aspects of mathematics performance. Third, there tends to be more research into online learning among post-school students (e.g., university/college) and to some extent among high school students (such as in our study); there is a need for more research among elementary school students (Means et al., 2009; Clinton, 2019). Fourth, this study relied on student reports of online learning barriers and support. Additional indicators, such as parent and teacher ratings, might be used in future to triangulate findings with students' reports of constructs in our study. Also on the matter of measurement, we assessed online learning resources in terms of student appraisals (*via* ratings of satisfaction) and not in terms of characteristics of the resources themselves. Findings and conclusions regarding job resources in our study must take this into account. Fifth, we suggest research that can identify different combinations of demands and resources and their relationships to online learning self-efficacy and academic achievement. As a case in point, latent profile analysis may identify distinct typologies of students who balance the diverse online demands and resources in different ways. Prior JD-R research has conducted latent profile analysis among teachers (Collie et al., 2020b) and expanding this to students would be illuminating.

Sixth, it will be helpful to understand adaptability and its role in online learning in real-time. For example, research has identified the in-situ dimensions of students' learning and engagement (Schneider et al., 2016; Martin et al., 2020); online learning demands and resources are also likely to have salient in-situ aspects. Seventh, due to constraints of time and to accommodate the fact students were located in diverse combinations of online and in-class learning modes, we wanted to guard against asking extensive batteries of questions about their online experience. Thus, single-item indicators were used in some cases. Although there is research suggesting single-item scales have merit in cases where long scales are not able to be used (e.g., Gogol et al., 2014) and we modeled an error-adjusted score for our central online learning self-efficacy factor,

future research might look to administering more extensive item sets. Eighth, our research was set in mathematics which is a challenging school subject and one in which students can struggle (Thomson et al., 2016; OECD, 2018). To the extent this is so, there may be disproportionate challenges in online mathematics learning—or, it may emerge there are unique opportunities afforded to mathematics when in online learning modes. It is thus important to expand the present study to other school subjects. Ninth, students in our sample were from above average SES backgrounds. As such, these students likely had fewer online learning barriers and more online learning support than some other cohorts of students. Our findings may be just the tip of the iceberg in terms of the role of these demands and resources. Finally, online learning platforms, programs, and content tend to be developed and published faster than research can assess their effectiveness (Escueta et al., 2017)—signaling a need to conduct more rapid research in order for researchers and research to stay abreast of the fast pace of developments in online learning.

CONCLUSION

The COVID-19 pandemic necessitated a rapid shift to remote learning for students around the world. During this time, in-class learning and instruction moved to remote online modes at speed and scale. Harnessing JD-R theory, the present study identified adaptability as a personal resource that may support students' online learning experience and achievement during such times. Findings demonstrated that adaptability does indeed play a significant role in this process, and thus may be an important personal resource to foster in students' online learning during COVID-19—and beyond.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because consent from participants to share dataset is not available; summative data (e.g., correlation matrix with standard deviations) are available to enable analyses. Requests to access the datasets should be directed to Andrew Martin, andrew.martin@unsw.edu.au.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the UNSW Human Ethics Committee. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AM shared in the development of the research design and led data analysis and report writing. RC and RN shared in the development of the research design and assisted with data analysis and report writing. All authors contributed to the article and approved the submitted version.

REFERENCES

Aiken, L. S., West, S. G., and Reno, R. R. (1991). *Multiple Regression: Testing and Interpreting Interactions*. London: Sage.

AITSL (2020). *What Works in Online/Distance Teaching and Learning?* Melbourne: AITSL.

Arbuckle, J. L. (1996). "Full information estimation in the presence of incomplete data," in *Advanced Structural Equation Modeling: Issues and Techniques*. eds. G. A. Marcoulides and R. E. Schumacker (Mahwah, NJ: Lawrence Erlbaum Associates), 243–278.

Australian Academy of Science (2020). Learning outcomes for online versus in-class education. *Australian Academy of Science*. Available at: https://www.science.org.au/covid19/learning-outcomes-online-vs-inclass-education (Accessed March 15, 2021).

Backes, B., and Cowan, J. (2019). Is the pen mightier than the keyboard? The effect of online testing on measured student achievement. *Econ. Educ. Rev.* 68, 89–103. doi: 10.1016/j.econedurev.2018.12.007

Bakker, A. B., and Demerouti, E. (2017). Job demands-resources theory: taking stock and looking forward. *J. Occup. Health Psychol.* 22, 273–285. doi: 10.1037/ocp0000056

Bakker, A., and Demerouti, E. (2018). "Multiple levels in job demands-resources theory: implications for employee well-being and performance," in *Handbook of Well-Being*. eds. E. Diener, S. Oishi and L. Tay (Utah: DEF Publishers), 1–13.

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York, NY: Freeman.

Burns, E. C., and Martin, A. J. (2014). ADHD and adaptability: the roles of cognitive, behavioural, and emotional regulation. *Aust. J. Guid. Couns.* 24, 227–242. doi: 10.1017/jgc.2014.17

Cavanaugh, C., Gillan, K. J., Kromrey, J., Hess, M., and Blomeyer, R. (2004). *The Effects of Distance Education on k-12 Student Outcomes: A Meta-Analysis*. Naperville, IL: Learning Point Associates/North Central Regional Educational Laboratory (NCREL).

Chang, M.-L. (2013). Toward a theoretical model to understand teacher emotions and teacher burnout in the context of student misbehavior: appraisal, regulation, and coping. *Motiv. Emot.* 37, 799–817. doi: 10.1007/s11031-012-9335-0

Clinton, V. (2019). Reading from paper compared to screens: a systematic review and meta-analysis. *J. Res. Read.* 42, 288–325. doi: 10.1111/1467-9817.12269

Cole, D. A., and Preacher, K. J. (2014). Manifest variable path analysis: potentially serious and misleading consequences due to uncorrected measurement error. *Psychol. Methods* 19, 300–315. doi: 10.1037/a0033805

Collie, R. J., Granziera, H., Martin, A. J., Burns, E. C., and Holliman, A. (2020a). Adaptability among science teachers in schools: a multi-nation examination of its role in school outcomes. *Teach. Teach. Educ.* 26, 350–364. doi: 10.1080/13540602.2020.1832063

Collie, R. J., Holliman, A. J., and Martin, A. J. (2017). Adaptability, engagement, and academic achievement at university. *Educ. Psychol.* 37, 632–647. doi: 10.1080/01443410.2016.1231296

Collie, R. J., Malmberg, L.-E., Martin, A. J., Sammons, P., and Morin, A. J. S. (2020b). A multilevel person-centered examination of teachers' workplace demands and resources: links with work-related well-being. *Front. Psychol.* 11:626. doi: 10.3389/fpsyg.2020.00626

Collie, R. J., and Martin, A. J. (2016). Adaptability: an important capacity for effective teachers. *Educ. Pract. Theory* 38, 27–39. doi: 10.7459/ept/38.1.03

Delgado, P., Vargas, C., Ackerman, R., and Salmerón, L. (2018). Don't throw away your printed books: A meta-analysis on the effects of reading media on comprehension. *Educ. Res. Rev.* 25, 23–38. doi: 10.1016/j.edurev.2018.09.003

Demerouti, E., Bakker, A. B., Nachreiner, F., and Schaufeli, W. B. (2001). The job demands-resources model of burnout. *J. Appl. Psychol.* 86, 499–512. doi: 10.1037/0021-9010.86.3.499

Dicke, T., Stebner, F., Linninger, C., Kunter, M., and Leutner, D. (2018). A longitudinal study of teachers' occupational well-being: applying the job demands-resources model. *J. Occup. Health Psychol.* 23, 262–277. doi: 10.1037/ocp0000070

Escueta, M., Quan, V., Nickow, A., and Oreopoulos, P. (2017). *Education Technology: An Evidence-Based Review (No. w23744)*. Cambridge, MA: National Bureau of Economic Research.

Galpin, A., and Taylor, G. (2018). *Changing Behaviour: Children, Adolescents and Screen Use*. Leicester: The British Psychological Society.

Garbe, A., Ogurlu, U., Logan, N., and Cook, P. (2020). COVID-19 and remote learning: experiences of parents with children during the pandemic. *Am. J. Qual. Res.* 4, 45–65. doi: 10.29333/ajqr/8471

Gogol, K., Brunner, M., Goetz, T., Martin, R., Ugen, S., Keller, U., et al. (2014). "My questionnaire is too long!" The assessments of motivational-affective constructs with three-item and single-item measures. *Contemp. Educ. Psychol.* 39, 188–205. doi: 10.1016/j.cedpsych.2014.04.002

Granziera, H., Collie, R. J., and Martin, A. J. (2020). "Understanding teacher wellbeing through Job Demands-Resources theory," in *Cultivating Teacher Resilience*. ed. C. F. Mansfield (New York, NY: Springer), 229–244.

Granziera, H., Collie, R. J., and Martin, A. J. (2021). *Teachers' Job Demands and Resources*. Submitted for publication.

Green, J., Martin, A. J., and Marsh, H. W. (2007). Motivation and engagement in English, Mathematics and science high school subjects: towards an understanding of multidimensional domain specificity. *Learn. Individ. Differ.* 17, 269–279. doi: 10.1016/j.lindif.2006.12.003

Gregori, E. B., Zhang, J., Galván-Fernández, C., and de Asís Fernández-Navarro, F. (2018). Learner support in MOOCs: identifying variables linked to completion. *Comput. Educ.* 122, 153–168. doi: 10.1016/j.compedu.2018.03.014

Gunderson, E. A., Ramirez, G., Levine, S. C., and Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles* 66, 153–166. doi: 10.1007/s11199-011-9996-2

Han, J., Yin, H., Wang, J., and Bai, Y. (2020). Challenge job demands and job resources to university teacher well-being: the mediation of teacher efficacy. *Stud. High. Educ.* 45, 1771–1785. doi: 10.1080/03075079.2019.1594180

Hassler Hallstedt, M., Klingberg, T., and Ghaderi, A. (2018). Short and long-term effects of a mathematics tablet intervention for low performing second graders. *J. Educ. Psychol.* 110, 1127–1148. doi: 10.1037/edu0000264

Hattie, J. (2009). *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*. New York, NY: Routledge.

Holliman, A. J., Martin, A. J., and Collie, R. J. (2018). Adaptability, engagement, and degree completion: a longitudinal investigation of university students. *Educ. Psychol.* 38, 785–799. doi: 10.1080/01443410.2018.1426835

Holliman, A., Sheriston, L., Martin, A. J., Collie, R. J., and Sayer, D. (2019). Adaptability: does students' adjustment to university predict their mid-course academic achievement and satisfaction? *J. Furth. High. Educ.* 43, 1444–1455. doi: 10.1080/0309877X.2018.1491957

Holliman, A., Waldeck, D., Jay, B., Murphy, S., Atkinson, E., Collie, J., et al. (2021). Adaptability and social support: examining links with psychological wellbeing among UK students and non-students. *Front. Psychol.* 12:636520. doi: 10.3389/fpsyg.2021.636520

Hu, L., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model. Multidiscip. J.* 6, 1–55. doi: 10.1080/10705519909540118

Kirschner, P. A., and De Bruyckere, P. (2017). The myths of the digital native and the multitasker. *Teach. Teach. Educ.* 67, 135–142. doi: 10.1016/j.tate.2017.06.001

Klassen, R. M., and Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction. *J. Educ. Psychol.* 102, 741–756. doi: 10.1037/a0019237

Kline, R. B. (2016). *Principles and Practice of Structural Equation Modeling. 4th Edn.* New York, NY: Guilford Press.

Kraft, M. A., and Hill, H. C. (2020). Developing ambitious mathematics instruction through web-based coaching: a randomized field trial. *Am. Educ. Res. J.* 57, 2378–2414. doi: 10.3102/0002831220916840

Lara, L., and Saracostti, M. (2019). Effect of parental involvement on children's academic achievement in Chile. *Front. Psychol.* 10:1464. doi: 10.3389/fpsyg.2019.01464

Lee, W., Lee, M. J., and Bong, M. (2014). Testing interest and self-efficacy as predictors of academic self-regulation and achievement. *Contemp. Educ. Psychol.* 39, 86–99. doi: 10.1016/j.cedpsych.2014.02.002

Liem, G. A. D., and Martin, A. J. (2015). Young people's responses to environmental issues: exploring the role of adaptability and personality. *Personal. Individ. Differ.* 79, 91–97. doi: 10.1016/j.paid.2015.02.003

Liu, C., and Li, H. (2018). Stressors and stressor appraisals: the moderating effect of task efficacy. *J. Bus. Psychol.* 33, 141–154. doi: 10.1007/s10869-016-9483-4

Ma, J., Peng, Y., and Wu, B. (2021). Challenging or hindering? The roles of goal orientation and cognitive appraisal in stressor-performance relationships. *J. Organ. Behav.* 42, 388–406. doi: 10.1002/job.2503

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., and Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychol. Methods* 7, 83–104. doi: 10.1037/1082-989X.7.1.83

Marsh, H. W., and Martin, A. J. (2011). Academic self-concept and academic achievement: relations and causal ordering. *Br. J. Educ. Psychol.* 81, 59–77. doi: 10.1348/000709910X503501

Martin, A. J. (2007). Examining a multidimensional model of student motivation and engagement using a construct validation approach. *Br. J. Educ. Psychol.* 77, 413–440. doi: 10.1348/000709906X118036

Martin, A. J. (2009). Motivation and engagement across the academic lifespan: a developmental construct validity study of elementary school, high school, and university/college students. *Educ. Psychol. Meas.* 69, 794–824. doi: 10.1177/0013164409332214

Martin, A. J. (2014). Academic buoyancy and academic outcomes: towards a further understanding of students with ADHD, students without ADHD, and academic buoyancy itself. *Br. J. Educ. Psychol.* 84, 86–107. doi: 10.1111/bjep.12007

Martin, A. J. (2020). *Motivation and Engagement Scale*. Sydney: Lifelong Achievement Group.

Martin, A. J., and Burns, E. C. (2014). Academic buoyancy, resilience, and adaptability in students with ADHD. *ADHD Rep.* 22, 1–9. doi: 10.1521/adhd.2014.22.6.1

Martin, A. J., Durksen, T. L., Williamson, D., Kiss, J., and Ginns, P. (2016). The role of a museum-based science education program in promoting content knowledge and science motivation. *J. Res. Sci. Teach.* 53, 1364–1384. doi: 10.1002/tea.21332

Martin, A. J., Kennett, R., Pearson, J., Mansour, M., Papworth, B., and Malmberg, L.-E. (2021). Challenge and threat appraisals in high school science: Investigating the roles of psychological and physiological factors. *Educ. Psychol.* 41, 618–639. doi: 10.1080/01443410.2021.1887456

Martin, A. J., Mansour, M., and Malmberg, L.-E. (2020). What factors influence students' real-time motivation and engagement? An experience sampling study of high school students using mobile technology. *Educ. Psychol.* 40, 1113–1135. doi: 10.1080/01443410.2018.1545997

Martin, A. J., and Marsh, H. W. (2009). Academic resilience and academic buoyancy: multidimensional and hierarchical conceptual framing of causes, correlates, and cognate constructs. *Oxf. Rev. Educ.* 35, 353–370. doi: 10.1080/03054980902934639

Martin, A. J., Nejad, H. G., Colmar, S., and Liem, G. A. D. (2012). Adaptability: conceptual and empirical perspectives on responses to change, novelty and uncertainty. *Aust. J. Guid. Couns.* 22, 58–81. doi: 10.1017/jgc.2012.8

Martin, A. J., Nejad, H. G., Colmar, S., and Liem, G. A. D. (2013). Adaptability: how students' responses to uncertainty and novelty predict their academic and non-academic outcomes. *J. Educ. Psychol.* 105, 728–746. doi: 10.1037/a0032794

Martin, A. J., Nejad, H. G., Colmar, S., Liem, G. A. D., and Collie, R. (2015). The role of adaptability in promoting control and reducing failure dynamics: a mediation model. *Learn. Individ. Differ.* 38, 36–43. doi: 10.1016/j.lindif.2015.02.004

Martin, A. J., Yu, K., Ginns, P., and Papworth, B. (2017). Young people's academic buoyancy and adaptability: a cross-cultural comparison of China with North America and the United Kingdom. *Educ. Psychol.* 37, 930–946. doi: 10.1080/01443410.2016.1202904

Means, B., Toyama, Y., Murphy, R., Bakia, M., and Jones, K. (2009). *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*. Washington DC: U.S. Department of Education, Office of Planning, Evaluation, and Policy Development.

Morales, E. E. (2000). A contextual understanding of the process of educational resilience: high achieving Dominican American students and the 'resilience cycle'. *Innov. High. Educ.* 25, 7–22. doi: 10.1023/A:1007580217973

Murayama, K., Pekrun, R., Suzuki, M., Marsh, H. W., and Lichtenfeld, S. (2016). Don't aim too high for your kids: parental overaspiration undermines students' learning in mathematics. *J. Pers. Soc. Psychol.* 111, 766–779. doi: 10.1037/pspp0000079

Muthén, L. K., and Muthén, B. O. (2017). *Mplus User's Guide. 7th Edn.* Los Angeles, CA: Muthén & Muthén.

Neubauer, A., Schmidt, A., Kramer, A., and Schmiedek, F. (2020). A little autonomy support goes a long way: daily autonomy-supportive parenting, child well-being, parental need fulfillment, and change in child, family, and parent adjustment across the adaptation to the COVID-19 pandemic. *Child Dev.* doi: 10.1111/cdev.13515 [Epub ahead of print]

Nguyen, T. (2015). The effectiveness of online learning: beyond no significant difference and future horizons. *MERLOT J. Online Learn. Teach.* 11, 309–319.

Nicholas, J., Poladian, L., Mack, J., and Wilson, R. (2015). Mathematics preparation for university: entry, pathways and impact on performance in first year science and mathematics subjects. *Int. J. Innovat. Sci. Math. Educ.* 23, 37–59.

OECD (2018). *PISA 2015 Results in Focus*. Paris: OECD.

Patrick, S., and Powell, A. (2009). *A Summary of Research on the Effectiveness of K-12 Online Learning*. Vienna, VA: International Association for K-12 Online Learning.

Peña-López, I. (2015). *Students, Computers and Learning: Making the Connection*. Paris: OECD.

Quesada-Pallarès, C., Sánchez-Martí, A., Ciraso-Calí, A., and Pineda-Herrero, P. (2019). Online vs. classroom learning: examining motivational and self-regulated learning strategies among vocational education and training students. *Front. Psychol.* 10:2795. doi: 10.3389/fpsyg.2019.02795

Rutter, M. (1987). Psychosocial resilience and protective mechanisms. *Am. J. Orthopsychiatry* 37, 317–331. doi: 10.1111/j.1939-0025.1987.tb03541.x

Schaufeli, W. B., and Bakker, A. B. (2004). Job demands, job resources, and their relationship with burnout and engagement: a multi-sample study. *J. Organ. Behav.* 25, 293–315. doi: 10.1002/job.248

Schaufeli, W. B., and Taris, T. W. (2014). "A critical review of the job demands-resources model: implications for improving work and health," in *Bridging Occupational, Organizational and Public Health*. eds. G. Bauer and O. Hemming (New York, NY: Springer).

Schneider, B., Krajcik, J., Lavonen, J., Salmela-Aro, K., Broda, M., Spicer, J., et al. (2016). Investigating optimal learning moments in US and Finnish science classes. *J. Res. Sci. Teach.* 53, 400–421. doi: 10.1002/tea.21306

Schunk, D. H., and DiBenedetto, M. K. (2014). "Academic self-efficacy," in *Handbook of Positive Psychology in Schools*. eds. M. J. Furlong, R. Gilman and E. S. Huebner (New York, NY: Elsevier), 115–521.

Shrout, P. E., and Bolger, N. (2002). Mediation in experimental and nonexperimental studies: new procedures and recommendations. *Psychol. Methods* 7, 422–445. doi: 10.1037/1082-989X.7.4.422

Skaalvik, E. M., and Skaalvik, S. (2018). Job demands and job resources as predictors of teacher motivation and well-being. *Soc. Psychol. Educ.* 21, 1251–1275. doi: 10.1007/s11218-018-9464-8

Sung, Y. T., Yang, J. M., and Lee, H. Y. (2017). The effects of mobile-computer-supported collaborative learning: meta-analysis and critical synthesis. *Rev. Educ. Res.* 87, 768–805. doi: 10.3102/0034654317704307

Thalheimer, W. (2017). *Does eLearning Work? What the Scientific Research Says*. Somerville, MA: Work-Learning Research, Inc.

Thomson, S., De Bortoli, L., and Underwood, C. (2016). *PISA 2015: A First Look at Australia's Results*. Melbourne: ACER.

Tinmaz, H., and Lee, J. H. (2020). An analysis of users' preferences on learning management systems. *Smart Learn. Environ.* 7, 1–17. doi: 10.1186/s40561-020-00141-8

Xanthopoulou, D., Bakker, A. B., Demerouti, E., and Schaufeli, W. B. (2007). The role of personal resources in the job demands-resources model. *Int. J. Stress. Manag.* 14, 121–141. doi: 10.1037/1072-5245.14.2.121

Yin, H., Huang, S., and Lv, L. (2018). A multilevel analysis of job characteristics, emotion regulation, and teacher well-being: a job demands-resources model. *Front. Psychol.* 9:2395. doi: 10.3389/fpsyg.2018.02395

Yukselturk, E., and Bulut, S. (2007). Predictors for student success in an online course. *J. Educ. Technol. Soc.* 10, 71–83.

Yuwono, K. T., and Sujono, H. D. (2018). The effectiveness of E-learning: a meta-analysis. *J. Phys. Conf. Ser.* 1140:012024. doi: 10.1088/1742-6596/1140/1/012024

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 18 August 2021
doi: 10.3389/fpsyg.2021.717380

Into the Unknown: Uncertainty and Procrastination in Students From a Life History Perspective

Amy J. Lim and Sasha Javadpour*

Discipline of Psychology, College of Science, Health, Engineering and Education, Murdoch University Singapore, Singapore, Singapore

While existing findings have established an increase in procrastination among students in higher education during COVID-19, they do not elucidate how COVID-19 has effected an increase in procrastination. Drawing upon previous findings and employing a life history framework, this paper proposed that the increase in procrastination may be attributed to the heightened levels of uncertainty in the pandemic. Additionally, this paper examined life history strategy as the psychological mechanism underlying the relation between uncertainty and procrastination. By collecting data across two school semesters in a university ($N = 253$), we found that uncertainty and procrastination did not differ between the semester where changes were abruptly imposed to stem the spread of COVID-19 and the following semester. Our findings also revealed that uncertainty predicted procrastination, and that life history strategy mediated the relation between uncertainty and procrastination. Specifically, uncertainty was associated with a faster life history strategy, which was positively associated with procrastination. By shedding light on the psychology behind the effect of uncertainty on procrastination, the findings of this paper hold important implications for the design of procrastination interventions for the uncertain climate during the pandemic and "the new normal" post COVID-19.

Keywords: COVID-19, higher education, uncertainty, procrastination, life history strategy

OPEN ACCESS

Edited by:
Sina Fackler,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Sebastian Franz,
Leibniz Institute for Educational Trajectories (LG), Germany
Antonio P. Gutierrez de Blume,
Georgia Southern University, United States

****Correspondence:***
Amy J. Lim
amy.lim@murdoch.edu.au

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 May 2021*
Accepted: *26 July 2021*
Published: *18 August 2021*

Citation:
Lim AJ and Javadpour S (2021) Into the Unknown: Uncertainty and Procrastination in Students From a Life History Perspective. Front. Psychol. 12:717380. doi: 10.3389/fpsyg.2021.717380

INTRODUCTION

COVID-19 has unequivocally disrupted the academic life of students (Organization for Economic Cooperation and Development, 2020; Chaturvedi et al., 2021). Studies examining the impact of COVID-19 reported decreases in study hours and increases in academic procrastination among students in higher education (Aucejo et al., 2020; Biricik and Sivrikaya, 2020; Jia et al., 2020). Additionally, the nature of online learning from home further encourages procrastination as students not only need to exert higher levels of self-control to overcome isolated learning and the challenges of online learning (Drumm and Jong, 2020; Rasheed et al., 2020; Hong et al., 2021), they must also resist distractions present at home (e.g., television and social media, Meier et al., 2016; Pan, 2020). Taken together, these studies evidenced that procrastination was at higher than average levels during the pandemic.

With the adverse effects procrastination has on academic performance and the effectiveness of online learning during COVID-19 (Kim and Seo, 2015; Hong et al., 2021), attention has been called to manage and reduce the increased procrastination observed in the pandemic (Arifiana et al., 2020). Yet, existing studies do not elucidate how COVID-19 has effected an increase

in procrastination. Without understanding how COVID-19 has introduced a preponderance of procrastination, efforts to curb procrastination would be ineffective. Drawing upon previous findings and employing a life history framework (Griskevicius et al., 2013; Del Giudice et al., 2015; Chen and Qu, 2017), this paper proposed that the increase in procrastination may be attributed to the heightened levels of uncertainty in the pandemic.

Uncertainty in the Air

Uncertainty was at an alarmingly elevated level when the COVID-19 pandemic was declared as a global health emergency (Ahir et al., 2019; Rettie and Daniels, 2020). The looming state of uncertainty was also undoubtedly experienced by students in higher education. Students faced concerns of becoming sick and the possibility that they may lack financial resources to complete their studies (Biricik and Sivrikaya, 2020; Jenei et al., 2020). Additionally, with the closure of schools and the abrupt shift from physical to online learning, students faced uncertain futures of their academic and professional careers (Jenei et al., 2020). A survey of 1,500 university students revealed that students withdrew from classes, changed their majors, delayed their graduation, and expressed less confidence in finding a job by graduation as a result of COVID-19 (Aucejo et al., 2020).

Procrastination, defined as the deliberate delay of a planned course of action, was found to be associated with negative emotional states such as anxiety and stress (Steel, 2007; Hen and Goroshit, 2014). Given that the uncertain climate introduced by the pandemic has resulted in several negative psychological consequences for students, including anxiety and frustration, it is likely that increased procrastination stemmed from the uncertainty experienced by students during the pandemic (Biricik and Sivrikaya, 2020; Brooks et al., 2020; Jenei et al., 2020; Wang and Zhao, 2020; Rahimi and Vallerand, 2021). Existing findings provide initial support for this prediction as they demonstrated that environmental unpredictability was positively related to procrastination (Chen and Qu, 2017).

To better effect strategies and interventions to reduce procrastination among students in higher education, it is important to also understand the underlying psychological mechanism through which procrastination occurs. Without understanding the psychology behind the effect of uncertainty on procrastination, preventing procrastination in a pandemic would be ineffective especially since an uncertain climate is likely to persist as people figure out "the new normal" post COVID-19. As such, this paper employed the life history theory in examining the underlying psychological mechanism behind uncertainty and procrastination.

Life History Theory and Procrastination

The life history theory posits that organisms allocate limited resources, energy, and time based on environmental constrains (Del Giudice et al., 2015). Life history strategies exist on a slow-fast continuum and are determined by the most optimal allocation of resources, energy, and time between somatic and reproductive effort in response to environmental conditions (Griskevicius et al., 2013; Del Giudice et al., 2015). A slower life history strategy evolved in favorable and predictable environments; as such, it promotes the preference for efforts directed at building the future, such as growing human and social capital. In contrast, a faster life history strategy evolved in harsh and unpredictable environments where it is optimal to focus on the present; as such, it is characterized by the preference for efforts directed at fulfilling immediate goals. Generally, fast life history strategists discount the future in favor of present gains (e.g., Wang et al., 2009; Griskevicius et al., 2011b). A faster life history strategy hedges against an uncertain future as individuals prioritize present survival and accelerated growth over investments for the future (Ellis et al., 2009).

Within this framework, procrastination, characterized by engaging in an activity that provides immediate hedonic rewards, is conceptualized as a manifestation of a fast life history strategy. As a fast life history strategy, procrastination may be the response to harsh and unpredictable environments where the likelihood of future success is low, hence serving the adaptive function of avoiding the cost of a current effort when there may not be a future in which the payoffs can be realized (Chen and Chang, 2016).

Existing data supports this proposition. Procrastination was positively associated with a fast life history orientation (Chen and Chang, 2016). Procrastination was higher when the environment was unpredictable and likelihood of future success was low (Chen and Qu, 2017; Chen and Kruger, 2017). Furthermore, the relation between environmental unpredictability and procrastination was mediated by life history strategy; environmental unpredictability was negatively related to a slower life history strategy, and in turn, slower life history strategy was negatively related to procrastination (Chen and Qu, 2017). Collectively, these findings suggest that an uncertain environment is likely to result in procrastination by psychologically shifting one's resource allocation strategy to a faster one that favors present gains.

The Present Research

Taking it all together, existing studies established that COVID-19 has resulted in a preponderance of procrastination among students in higher education (Aucejo et al., 2020; Biricik and Sivrikaya, 2020; Jia et al., 2020); yet, they do not elucidate how COVID-19 have effected an increase in procrastination. Drawing upon previous findings and employing a life history framework (Griskevicius et al., 2013; Del Giudice et al., 2015; Chen and Qu, 2017), we propose that the increase in procrastination may be attributed to the heightened levels of uncertainty in the pandemic. While it is not possible to compare the difference in uncertainty before and after the occurrence of the pandemic in this paper, we examine the change in uncertainty, and its effect on procrastination, across different phases of the pandemic. Specifically, we predict that students experience elevated levels of uncertainty, and correspondingly, higher levels of procrastination during the initial phase of the pandemic than subsequent phases.

For this paper, we examine the perceptions of students from a university based in Western Australia across two semesters. Following a declared state of emergency, social distancing restrictions began in Western Australia in early March 2020

(Government of Western Australia, 2020a). With the exception of essential services, public spaces were closed and gatherings were only limited to two people (GardaWorld, 2020a,b). Even though universities were exempt from the restrictions—as they fall under essential services, Western Australian universities prepared for closures of physical campuses and swiftly transited to online teaching and learning services (Pilat, 2020). At the university in which the sample of this paper was based in, these measures were implemented in the middle of a school semester. Classes were suspended for 2 weeks to allow for staff and students to prepare to transit to an online learning environment. Timetables had to be rescheduled to accommodate for such changes. However, classes that required the use of labs and clinics were under review. Collectively, these changes are likely to produce heightened levels of uncertainty among students during this school semester (February to May 2020).

COVID-19 restrictions started to ease in Western Australia by June 2020 (Government of Western Australia, 2020b). Social and recreational activities can resume with social distancing measures (limited number of people, two square meter per person capacity). Moreover, before the commencement of the following semester commenced, the university of this sample in which the paper was based on, announced that classes in the following semester were to be the same as the semester before. That is, classes and examinations were to take place online. Given student's prior experience with online learning, and the improving COVID-19 situation, students are likely to experience less uncertainty in the following semester (August to November 2020) compared to the semester before.

Additionally, we further propose life history strategy as the psychological mechanism through which procrastination occurs: uncertainty in the pandemic climate psychologically shifts resource allocation strategies such that it is more optimal to favor present gains, which consequently results in procrastination. Specifically, we predict that uncertainty is associated with a faster life history strategy, which in turn, is positively related to procrastination. In doing so, we hope to shed light on the psychology behind the effect of uncertainty on procrastination, which is imperative for the design of procrastination interventions for the pandemic and "the new normal" post COVID-19.

MATERIALS AND METHODS

To examine the change in uncertainty, and its effect on procrastination, across different phases of the pandemic, data was collected across two time periods for this study. The first period (Time 1) was during the school semester in 2020, between August and November 2020 when COVID-19 surfaced and several changes were abruptly imposed, and the second period (Time 2) during the following school semester in 2021, between February and May 2021.

Participants

A total of 253 participants were recruited through an Australian university's subject pool system (201 females, M_{age} = 23.23, SD_{age} = 7.30). One hundred and forty six participants were recruited in Time 1 (118 females, M_{age} = 24.03, SD_{age} = 7.67) and 107 participants were recruited in Time 2 (83 females, M_{age} = 22.14, SD_{age} = 6.65). All participants were undergraduate students with the majority in their first year ($N_{Time\ 1}$ = 52, $N_{Time\ 2}$ = 62). Participants were only allowed to participate in this study once; participants who have responded to the survey in Time 1 did not participate in the survey conducted at Time 2.

Procedure

After providing informed consent, participants responded to a series of questionnaires assessing uncertainty, life history strategy, and procrastination. For the survey in Time 1, participants were instructed to respond to the questions with reference to the period of time between March and May 2020 when COVID-19 cases spiked, and several measures were introduced in Western Australia and the university to curb the spread of COVID-19. For the survey in Time 2, participants were instructed to respond to the questions with reference to the period of time between August and November 2020 when COVID-19 was more managed. Participants provided demographic information before completing the study.

Materials

Uncertainty

The Environmental Unpredictability Scale (Davis and Werre, 2008) was employed to assess participants' perception of environmental uncertainty. Participants were asked to rate the chances they had of attaining future outcomes in three broad aspects: resource acquisition, offspring survivability, and social rank. Participants responded to items such as, "I will have a job that pays well," "Life will turn out better for me than it has for my parents," and "I will have a happy family life" for each aspect, respectively. Participants rated a total of 12 items on a 5-point scale (1 = *very low chance,* 5 = *very high chance*). The scores for each item was reversed coded and averaged to form a composite score for environmental uncertainty, where higher scores indicated higher perceived environmental uncertainty (M = 2.72, SD = 0.66, $\alpha_{resourceacquisition}$ = 0.88, $\alpha_{offspringsurvivability}$ = 0.75, $\alpha_{socialrank}$ = 0.73, $\alpha_{overall}$ = 0.88, ω = 0.75).

Life History Strategy

The life history strategy adopted by an individual was assessed with the Life History Strategy Short-Form scale (Figueredo et al., 2006). Participants responded to 20 statements (e.g., "I often make plans in advance" and "I avoid taking risks") using a 7-point Likert scale (1 = "*strongly disagree*" to 7 = "*strongly agree*"). The items were reverse-scored and averaged to form a composite score; higher scores indicated the adoption of a faster life history strategy (M = 3.10, SD = 0.71, α = 0.77).

Procrastination

Procrastination on academic tasks was assessed by the Pure Procrastination Scale (Steel, 2010). Participants responded to 12 statements (e.g., "I delay making decision until it's too late" and "Even after I make a decision I delay acting upon it") on a

5-point scale (1 = *very seldom true of me*, 5 = *very often true of me*) (M = 3.21, SD = 0.83, α = 0.90).

ANALYTICAL STRATEGY

Statistical analyses were performed using the software package SPSS Statistics for Windows, version 26.0 (IBM Corporation, 2019). Descriptive statistics were provided for environmental unpredictability, life history strategy, and procrastination. Before proceeding to the main analyses, the assumption of normality was checked. Values for skewness and kurtosis for all variables were between −1 and + 1, which were acceptable standards for a normal distribution (George and Mallery, 2010). This indicates that parametric tests can be employed in the subsequent analyses. Independent t-tests were conducted to compare the differences in means of environmental uncertainty and procrastination between two phases of the pandemic (i.e., Time 1 versus Time 2).

A multiple regression analysis was conducted to investigate if environmental uncertainty predicted procrastination. Gender, age, the school year in which participants were in,[1] and the time at which the survey was conducted were also included in the regression model as control variables. Assumptions for regression analyses were also evaluated before the interpretation of its results. Inspection of the normal probability plot of standardized residuals and the scatterplot of standardized residuals against standardized predicted values indicated that the assumptions of normality, linearity, and homoscedasticity of residuals were met. Relatively high tolerances of all predictors in the regression model (Tolerance values were between 0.86 and 0.99) indicated that multicollinearity is not an issue. Examination of boxplots indicated the presence of 3 univariate outliers for environmental uncertainty. Mahalanobis distance exceeded the critical χ^2 for df = 5 (at α = 0.01) of 15.09 for 6 cases in the data, indicating the presence of multivariate outliers. Multiple regression analyses were conducted with and without these univariate and multivariate outliers.

Finally, a mediation analysis using PROCESS version 3.1 (Hayes, 2018) was performed to examine if life history strategy mediated the relation between environmental uncertainty and procrastination. For mediation to be demonstrated, the bootstrap confidence interval of the indirect effect (path a*b) must not include zero (bootstrap samples = 5,000) (Hayes, 2018). Similarly, mediation analyses were conducted with and without the univariate and multivariate outliers.

RESULTS

Descriptive Analyses

Table 1 displays the means, standard deviations, skewness, and kurtosis of all the variables involved in this study. **Table 2** displays the intercorrelations of the variables. Environmental uncertainty was negatively correlated with life history strategy and positively correlated with procrastination. Additionally, life history strategy was negatively correlated with procrastination.

TABLE 1 | Descriptive statistics of all variables.

Variables	Time 1 (N = 146)				Time 2 (N = 107)			
	M	SD	Skew	Kurtosis	M	SD	Skew	Kurtosis
Environmental uncertainty	2.77	0.68	0.31	0.05	2.65	0.63	0.46	0.99
Life history strategy	3.00	0.68	0.60	−0.20	3.22	0.73	0.43	−0.39
Procrastination	3.21	0.82	−0.06	−0.88	3.19	0.85	−0.35	−0.15

TABLE 2 | Intercorrelations of all variables.

Variables	1.	2.	3.
1. Environmental uncertainty	–		
2. Life history strategy	0.32**	–	
3. Procrastination	0.26**	0.21*	–

*$p < 0.01$;
**$p < 0.001$.

Main Analyses

An independent t-test was conducted to examine if environmental uncertainty was higher in Time 1 than in Time 2. Results indicated that environmental uncertainty was higher in Time 1 (M = 2.77, SD = 0.68) than in Time 2 (M = 2.65, SD = 0.63); however, this difference was not significant, $t(251) = 1.40$, $p = 0.16$, $d = 0.18$.

An independent samples t-test was conducted to examine if procrastination was higher in Time 1 than in Time 2. The analysis yielded no significant difference in procrastination between the two time periods, $t(251) = 0.20$, $p = 0.84$, $d = 0.02$. It is worth noting that procrastination was higher in Time 1 (M = 3.21, SD = 0.82) than in Time 2 (M = 3.19, SD = 0.85).

A multiple regression analysis was conducted to examine the effect of environmental uncertainty on procrastination. Results showed that the model accounted for a significant 9.2% of the variability in procrastination, $R^2 = 0.092$, adjusted $R^2 = 0.074$, $F(5, 247) = 5.03$, $p < 0.01$, $f^2 = 0.10$. The analysis revealed that environmental uncertainty predicted procrastination, $B = 0.32$, $t(247) = 4.15$, $p < 0.01$, 95% CI [0.17, 0.47].[2] Unstandardized (B) and standardized (β) regression coefficients for each predictor are reported in **Table 3**. A sensitivity analysis conducted using G-Power indicated that given a total sample size of 253, the minimum effect size to detect a power of 0.80 at α = 0.05 is $f^2 = 0.04$ for this study.

To examine if participants' life history strategy mediated the relationship between perceived uncertainty and procrastination, a mediation analysis using Hayes' PROCESS model 4 was conducted (Hayes, 2018). Environmental uncertainty was included as the independent variable, procrastination as the

[1]The school year participants were in were coded as 1 = first years and 0 = non-first-years.

[2]A similar regression analysis was conducted with the exclusion of univariate and multivariate outliers. The analysis excluding the outliers revealed similar finding. The model accounted for a significant 9.3% of the variability in procrastination, $R^2 = 0.093$, adjusted $R^2 = 0.074$, $F(5, 239) = 4.89$, $p < 0.01$. The analysis revealed that environmental uncertainty predicted procrastination, $B = 0.33$, $t(239) = 3.99$, $p < 0.01$, 95% CI [0.17, 0.49]. The significance of the effect of uncertainty on procrastination remained.

TABLE 3 | Unstandardized (B) and standardized (β) regression coefficients for predictors in regression model predicting procrastination.

Variables		95% CI			
	B	LL	UL	se	β
Constant	2.34	1.65	3.03	0.35	
Environmental uncertainty	0.32***	0.17	0.47	0.08	0.26
Gender	0.12	−0.12	0.37	0.12	0.06
Age	−0.003	−0.02	0.01	0.01	−0.03
School year	0.23**	0.01	0.44	0.11	0.14
Time	−0.04	−0.25	0.16	0.11	−0.03

$^{**}p < 0.05$; $^{***}p < 0.01$.

TABLE 4 | Mediation model coefficients for environmental uncertainty, life history strategy, gender, age, school year, time, and procrastination (N = 253).

Variables	*B*	LLCI	ULCI	se
DV = life history strategy (R^2 = 0.18, $p < 0.01$)				
Constant	1.59	1.03	2.15	0.28
Environmental uncertainty	0.38***	0.26	0.51	0.06
Gender	0.34***	0.14	0.54	0.10
Age	0.002	−0.01	0.01	0.01
School year	−0.03	−0.20	0.14	0.09
Time	0.26***	0.09	0.43	0.09
DV = procrastination (R^2 = 0.11, $p < 0.01$)				
Constant	2.07	1.35	2.79	0.37
Environmental uncertainty	0.25***	0.09	0.42	0.08
Life history strategy	0.17**	0.02	0.32	0.08
Gender	0.06	−0.19	0.31	0.13
Age	−0.004	−0.02	0.01	0.01
School year	0.23**	0.02	0.44	0.11
Time	−0.09	−0.30	0.12	0.11

$^{**}p < 0.05$. $^{***}p < 0.01$.

dependent variable, and life history strategy as the mediator. The time at which the survey was conducted was included as a covariate. Gender, age, and the school year participants were in were also included as covariates. Results revealed that environmental uncertainty was positively associated with life history strategy, B = 0.38, $p < 0.01$, 95% CI [0.26, 0.51], where higher perceived uncertainty predicted the adoption of faster life history strategies. Next, results also revealed that life history strategy was positively associated with procrastination, B = 0.17, p = 0.03, 95% CI [0.02, 0.32]. Participants with a faster life history strategy were more likely to procrastinate. Finally, results indicated that perceived uncertainty was positively associated with procrastination via participants' life history strategy, B = 0.07, 95% CI = [0.003, 0.14], thus demonstrating the mediation effect of life history strategy on the relation between perceived uncertainty and procrastination.[3] Unstandardized (B) regression coefficients, 95% confidence intervals, and R^2 values for the mediation model are presented in **Table 4**.

DISCUSSION

This paper sought to elucidate how COVID-19 has effected an increase in procrastination. We proposed that the increase in procrastination may be attributed to the heightened levels of uncertainty in the pandemic. Moreover, we also examined the underlying psychological mechanism for *how* an uncertain climate drives procrastination. Specifically, we investigated life history strategy as the psychological mechanism through which procrastination occurs. Data was collected from undergraduate students across two time periods. Data collected at Time 1 assessed the perceptions of students in the semester where changes were abruptly imposed to stem the spread of COVID-19. Data collected at Time 2 assessed the perceptions of students one semester after changes to the curriculum were made. Our findings showed that environmental uncertainty and procrastination were similar between both semesters. We also found environmental uncertainty predicted procrastination. Furthermore, our results revealed that life history orientation mediated the relation between uncertainty and procrastination, suggesting that environmental uncertainty psychologically shifted the resource allocation strategies of students to a faster one such that it was more optimal to favor present gains, which consequently predicted procrastination.

Our findings showed that uncertainty was higher in Time 1 than in Time 2, even though this difference was not significant, it suggests that perceived uncertainty was especially heightened at the time when several changes were effected to curb the spread of COVID-19. This is consistent with anecdotal evidence that reported the uncertain futures students face relating to their education and professional careers (Aucejo et al., 2020; Jenei et al., 2020). The lack of significance in the difference in perceived uncertainty between the two time periods is likely due to the evolving nature of COVID-19 (e.g., new strain and sudden lockdowns due to new clusters of infected cases). As such, even though students may have accustomed to the changes made to their curriculum (e.g., online learning), which may lower uncertainty, being on a constant lookout for abrupt changes regarding the pandemic may keep uncertainty at relatively high levels for students. Moreover, individuals differ in their sensitivity toward uncertainty. Intolerance to uncertainty is the tendency to perceive and interpret uncertain situations as aversive and stressful (Dugas et al., 2004). Students' intolerance to uncertainty may have influenced their perceptions of uncertainty during the pandemic, such that those with lower intolerance to uncertainty would have perceived less uncertainty than those with higher intolerance to uncertainty. Such individual difference could contribute to the similar levels of uncertainty perceived between the two time periods.

Our findings also demonstrated that procrastination was higher in Time 1 than in Time 2, though the difference

[3] A similar mediation analysis was conducted with the exclusion of univariate and multivariate outliers. The analysis excluding the outliers revealed similar findings: Eenvironmental uncertainty was positively associated with life history strategy, B = 0.37, $p < 0.01$, 95% CI [0.22, 0.52]. Life history strategy was positively associated with procrastination, B = 0.19, p = 0.02, 95% CI [0.03, 0.35]. Perceived uncertainty was positively associated with procrastination via participants' life history strategy, B = 0.07, 95% CI = [0.006, 0.14], indicating that life history strategy mediated the relation between environmental uncertainty and procrastination.

in procrastination was not significant between the two time periods. While our results cannot conclude that procrastination levels were higher during the pandemic than before (Aucejo et al., 2020; Biricik and Sivrikaya, 2020; Jia et al., 2020), our finding showed that procrastination was higher during the initial phases of the pandemic than in the subsequent phases, suggesting that sudden changes brought about by COVID-19 played a part in encouraging procrastination. The lack of significant difference in procrastination may be an artifact of the similarity in environmental uncertainty levels. Additionally, as procrastination is often engaged to cope with negative emotional states (Hen and Goroshit, 2014), and elevated negative emotional states were also constantly reported during the pandemic (Biricik and Sivrikaya, 2020; Jenei et al., 2020; Rahimi and Vallerand, 2021), it is likely the affective state of participants contributed to similar levels of procrastination observed between the time two periods.

We also found that uncertainty predicted procrastination, and that life history orientation mediated the relation between uncertainty and procrastination, which is consistent with the life history framework (Chen and Qu, 2017; Chen and Kruger, 2017). In line with this theoretical framework, our results demonstrated that environmental uncertainty predicted a faster life history strategy, which signaled that it was more optimal to favor present gains than future ones, consequently predicting procrastination. Our findings also provided further support to the conceptualization of procrastination as an adaptive response to environmental conditions—specifically, to environmental unpredictability (Chen and Qu, 2017; Chen and Kruger, 2017). Moreover, consistent with previous findings, our findings also showed that procrastination was associated with a faster life strategy, suggesting that procrastination is more likely when present gains are favored (Chen and Chang, 2016; Chen and Qu, 2017). This also corroborates findings that demonstrated the association procrastination and negative attitudes of academic investment have with reductions in future time perspective and future outlook (Ferrari and Díaz-Morales, 2007; Schechter and Francis, 2010).

Although we found life history strategy to mediate the association between uncertainty and procrastination, the mediation effect is relatively small. This suggests that there could be factors that influenced the mediating effect of life history strategy—one factor could be an individual's childhood socioeconomic status. Within life history theory, an individual's early life environment determines the life history strategy they adopt (Del Giudice, 2009; Ellis et al., 2009; Griskevicius et al., 2011a). Individuals who grew up in low socioeconomic environments were more likely to be exposed to environmental stressors, such as fluctuating resource availability and changing household memberships, which prompts them to adopt faster life history strategies compared to individuals who grew up in high socioeconomic environments (where environmental stressors were largely absent) (Belsky, 2007). This early exposure to environmental stressors not only affects the life history strategy one adopts during their childhood, it also affects how individuals respond to environmental stressors later in life (Caretta et al., 1995). Individuals who have developed a faster life history strategy tendency as a function of their early life low socioeconomic environments are sensitive to environmental stressors and likely to discount the future in favor of present gains (Boyce and Ellis, 2005; Griskevicius et al., 2011b). As such, it is likely that these individuals will be more sensitive to the uncertain climate during the pandemic and hence, are more responsive in adopting a faster life history strategy than individuals who grew up in high socioeconomic environments (and have developed a tendency to adopt slower life history strategies). This difference in response to environmental uncertainty could explain the small mediation effect observed.

Limitations and Future Directions

Our work is far from conclusive and poses questions for future work. As we have discussed previously, childhood socioeconomic status can potentially influence one's sensitivity to environment stresses and shifts in life history strategy. Given that we only measured participants' life history strategy based on their current environment than their early life environment, and childhood socioeconomic status was not assessed in this study, we are not able to ascertain the extent to which participants' childhood socioeconomic status affected participants' reaction to heightened levels of uncertainty during the pandemic. Future studies should assess participants' childhood socioeconomic status and test for a moderated mediation model, where life history strategy mediates the relation between uncertainty and procrastination and childhood socioeconomic status moderates the shift in life history orientation in response to environmental uncertainty.

Additionally, we did not account for personality traits that may influence one's tendency to procrastinate. The tendency to procrastinate has also been associated with personality traits, specifically, conscientiousness and neuroticism. Conscientiousness was inversely correlated to procrastination (Johnson and Bloom, 1995; Van Eerde, 2003; Steel, 2007). Neuroticism was also significantly correlated to procrastination (Johnson and Bloom, 1995). With these personality traits predicting procrastination, it would be difficult to tease apart the unique effects of environmental uncertainty from the effects of these traits on procrastination.

We recognize that our study is limited to self-reported measures, which may limit interpretation of our findings, especially since the internal consistency of the measures assessing environmental uncertainty ($\alpha_{\text{socialrank}} = 0.73$) and life history strategy ($\alpha = 0.77$) were relatively lower, though still within acceptable range (Cortina, 1993), than the rest. Given that uncertainty have been associated with physiological changes, such as heart rate (Averill et al., 1972; Monat et al., 1972), future studies can consider measuring for physiological changes on top of self-reported perceived environmental uncertainty. Life history strategy can also be assessed behaviorally by observing how they interact with others—fast life history strategists tend to express criticism and talk with physical animations (Sherman et al., 2013). Hence, future studies can consider employing these other means of assessment to complement the

self-reported measures of environmental uncertainty and life history strategy.

Furthermore, as participants often evaluate their behaviors negatively when asked to think about them retrospectively, self-reported measures of procrastination may not accurately reflect actual procrastination (Steel et al., 2001; Moon and Illingworth, 2005). Thus, it is likely that procrastination scores were inflated—as an artifact of using a self-report measure—and not truly reflective of participants' actual procrastination in this study. To overcome this shortcoming, future studies should consider employing observed measures for assessing actual procrastination.

With the adverse effect procrastination has on academic performance (Kim and Seo, 2015), it is important that procrastination is managed. Given that an emphasis on present gains predicts procrastination, one way to ameliorate procrastination in students would be to shift the emphasis to the future by boosting their perceived value of the future. This can be done by making the future self a salient concept in students as students have found that a future self can motivate action. An event-related fMRI study found that future self-continuity reduced temporal distancing—the extent to which individuals distinguish between the present self and future self; when individuals perceived their future-self more clearly, they made better decisions for their future (Ersner-Hershfield et al., 2009). Increasing the congruence between the present and future self was found to generate motivation for current action (Lewis and Oyserman, 2015). Self-focused mental imagery can be used as a psychological tool to bridge the present-future gap to reduce procrastination (Blouin-Hudon and Pychyl, 2017). As an uncertain climate is likely to persist, eliminating procrastination by reducing uncertainty may not necessarily be an ineffective strategy. Having identified life history orientation as the psychological mechanism behind uncertainty and procrastination, future studies can examine the feasibility in shifting students' emphasis on the future to minimize procrastination.

CONCLUSION

This paper demonstrated that levels of uncertainty and procrastination in undergraduate students were similar between the semester where COVID-19 changes are abruptly imposed to stem the spread of COVID-19 and the following semester. Employing an evolutionary life history framework, this paper found that uncertainty predicted procrastination. This paper also provided an underlying explanation for *how* an uncertain climate drives procrastination. Specifically, the findings of this paper showed that uncertainty in the current pandemic prompted students to psychologically shift their life history strategy such that it was more optimal to focus on present gains, which consequently predicted procrastination.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The present study has been approved by the Murdoch University Research Ethics with the following approval reference number: 2020/145. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AL and SJ were involved in the conceptualization of the project and formulation the study design. AL acquired and analyzed the data and drafted the manuscript. Both authors read and approved the final manuscript, agreed to be accountable for the content of this manuscript.

REFERENCES

Ahir, H., Bloom, N., and Furceri, D. (2019). *The World Uncertainty Index*. Rochester, NY: SSRN.

Arifiana, I. Y., Rahmawati, H., Hanurawan, F., and Eva, N. (2020). Stop academic procrastination during Covid 19: academic procrastination reduces subjective well-being. *KnE Soc. Sci.* 4, 312–325.

Aucejo, E. M., French, J., Araya, M. P. U., and Zafar, B. (2020). The impact of COVID-19 on student experiences and expectations: evidence from a survey. *J. Public Econ.* 191:104271. doi: 10.1016/j.jpubeco.2020.104271

Averill, J. R., Olbrich, E., and Lazarus, R. S. (1972). Personality correlates of differential responsiveness to direct and vicarious threat: a failure to replicate previous findings. *J. Pers. Soc. Psychol.* 21, 25–29. doi: 10.1037/h0031948

Belsky, J. (2007). "Childhood experiences and reproductive strategies," in *Oxford Handbook of Evolutionary Psychology*, eds L. Barrett and R. Dunbar (New York, NY: Oxford University Press), 237–254.

Biricik, Y. S., and Sivrikaya, M. H. (2020). COVID-19 fear in sports sciences students and its effect on academic procrastination behavior. *Int. J. Appl. Exerc. Physiol.* 9, 50–56.

Blouin-Hudon, E. M. C., and Pychyl, T. A. (2017). A mental imagery intervention to increase future self-continuity and reduce procrastination. *Appl. Psychol.* 66, 326–352. doi: 10.1111/apps.12088

Boyce, W. T., and Ellis, B. J. (2005). Biological sensitivity to context: I. an evolutionary–developmental theory of the origins and functions of stress reactivity. *Dev. Psychopathol.* 17, 271–301. doi: 10.1017/S0954579405050145

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 395, 912–920. doi: 10.1016/S0140-6736(20)30460-8

Caretta, C. M., Caretta, A., and Cavaggioni, A. (1995). Pheromonally accelerated puberty is enhanced by previous experience of the same stimulus. *Physiol. Behav.* 57, 901–903. doi: 10.1016/00319384(94)00344-5

Chaturvedi, K., Vishwakarma, D. K., and Singh, N. (2021). COVID-19 and its impact on education, social life and mental health of students: a survey. *Child. Youth Serv. Rev.* 121:105866. doi: 10.1016/j.childyouth.2020.105866

Chen, B. B., and Chang, L. (2016). Procrastination as a fast life history strategy. *Evol. Psychol.* 14, 1474704916630314.

Chen, B. B., and Kruger, D. (2017). Future orientation as a mediator between perceived environmental cues in likelihood of future success and

procrastination. *Pers. Individ. Differ.* 108, 128–132. doi: 10.1016/j.paid.2016.12.017

Chen, B. B., and Qu, W. (2017). Life history strategies and procrastination: the role of environmental unpredictability. *Pers. Individ. Differ.* 117, 23–29. doi: 10.1016/j.paid.2017.05.036

Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *J. Appl. Psychol.* 78, 98–104. doi: 10.1037/0021-9010.78.1.98

Davis, J., and Werre, D. (2008). A longitudinal study of the effects of uncertainty on reproductive behaviors. *Hum. Nat.* 19, 426–452. doi: 10.1007/s12110-008-9052-2

Del Giudice, M. (2009). Sex, attachment, and the development of reproductive strategies. *Behav. Brain Sci.* 32, 1–67. doi: 10.1017/S0140525X09000016

Del Giudice, M., Gangestad, S. W., and Kaplan, H. S. (2015). "Life history theory and evolutionary psychology," in *The Handbook of Evolutionary Psychology*, ed. D. M. Buss (New York, NY: Wiley). doi: 10.1002/9781119125563.evpsych102

Drumm, B. T., and Jong, A. S. (2020). A semester like no other: a student and lecturer perspective on the impact of Covid-19 on 3rd level academic life. *All Ireland J. High. Educ.* 12, 1–14.

Dugas, M. J., Buhr, K., and Ladouceur, R. (2004). "The role of intolerance of uncertainty in etiology and maintenance," in *Generalized Anxiety Disorder: Advances in Research and Practice*, eds R. G. Heimberg, C. L. Turk, and D. S. Mennin (New York, NY: Guilford Press), 143–163.

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., and Schlomer, G. L. (2009). Fundamental dimensions of environmental risk. *Hum. Nat.* 20, 204–268.

Ersner-Hershfield, H., Wimmer, G. E., and Knutson, B. (2009). Saving for the future self: neural measures of future self-continuity predict temporal discounting. *Soc. Cogn. Affect. Neurosci.* 4, 85–92. doi: 10.1093/scan/nsn042

Ferrari, J. R., and Díaz-Morales, J. F. (2007). Procrastination: different time orientations reflect different motives. *J. Res. Pers.* 41, 707–714. doi: 10.1016/j.jrp.2006.06.006

Figueredo, A. J., Vásquez, G., Brumbach, B. H., Schneider, S. M., Sefcek, J. A., Tal, I. R., et al. (2006). Consilience and life history theory: from genes to brain to reproductive strategy. *Dev. Rev.* 26, 243–275. doi: 10.1016/j.dr.2006.02.002

GardaWorld (2020a). *Australia: Government Announces Lockdown Extension April 16*. Montreal: GardaWorld.

GardaWorld (2020b). *Australia: Non-Essential Services Suspended and Public Spaces Close March 23*. Montreal: GardaWorld.

George, D., and Mallery, M. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference, 17.0 Update* (10th Edn.). Boston, MA: Pearson.

Government of Western Australia (2020a). *Coronavirus: COVID-19 State of Emergency - Message from the State Emergency Coordinator*. West Perth, WA: Government of Western Australia.

Government of Western Australia (2020b). *Phase 3 of COVID-19 Roadmap to Commence from Saturday, June 6*. West Perth, WA: Government of Western Australia

Griskevicius, V., Ackerman, J. M., Cantú, S. M., Delton, A. W., Robertson, T. E., Simpson, J. A., et al. (2013). When the economy falters, do people spend or save? Responses to resource scarcity depend on childhood environments. *Psychol. Sci.* 24, 197–205. doi: 10.1177/0956797612451471

Griskevicius, V., Delton, A. W., Robertson, T. E., and Tybur, J. M. (2011a). Environmental contingency in life history strategies: the influence of mortality and socioeconomic status on reproductive timing. *J. Pers. Soc. Psychol.* 100, 241–254. doi: 10.1037/a0021082

Griskevicius, V., Tybur, J. M., Delton, A. W., and Robertson, T. E. (2011b). The influence of mortality and socioeconomic status on risk and delayed rewards: a life history theory approach. *J. Pers. Soc. Psychol.* 100, 1015–1026. doi: 10.1037/a0022403

Hayes, A. F. (2018). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, Second Edn. New York, NY: Guilford Press.

Hen, M., and Goroshit, M. (2014). Academic procrastination, emotional intelligence, academic self-efficacy, and GPA: a comparison between students with and without learning disabilities. *J. Learn. Disabil.* 47, 116–124. doi: 10.1177/0022219412439325

Hong, J. C., Lee, Y. F., and Ye, J. H. (2021). Procrastination predicts online self-regulated learning and online learning ineffectiveness during the coronavirus lockdown. *Pers. Individ. Differ.* 174:110673. doi: 10.1016/j.paid.2021.110673

IBM Corporation (2019). *IBM SPSS Statistics for Windows, Version 26.0*. Armonk, NY: IBM Corporation. doi: 10.1016/j.paid.2021.110673

Jenei, K., Cassidy-Matthews, C., Virk, P., Lulie, B., and Closson, K. (2020). Challenges and opportunities for graduate students in public health during the COVID-19 pandemic. *Can. J. Public Health* 111, 408–409. doi: 10.17269/s41997-020-00349-8

Jia, J., Jiang, Q., and Lin, X. H. (2020). *Academic Anxiety and Self-Handicapping Among Medical Students During the COVID-19 Pandemic: A Moderated Mediation Model*. Durham: Research Square.

Johnson, J. L., and Bloom, A. M. (1995). An analysis of the contribution of the five factors of personality to variance in academic procrastination. *Pers. Individ. Differ.* 18, 127–133. doi: 10.1016/0191-8869(94)00109-6

Kim, K. R., and Seo, E. H. (2015). The relationship between procrastination and academic performance: a meta-analysis. *Pers. Individ. Differ.* 82, 26–33. doi: 10.1016/j.paid.2015.02.038

Lewis, N. A. Jr., and Oyserman, D. (2015). When does the future begin? Time metrics matter, connecting present and future selves. *Psychol. Sci.* 26, 816–825. doi: 10.1177/0956797615572231

Meier, A., Reinecke, L., and Meltzer, C. E. (2016). "Facebocrastination"? Predictors of using Facebook for procrastination and its effects on students' well-being. *Comput. Hum. Behav.* 64, 65–76. doi: 10.1016/j.chb.2016.06.011

Monat, A., Averill, J. R., and Lazarus, R. S. (1972). Anticipatory stress and coping reactions under various conditions of uncertainty. *J. Pers. Soc. Psychol.* 24, 237–253. doi: 10.1037/h0033297

Moon, S. M., and Illingworth, A. J. (2005). Exploring the dynamic nature of procrastination: a latent growth curve analysis of academic procrastination. *Pers. Individ. Differ.* 38, 297–309. doi: 10.1016/j.paid.2004.04.009

Organization for Economic Cooperation and Development [OECD] (2020). *Education at a Glance 2020*. Paris: Organization for Economic Cooperation and Development.

Pan, H. (2020). A glimpse of university students' family life amidst the COVID-19 virus. *J. Loss Trauma* 25, 594–597. doi: 10.1080/15325024.2020.1750194

Pilat, L. (2020). *WA Unis Move to Online Learning as Social Distancing Measures Heighten*. East Perth, WA: WAtoday.

Rahimi, S., and Vallerand, R. J. (2021). The role of passion and emotions in academic procrastination during a pandemic (COVID-19). *Pers. Individ. Differ.* 179:110852. doi: 10.1016/j.paid.2021.110852

Rasheed, R. A., Kamsin, A., and Abdullah, N. A. (2020). Challenges in the online component of blended learning: a systematic review. *Comput. Educ.* 144:103701. doi: 10.1016/j.compedu.2019.103701

Rettie, H., and Daniels, J. (2020). Coping and tolerance of uncertainty: predictors and mediators of mental health during the COVID-19 pandemic. *Am. Psychol.* 76, 427–437. doi: 10.1037/amp0000710

Schechter, D. E., and Francis, C. M. (2010). A life history approach to understanding youth time preference: mechanisms of environmental risk and uncertainty and attitudes toward risk-behavior and education. *Hum. Nat.* 21, 140–164. doi: 10.1007/s12110-010-9084-2

Sherman, R. A., Figueredo, A. J., and Funder, D. C. (2013). The behavioral correlates of overall and distinctive life history strategy. *J. Pers. Soc. Psychol.* 105, 873–888. doi: 10.1037/a0033772

Steel, P. (2007). The nature of procrastination: a meta-analytic and theoretical review of quintessential self-regulatory failure. *Psychol. Bull.* 133, 65–94. doi: 10.1037/0033-2909.133.1.65

Steel, P. (2010). Arousal, avoidant and decisional procrastinators: do they exist? *Pers. Individ. Differ.* 48, 926–934. doi: 10.1016/j.paid.2010.02.025

Steel, P., Brothen, T., and Wambach, C. (2001). Procrastination and personality, performance, and mood. *Pers. Individ. Differ.* 30, 95–106. doi: 10.1016/S0191-8869(00)00013-1

Van Eerde, W. (2003). A meta-analytically derived nomological network of procrastination. *Pers. Individ. Differ.* 35, 1401–1418. doi: 10.1016/S0191-8869(02)00358-6

Wang, C., and Zhao, H. (2020). The impact of COVID-19 on anxiety in Chinese university students. *Front. Psychol.* 11:1168. doi: 10.3389/fpsyg.2020.01168

Wang, X. T., Kruger, D. J., and Wilke, A. (2009). Life-history variables and risk-taking propensity. *Evol. Hum. Behav.* 30, 77–84. doi: 10.1016/j.evolhumbehav.2008.09.006

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 20 August 2021
doi: 10.3389/fpsyg.2021.703404

"We Will Appreciate Each Other More After This": Teachers' Construction of Collective and Personal Identities During Lockdown

Kathryn Spicksley[1]*, *Alison Kington*[1] and *Maxine Watkins*[2]

[1] School of Education, University of Worcester, Worcester, United Kingdom, [2] School of Psychology, University of Worcester, Worcester, United Kingdom

In March 2020, schools in England were closed to all but vulnerable children and the children of key workers, as part of a national effort to curb the spread of the Covid-19 virus. Many teachers were required to work from home as remote learning was implemented. Teaching is primarily a relational profession, and previous literature acknowledges that supportive relationships with peers help to maintain teachers' resilience and commitment during challenging periods. This paper reports on findings from a small-scale study conducted in England during the first national lockdown beginning in March 2020, which explored the impact of the requirement to teach remotely on teachers' identity and peer relationships. A discourse analysis, informed by the aims and practices of discursive psychology, was conducted in order to explore the association between constructions of peer support and responses to the Covid-19 pandemic. Findings indicate that teachers who presented their professional self-identity as collective rather than personal appeared to have a more positive perspective on the difficulties caused by the Covid-19 pandemic. These findings, which have implications for policymakers and school leaders, contribute to the growing field of research on the impact of the Covid-19 pandemic on education by showing the strong association between teachers' constructions of identity and their capacity to respond positively to the challenges brought about by the Covid-19 pandemic.

Keywords: teacher identity, social identity theory, COVID-19, lockdown, remote teaching, collegiality, teacher peer relationships, discourse analysis

OPEN ACCESS

Edited by:
Karin Gehrer,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Frank Hellmich,
University of Paderborn, Germany
Caterina Mamprin,
Université de Moncton, Canada

***Correspondence:**
Kathryn Spicksley
k.spicksley@worc.ac.uk

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 April 2021*
Accepted: *28 July 2021*
Published: *20 August 2021*

Citation:
Spicksley K, Kington A and Watkins M (2021) "We Will Appreciate Each Other More After This": Teachers' Construction of Collective and Personal Identities During Lockdown. Front. Psychol. 12:703404. doi: 10.3389/fpsyg.2021.703404

INTRODUCTION

Covid-19 and Education in England

The pandemic spread of the Covid-19 virus in 2020 created unprecedented disruption to education on a global scale. School buildings were reported to have closed in 188 countries by April 2020 (UNICEF, 2020). In England, schools closed in March 2020 except for those children considered vulnerable and children of key workers (BBC, 2020). Restrictions were imposed quickly leaving little time for teachers and schools to prepare; on the 13th March, Gavin Williamson, the Secretary of State for Education, spoke to school leaders at the Association of School and College Leaders (ASCL) Conference, saying that "[i]n the overwhelming majority of situations, there is absolutely no need to close a school" (Williamson, 2020, n.p.). On the 18th March, only a few days later,

Williamson ordered all schools to "shut their gates [and] remain closed" from 20th March (UK Parliament, 2020, n.p.). Examinations were canceled and teaching was moved online, with teachers required to educate pupils remotely from home; most pupils did not return to school until September 2020 (Ofsted, 2020). Research is beginning to detail the negative effect that this initial lockdown and subsequent disruption has had on the well-being and attainment of many pupils (Young Minds, 2020; Rose et al., 2021).

Less attention has been paid to the impact on teacher peer relationships, although there have been indications that teachers sought out supportive relationships with their colleagues in order to maintain resilience during this challenging time (Kim and Asbury, 2020; Klapproth et al., 2020), and that senior leaders reorientated their attention toward relational aspects of schooling (Ferguson et al., 2021). The requirement to teach online had an impact on pedagogy (Greenhow et al., 2020; Spoel et al., 2020; Carpenter and Dunn, 2021), attainment (Ofsted, 2020; Rose et al., 2021), student motivation (Ofsted, 2020; Zaccoletti et al., 2020), and student–teacher relationships (Jones and Kessler, 2020; Moss et al., 2020; Wong, 2020). Headteachers reported that their strategies of leadership shifted becoming more closely aligned to an ethic of care, recognizing the traumatic nature of the crisis (Beauchamp et al., 2021).

This article explores how teachers discursively constructed their relationships with peers during the first lockdown in England (March 2020), and how this impacted on their perspectives on the crisis and their construction of a professional identity. Findings show that teachers who constructed a salient *social* identity portrayed more positive perspectives on the Covid-19 crisis, whereas those who constructed a salient *personal* identity had more negative perspectives. The reasons why these teachers chose to construct their professional identities in these ways are also touched upon. We show that senior leaders used a social identity to present a positive professional identity, and that teachers who were considering leaving the profession discursively justified their loss of commitment through the foregrounding of a personal identity.

Teachers' Mental Health: Stress and Social Support

The association between teaching and mental health difficulties is long established (Blase, 1982; Kalker, 1984; Kyriacou, 1987; Guglielmi and Tatrow, 1998), and consequently a vast literature exists documenting teacher stress and burnout. Before the Covid-19 pandemic, teachers stress was already recognized as a serious problem (Johnson and Birkeland, 2003; Johnson et al., 2005; Newberry and Allsop, 2017), causally linked to teacher burnout and attrition (Betoret, 2009; Jones and Youngs, 2012; Skaalvik and Skaalvik, 2016; Ryan et al., 2017). Teacher stress has been attributed to negative relationships with pupils (Aldrup et al., 2018; Harmsen et al., 2018), insufficient support within school or negative relationships with teaching colleagues (Troman, 2000; Van Dick and Wagner, 2001; Yuan and Lee, 2016), and accountability procedures leading to increased workload and loss of agency (Perryman, 2007; Brown and Manktelow, 2016; Towers and Maguire, 2017). The Covid-19 pandemic brought additional stressors for teachers, including Covid-19 related anxiety (Pressley, 2021) and teachers reported higher feelings of nervousness, anger, and boredom while remote teaching (Letzel et al., 2020) and on their return to school (Ozamiz-Etxebarria et al., 2020). Research conducted during the Covid-19 pandemic has, however, highlighted several factors which can mitigate teacher stress, including autonomy supportive leadership (Collie, 2021), social support (Zhou and Yao, 2020), and feelings of self-efficacy (Rabaglietti et al., 2021).

Although social support is recognized as a way of reducing stress generally (Viswesvaran et al., 1999; Ozbay et al., 2007; McKimmie et al., 2019) and specifically within education (Kinman et al., 2011; Larrivee, 2012), it is recognized that certain groups have tendencies toward particular methods of coping with stress. Strategies of developing and sustaining social support in order to alleviate stress appear to be more common amongst women rather than men (Taylor, 2011); this is in line with research which has identified maladaptive and avoidant coping strategies as more often practiced by males in response to stress, whereas females will more often use adaptive coping strategies (Gentry et al., 2007; Adasi et al., 2020). Studies have identified this gendered pattern in teachers' responses to the pandemic (Klapproth et al., 2020; Truzoli et al., 2021). As three quarters of the teaching population in England are female (Gov.uk, 2020), it would therefore be expected that developing and maintaining social support networks would be a prominent coping strategy to manage stress amongst teachers working in this context.

The present article is influenced by the field of discursive psychology (Potter and Wetherell, 1987; Edwards and Potter, 1992); as such, the focus of research is not on the causes of psychological issues such as stress, or on the efficacy of coping mechanisms used to prevent or cure such problems. Instead, discursive psychological research focuses on how people *talk* about psychological issues such as stress, and how the introduction of such issues into talk are *used* to achieve certain aims. Researchers using discursive psychological approaches identify the relationship between causal attributions of stress in the workplace (Kinman and Jones, 2005), and explore what is considered "normative" with regard to workplace stress (Harkness et al., 2007).

Such discursive approaches to education seek to identify the discursive associations and strategies which are deployed when teachers talk about their working lives. In their research with 15 Scottish secondary school teachers, Hepburn and Brown showed that in their research conversations teachers used "[s]tress as a category, and its ability to be generalized to the whole population of teachers [to] build immunity from any accusations" (2001, p. 701). Stress was called upon within research conversations to protect teachers' sense of positive professional identity and to defend them from accusations of impropriety. Kelly and Colquhoun (2010) found that reducing stress was constructed by policymakers as key to improving school improvement, with subsequent responsibility placed on school managers to manage stress amongst their workforce, and for individual teachers to position themselves as able to successfully manage stress. Thomson (2008) showed how one headteacher used the theme

of stress in a radio interview to criticize government policy and justify decisions by headteachers to leave the profession. In such research, the focus is not on how stress manifests in individuals or how individuals cope with stressful situations, but instead on how the theme of stress is discursively deployed in conversations in order to support the speaker's construction of a positive professional identity.

Social Relationships and Social Identity Theory

Our study was primarily driven by an interest in how teachers spoke about their relationships with colleagues during the Covid-19 lockdown. Positive social relationships are strongly associated with improved mental and physical health outcomes, including higher well-being and lower rates of mortality (Kawachi and Berkman, 2001; Cohen, 2004; Holt-Lundstrad and Smith, 2012; Tay et al., 2012). The "stress buffering hypothesis" (Cohen and Wills, 1985; Raffaelli et al., 2013) holds that supportive social relationships are able to provide a "buffer" to individuals during times of perceived stress and anxiety, protecting their mental and physical health. In their theoretical work on the importance of social relationships, Feeney and Collins have defined social support as "an interpersonal process with a focus on thriving" (Feeney and Collins, 2014, p. 113). Taking a lead from the seminal work of Bowlby (2005) on attachment theory, Feeney and Collins argue that supportive social relationships enable individuals to flourish, as well as being protective during challenging times. However, it is also acknowledged that close relationships which are negative can have detrimental effects (Bertera, 2005; Ibarra-Rovillard and Kuiper, 2011).

Developing supportive relationships with peers has been recognized within education literature as a necessary factor in maintaining teachers' resilience, commitment, and motivation. Day et al. (2007) argued that teacher identity was a composite of professional identity (reflecting policy and social trends), situated identity (involving relationships with others within a school context), and personal identity (generated from life beyond school). When all these composite elements were in balance, teachers were able to maintain commitment and resilience. However, when one or more of these composite elements became unbalanced and dominated by negative influences, teachers became at risk of losing motivation. During times of rapid change caused by internal or external events—such as that brought about by the Covid-19 crisis—"additional effort would need to be made by the individual in order to manage the imbalance" (Day et al., 2007, p. 108). Teachers were defined as vulnerable within this study when they were unable to "find a suitable strategy for coping with challenging situations" (2007, p. 108). The VITAE findings are highly relevant to the present study on the challenges faced by teachers in the Covid-19 crisis, as all teachers during the Covid-19 lockdown faced an imbalance in their professional and situated identities as national and school-level policies rapidly shifted.

The literature on the beneficial and protective effects of social support and a sense of belonging can be further illuminated by social identity theory. Social identity is the sense of self that is due to a person's connection to, and identification with, a significant social group, such as family, a professional group, or friends (Tajfel, 1978; Tajfel and Turner, 1979). This collective level of identity means that people define themselves in terms of *we*, as opposed to the individual sense of self, using *I*. Collective identity indicates an individual's sense of belonging within a particular social group or community, and involves firstly a "reflexive knowledge of group membership" and, secondly, an "emotional attachment or specific disposition to this belonging" (Benwell and Stokoe, 2006, p. 25). The personal self, in contrast, is a concept of the self as individual, differentiated from others (Brewer and Gardner, 1996). The social identity approach has been applied in organizational literature, exploring topics such as leadership (Steffens et al., 2014), stress (Haslam and Reicher, 2006; Muhlhaus and Bouwmeester, 2016), and motivation (Haslam et al., 2000). Haslam et al. (2000) argued that this sense of "we-ness" plays an important motivational role, while also facilitating positive and sustainable organizational outcomes.

The claim that a sense of belonging within a social group can act as a protective factor for the individual, and improve their sense of well-being, was further established by Jetten et al. (2017), who argued that identification with a meaningful social group should be considered to be the "social cure" in relation to health and well-being. Such findings are particularly pertinent to our understanding of self-identity in times of crisis. Drury (2018) argued that a shared identity leads to an *expectation* of support from others during crisis situations, which in turn leads to an increased sense of collective efficacy and well-being. This phenomenon is referred to as "collective resilience" (Drury et al., 2009; Drury, 2012), where it has been recognized that "shared social identity based on group membership can explain social support and hence coping, survival and wellbeing" (Drury, 2012, p. 210).

A sense of social identity has been found to have a positive impact on individuals during the Covid-19 crisis. Kim and Asbury found in a small-scale study of 24 teachers working in English schools that a sense of shared identity acted as a support for teachers during the Covid-19 crisis, arguing that teachers "drew upon characteristics they perceived as being widespread in the teaching profession to find ways to make remote education work for them" (2020, p. 1075). More generally, Biddlestone et al. (2020) found that collectivism positively predicted engagement with social distancing and hygiene recommendations, whereas individualism negatively predicted engagement with measures to control COVID-19.

Previous research had therefore highlighted the importance of teachers' situated identity within school contexts, and the importance of social support to teachers as a coping mechanism during time of stress (including during the Covid-19 pandemic). Our research extended previous research by specifically attending to how teachers constructed their relationships with peers during the Covid-19 pandemic lockdown, and by exploring the associations between these constructions and how psychological states (both negative and positive) were reported.

METHODOLOGY

Theoretical Framework and Approach to Identity

The approach taken to identity in this paper was informed by the field of discursive psychology, which seeks to "study how people deploy everyday psychological notions and manage psychological business within talk and text, and what they accomplish by such deployments" (Edwards, 2012, p. 425). Discursive psychology differs from what Edwards (2012) classifies as "scientific psychology" and is "completely different from the factors and outcomes approach that is characteristic of much mainstream social psychology" (Wiggins and Hepburn, 2007, p. 281), in that it is focused on the linguistic and interactional strategies used by individuals to construct psychological issues when involved in discursive communication—that is, through text and talk. Researchers in this field start from an understanding of language as action, rather than as representation: that is, language is not understood as a gateway to understanding pre-existing mental states, but as actively creating and defining what psychological concepts are and how they are understood (Potter, 2012).

In contrast to other psychological methods, being led by discursive psychology demands that we "begin with discourse practices" (Edwards and Stokoe, 2004, p. 499). The approach to identity and identity categories in the field of discursive psychology is informed by conversation analysis, which understands identity distinctions as constructed and used in conversation rather than as reflective of a priori groupings (Edwards, 1998). As such, analysis of identity starts from the discourse as data, rather than from categories about which the researcher has prior knowledge. How this impacts on data analysis is profound: for example, rather than comparing the responses of teachers with the responses of school leaders, an analysis of identity informed by conversation analysis would begin with data collected and look for how teachers constructed themselves as either teachers or leaders, using the conversational resources available to them. As such, the discursive deployment of pronouns during talk is particularly important in understanding individuals' identity constructions, as they reveal the groups which individuals wish to be associated with, alongside those they seek to distance their "selves" from. This approach to identity complements Davies and Harré's (1990) work on Positioning Theory and the theories of Goffman (1955); both emphasize the dynamic and fluid nature of identity in conversation. Identity is not understood as a fixed consequence of having a particular feature or background, but instead as being agentially and dynamically iterated and reiterated within discursive situations (Locher and Bolander, 2017).

The particular discursive framework employed in this research project troubled some of the assumptions of social identity theory, as established in works by Tajfel (1978) and Tajfel and Turner (1979), most obviously the claim of social psychology that groups and categories are "entities that reside in individuals and are always latently present, although they are not continuously activated" (Mieroop, 2015, p. 409). Instead, we understand identity categories as a rhetorical tool, something that individuals use in conversation to achieve certain discursive ends. As such, we recognize identity and the membership of certain identity groups as a "discursive accomplishment" (Mieroop, 2015, p. 410) or "something that is *used* in talk" (Antaki and Widdicombe, 1998, p. 2) rather than as a reflection of a group membership which exists prior to discursive construction. Social identity theory has been criticized by discursive psychologists for its presentation of identity as pre-discursive, that is cognitive and essentialist rather than constructed through language (Benwell and Stokoe, 2006). However, a number of theorists have successfully integrated the central tenets of social identity theory within a more discursive framework (Hogg et al., 1995; Mieroop, 2015; Rich et al., 2017).

In terms of social identity, therefore, researching through the lens of discursive psychology turned our attention toward the discursive ways in which individuals structure and construct their group membership. We consider identity as dynamic, actively constructed *through* talk; our interest is the discursive patterns and relationships which emerge when teachers talk about their identity and social identity categorizations. We recognize that "identity is a site of permanent struggle for everyone" (Maclure, 1993, p. 311) and that through a careful analysis of language, we are able to better pinpoint the identity work undertaken by teachers during the Covid-19 lockdown.

Sampling and Participants

Open-ended qualitative interviews, with 30 teachers working in primary and secondary schools across England, were used to gather data for the research project. In using open-ended interviews, this research project was aligned with previous research in the tradition of discursive psychology (Lawes, 1999; Potter and Hepburn, 2005), which is distinct from other forms of discourse analysis in utilizing open ended interviews, rather than naturalistic sources, to gather data (Hepburn and Wiggins, 2007). Such interviews are sometimes referred to as "conversational" or "semi-structured" (Potter and Hepburn, 2005, p. 283), and the freedom afforded to research participants during open-ended interviews enables researchers to study their responses as actions, discursive attempts to construct specific identities, and ways of perceiving the world. Interviews explored specific aspects of remote educating and teacher peer relationships, including:

- changes to role since the partial closure of schools;
- benefits to professional relationships, family dynamics, shared activities, and enhanced learning opportunities;
- challenges of peer relationships, stress, well-being, family dynamics, physical space, work-school balance, and resources;
- influence of remote working on well-being;
- Support given during the lockdown period from peers and school leadership; and,
- Strategies for dealing with remote teaching.

Interview questions were designed to encourage participants to share their perceptions of relationships with other teachers, interpersonal dynamics, and communication. Some questions were designed to elucidate narratives from the participants about how their responses to the pandemic and their relationships with others had changed over the course of the lockdown, recognizing that "narratives and stories are vital parts of an individual's

TABLE 1 | Characteristics of sample.

	School phase			Gender			Career phase			Leadership responsibility	
	N	%		*N*	%		*N*	%		*N*	%
Primary	16	53	Male	12	40	0–7 years	4	13	Leader	10	33
			Female	4	13	8–15 years	10	33	Non-leader	6	20
						16+ years	2	7			
Secondary	14	47	Male	5	17	0–7 years	4	13	Leader	9	30
			Female	9	30	8–15 years	4	13	Non-leader	5	17
						16+ years	6	20			
Total	30	100		30	100		30	100		30	100

and organization's sensemaking apparatus" (Gabriel, 2015, p. 276); others were designed to encourage participants to engage in "intergroup positioning" which is "fundamentally achieved through the use of linguistic devices such as 'we', 'they', 'us', 'them', 'I'" (Tan and Moghaddam, 1999, p. 183).

There were also practical concerns which rendered remote, individual interviews the most suitable qualitative data collection tool during the particular time in which the research was being conducted, when social distancing measures were being enforced. As a result of measures brought in to reduce the spread of the Covid-19 virus, other prominent qualitative research methods which may otherwise have been considered—such as ethnographic methods, case studies and observations—were unsuitable for this research project.

Interviews were conducted online via Microsoft Teams with each teacher and lasted between 30 and 90 min. Adopting this approach enabled the participant and a single researcher, who carried out all interviews, to see each other, building a rapport prior to the interview itself. All interviews were recorded using the facility on Teams and then transcribed. Participant names were not used; rather a unique code chosen by each teacher was added to the transcripts, providing anonymity.

The speed with which policies on Coronavirus restrictions changed in England during March 2020 meant that, as researchers wishing to catch the perspectives of teachers at this unique moment, we were required to act extremely quickly. As such, we acknowledge that in our efforts to quickly recruit participants in order to gain rapid insights into the impact of school closures on teachers in England, we employed methods of "convenience sampling" (Robson, 2011) which would not be necessary during a research project with a more conventional trajectory. Initially, personal contacts were contacted to raise awareness of the project, and this was followed by a snowball sampling strategy to achieve the required number of participant teachers for meaningful analysis. This small-scale participant recruitment target was guided by previous studies which had a similar methodological approach (Mieroop, 2005; Fest, 2015). We were aware that employing a research design that involved the recruitment of large numbers of participants may slow the research process, and in doing so prevent us from accessing data on the immediate perspectives and concerns of teachers during the first few weeks of the lockdown in England. Our study, which collected rich qualitative data from a small sample, was aligned with a number of other small-scale educational studies conducted during the early stages of the Covid-19 crisis (Anderson et al., 2020; Kim and Asbury, 2020; Sequeira and Dacey, 2020; Ferguson et al., 2021).

A sample of 30 participants was achieved (**Table 1**). Potential participants were sent an email inviting them to take part in the research, which also included a participant information sheet outlining key aspects of the research such as purpose, proposed schedule, time commitment, data use, and ethical issues. They were also sent a consent form outlining issues related to confidentiality and anonymity, right to withdraw, avoidance of harm, data storage and disposal, and publication of material. Those willing to participate were asked to sign and return the consent form to the researcher team by email.

The teacher participants (13 female, 17 male) all worked in different schools across England. The sample was made up of 16 primary and 14 secondary practitioners. Those who taught in the secondary phase taught a variety of subjects including core subjects (mathematics, English, science) and foundation subjects (art, history, geography, and modern foreign languages). Teachers were in differing phases of their careers, including eight teachers with fewer than 8 years of experience, 14 teachers with between 8 and 15 years of experience and eight teachers with more than 16 years of teaching experience[1]. Ten primary school teachers and nine secondary school teachers had leadership responsibilities under normal teaching conditions. The participants recruited for this research project were not representative of the wider teacher population, which is a limitation of the study caused by the strategy of convenience sampling. For example, whereas 24% of state employed teachers in England are male (Gov.uk, 2020), 57% of the teachers who participated in this research were male. Although a convenience sample, efforts were made to recruit participants from a range of school types, including those in rural ($n = 7$), suburban ($n = 14$), and urban ($n = 9$) settings. Again, we make no claim that

[1]The career phase groupings for this study were selected based on research conducted by Day et al. (2007), who identified six phases reflecting variations in teachers' identity, commitment, and self-efficacy. These phases were: 0–3 years; 4–7 years; 8–15 years; 16–23 years; 24–30 years; and 31+ years.

the participants recruited for this project are representative of the wider school population in England.

Data Analysis

The research questions which led the study were informed by the preoccupations of discursive psychology, and were:

RQ1 How did primary and secondary teachers in England use language to construct their psychological experiences of remote teaching during the Covid-19 lockdown?
RQ2 How did teachers discursively construct their relationships with other teachers while remote teaching during the Covid-19 lockdown?
RQ3 How did the construction of social relationships during the Covid-19 lockdown function discursively to justify particular responses or actions by teachers?

Analysis of data took place in several stages, as shown in **Figure 1**. In line with much research in discursive psychology, the data was initially coded to identify emergent themes and linguistic patterns, in a "precursor to the analysis [which involved] sifting through the larger data corpus for instances of a phenomenon" (Wiggins and Potter, 2007, p. 84); the findings from this initial coding and the literature review were used as "entry or starting points" (Baker et al., 2008, p. 295) into the corpus of interview data. Following the identification of interesting linguistic features, a corpus-assisted discourse analysis was then performed to verify the extent of these features and to explore them in greater detail. As such, analysis of the interviews involved an integration of inductive coding and corpus linguistic methods, involving an "interdisciplinary application of methods" (Fest, 2015, p. 49). Corpus linguistics is defined as a "scientific method of language analysis [which] requires the analyst to provide empirical evidence in the form of data drawn from language corpora in support of any statement made about language" (Brezina, 2018, p. 2); usually, it involves the use of specialized computer software to identify linguistic patterns within a body of texts selected by the researcher. The use of corpus linguistic methods to isolate discursive strategies of identity construction is well-established within linguistic research (Baker, 2006; Bednarek and Martin, 2011; Bakar, 2014; Fuoli, 2018). There is no prescribed method for conducting analysis which combines thematic and corpus approaches, as corpus linguistics is an emergent method within education research (Pérez-Paredes, 2021).

During analysis, we attended to participants' attempts at self-categorization, rather than starting from a priori identity groupings such as age, gender, ethnicity, leadership status, or length of service. That is, we were more interested in how participants constructed their own identity, than in pre-existing identity categories that we as researchers may attach to them (Fitzgerald, 2012; Paulsen, 2018). At the initial stage of coding, the discursive utilization of pronouns was identified as a phenomenon present within the corpus which merited further investigation. Teachers who constructed a collective identity with their teaching peers through the use of the pronoun *we* appeared to have a more positive perspective on the experience of remote teaching during the Covid-19 lockdown than teachers who constructed a salient personal identity, using the pronoun *I* to foreground their individual concerns. The use of personal pronouns, such as *I* and *we*, "gives a sense of whom a speaker identifies himself with" (Lenard, 2016, p. 166), and are used to stand in for membership categories which have been previously introduced by speakers during conversations, as Sacks explains:

> *"If you've used any membership categorization device category, i.e., any category like male-female [. . .] you can on some next occasion wherein you want to refer to the same object, use a pronoun to do it. If you've referred to a category in its plural form, e.g., [. . .] women, then you choose from a plural pronoun, most particularly 'we' or 'they,' and you may pick 'we' or 'they' by reference to whether you are, or propose to be, a member of that category."* (Sacks, 1992, p. 334).

The use of *we* indicates an attempt to construct or maintain an association *with* the group, whereas the use of *they* an attempt by the speaker to distance himself *from* the group. Individuals present their affiliation with an institution by using personal pronouns (Drew and Sorjonen, 1997), and teachers' pronoun choice can indicate the extent to which they claim alignment with their school (Spicksley and Watkins, 2020).

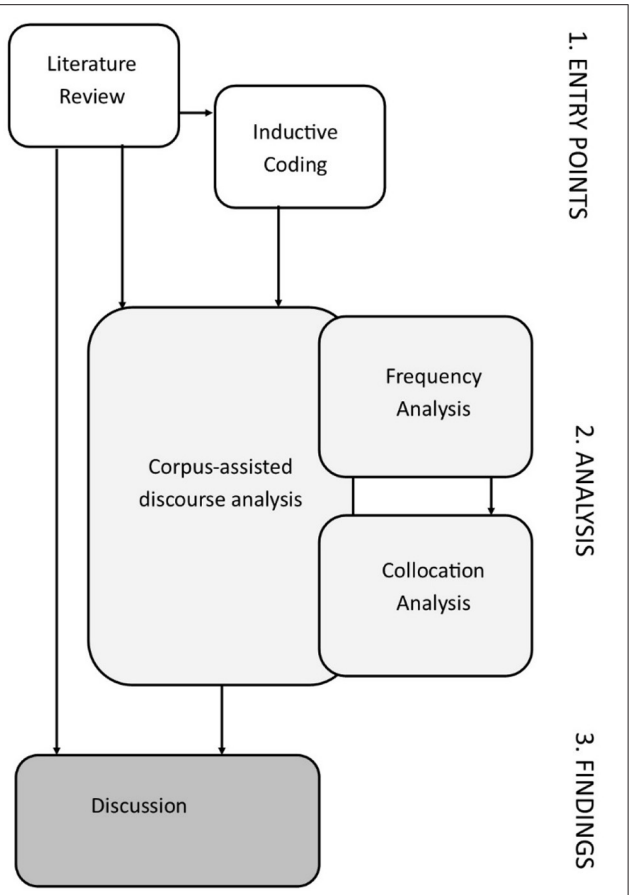

FIGURE 1 | Stages of research analysis.

At the following stage of "analysis" (Wiggins and Potter, 2007) we employed a corpus-assisted discourse analysis to explore the phenomenon of interpersonal pronoun use in more depth (Hepburn and Potter, 2003; Pérez-Paredes, 2021). At this stage, as we moved away from initial coding and toward analysis, "simple counts" of the pronouns *I* and *we* were used as an "aid to understanding the patterning" (Hepburn and Potter, 2003, p.189) of pronoun use. This stage of analysis was oriented around the hypothesis that teachers who foregrounded the pronoun *we* had a more positive perspective on remote teaching during the Covid-19 lockdown than teachers who foregrounded the pronoun *I*. The research questions for this stage of analysis were therefore as follows:

RQ1 Is there a pattern of pronoun usage (we/I) across the corpus of interviews?
RQ2 If evident, is this pattern predictive of positive or negative constructions of the experience of remote teaching during the Covid-19 lockdown?

A recognized analytical technique in corpus linguistics is the use of quantitative data to isolate representative cases, which are then subject to further qualitative analysis (Mieroop, 2005; Bednarek, 2011). In the present study, quantitative data on pronoun use was employed to identify two sub-corpora: one in which the participants foregrounded the use of "we," and one in which the use of "I" was foregrounded. Further analysis using both quantitative and qualitative methods was then used to compare these contrasting sub-corpora in response to the research questions.

Corpus linguistic analysis of data is facilitated through specialized computer programs. In this project, analysis of pronoun use within the interview data was undertaken using Wordsmith 7.0 (Scott, 2016), which facilitated the construction of wordlists (frequency counts of words within a specific corpus) and concordances (which show all the occurrences of a target word within their context, to reveal linguistic patterns and associations). Corpus linguistics is a comparatively "young discipline that is [. . .] witnessing a rich debate in terms of methodological foundations" (Pérez-Paredes, 2021, p. 35). Although corpus linguistic methods are traditionally associated with the macro-analysis of large data sets (McEnery and Wilson, 2001; Baker, 2006), such techniques can be effectively used to isolate patterns of language in smaller data sets at a meso-level, or even in individual texts (Bednarek, 2011). One of the advantages of incorporating corpus methods into a discourse analysis is to reduce researcher bias, improving the validity and reliability of findings by introducing a quantitative aspect to the research (Baker, 2006, 2012; Mautner, 2009). However, within critical fields which employ discourse analysis as a research method (such as discursive psychology) there is a resistance to seeking neutral objectivity and instead a recognition that "bias is unavoidable when conducting social research" (Baker, 2012, p. 255), and even the selection of which numbers are investigated is a subjective decision, driven by the research question and researcher interest and knowledge.

Corpus linguistic approaches have been successfully used in previous research to better understand the use of pronouns in constructing educational and institutional identities, within relatively small collections of spoken data. Fest (2015) first conducted a qualitative thematic analysis on 14 interviews with students concerning an online assessment tool, before subjecting these interviews to a corpus linguistic analysis which began by analyzing the frequency of pronoun usage. Mieroop's (2005) research took the opposite approach, beginning with a quantitative analysis of pronoun usage within a corpus of 40 speeches. This quantitative analysis enabled Mieroop to isolate a sub-corpus of speeches in which the speaker presented with a strong institutional identity; this sub-corpus was then subject to a further qualitative analysis to isolate the particular strategies employed by these speakers to construct a strong institutional identity through discourse. Combining qualitative and quantitative data by synthesizing traditional thematic approaches to data analysis and corpus linguistic methods enables "both an in-depth view and an overview of the corpus" (Mieroop, 2005, p. 108) while facilitating researchers to gain "new insights into the data" (Fest, 2015, p. 64).

The overall methodological approach therefore recognized an alignment between social identity theory and discursive approaches to the interpretation and analysis of data (Rich et al., 2017), and was located with a long history of education research which has explored how teachers construct their professional identities through discourse (Maclure, 1993; Alsup, 2005, 2019; Urzúa and Vásquez, 2008; Bates, 2016). In such research, it is recognized that "motive talk [. . .] does not have a simple inner referent but is a performative speech act in a complex language game" (Edwards and Potter, 1992, p. 141). The focus of analysis was on how teachers constructed and presented their identities through the linguistic affordances offered through their semi-structured interviews, and the effects that these constructions achieved (Fairclough, 1992; Benwell and Stokoe, 2006; Zhang Waring, 2018). Corpus linguistic methods supported the theoretical decision to focus on the identities that teacher participants chose to actively construct for themselves through discourse.

Research Ethics

This study was reviewed and approved by the University's Arts, Humanities, and Education Research Ethics Panel, and ethical guidance from the British Educational Research Association (BERA, 2018) and the University were followed throughout the study. Signed consent forms were required from all participants, and if a teacher wished to withdraw from the study, they were able to contact the research team and request this without explanation. All data were stored and destroyed in accordance with University policy, GDPR (2018) and the Data Protection Act (2018a,b) (ICO, 2021).

FINDINGS

Initial Coding

A number of accounts of teaching remotely suggested that teachers perceived themselves to be working with their colleagues

in a collective effort. These teachers' narratives constructed the experience of remote teaching as a shared endeavor:

> *We're sharing all the lesson plans and ideas for lessons. We're all doing the tutorials and sharing information about the students when necessary. We have a department meeting each Monday evening and then a message from the Head each Monday morning. We're a social department and so are used to communicating all the time and that has leaked into the weekends with some interaction.* (Jenny)
> *We're more than just a department of individual teachers, we're a solid team who work well together, respect each other, learn from each other, and support each other.* (Tamara)
> *I think we've stayed strong as a school, shared our expertise and remained confident in our ability to do the job we trained for [. . .] even in these strange times.* (Noah)

During these utterances, use of the pronoun *we* constructed a sense of collegiality in schools; for the individuals, the use of the pronoun *we* served a particular function in the discursive construction of identity. By constructing their selves as being part of a wider collective team, these teachers were able to tacitly position themselves as having particular personality traits which are generally considered to be positive. These traits include sharing and communicating effectively, being social, respecting others, and teaching confidently. For these teachers, constructing a sense of social identity was a way of rhetorically positioning themselves as having valuable characteristics.

In contrast, other participants argued that they felt disconnected from their colleagues and missed the day-to-day support they had previously received in school:

> *The main change has been that there is no-one to discuss lesson plans with. That sense of support has disappeared, not intentionally, but the reality is that we are dealing with everything on our own now [. . .] It's very lonely. I actually miss staff meetings.* (Peter)
> *I'm far more detached now as I'm not hearing about all the things that would usually be happening around school. We're completely cut off and that's hard to deal with.* (Camilla)

The utterances of Peter and Camilla involved a "shift of footing" (Goffman, 1981) as pronoun use changed from *I* to *we*. The function of these utterances is to justify or explain why Peter and Camilla are experiencing the negative emotion of loneliness. Camilla and Peter use the pronoun *I* to emphasize their isolation from colleagues, alongside *we* to construct this not as an individual problem which only affects them, but also a problem experienced by others within their setting. Pronoun choice enables Camilla and Peter not only to emphasize their isolation from colleagues, but also to construct their feelings of isolation as normal and as being experienced by others, lessening the possibility of them being perceived as dysfunctional or antisocial.

For some participants, constructing a sense of isolation functioned as an explanation for decisions to leave teaching. Pronoun use in such cases was again found to be significant. Susan and Robert used *I* to emphasize their sense of individualism during the crisis:

> *Yes, it's been very stressful from a professional point of view and a personal one. Professionally, I've found it hard to be isolated from the others and feel as if I'm missing out on things [. . .]it's starting to affect the bond I used to feel with being a teacher.* (Susan)
> *I'm thinking about leaving the profession, definitely about leaving the school at least. This has given me time to think about it without having to be with them every day.* (Robert)

The decision to leave teaching is often associated with a sense of failure (Smith and Ulvik, 2017). In these utterances, when teachers constructed a professional identity which was faltering or at risk, use of the pronoun *I* functioned to emphasize their feelings of isolation from their colleagues. By emphasizing how they felt separated from their school community, Susan and Robert sought to excuse and make acceptable the decision to leave teaching, which is often associated with negative traits such as a lack of commitment or resilience.

Initial coding had therefore indicated that choices about pronoun use were one important way in which participants discursively navigated the complexities of reflecting on the difficulties caused by the Covid-19 pandemic and the requirement to teach remotely. Furthermore, whereas the use of *we* and the construction of a *collective* identity within the participants' schools appeared to be associated with positive perspectives on the Covid-19 crisis, the use of *I* and the foregrounding of a salient *personal* identity appeared to be associated with negative perspectives and emotional responses.

Discourse Analysis

Collective Identity and Personal Identity Groupings

Using Wordsmith, it was possible to identify the frequency of the pronouns *I* and *we* within each interview transcript, and (for comparative purposes) across the entirety of the interviews. The identification of these differing "person deictics" (Mieroop, 2015, p. 414) provided an innovative way in to exploring the identity constructions of research participants, indicating each participant's sense of "we-ness" within their school community (Haslam et al., 2000).

Results from the analysis of all interview transcripts indicated that there were indeed significant differences in the use of the pronouns *we* and *I* across interview transcripts (**Table 2**). Five participants (Noah, Maria, Isaac, Ivy, and Edwin, henceforth referred to as the "CI Group") used *we* more frequently than *I* in their responses, indicating the construction of a salient *collective* identity. Twenty-five participants used *I* more frequently than *we*; considering the private and individualized nature of the semi-structured interviews conducted, this overall preference for the pronoun *I* across the dataset was to be expected. Of these 25 participants, however, five participants (Ava, Tamara, Matilda, Timothy, and Christopher, henceforth, the "PI Group") had a significant preference for the pronoun *I* over *we*, indicating the construction of a salient *personal* identity. The PI group was formed of participants who displayed more than a 3% difference between their use of the pronoun *we* and their use of the pronoun *I*.

There were some noticeable similarities between the teachers within the CI Group. All CI Group participants were experienced

TABLE 2 | Interpersonal pronoun data across sample.

PSEUDONYM	I freq	I %	WE freq	WE%	Difference I/WE Freq	Difference I/WE %	Analysis sub-group
Isaac	40	2.15	44	2.37	−4	−0.22	CI
Noah	30	1.82	31	1.88	−1	−0.06	CI
Maria	32	1.84	33	1.9	−1	−0.06	CI
Ivy	37	2.14	38	2.19	−1	−0.05	CI
Edwin	42	2.23	43	2.28	−1	−0.05	CI
Steve	50	2.63	48	2.53	2	0.1	None
Paul	38	2.47	33	2.15	5	0.32	None
Grace	40	2.65	27	1.79	13	0.86	None
Camilla	36	2.78	22	1.7	14	1.08	None
Peter	84	4.32	43	3.09	41	1.23	None
Gary	47	2.82	26	1.56	21	1.26	None
Oliver	42	2.65	20	1.26	22	1.39	None
Helen	35	2.67	15	1.14	20	1.53	None
Harry	48	3.51	24	1.76	24	1.75	None
Audrey	39	2.76	13	0.92	26	1.84	None
Jenny	51	3.09	15	0.91	36	2.18	None
Aiden	45	3.46	14	1.08	31	2.38	None
Susan	67	3.5	19	0.99	48	2.51	None
Mark	58	3.89	20	1.34	38	2.55	None
Lily	49	3.78	15	1.16	34	2.62	None
Robert	29	3.05	4	0.42	25	2.63	None
Alexander	52	3.54	13	0.88	39	2.66	None
Sally	75	4.33	28	1.61	47	2.72	None
Ethan	59	4.23	20	1.43	39	2.8	None
Hayden	134	4.44	44	1.46	90	2.98	None
Ava	70	4.88	21	1.46	49	3.42	PI
Matilda	64	4.48	12	0.84	52	3.64	PI
Timothy	84	4.32	13	0.67	71	3.65	PI
Christopher	87	4.48	16	0.82	71	3.66	PI
Tamara	56	4.35	8	0.62	48	3.73	PI
Across all interviews	1,586	3.3	722	1.5	864	1.8	

teachers, with more than 8 years of experience and having a leadership role. Four of the five were teaching within primary schools, with only one (Maria) teaching within a secondary setting. The gender of teachers within the CI group was, however, quite balanced, with three male and two female participants within this category. In terms of the PI Group, there was one noticeable pattern which emerged in terms of characteristics. Four PI teachers worked in secondary settings and one in primary, reversing the trend seen within the CI Group. In terms of the other characteristics, the PI Group had a wider spread of teachers from all career phases than the CI Group. Three of the teachers in the PI group had leadership roles, and two were non-leaders, again indicating a wider spread of characteristics than the CI Group in which all teachers identified as leaders. Like the CI Group, gender was quite balanced, including three female and two male teachers.

Collective Identity Group interviews and PI Group interviews were then subjected to a further manual discourse analysis in order to determine these teachers' perspectives on the Covid-19 pandemic lockdown and its effects. This manual analysis was conducted to determine whether there was a significant difference between the way that teachers with a salient collective identity (CI Group) constructed the experience of teaching remotely during the Covid-19 lockdown, in comparison with teachers who had a salient personal identity (PI Group). During this discourse analysis, each sentence was evaluated as being either a positive, a negative, or a neutral utterance (Liebrecht et al., 2019). **Figure 2** compares the percentage of sentences considered to be negative, positive, and neutral utterances in the interview transcripts of the CI and PI Groups, in order to enable a comparison between the perspectives of the two groups.

The PI group had a significantly higher percentage of negative utterances in their interviews, ranging from 69 to 77% of the sentences recorded in their interviews being negative. In comparison, the percentage of sentences considered negative within the CI Group's interviews ranged from 20 to 34%. The pattern was reversed with the percentage of positive utterances. In the PI Group, positive utterances as a percentage ranged from

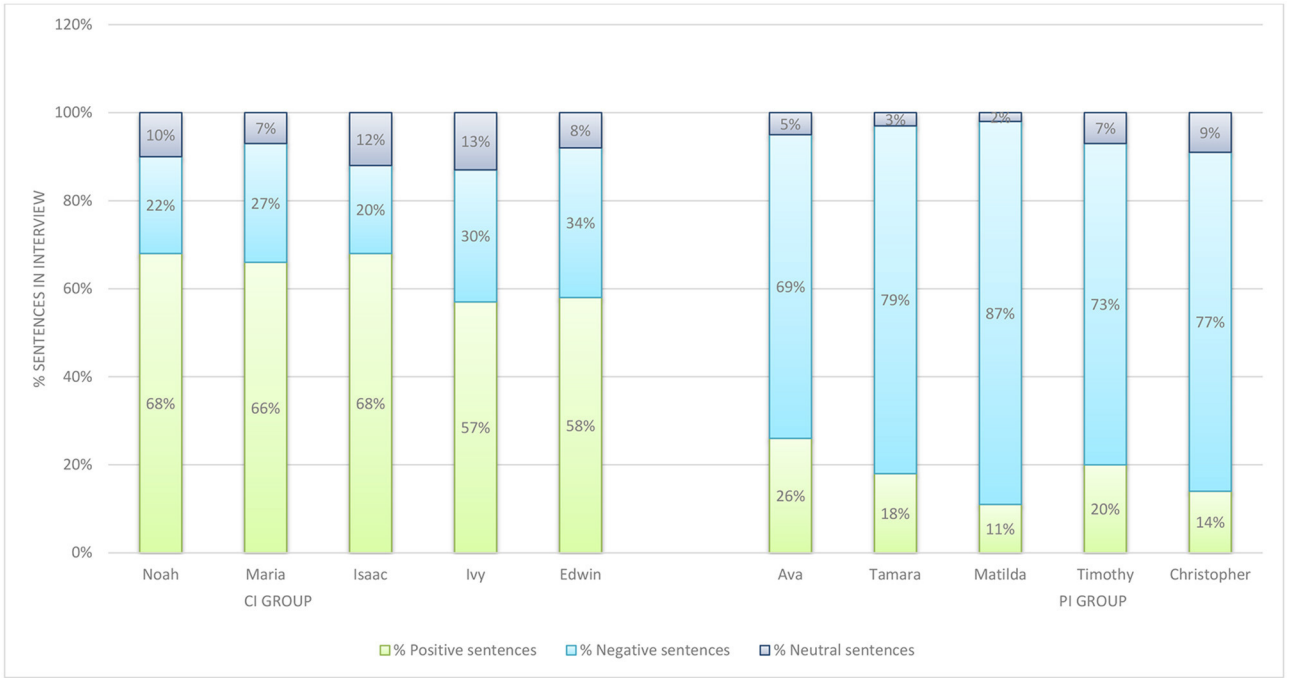

FIGURE 2 | Comparative analysis of CI and PI Group utterances.

11 to 26% of their interview transcripts. However, participants in the CI Group used positive utterances between 57 and 68% of their interview. Findings clearly showed, therefore, that members of the CI Group constructed the challenges of the Covid-19 pandemic using more positive language than members of the PI Group. Teachers who constructed a collective identity for themselves, having a preference for the pronoun *we*, constructed a more positive perspective on the Covid-19 crisis. Teachers who identified primarily as an individual, preferring the pronoun *I*, instead constructed a more negative perspective during the Covid-19 pandemic lockdown. As the findings from this discourse analysis appeared to be significant, further analysis on the difference between the discourse of CI Group and PI Group participants was then conducted, using methods commonly associated with corpus linguistics. This included further frequency analysis, and collocation analysis using concordances (which show every occurrence of a target word in context).

Wordlist Data

A comparison of the 20 most frequent content words[2] across CI and PI Group interviews can be found in **Table 3**. There were many similarities across the groups. Both CI and PI Group participants had a high frequency of words related to their job as teachers, including *work, school, teaching,* and *teacher*. Some differences across the CI and PI Groups can be attributed to the differential between the groups in terms of phases taught: whereas *department* features as a frequent content word in the PI Group interviews, it was not present in the 20 most frequent words of the CI Group participants. As the majority of participants in the CI Group were primary teachers, and primary schools are generally not split into departments, this could explain this discrepancy. In secondary schools, which most of the PI Group worked in, work is more often organized through departments, explaining why PI Group data featured this word more prominently. The same could be true of the inclusion of *children* within CI Group data, mainly consisting of primary teachers: *students* would be a more prominent term within secondary settings, which had a higher frequency within the PI Group.

Two content words were prominent in both CI and PI Group data: *support* and *feel*. Support was the 11th most frequent content word for PI Group teachers ($n = 18$), and the 10th for CI Group teachers ($n = 23$), indicating that both groups of teachers sought to foreground discourse around support. Further concordance analysis, detailed below, was therefore undertaken to determine whether there were any differences in the way that CI Group and PI Group teachers constructed support. The word *feel* was used a similar number of times by both CI Group ($n = 20$) and PI Group ($n = 23$) teachers, indicating that both groups wished to talk about their inner emotional or psychological states. However, it was interesting to note that *feel* was a comparatively more frequent content word used PI Group teachers, being the eighth most common content word used within this group (in comparison to being the 15th most frequent content word used by CI Group teachers). Such discourse around feelings is of particular interest within discursive psychology so, as with

[2]Content words contribute to the meaning of a sentence, rather than the grammar.

TABLE 3 | Comparative analysis of 20 most frequent function words in CI and PI Group interviews.

Function word ranking in group	PI Group		CI Group	
	Content word	Frequency in PI g roup interviews	Content word	Frequency in CI group interviews
1	WORK	48	THINK	61
2	THINK	43	WORK	61
3	STUDENTS	33	SCHOOL	58
4	SCHOOL	32	CHILDREN	49
5	THINGS	29	STAFF	29
6	GET	28	THINGS	29
7	TIME	25	TEACHERS	27
8	FEEL	23	WORKING	24
9	TEACHING	22	SCHOOLS	23
10	TEACHER	21	SUPPORT	23
11	SUPPORT	18	TEACHING	22
12	TEAM	18	YEAR	22
13	COLLEAGUES	17	HOME	21
14	GOOD	16	TOGETHER	21
15	BACK	15	FEEL	20
16	LIFE	15	PARENTS	20
17	WORKING	15	DIFFERENT	18
18	DAY	14	MAKE	18
19	DEPARTMENT	14	WEEK	18
20	FACT	14	GROUP	16

support, references to feelings were subject to further contextual analysis using concordance lines.

One interesting difference between CI Group and PI Group participants was the use of the singular or plural when using the word *teacher*. Whereas, PI Group participants foregrounded the singular *teacher* ($n = 21$), CI Group participants foregrounded the plural *teachers* ($n = 27$). This again indicates a more collective, social identity on the part of CI Group teachers, and a more personal identity being constructed by PI Group teachers. As evaluative terms associated with *teacher* could indicate the construction of a specific teacher identity by participants, *teacher* was also subject to further concordance analysis.

Concordance Data

Support

Figures 3, **4** are concordances which detail every occurrence of words with the root *support** (*support, supports, supported, supporting, supportive*) in CI (**Figure 3**) and PI (**Figure 4**) Groups. In both groups, *support** occurred at the same general frequency, with 31 occurrences in the CI Group and 29 occurrences in the PI Group interviews. This similarity in frequency suggests that both teachers who had a salient collective identity and teachers who had a salient personal identity worked to discursively construct support as an important factor in their presentation of teaching during the Covid-19 pandemic lockdown.

Two noticeable discursive patterns were evident in the CI Group data regarding associations with the word *support*. The first was a temporal construction of support as continuing or ongoing, as in the following concordance lines. Support was twice described as constant:

without the **constant support** of my colleagues
constant daily **support** structure we have

There was also a pattern through which support was constructed as a continuing process:

we **continued** to **support** each other
I need them to **continue** to **support** each other
continuing to **support** their science education

Within the CI Group, therefore, support was constructed as something which was ongoing and reliable, with a tacit construction of support during the Covid-19 pandemic as a continuation of support prior to these difficulties.

Second, the word support was discursively associated with the collocation *each other* ($n = 7$) or one *another* ($n = 1$), as in the following statements:

we have all **supported each other**
kept in touch and **supported each other**
been **supportive** of **each other**
look after and **support one another**

In these utterances, *support* is constructed as a communal and collegial enterprise: the term support indicates a process through which all members of a group are involved in supporting and being supported simultaneously.

N	Concordance
1	come. I think we have all supported each other as a school.
2	all need to look after and support one another. Everything e
3	at groups have helped and supported our teachers to get thro
4	lly pulling together and supporting each other. I feel bless
5	sure we kept in touch and supported each other. It was clear
6	I hope that I've been as supportive to others as they have t
7	wife, but they have been supportive of each other and that h
8	bunsen burners! The close support network that has always b
9	ubble without the constant support of my colleagues and frie
10	definitely have. My family support has also helped with this
11	ould pull together. We had support from the Head. I didn't
12	often those who don't have support around them from family o
13	uldn't have asked for more support. I hope that I've been as
14	a school. We've all needed support and have made sure no-one
15	hey need help or advice or support, or anything really. No.
16	were safe and had parental support, and videoed and then the
17	ped but the constant daily support structure we have in the
18	ng to say about the school support because it's been as you'
19	k early retirement and so supports me working. He's been abl
20	had the benefit of the TA support, which I know they've mis
21	e said there and then that support and interaction would be
22	hey feel they have had the support from each other and that
23	d, and they havent had the support of the multiagency worker
24	nt, we've done most of the support ourselves and have turned
25	that. It comes back to the support and interaction - we want
26	l need them to continue to support each other as we start to
27	sure that we continued to support each other and interact w
28	ents and are continuing to support their science education,
29	have plenty of evidence to support the commendation. For me,
30	The important thing is to support your team and keep each o
31	as well as we can. We've supported staff and made them feel

FIGURE 3 | Concordance showing utterances of *support** in CI Group interviews.

In PI Group interviews, the most noticeable pattern is associations which give the impression of a support deficit ($n = 10$), as in the following statements:

don't feel as if I've been **supported** by them
I **don't** feel **supported** by the school
We've had **no support**
I felt that the **lack of support**
I **should** have been **supported more**

In contrast to the CI Group—in which participants made efforts to construct support as a shared, communal process—in these PI Group utterances there was again a focus on the individual, indicated by the close association of *I* and *me* with constructions of support ($n = 15$):

I felt that the lack of **support**
has had the time to **support me**
I was only **supported** by friends

Even when support was not constructed as deficient by PI Group participants, this construction of support as being focused on the individual remained:

I have had **support**
They've tried to **support me**

There appeared, therefore, to be a difference in the way that PI Group and CI Group teachers talked about support. For CI Group teachers, support was constructed as a communal activity, shared by everyone. In contrast, for PI Group teachers—who had a salient personal identity—support was constructed as something given to an individual by others, in an almost transactional process.

Teacher Identity

In order to explore how participants constructed their identities as teachers, concordances for the word *teacher* were analyzed across the CI Group (**Figure 5**) and PI Group (**Figure 6**).

N	Concordance
1	dn't go to the funeral and support her then either. I think
2	unication, interaction and support. They should have been ab
3	learn from each other, and support each other. It's a lifeli
4	eader, I should have been supported more I think. Not sure w
5	on't feel as if I've been supported by them and we have been
6	t help this. I don't feel supported by the school and it was
7	other students and getting support from staff. I do think th
8	all this time. I have had support with some of my leadershi
9	uld. The departments have supported each other as much as th
10	tressful. Also seeing how supported my flat mate is by her c
11	have started being more supportive again. It took time. I'm
12	led badly and we've had no support for how we were supposed
13	te a computer'! That's not support, it barely resembles a re
14	how important that kind of support from colleagues is. I've
15	t. I felt that the lack of support from colleagues was a cha
16	uch because of the lack of support, but it paid well. I've f
17	To begin with I was only supported by friends outside of th
18	ith my family. My partner supports my position and has been
19	epartmental issues and the support of my team. Luckily there
20	this, benefitting from the support of the team, but as it tu
21	school and we spend time supporting them with their school w
22	rather than continuing to support and motivate the team. I
23	the flat as we both had to support children of key workers.
24	ld like the opportunity to support them. I've had a routine
25	can be there, in person, to support her. The lack of control
26	ent so has had the time to support me. Once I had been told
27	ere else. They've tried to support me but I've not been able
28	sition and has been very supportive. I have two children who
29	em. It doesnt sound very supportive does it? Asking for help

FIGURE 4 | Concordance showing utterances of *support** in PI Group interviews.

We hoped that such an analysis would provide a way in to exploring the ways in which teachers described their roles and characteristics during the Covid-19 pandemic. When comparing concordances of *teacher* across the CI Group and PI Group, it became evident that there was a significant quantitative difference between the two groups. There were 21 uses of the word *teacher* within the PI Group interviews, yet only seven in the CI Group interviews. This disparity suggests that for PI Group participants, the subject of the teacher was an object of discourse (Fairclough, 1992); the frequent use of the term *teacher* suggests that the role and characteristics of the teacher are being discursively constituted and renewed, rather than being accepted. PI Group participants expended significantly more time focusing on the teacher than their CI Group counterparts, because CI Group teachers were not as focused on working discursively through what being a teacher meant during the Covid-19 pandemic period of remote teaching.

When the concordances are analyzed qualitatively in more detail, this distinction between CI Group and PI Group teachers becomes even more apparent. **Figure 5** is the concordance showing references to *teacher* within the CI Group sub-corpus. In one of these utterances, there does appear to be some performative effort made to construct a teacher identity:

> Being a **teacher** means that you give up

In another utterance, the participant explicitly refers to their "identity as a teacher and leader," which again has a performative effect. However, in the other five utterances, the word *teacher* appears to be deployed in a descriptive capacity rather than a performative one, as in:

> the other **teacher** needed to be in bed
> assessed to the class **teacher**
> rallied round the **teacher** we want to praise
> like to be with the same **teacher** all the time

In these utterances, the intention of the sentence is primarily to report incidents or school policies, rather than to rhetorically position teachers and teaching.

In contrast, there were repeated utterances within PI Group interviews to teacher identity, indicating discursive attempts to make sense of or rhetorically justify teacher identity. This was

N	Concordance
1	! I think my identity as a teacher and a leader must have be
2	the other schools. Being a teacher means that you give up al
3	l with a parent or another teacher and there's not much I ca
4	ecommend it, but the other teacher needed to be in bed. This
5	o be assessed to the class teacher. Sometimes this would be
6	y like to be with the same teacher all the time as they usua
7	e've all rallied round the teacher we want to praise each we

FIGURE 5 | Concordance showing utterances of *teacher* in CI Group interviews.

N	Concordance
1	ith a friend who is also a teacher but in a primary school a
2	ing at the school and as a teacher generally. I know that my
3	nal, has been eroded. As a teacher you pin a lot on 'being a
4	ax. I won't last long as a teacher if I don't try to find a
5	students since becoming a teacher and have always enjoyed t
6	k that my sense of being a teacher, a professional, has been
7	motional aspect of being a teacher. He does his job because
8	you pin a lot on 'being a teacher' and what that means and
9	a result of this. Being a teacher isn't like other jobs. Yo
10	s get on top of me. He's a teacher too but with a lot more e
11	e hard for the family of a teacher. When it's good, it's a b
12	ed to go from being an art teacher to an IT teacher in a wee
13	onal life. I'm a committee teacher but I have to be able to
14	, experienced and creative teacher to not even wanting to st
15	the pandemic, nearly every teacher in our department has bee
16	hs are. You can be a great teacher, but not be able to cope
17	n over from the fact I'm a teacher first. I've been asked to
18	ng an art teacher to an IT teacher in a weekend and it wasn'
19	lationship. I'm the oldest teacher in the department, possib
20	in as an honorary primary teacher for the period of isolati
21	I don't feel like a proper teacher at the moment because I c

FIGURE 6 | Concordance showing utterances of *teacher* in PI Group interviews.

most prominent in the repeated collocation *being a teacher* ($n = 4$):

my sense of **being a teacher**
emotional aspect of **being a teacher**
you pin a lot on **"being a teacher"**
Being a teacher isn't like other jobs

These utterances indicate that participants are discursively working through changes in their professional role and identity, rhetorically justifying their actions, and feelings. Rather than talking as if the role of the teacher is accepted and understood, as with the CI Group, PI Group teachers foreground the challenges they face in making sense of their identity and what it means to "be a teacher" during the Covid-19 crisis.

In other utterances, PI Group teachers explicitly position themselves as a certain "type" of teacher:

I'm a **committee teacher**
experienced and creative teacher
oldest teacher in the department

Finally, in a number of utterances, the identity work brought about by the Covid-19 pandemic lockdown is explicitly discussed by PI Group teachers:

an **art teacher** to an **IT teacher** in a weekend
honorary primary teacher for the period of isolation

In these statements, PI Group participants attempt to make sense of the shifts in identity caused by the requirement to teach remotely. It is significant that there are no such statements within the CI Group data. For CI Group participants, relative lack of discussion about what it means to be a teacher indicates a stable and consistent sense of teacher identity. In contrast, PI Group participants talk about teachers more

N	Concordance
1	ven more than usual. I also feel lucky as my head obviously
2	them, so some of them are feeling a bit low at the moment.
3	hing, but they'll still be feeling pressure. I think the way
4	ressful for them. I don't feel that my wellbeing has decre
5	n, and it's a lovely family feel. Those Fridays night have c
6	would say the same again. I feel my wellbeing is okay and th
7	which helps of course and I feel that we have maintained our
8	wellbeing is good because I feel positive about how we've co
9	hese ideas in the future. I feel that we've worked well toge
10	t this, which also helps. I feel lucky to be in such a wonde
11	start. But at the moment I feel really proud of our school
12	ll that is different now. I feel more like a coordinator at
13	nd supporting each other. I feel blessed to work with such g
14	verwhelming but otherwise I feel tired but fine. No challeng
15	filling at the same time. I feel as if we've been successful
16	being is okay and that I'm feeling positive but that's in my
17	w other members of the team feel the same because several of
18	nt in making sure the staff feel informed and prepared for h
19	my part of the job and that feels good too. That's been good
20	pported staff and made them feel important in this process.
21	ally matter as long as they feel they have had the support f
22	affect on them and how they feel about the job, the work, th
23	he deputy to make sure they feel comfortable and reassured t
24	be able to share how we're feeling. We were all worried abou
25	huge difference to how you feel in yourself and your confid

FIGURE 7 | Concordance showing utterances of *feel** in CI Group interviews.

because the Covid-19 pandemic has caused them to navigate changes to their professional identity, destabilizing their sense of professional self.

Feelings and Stress

There was a clear distinction in the way that CI Group and PI Group participants constructed their feelings, as indicated by the concordances shown in **Figure 7** (CI Group) and **Figure 8** (PI Group). CI Group members were significantly more likely than PI Group members to associate positive emotions with the word *feel* than negative:

I also **feel lucky**
I **feel positive**
I **feel blessed**
that **feels good**
I **feel** really **proud**
make sure they **feel comfortable**
it's a **lovely family feel**

In total, within the CI Group, 16 of the 25 references to *feel** associated this word with positive emotions or processes. These findings support the discourse analysis which identified CI Group participants as constructing a positive perspective on the Covid-19 pandemic lockdown.

In contrast, utterances from members of the PI Group had a tendency to associate negative emotions with the word *feel,* as in the following examples:

I **feel worn down**
I **feel** that I've **lost** all contact
I **feel let down**
I **feel** at a **loose end**
I can **feel** that they're **losing confidence**
I **don't feel supported**

Out of 25 occurrences of the word *feel** within the corpus of PI Group speeches, 17 were associated with negative emotions or processes. Again, this finding supports the discourse analysis which indicated that PI Group participants generally constructed a negative perspective on the Covid-19 pandemic in comparison to their CI Group counterparts.

In addition to analyzing data related to feelings which was prompted by wordlist data, we also chose to analyze linguistic data specifically regarding the use of the term *stress* across CI and PI Groups[3]. **Figures 9**, **10** are concordances showing every occurrence of words with the root *stress** (*stress, stressful, stress*) across CI (**Figure 8**) and PI (**Figure 9**) Groups. It is interesting

[3]*Stress* was not the only word which was analyzed outside the high frequency content words identified in **Table 3**, but the findings concerning stress were particularly relevant and therefore warranted inclusion within this paper.

N	Concordance
1	icious cycle of stress and feeling unhappy. I don't think
2	eir good will now and I can feel that they're losing confide
3	ow it feels anyway. I don't feel as if I've been supported b
4	doesn't help this. I don't feel supported by the school and
5	can't get together. I don't feel like a proper teacher at th
6	I feel completely unprepared every
7	I feel like an administrator at the
8	at has gone this year and I feel really sorry for them. If y
9	here with [name] because I feel closer to the school, which
10	wellbeing is challenged. I feel worn down by this sense of
11	leave anything to chance. I feel that I have to plan for eve
12	then I get the criticism. I feel that I've lost all contact
13	rship of the team harder. I feel as if I'm having to do ever
14	taught me a lot about how I feel about my colleagues. I alwa
15	tand a bit more about how I feel but that's not going to cha
16	e where's the leadership? I feel let down and will contempla
17	... you know what I mean. I feel like I am still part of it.
18	pening behind the scenes. I feel very lucky. I don't have a
19	sual obviously. I suppose I feel at a loose end. I live with
20	complaints. That's how irt feels anyway. I don't feel as if
21	mmitted to my work but just feel unable to do it right. Mayb
22	hallenged and that makes me feel stressed. I could say that
23	e excitement the older ones feel about going to university.
24	bit although I know they're feel awful if they knew I felt l
25	up at anyone who makes you feel small and insignificant. Be

FIGURE 8 | Concordance showing utterances of *feel** in PI Group interviews.

to note that there were more occurrences of *stress** in the CI Group ($n = 20$) than the PI Group ($n = 12$), despite the CI Group having a more positive perspective on the Covid-19 pandemic. Quantitative data alone would therefore indicate that members of the CI Group were more concerned with stress than members of the PI Group. However, when these utterances of *stress** were contextualized using concordance data, a pattern became clear in the way that CI Group and PI Group members conceptualized stress.

Looking at the PI Group concordance, (**Figure 10**), the first person pronouns *me* ($n = 4$) and *I* ($n = 4$) feature heavily in close proximity to *stress**, for example: Tamara stated in her interview that:

> The lack of control is **stressful** for **me**
> make(s) **me stressed.**
> **I** don't like to show **stress** so **I** keep it inside.
> **I've** found that **stressful**
> **I'm** very **stressed** by this experience

Members of the PI Group had a tendency to focus on the impact of stress on themselves as individuals, foregrounding the outcome of stress on their internal psychological state.

In comparison, the most common collocations with *stress** in the CI group were *it* ($n = 4$) and *the* ($n = 6$). Examples of *it* in a close relationship with *stress** include:

> I haven't found **it stressful** myself
> **it's stressful** again
> some who have found **it stressful**.

In these statements, stress is most closely associated with the situation of teaching during the Covid-19 pandemic, rather than being constructed as causing a psychological effect within the individual speaking. Examples of *the* in a close relationship with *stress* within CI Group utterances include:

> **the** new **stresses**
> that's when **the stress** might start
> **the stress** at times has been higher

In these utterances, stress is constructed as something external to the person speaking. Stress in these utterances may indeed be constructed as having a psychological impact, but the use of *the* makes the sense of stress more general, affecting teachers or people generally rather than the individual specifically. In the case of the utterance "I think the stress affects your well-being," the shift of footing (Goffman, 1981) from *I* to *your* indicates an attempt to generalize the experience of stress during the Covid-19 pandemic, as the interviewee attempted to build common ground between herself and the interviewer by assuming a common experience of stress.

In a number of utterances, CI Group participants explicitly referred to the stress of others:

N	Concordance
1	usual, and teaching is a stressful job all the time, but it
2	there was much time to be stressed. My wellbeing is good bec
3	at. I think we've all felt stress - to different degrees I'm
4	be some who have found it stressful and that will have a neg
5	pupils. I haven't found it stressful myself but I think some
6	back but not others, it's stressful again. We really don't k
7	e time consuming and more stressful for some but we've got t
8	een taken over by the new stresses. It was stressful at the
9	y. This has caused me some stress. The weight of someone's s
10	. The weight of someone's stressful situation is overwhelmin
11	more of a challenge than stressful but that's the sort of p
12	e before that happens. The stress at times has been higher t
13	ave been going well so the stress wasn't so bad. Now that we
14	e way. I don't think the stress will subside until we are
15	ppen and when. I think the stress affects your well being in
16	ctice, but that's when the stress might start. But at the mo
17	ouldn't. Some of the usual stress has been taken over by the
18	the new stresses. It was stressful at the start of this, be
19	just get on with it. Very stressful for them. I don't feel
20	someone is suffering with stress or anxiety through this. I

FIGURE 9 | Concordance showing utterances of *stress** in CI Group interviews.

N	Concordance
1	something. Yes, it's been stressful. Even though I've manage
2	ed and that makes me feel stressed. I could say that I think
3	my parents know that I'm stressed. It would upset them. I h
4	me additional contact, is stressful and we don't seem to hav
5	r. The lack of control is stressful for me. And the fact tha
6	over issues that make me stressed. I can see how people can
7	y her colleagues makes me stressed - I keep thinking that's
8	o carry the burden of more stress because of my leadership p
9	et into a vicious cycle of stress and feeling unhappy. I don
10	day. I don't like to show stress so I keep it inside and th
11	e others. I've found that stressful. Also seeing how support
12	ill in the loop. I'm very stressed by this experience as you

FIGURE 10 | Concordance showing utterances of *stress** in PI Group interviews.

Very **stressful** for **them**
The weight of **someone's stressful** situation is overwhelming.
some who have found it **stressful**
we've all felt **stress**.

In these utterances, CI Group members emphasized the communal feeling of stress that affected their social group, in contrast to PI Group utterances which foregrounded the impact of stress upon themselves as individuals.

The salience of either personal or collective identity appears, therefore, to be predictive of how individuals construct stress. Participants in the CI Group had a tendency to construct stress as external to themselves and, in repeated occurrences, portrayed concerns about the stress of others. In contrast, participants in the PI Group generally emphasized their personal experiences of stress, constructing stress as having a detrimental impact on them specifically. Although there a small number of deviant cases were identified, overall there was a clear pattern which distinguished the way that CI Group and PI Group members constructed stress during the Covid-19 pandemic.

Discursive Justifications

The aim of conducting a discourse analysis within the field of discursive psychology is to take a "functionally oriented approach to the analysis of talk and text" (Edwards and Potter, 1992, p. 27).

As such, analysis should not simply be descriptive, but should seek to make sense of the discursive justifications that people use to explain their feelings and behavior. In the final section of the analysis, we returned to the interview transcripts to understand *why* teachers constructed their identities in particular ways—as collective in the CI Group, and personal in the case of the PI Group.

For teachers in the PI Group, the construction of a salient personal identity served as a justification for a loss of commitment and motivation:

> *I've been out in a really awful position. My team are looking to me for guidance but I don't know what we're supposed to be doing. I'm losing their good will now and I can feel that they're losing confidence in me. Although we're a relatively big school, we're in the middle of a close city community and I'm not sure how I'll be able to go back at this rate.* (Timothy)
>
> *I feel let down and will contemplate my position over the summer. I won't move to another school—it's too late for me to do that, but I don't have to go on teaching if I don't want to. I've been doing this for over 40 years so I have a choice to make.* (Christopher)
>
> *Rubbish, rubbish, rubbish! One headteacher responsible for reducing this committed, experienced and creative teacher to not even wanting to stay in the profession!* (Matilda)
>
> *I also need to make sure I have some kind of life outside work because I worry about it too much and never really relax. I won't last long as a teacher if I don't try to find a better balance...and I love my job so that's a big thing to say.* (Ava)

Teachers in the PI Group emphasized their personal identity to work through difficult feelings about being a teacher, and to justify changes in their teacher identity. For Matilda, emphasizing her personal identity provided some justification for her identity shift from a "committed, experienced and creative teacher" to someone who wanted to leave the profession. Timothy emphasized how he felt isolated from his team and used this to explain how he would find it difficult to return to his school. Christopher foregrounded his personal feelings and his identity as an experienced teacher to justify his decision to "contemplate my position over summer." Ava, although keen to stress that she enjoyed teaching by saying "I love my job," argued that she needed to "have some kind of life outside work," rhetorically using a desire for a sense of identity outside work as a justification for concerns about a future lack of motivation and commitment. For the PI Group, constructing their identities as distinct from their school community provided a justification for the negative admission that they were considering leaving teaching as a result of the changes brought about by the Covid-19 pandemic lockdown.

For teachers in the CI Group, the construction of a salient collective identity served to position them as good leaders and managers:

> *I've felt more like an army general for the past three months, than I have a headteacher. It's been full on, all hands to the pump, but we've pulled through it and I think we'll be stronger for it.* (Edwin)
>
> *I've taken it head on and done everything needed to take the staff with me. We're a unit and we had to tackle this as a unit. This was the biggest challenge we had faced as a team so we all had to be on board with the decisions made. I've had to hand over all of my actual teaching. I think it's important that the deputy head teaches, but in this situation, that wasn't possible. I'm really sad about it, but we all had to make sacrifices and that was mine.* (Ivy)
>
> *It's been an interesting experience and one which has brought us altogether in many ways. My role as a leader in the school has been important in making sure the staff feel informed and prepared for how we move forward both during and after the closure. As deputy, I've been responsible in implementing the remote teaching strategy across the school, but with the help of the Key stage leads and subject coordinators.* (Isaac)
>
> *I'm Head of Science and I usually work very closely with the leads for the three sciences and we haven't been able to do that in the same way as before. The departmental meetings have been done differently, as has planning and assessment.* (Maria)
>
> *I'm taking on the role of the head really which he does the bigger planning of how to move forward when the children can come back to school. Our roles have changed a lot, but it's worked and we're really proud that our small school has coped well with it all.* (Noah)

As with teachers in the PI Group, those in the CI Group also reported undergoing changes to their role as a result of the Covid-19 crisis. This rhetorical argument is perhaps most obvious in Edwin's dialogue. He starts by comparing his changed role under Covid-19 to one of an "army general," but then constructs a sense of democratic and consensual leadership by using the pronoun we: "we've pulled through it [. . .] we'll be stronger for it." Edwin therefore justifies his changed role by emphasizing a sense of social identity within his school institution. Similarly, Ivy and Noah reported significant changes to their role, but both justified these changes by emphasizing that they were part of a wider group of teachers within their school, all of whom had experienced changes to their role. Maria emphasized her democratic approach to leadership prior to the Covid-19 crisis, and Isaac similarly foregrounded an inclusive leadership style in response to the Covid-19 pandemic. By emphasizing their shared experience with other teachers, rather than their distinctiveness and individual experience, teachers in the CI Group discursively justified the decisions they had made during the period of remote teaching.

It is interesting that all teachers in the CI Group explicitly categorized themselves as having senior leadership roles: Edwin as a headteacher; Ivy, Isaac, and Noah as deputy heads; and Maria as head of department. Findings suggest that the discursive construction of a social identity and portrayal of a democratic, inclusive leadership style were used to justify rapid changes to school structure and policies during the Covid-19 crisis. Members of the CI Group detail changes to their role, but justify these changes as being supported by their staff and as being aligned with the experiences of other teachers within their schools.

DISCUSSION

Previous research published on education during the Covid-19 crisis has highlighted changes in teacher–pupil relationships which occurred as a result of the sudden requirement to teach remotely (Jones and Kessler, 2020; Moss et al., 2020; Wong,

2020). Our research has extended this body of knowledge by exploring the way that teachers spoke about their relationships with other *teachers* during this challenging time. Research on teacher–pupil relationships highlights how teachers' sense of professional identity shifted as welfare support for children took priority, with teachers organizing food banks and delivering learning materials (Moss et al., 2020). The requirement to teach online was particularly challenging for those who sought to construct respectful and communicative relationships with families and children embedded within an ethic of care (Jones and Kessler, 2020; Ferguson et al., 2021), and for teachers who sought to meet children's basic need for relatedness (Wong, 2020). Our research on teachers' relationships with their colleagues appears to suggest that it was not only relationships with *students* which demanded identity work during the Covid-19 crisis, but also relationships with other teachers.

Our research indicates that teachers who presented a salient collective identity, emphasizing strong and positive relationships between staff and a sense of belonging, also constructed a more positive perspective on the Covid-19 crisis than teachers who presented a salient personal identity. This finding supports the work of Day et al. (2007) which found that teachers who had unstable professional and situated identities were more vulnerable than teachers whose identities were in balance. Although all teachers during the period of Covid-19 suffered from instability in their professional identity as remote teaching was implemented and their professional role changed, teachers in the CI Group appeared to maintain a more stable situated identity than those in the PI Group, reporting more consistent and positive relationships with colleagues. Teachers in the PI Group constructed both their professional and situated identities as being unstable during the Covid-19 crisis, and it is perhaps therefore unsurprising that the PI Group reported a lack of commitment, motivation and resilience during the Covid-19 lockdown.

In line with much research which indicates the protective effects of social support and collective identity both in school settings and elsewhere (Kinman et al., 2011; Drury, 2012; Jetten et al., 2017), our research suggests that teachers who presented themselves as being supported by other teachers within their school may have felt more able to cope with the challenges presented by the Covid-19 lockdown. Certainly, our research has indicated a close association between discursive constructions of collective and personal identity, perspectives on the pandemic, and psychological issues including stress. Like the teachers in Kim and Asbury's (2020) study, the CI Group of teachers within our study constructed a strong sense of shared or collective identity which they argued enabled them to navigate the difficulties of the Covid-19 pandemic lockdown. However, our study also revealed another group of teachers, as represented by the PI Group, who constructed themselves as lacking social support and, consequently, as feeling extremely vulnerable as a result of the Covid-19 crisis. Our study therefore challenges one of the claims of Kim and Asbury's study, that teachers "made extra efforts to create and develop relationships with each other" (2020, p. 1077) during the Covid-19 lockdown. Whereas, this may have been true of teachers who constructed a salient collective identity, other teachers who constructed a salient personal identity reported feeling isolated from their peers, and making efforts to distance themselves by considering leaving the profession.

It was interesting to note that despite previous research showing that female teachers were more likely to deploy functional coping strategies (such as seeking social support) than male teachers (Klapproth et al., 2020; Truzoli et al., 2021), our project indicated no significant difference between the way that male and female teachers spoke about their construction of social identity and use of social support. The majority of teachers in the CI Group (three of five) were male, and the majority of teachers in the PI Group were female (again, three out of five), suggesting that male teachers were more likely to seek out social support than females. This finding could be a function of the small sample size and requires further investigation. However, it may also point to the importance of research which departs from individuals' own identity constructs, rather than from assuming the priority of predetermined groups such as gender.

In terms of the way that participants categorized themselves, one significant difference between the CI Group and the PI Group was the self-categorization of CI Group teachers as senior leaders within their schools. All of the CI Group categorized themselves as senior leaders and used a construction of social identity to present their "selves" as effective managers during this time of difficulty. Our research findings therefore have an interesting relationship to those of Ferguson et al. who, in their research with primary head teachers during the Covid-19 lockdown in Scotland, found that "Head Teachers demonstrated indomitable attentiveness, responsiveness, and responsibility for others, thus showing that relationships are fundamentally about values within education" (2021, p. 11). The findings from our project highlight that one of the rhetorical devices employed by headteachers and other senior leaders to justify their actions and professional identity during the Covid-19 crisis was to emphasize collegial relationships with others. Our research does not contradict the findings of Ferguson et al. (2021); in many ways the findings of the two studies are aligned. However, our findings emphasize the importance of attending to the rhetorical *purpose* of such claims and their function in discourse, rather than accepting such self-positionings as representative of an objective reality.

With regard particularly to PI Group teachers, our findings support the work of previous research on stress within the field of critical education studies and discursive psychology. Teachers in the PI Group constructed a salient personal identity partially to justify their feelings of stress, shifting the locus of responsibility for such stress from themselves and onto others. This supports Kelly and Colquhoun's argument that prominent psychological discourses within school settings not only encourage teachers to view themselves as stressed, but as "responsible for managing that stress" (2003, p. 202). In order to rhetorically manage the negative feelings associated with being unable to manage the stress brought about by the Covid-19 lockdown, PI Group teachers emphasized negative relationships with peers. The findings from the present study extend the findings of Hepburn and Brown (2001), who found that teachers use the discourse of stress to

protect themselves from accusations. We found that teachers also use discourses oriented around negative relationships with peers to justify their negative feelings and future actions, particularly those associated with attrition; as such, our findings support those of Thomson (2008) who detailed how a headteacher used discourses of stress to justify decisions to leave the profession.

CONCLUSION

This paper has made contributed to the growing field of study concerning the impact of Covid-19 lockdowns on individuals and social groups. We have argued that interpersonal pronoun usage may serve as a predictor of teachers' perspectives on the Covid-19 crisis, extending previous research on the impact of teachers' peer relationships during this unprecedented time by employing a methodological stance informed by discursive psychology. This paper does not seek to claim that interpersonal pronoun use is sufficient to explain and understand teacher identities in their entirety, either during the Covid-19 crisis or during other challenging situations. More research would need to be conducted with a larger sample in order to determine whether the findings of this study are generalizable within a wider and more representative teaching population, or during other times of stress or difficulty. Although it is usual for studies within the field of discursive psychology to rely on interview data from a small sample, innovative use of corpus-assisted discourse analysis (as employed in this paper) could enable future studies to work with larger samples to determine the generalizability of the results presented here. Therefore, although one of the limitations of this study was the small sample size, the study could serve as a pilot for future work exploring teachers' discursive constructions of peer relationships.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

This research study was reviewed and approved by University of Worcester Arts, Humanities and Education Research Ethics Panel. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AK was responsible for the development of the research project and the collection of data. AK, KS, and MW completed initial thematic analysis. KS completed discourse analysis and wrote the findings, discussion, and conclusion. MW and KS developed the conceptual framework and wrote the introduction. AK and KS wrote the methodology, revised, and edited the manuscript together before submission. All authors contributed to the article and approved the submitted version.

FUNDING

Fees for open access publication were provided by the University of Worcester.

ACKNOWLEDGMENTS

The authors would like to thank the teachers who participated in this research study. Thanks are also extended to the University of Worcester for their continued support for the research.

REFERENCES

Adasi, G. S., Amponsah, K. D., Mohammed, S. M., Yeboah, R., and Mintah, P. C. (2020). Gender differences in stressors and coping strategies among teacher education students at University of Ghana. *J. Educ. Learn.* 9, 123–133. doi: 10.5539/jel.v9n2p123

Aldrup, K., Klusmann, U., Lüdtke, O., Göllner, R., and Trautwein, U. (2018). Student misbehavior and teacher well-being: testing the mediating role of the teacher-student relationship. *Learn. Instruct.* 58, 126–136. doi: 10.1016/j.learninstruc.2018.05.006

Alsup, J. (2005). *Teacher Identity Discourses: Negotiating Personal and Professional Spaces*. Mahwah, NJ: Lawrence Erlbaum Associates.

Alsup, J. (2019). *Millennial Teacher Identity Discourses: Balancing Self and Other*. Abingdon; Oxon: Routledge. doi: 10.4324/9781351036542

Anderson, R. C., Bousselot, T., Katz-Buoincontro, J., and Todd, J. (2020). Generating buoyancy in a sea of uncertainty: teachers creativity and well-being during the covid-19 pandemic. *Front. Psychol.* 11:614774. doi: 10.3389/fpsyg.2020.614774

Antaki, C., and Widdicombe, S. (1998). "Identity as an achievement and as a tool," in *Identities in Talk*, eds C. Antaki and S. Widdicombe (London: Sage), 1–14. doi: 10.4135/9781446216958.n1

Bakar, K. A. (2014). Attitude and identity categorizations: a corpus-based study of gender representation. *Proc. Soc. Behav. Sci.* 112, 747–756. doi: 10.1016/j.sbspro.2014.01.1226

Baker, P. (2006). *Using Corpora in Discourse Analysis*. London: Continuum.

Baker, P. (2012). Acceptable bias? Using corpus linguistic methods with critical discourse analysis. *Crit. Discour. Stud.* 9, 247–256. doi: 10.1080/17405904.2012.688297

Baker, P., Gabrielatos, C., Khosravinik, M., Krzyzanowski, M., McEnery, T., and Wodak, R. (2008). A useful methodological synergy? Combining critical discourse analysis and corpus linguistics to examine discourses of refugees and asylum seekers in the UK press. *Discour. Soc.* 19, 273–306. doi: 10.1177/0957926508088962

Bates, A. (2016). Reculturing schools in England: how 'cult' values in education policy discourse influence the construction of practitioner identities and work orientations. *Crit. Stud. Educ.* 57, 191–208. doi: 10.1080/17508487.2015.1018289

BBC (2020). *Coronavirus: UK Schools, Colleges and Nurseries to Close from Friday*. Available online at: https://www.bbc.co.uk/news/uk-51952314 (accessed April 12, 2021).

Beauchamp, G., Hulme, M., Clarke, L., Hamilton, L., and Harvey, J. A. (2021). 'People miss people': a study of school leadership and management in the four nations of the United Kingdom in the early stage of the Covid-19 pandemic. *Educ. Manage. Admin. Leader.* 49, 375–392. doi: 10.1177/1741143220987841

Bednarek, M. (2011). "Corpus linguistics and systemic functional linguistics: interpersonal meaning, identity and bonding in popular culture." in *New Discourse on Language: Functional Perspectives on Multimodality, Identity, and Affect*, eds M. Bednarek and J. R. Martin (London: Bloomsbury), 237–266.

Bednarek, M., and Martin, J. R. (eds.). (2011). *New Discourse on Language: Functional Perspectives on Multimodality, Identity, and Affiliation*. London: Continuum.

Benwell, B., and Stokoe, E. (2006). *Discourse and Identity*. Edinburg: Edinburgh University Press.

BERA. (2018). *Ethical Guidelines for Educational Research. 4th Edn*. British Educational Research Association (BERA). Available online at: https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2018 (accessed September 29, 2020).

Bertera, E. M. (2005). Mental health in U.S. adults: the role of positive social support and social negativity in personal relationships. *J. Soc. Pers. Relat.* 22, 33–48. doi: 10.1177/0265407505049320

Betoret, F. D. (2009). Self-efficacy, school resources, job stressors and burnout among Spanish primary and secondary school teachers: a structural equation approach. *Educ. Psychol.* 29, 45–68. doi: 10.1080/01443410802459234

Biddlestone, M., Green, R., and Douglas, K. M. (2020). Cultural orientation, power, belief in conspiracy theories, and intentions to reduce the spread of COVID-19. *Brit. J. Soc. Psychol.* 59, 663–673. doi: 10.1111/bjso.12397

Blase, J. J. (1982). A social-psychological grounded theory of teacher stress and burnout. *Educ. Admin. Quar.* 18, 93–113. doi: 10.1177/0013161X82018004008

Bowlby, J. (2005). *A Secure Base: Clinical Applications of Attachment Theory*. Routledge Classics Ed. Abingdon; Oxon: Routledge.

Brewer, M. B., and Gardner, W. (1996). Who is this "we"? Levels of collective identity and self representations. *J. Pers. Soc. Psychol.* 71, 83–93. doi: 10.1037/0022-3514.71.1.83

Brezina, V. (2018). *Statistics in Corpus Linguistics: An Introduction*. Cambridge: Cambridge University Press. doi: 10.1017/9781316410899

Brown, Z., and Manktelow, K. (2016). Perspectives on the standards agenda: exploring the agenda's impact on primary teachers' professional identities. *Education 3-13* 44, 68–80. doi: 10.1080/03004279.2015.1089920

Carpenter, D., and Dunn, J. (2021). We're all teachers now: remote learning during COVID-19. *J. Sch. Choice* 14, 567–594. doi: 10.1080/15582159.2020.1822727

Cohen, S. (2004). Social relationships and health. *Amer. Psychol.* 59, 676–684. doi: 10.1037/0003-066X.59.8.676

Cohen, S., and Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychol. Bull.* 98, 310–357. doi: 10.1037/0033-2909.98.2.310

Collie, R. J. (2021). COVID-19 and teachers' somatic burden, stress, and emotional exhaustion: examining the role of principal leadership and workplace buoyancy. *AERA Open.* 7, 1–15. doi: 10.1177/2332858420986187

Data Protection Act. (2018a). Data Protection Act 2018. *[online] GOV.UK. Available online at: https://www.gov.uk/government/collections/data-protection-act-2018* (accessed August 5, 2021).

Data Protection Act. (2018b). Available online at: https://www.legislation.gov.uk/ukpga/2018/12/contents/enacted (accessed April 27, 2021).

Davies, B., and Harré, R. (1990). Positioning: the discursive production of selves. *J. Theory Soc. Behav.* 20, 46–63. doi: 10.1111/j.1468-5914.1990.tb00174.x

Day, C., Sammons, P., Stobart, G., Kington, A., and Gu, Q. (2007). *Teachers Matter: Connecting Work, Lives, and Effectiveness*. Maidenhead: Open University Press. doi: 10.1037/e615332007-001

Drew, P., and Sorjonen, M. (1997). "Institutional dialogue," in *Discourse as Social Interaction*, ed T. A. van Dijk (London: Sage), 92–118.

Drury, J. (2012). "Collective resilience in mass emergencies and disasters: a social identity model," in *The Social Cure: Identity, Health, and Well-Being*, eds J. Jetten, C. Haslam, and S. A. Haslam (Hove: Psychology Press), 195–215.

Drury, J. (2018). The role of social identity processes in mass emergency behaviour: an integrative review. *Eur. Rev. Soc. Psychol.* 29, 38–81. doi: 10.1080/10463283.2018.1471948

Drury, J., Cocking, C., and Reicher, S. (2009). Everyone for themselves? A comparative study of crowd solidarity among emergency survivors. *Brit. J. Soc. Psychol.* 48, 487–506. doi: 10.1348/014466608X357893

Edwards, D. (1998). "The relevant thing about her: social identity categories in use," in *Identities in Talk*, eds C. Antaki and S.Widdicombe (London: Sage), 15–33.

Edwards, D. (2012). Discursive and scientific psychology. *Brit. J. Soc. Psychol.* 51, 425–435. doi: 10.1111/j.2044-8309.2012.02103.x

Edwards, D., and Potter, J. (1992). *Discursive Psychology*. London: Sage.

Edwards, D., and Stokoe, E. H. (2004). Discursive psychology, focus group interviews and participants' categories. *Brit. J. Dev. Psychol.* 22, 499–507. doi: 10.1348/0261510042378209

Fairclough, N. (1992). *Discourse and Social Change*. Cambridge: Polity Press.

Feeney, B. C., and Collins, N. L. (2014). A new look at social support: a theoretical perspective on thriving through relationships. *Pers. Soc. Psychol. Rev.* 19, 113–147. doi: 10.1177/1088868314544222

Ferguson, P., McKenzie, M., Mercieca, D., Mercieca, D. P., and Sutherland, L. (2021). Primary head teachers' construction and re-negotiation of care in COVID-19 lockdown in Scotland. *Front. Educ.* 6:617869. doi: 10.3389/feduc.2021.617869

Fest, J. (2015). Corpora in the social sciences - how corpus-based approaches can support qualitative interview analyses. *Rev. Leng. Fin. Espec.* 21, 48–69. doi: 10.20420/rlfe.2015.0011

Fitzgerald, R. (2012). Membership categorization analysis: wild and promiscuous or simply the joy of Sacks? *Discour. Stud.* 14, 305–311. doi: 10.1177/1461445612440776

Fuoli, M. (2018). Building a trustworthy corporate identity: a corpus-based analysis of stance in annual and corporate social responsibility reports. *Appl. Linguist.* 39, 846–885. doi: 10.1093/applin/amw058

Gabriel, Y. (2015). "Narratives and stories in organisational life," in *The Handbook of Narrative Analysis*, eds A. De Fina and A. Georgakopoulou (Chichester: Wiley), 275–292. doi: 10.1002/9781118458204.ch14

Gentry, L. A., Chung, J. J., Aung, N., Keller, S., Heinrich, K. M., and Maddock, J. E. (2007). Gender differences in stress and coping among adults living in Hawai'i. *Californian J. Health Promot.* 5, 89–102. doi: 10.32398/cjhp.v5i2.1235

Goffman, E. (1955). On face-work: an analysis of ritual elements in social interaction. *Psychiatry* 18, 213–231. doi: 10.1080/00332747.1955.11023008

Goffman, E. (1981). *Forms of Talk*. Oxford: Blackwell.

Gov.uk. (2020). *School Workforce in England. Reporting Year 2019*. Available online at: https://explore-education-statistics.service.gov.uk/find-statistics/school-workforce-in-england (accessed May 30, 2021).

Greenhow, C., Lewin, C., and Willet, K. B. S. (2020). The educational response to Covid-19 across two countries: a critical examination of initial digital pedagogy adoption. *Technol. Pedag. Educ.* 30, 7–25. doi: 10.1080/1475939X.2020.1866654

Guglielmi, R. S., and Tatrow, K. (1998). Occupational stress, burnout, and health in teachers: a methodological and theoretical analysis. *Rev. Educ. Res.* 68, 61–99. doi: 10.2307/1170690

Harkness, A. M. B., Long, B. C., Bermback, N., Patterson, K., Jordan, S., and Kahn, H. (2007). Talking about work stress: discourse analysis and implications for stress interventions. *Work Stress* 2005, 121–136. doi: 10.1080/02678370500160068

Harmsen, R., Helms-Lorenz, M., Maulana, R., and van Veen, K. (2018). The relationship between beginning teachers' stress causes, stress responses, teaching behaviour and attrition. *Teach. Teach.* 24, 626–643. doi: 10.1080/13540602.2018.1465404

Haslam, S. A., Powell, C., and Turner, J. (2000). Social identity, self-categorization, and work motivation: rethinking the contribution of the group to positive and sustainable organisational outcomes. *Appl. Psychol. Int. Rev.* 49, 319–339. doi: 10.1111/1464-0597.00018

Haslam, S. A., and Reicher, S. (2006). Stressing the group: social identity and the unfolding dynamics of responses to stress. *J. Appl. Psychol.* 91, 1037–1052. doi: 10.1037/0021-9010.91.5.1037

Hepburn, A., and Brown, S. D. (2001). Teacher stress and the management of accountability. *Hum. Relat.* 54, 691–715. doi: 10.1177/0018726701546001

Hepburn, A., and Potter, J. (2003). "Discourse analytic practice," in *Qualitative Research Practice,* eds C. Seale, D. Silverman, J. Gubrium and G. Gobo (London: Sage), 180–196.

Hepburn, A., and Wiggins, S. (2007). *Discursive Research in Practice: New Approaches to Psychology and Interaction*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511611216

Hogg, M. A., Terry, D. J., and White, K. M. (1995). A tale of two theories: a critical comparison of identity theory with social identity theory. *Soc. Psychol. Q.* 58, 255–269. doi: 10.2307/2787127

Holt-Lundstrad, J., and Smith, T. B. (2012). Social relationships and mortality. *Soc. Personal. Psychol. Compass* 6, 41–53. doi: 10.1111/j.1751-9004.2011.00406.x

Ibarra-Rovillard, M. S., and Kuiper, N. A. (2011). Social support and social negativity findings in depression: perceived responsiveness

to basic psychological needs. *Clin. Psychol. Rev.* 31, 342–352. doi: 10.1016/j.cpr.2011.01.005

ICO. (2021). *Guide to the UK General Data Protection Regulation (UK GDPR)*. Information Commissioner's Office. Available online at: https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/ (accessed April 27, 2021).

Jetten, J., Haslam, S. A., Cruwys, T., Greenaway, K. H., Haslam, C., and Steffens, N. K. (2017). Advancing the social identity approach to health and well-being: progressing the social cure research agenda. *Eur. J. Soc. Psychol.* 47, 789–802. doi: 10.1002/ejsp.2333

Johnson, S., Cooper, C., Cartwright, S., Donald, I., Taylor, P., and Millet, C. (2005). The experience of work-related stress across occupations. *J. Manag. Psychol.* 20, 178–187. doi: 10.1108/02683940510579803

Johnson, S. M., and Birkeland, S. E. (2003). Pursuing a "sense of success": new teachers explain their career decisions. *Am. Educ. Res. J.* 40, 581–617. doi: 10.3102/00028312040003581

Jones, A. L., and Kessler, M. A. (2020). Teachers' emotion and identity work during a pandemic. *Front. Educ.* 5:583775. doi: 10.3389/feduc.2020.583775

Jones, N., and Youngs, P. (2012). Attitudes and affect: daily emotions and their association with the commitment and burnout of beginning teachers. *Teach. Coll. Rec.* 114, 1–36.

Kalker, P. (1984). Teacher stress and burnout: causes and coping strategies. *Contemp. Educ.* 56, 16–19.

Kawachi, I., and Berkman, L. F. (2001). Social ties and mental health. *J. Urban Health* 78, 458–467. doi: 10.1093/jurban/78.3.458

Kelly, P., and Colquhoun, D. (2010). Governing the stressed self: teacher 'health and well-being' and 'effective schools.' *Discourse Stud. Cult. Polit. Educ.* 24, 191–204. doi: 10.1080/01596300303038

Kim, L. E., and Asbury, K. (2020). 'Like a rug had been pulled from under you.': the impact of COVID-19 on teachers in England during the first six weeks of UK lockdown. *Brit. J. Educ. Psychol.* 90, 1062–1083. doi: 10.1111/bjep.12381

Kinman, G., and Jones, F. (2005). Lay representations of workplace stress: what do people really mean when they say they are stressed? *Work Stress* 19, 101–120. doi: 10.1080/02678370500144831

Kinman, G., Wray, S., and Strange, C. (2011). Emotional labour, burnout and job satisfaction in UK teachers: the role of workplace social support. *Educ. Psychol.* 31, 843–856. doi: 10.1080/01443410.2011.608650

Klapproth, F., Federkeil, L., Heinschke, F., and Jungmann, T. (2020). Teachers' experiences of stress and their coping strategies during COVID-19 induced distance teaching. *J. Pedagog. Res.* 4, 444–452. doi: 10.33902/JPR.2020062805

Kyriacou, C. (1987). Teacher stress and burnout: an international review. *Educ. Res.* 29, 146–152. doi: 10.1080/0013188870290207

Larrivee, B. (2012). *Cultivating Teacher Renewal: Guarding Against Stress and Burnout*. Plymouth: Rowman and Littlefield Education.

Lawes, R. (1999). Marriage: an analysis of discourse. *Brit. J. Soc. Psychol.* 38, 1–20. doi: 10.1348/014466699164004

Lenard, D. B. (2016). Gender differences in the personal pronouns usage on the corpus of congressional speeches. *J. Res. Des. Stat. Linguist. Commun. Sci.* 3, 161–188. doi: 10.1558/jrds.30111

Letzel, V., Pozas, M., and Schneider, C. (2020). Energetic students, stressed parents, and nervous teachers: a comprehensive exploration of inclusive homeschooling during the covid-19 crisis. *Open Educ. Stud.* 2, 159–170. doi: 10.1515/edu-2020-0122

Liebrecht, C., Hustinx, L., and van Mulken, M. (2019). The relative power of negativity: the influence of language intensity on perceived strength. *J. Lang. Soc. Psychol.* 38, 170–193. doi: 10.1177/0261927X18808562

Locher, M. A., and Bolander, B. (2017). "Facework and identity," in *Pragmatics of Social Media*, eds C. R. Hoffmann and W. Bublitz (Berlin: De Gruyter Mouton), 407–434. doi: 10.1515/9783110431070-015

Maclure, M. (1993). Arguing for Your Self: identity as an organising principle in teachers' jobs and lives. *Br. Educ. Res. J.* 19, 311–322. doi: 10.1080/0141192930190401

Mautner, G. (2009). "Corpora and critical discourse analysis," in *Contemporary Corpus Linguistics*, ed P. Baker (London: Bloomsbury), 32–46.

McEnery, T., and Wilson, A. (2001). *Corpus Linguistics: An Introduction*. Edinburgh: Edinburgh University Press.

McKimmie, B. M., Butler, T., Chan, E., Rogers, A., and Jimmieson, N. L. (2019). Reducing stress: social support and group identification. *Group Process. Intergroup Relat.* 23, 241–261. doi: 10.1177/1368430218818733

Mieroop, D. (2005). An integrated approach of quantitative and qualitative analysis in the study of identity in speeches. *Discour. Soc.* 16, 107–130. doi: 10.1177/0957926505048232

Mieroop, D. (2015). "Social identity theory and the discursive analysis of collective identities in narratives," in *The Handbook of Narrative Analysis*, eds A. De Fina and A. Georgakopoulou (Chichester: Wiley), 408–428. doi: 10.1002/9781118458204.ch21

Moss, G., Allen, R., Bradbury, A., Duncan, S., Harmey, S., and Levy, R. (2020). *Primary Teachers' Experience of the COVID-19 Lockdown - Eight Key Messages for Policymakers Going Forward*. Available online at: https://discovery.ucl.ac.uk/id/eprint/10103669/1/Moss_DCDT%20Report%201%20Final.pdf (accessed April 27, 2021).

Muhlhaus, J., and Bouwmeester, O. (2016). The paradoxical effect of self-categorization on work stress in a high-status occupation: insights from management consulting. *Hum. Relat.* 69, 1823–1852. doi: 10.1177/0018726715626255

Newberry, M., and Allsop, Y. (2017). Teacher attrition in the USA: the relational elements in a Utah case study. *Teach. Teach.* 23, 863–880. doi: 10.1080/13540602.2017.1358705

Ofsted (2020). *COVID-19 Series: Briefing on Schools, October 2020. Evidence From Pilot Visits to Schools Between 29 September and 23 October 2020*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/933490/COVID-19_series_briefing_on_schools_October_2020.pdf (accessed April 12, 2021).

Ozamiz-Etxebarria, N., Berasategi Santxo, N., Idoiaga Mondragon, N., and Dosil Santamaria, M. (2020). The psychological state of teachers during the covid-19 crisis: the challenge of returning to face-to-face teaching. *Front. Psychol.* 11: 620718. doi: 10.3389/fpsyg.2020.620718

Ozbay, F., Johnson, D. C., Dimoulas, E., Morgan, C. A., Charney, D., and Southwick, S. (2007). Social support and resilience to stress: from neurobiology to clinical practice. *Psychiatry* 4, 35–40.

Paulsen, J. (2018). Membership categorization analysis as an important qualitative method in evaluation. *Eval. Program Plann.* 67, 138–145. doi: 10.1016/j.evalprogplan.2018.01.003

Pérez-Paredes, P. (2021). *Corpus Linguistics for Education: A Guide for Research*. Abingdon; Oxon: Routledge. doi: 10.4324/9780429243615

Perryman, J. (2007). Inspection and emotion. *Cambridge J. Educ.* 37, 173–190. doi: 10.1080/03057640701372418

Potter, J. (2012). "Discourse analysis and discursive psychology," in *APA Handbook of Research Methods in Psychology, Vol. 2. Research Designs: Quantitative, Qualitative, Neuropsychological, and Biological*, eds H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, and K. J. Sher (Washington, DC: American Psychological Association), 119–138. doi: 10.1037/13620-008

Potter, J., and Hepburn, A. (2005). Qualitative interviews in psychology: problems and possibilities. *Qual. Res. Psychol.* 2, 281–307. doi: 10.1191/1478088705qp045oa

Potter, J., and Wetherell, M. (1987). *Discourse and Social Psychology: Beyond Attitudes and Behaviour*. London: Sage.

Pressley, T. (2021). Factors contributing to teacher burnout during covid-19. *Educ. Res.* 50, 325–327. doi: 10.3102/0013189X211004138

Rabaglietti, E., Lattke, L. S., Tesauri, B., Settanni, M., and Lorenzo, A. D. (2021). A balancing act during covid-19: teachers' self-efficacy, perception of stress in the distance learning experience. *Front. Psychol.* 12: 644180. doi: 10.3389/fpsyg.2021.644108

Raffaelli, M., Andrade, F. C. D., Wiley, A. R., Sanchez-Armass, O., Edwards, L. L., and Aradillas-Garcia, C. (2013). Stress, social support, and depression: a test of the stress-buffering hypothesis in a mexican sample. *J. Res. Adolesc.* 23, 283–289. doi: 10.1111/jora.12006

Rich, E., Mavor, K. I., and Webb, L. (2017). "The social construction of teachers' identities: finding connections in social identity and post-structuralist perspectives," in *Self and Social Identity in Educational Contexts*, eds K. I. Mavor, M. J. Platow and B. Bizumic (London: Routledge), 341–363. doi: 10.4324/9781315746913-ch19

Robson, C. (2011). *Real World Research, 3rd Edn*. Chichester: Wiley.

Rose, S., Twist, L., Lord, P., Rutt, S., Badr, K., Hope, C., et al. (2021). *Impact of School Closures and subsequent support strategies on attainment and socio-economic wellbeing in Key Stage 1: Interim Paper 1*. Available online at: https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/nfer-impact-of-school-closures-and-subsequent-support-strategies-on-attainm/ (accessed April 26, 2021).

Ryan, S. V., von der Embse, N. P., Pendergast, L. L., Saeki, E., Segool, N., and Schwing, S. (2017). Leaving the teaching profession: the role of teacher stress and educational accountability policies on turnover intent. *Teach. Teach. Educ.* 66, 1–11. doi: 10.1016/j.tate.2017.03.016

Sacks, H. (1992). *Lectures on Conversation, Vol. 1*. Oxford: Blackwell.

Scott, M. (2016). *Wordsmith Tools. Version 7*. Stroud: Lexical Analysis Software.

Sequeira, L., and Dacey, C. M. (2020). The COVID-19 diaries: identity, teaching and learning at a crossroads. *Front. Educ.* 5:586123. doi: 10.3389/feduc.2020.586123

Skaalvik, E. M., and Skaalvik, S. (2016). Teacher stress and teacher self-efficacy as predictors of engagement, emotional exhaustion, and motivation to leave the teaching profession. *Creat. Educ.* 7, 1785–1799. doi: 10.4236/ce.2016.713182

Smith, K., and Ulvik, M. (2017). Leaving teaching: lack of resilience or sign of agency? *Teach. Teach.* 23, 928–945. doi: 10.1080/13540602.2017.1358706

Spicksley, K., and Watkins, M. (2020). "Early-career teacher relationships with peers and mentors: exploring policy and practice," in *Social and Learning Relationships in Primary Schools*, eds A. Kington and K. Blackmore (London: Bloomsbury Academic), 93–116. doi: 10.5040/9781350096097.ch-005

Spoel, I., Noroozi, O., Schuurink, E., and Ginkel, S. (2020). Teachers' online teaching expectations and experiences during the Covid-19 pandemic in the Netherlands. *Eur. J. Teach. Educ.* 43, 623–638. doi: 10.1080/02619768.2020.1821185

Steffens, N. K., Haslam, S. A., and Reicher, S. D. (2014). Up close and personal: evidence that shared social identity is a basis for the 'special' relationship that binds followers to leaders. *Leadersh. Q.* 25, 296–313. doi: 10.1016/j.leaqua.2013.08.008

Tajfel, H. (1978). *Differentiation Between Social Groups: Studies in the Social Psychology of Intergroup Relations*. London: Academic Press.

Tajfel, H., and Turner, J. (1979). "An integrative theory of intergroup conflict," in *The Social Psychology of Intergroup Relations*, eds W. G. Austin and S. Worchel (Monterey: Brooks/Cole), 33–47.

Tan, S. L., and Moghaddam, F. M. (1999). "Positioning in intergroup relations," in *Positioning Theory*, eds R. Harré and L. van Langenhove (Oxford: Blackwell), 178–194.

Tay, L., Tan, K., Diener, E., and Gonzalez, E. (2012). Social relations, health behaviors, and health outcomes: a survey and synthesis. *Appl. Psychol. Health Wellbeing* 5, 28–78. doi: 10.1111/aphw.12000

Taylor, S. E. (2011). "Social support: a review," in *The Oxford Handbook of Health Psychology*, ed H. S. Friedman (Oxford: Oxford University Press), 189–214.

Thomson, P. (2008). Answering back to policy? Headteachers' stress and the logic of the sympathetic interview. *J. Educ. Policy* 23, 649–667. doi: 10.1080/02680930802214248

Towers, E., and Maguire, M. (2017). Leaving or staying in teaching: a 'vignette' of an experienced urban teacher 'leaver' of a London primary school. *Teach. Teach.* 23, 946–960. doi: 10.1080/13540602.2017.1358703

Troman, G. (2000). Teacher stress in the low-trust society. *Br. J. Sociol. Educ.* 21, 331–353. doi: 10.1080/713655357

Truzoli, R., Pirola, V., and Conte, S. (2021). The impact of risk and protective factors on online teaching experience in high school Italian teachers during the COVID-19 pandemic. *J. Comput. Assist. Learn.* 37, 940–952. doi: 10.1111/jcal.0.12533

UK Parliament. (2020). *Statement from Education Secretary on Education Settings Update*. Available online at: https://www.parliament.uk/business/news/2020/march/statement-from-education-secretary-on-education-settings-update/ (accessed May 28, 2021).

UNICEF. (2020) *Education and Covid-19. United Nations Children's Fund*. Available online at: https://data.unicef.org/topic/education/covid-19/ (accessed April 12, 2021).

Urzúa, A., and Vásquez, C. (2008). Reflection and professional identity in teachers' future-oriented discourse. *Teach. Teach. Educ.* 24, 1935–1946. doi: 10.1016/j.tate.2008.04.008

Van Dick, R., and Wagner, U. (2001). Stress and strain in teaching: a structural equation approach. *Brit. J. Educ. Psychol.* 71, 243–259. doi: 10.1348/000709901158505

Viswesvaran, C., Sanchez, J. I., and Fisher, J. (1999). The role of social support in the process of work stress: a meta-analysis. *J. Vocat. Behav.* 54, 314–334. doi: 10.1006/jvbe.1998.1661

Wiggins, S., and Hepburn, A. (2007). "Discursive research: applications and implications," in *Discursive Research in Practice: New Approaches to Psychology and Interaction*, eds A. Hepburn and S. Wiggins (Cambridge: Cambridge University Press), 281–291. doi: 10.1017/CBO9780511611216.015

Wiggins, S., and Potter, J. (2007). "Discursive psychology," in *The Sage Handbook of Qualitative Research in Psychology*, eds C. Willig and W. Stainton-Rogers (London: Sage), 73–90. doi: 10.4135/9781848607927.n5

Williamson, G. (2020). *Education Secretary speech at ASCL's Annual Conference*. March 13, 2020. Available online at: https://dera.ioe.ac.uk//35372/1/Education%20Secretary%20speech%20at%20ASCL%27s%20Annual%20Conference%20-%20GOV.UK.pdf (accessed May 28, 2021).

Wong, R. (2020). When no one can go to school: does online learning meet students' basic learning needs. *Interact. Learn. Environ.* doi: 10.1080/10494820.2020.1789672. [Epub ahead of print].

Young Minds. (2020). *Coronavirus: Impact on Young People with Mental Health Needs*. Available online at: https://youngminds.org.uk/media/3708/coronavirus-report_march2020.pdf (accessed April 26, 2021).

Yuan, R., and Lee, I. (2016). 'I need to be strong and competent:' a narrative inquiry of a student-teacher's emotions and identities in teaching practicum. *Teach. Teach.* 22, 819–841. doi: 10.1080/13540602.2016.1185819

Zaccoletti, S., Camacho, A., Correia, N., Aguiar, C., Mason, L., Alves, R. A., et al. (2020). Parents' perceptions of student academic motivation during the COVID-19 lockdown: a cross-country comparison. *Front. Psychol.* 11:592670. doi: 10.3389/fpsyg.2020.592670

Zhang Waring, H. (2018). *Discourse Analysis: The Questions Discourse Analysts Ask and How They Answer Them*. Abingdon; Oxon: Routledge. doi: 10.4324/9781315621340

Zhou, X., and Yao, B. (2020). Social support and acute stress symptoms (ASSs) during the COVID-19 Outbreak: deciphering the roles of psychological needs and sense of control. *Eur. J. Psychotraumatol.* 11, 1–8. doi: 10.1080/20008198.2020.1779494

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 03 September 2021
doi: 10.3389/fpsyg.2021.701255

Predicting Coping With Self-Regulated Distance Learning in Times of COVID-19: Evidence From a Longitudinal Study

Fred Berger[1]†, Claudia Schreiner[2]*†, Wolfgang Hagleitner[1]‡, Livia Jesacher-Rößler[2]‡, Susanne Roßnagl[1]‡ and Christian Kraler[2]*

[1]Institute of Education, University of Innsbruck, Innsbruck, Austria, [2]Department for Teacher Education and School Research, University of Innsbruck, Innsbruck, Austria

OPEN ACCESS

Edited by:
Sina Fackler,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Chris Heemskerk,
University of Bern, Switzerland
Manuel Soriano-Ferrer,
University of Valencia, Spain

***Correspondence:**
Fred Berger
fred.berger@uibk.ac.at
Claudia Schreiner
claudia.schreiner@uibk.ac.at

†These authors have contributed equally to this work and share first authorship

‡These authors have contributed equally to this work and share second authorship

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: 27 April 2021
Accepted: 29 July 2021
Published: 03 September 2021

Citation:
Berger F, Schreiner C, Hagleitner W, Jesacher-Rößler L, Roßnagl S and Kraler C (2021) Predicting Coping With Self-Regulated Distance Learning in Times of COVID-19: Evidence From a Longitudinal Study. Front. Psychol. 12:701255. doi: 10.3389/fpsyg.2021.701255

Due to the COVID-19 pandemic, students worldwide have experienced fundamental changes to their learning. Schools had to shift to distance education as part of the effort to stop the spread of the virus. Although distance learning undoubtedly resulted in challenges for all students, there is much concern that it exacerbated existing educational inequalities and led to disadvantages – particularly for students who were already struggling academically and lacking support from family and school. The aim of this paper was to investigate the possible impact of family and child characteristics, school performance prior to lockdown, and support at home and from school during lockdown in coping with self-regulated distance learning during times of COVID-19. The paper draws on data from a two-wave longitudinal study surveying 155 lower secondary school students aged 13–14 years from a rural-alpine region in Austria. Data were collected 1 year before the start of the pandemic and directly after schools had returned to in-class teaching after the first lockdown. Our findings support the notion that distance learning poses a substantial risk for exacerbating existing educational disadvantages. They show that coping with out-of-school learning was especially challenging for students with low academic achievement and learning motivation prior to the pandemic. Furthermore, findings demonstrate that the support from parents and teachers foster students' capabilities to cope with the self-regulatory demands connected with distance learning. Although the importance of competencies for self-regulated learning became particularly evident in the context of the pandemic, from our findings, it can be concluded that in the future, schools should strengthen their investment in promoting competencies for self-regulated learning. Self-regulation must be recognized as an essential educational skill for academic achievement and life-long learning.

Keywords: COVID-19, coping with self-regulated learning, distance learning, educational inequality, academic achievement, learning motivation, support at home and from school, longitudinal study

INTRODUCTION

Shortly after the World Health Organization (2020) had declared the Coronavirus disease outbreak a pandemic on March 11, 2020, many countries around the world instigated temporary closures of schools and universities as part of an effort to prevent and slow down transmission of the virus. By the end of April 2020, more than 1.5 billion students (over 90% globally) had been affected by the closure of schools and higher education institutions in response to the COVID-19 pandemic (UNESCO, 2021). As a consequence of these shutdowns, students were confronted with abrupt changes, both in their learning and their daily lives as a whole. Distance learning requires a large amount of self-regulation, potentially putting students at risk of missing out on wider learning opportunities and of being overwhelmed by the requirements to acquire and understand academic content with reduced or minimal support from their teachers (Pelikan et al., 2021). Moreover, the lack of physical presence and the lesser extent of informal discourse and spontaneous interaction with classmates, friends, and teachers increase the risk of developing negative emotions and feelings of loneliness.

In this study, we seek to examine how students managed to cope with the new challenges of self-regulated distance learning during school closures. Although involuntary distance learning created challenges for all students, based upon previous studies and theoretical considerations of the development of educational inequalities (Maaz et al., 2010; APA, 2020; Grewenig et al., 2020; Huber and Helm, 2020; SRCD, 2020), we argue that school closures did not affect all students to the same extent. We assert that distance learning exacerbated existing vulnerabilities and led to increased disadvantages in learning for particular groups of students. In particular, we assume increased disadvantages for those students with low levels of academic achievement and learning motivation and with low competence in self-regulation prior to lockdown and for those students with little support at home or from school during the shutdown.

Our analyses draw upon data from a two-wave longitudinal study with students from an alpine region of Austria. Students were in seventh grade during wave 1 and in eighth grade during wave 2 (aged approx. 13–14 years). Data were collected in May 2019, 1 year before the start of the pandemic, and in June and July 2020, right after Austrian schools had reopened after the first lockdown from March 16 to May 18, 2020.

Since the equipment for and use of digital media in Austrian schools was rather low in comparison to schools of other European countries (OECD, 2020), the involuntary shift to distance learning in March 2020 was especially challenging. In many cases, models and strategies for distance learning had to be developed first (Jesacher-Rößler and Klein, 2020). Furthermore, due to the regulations during the first strict lockdown, schools were only allowed to provide in-school education for students whose parents were key workers (BMBWF, 2020). Therefore, schools could not ask specific groups of students, for example, low achieving and low motivated students or students with little support at home, to come into school in order to support them.

Theoretical Considerations on the Link Between Self-Regulated Learning and Academic Achievement

In this article, the term self-regulated learning refers to a learner's competence to plan, execute, and evaluate his or her learning autonomously (Wirth and Leutner, 2008). Self-regulation is seen as a dynamic and cyclical process, which involves the active interpretation of tasks, goal setting, making plans, identifying strategies that will ensure success, and constantly monitoring and readjusting one's learning toward the attainment of set goals (Schunk and Greene, 2018). In the research literature, self-regulation is recognized as a developmental process that begins well before children enter formal schooling. It must be learned over the course of life and is considered to be an essential educational skill, especially with regard to academic achievement and life-long learning (Illeris, 2009; Usher and Schunk, 2018). There is a substantial body of literature, which links self-regulation to academic achievement; identifying it as a major cause and consequence of achievement gaps among students across educational levels and settings, even after controlling for previous achievement, IQ, and demographic characteristics (Cleary and Zimmerman, 2006; Zimmerman and Schunk, 2011; Jacob and Parkinson, 2015; Edossa et al., 2017; Perry et al., 2018). Students who struggle with self-regulation often show low academic achievement and vice versa. Furthermore, they frequently display low self-esteem and demonstrate low self-efficacy for changing outcomes in their lives (Cleary and Zimmerman, 2006; Zimmerman and Schunk, 2011; Perry et al., 2018).

Although there are several theoretical perspectives on self-regulated learning, these perspectives share common features (Pandero, 2017). One central feature is the key role of *motivation*. It is considered to be critical in both directing self-regulation and in maintaining energy to achieve goals (Schunk and Zimmerman, 2008; Efklides, 2011). A learner's motivation predicts his/her willingness to engage in cycles of strategic actions to facilitate learning (Zimmerman, 2008). Without the motivation to act and to "sustain the behaviors necessary, potentiality remains just that" (Usher and Schunk, 2018, p. 27).

A second common feature is the strong influence of *contextual factors*. Supportive contexts and relationships can help learners to withstand challenges that might otherwise overwhelm them and can assist them in developing self-regulation competency. In particular, support from parents and teachers is considered as very important in fostering self-regulated learning. Home and school environments, where children and adolescents experience authoritative forms of parenting and teaching (e.g., warmth and responsiveness, support of autonomy, and scaffolding), are likely to exert a positive influence on learners' own development of self-regulation (Eisenberg et al., 2009; Perry et al., 2018). In contrast, where low levels of instructional support and organizational qualities exist at home or at school, this can negatively impact children's development of self-regulation (Perry et al., 2018). Children gradually assume control of their thoughts and actions when they grow up in emotionally safe surroundings, which support their autonomy and by learning from parents and teachers as positive role models for

self-regulation (Schunk and Zimmerman, 1997; Rimm-Kaufman et al., 2009). Specifically in classrooms, instructional emphases on higher-order thinking, talking about learning and engaging students in meaningful work with formative feedback have been shown to support students' development of self-regulation (Perry, 2013). Self-regulated learning is very much shaped through the personal agency of the teacher who introduces and reinforces self-regulated learning experiences and offers scaffolded instructions and feedback, which help students to master their tasks and to meet their goals (Bembenutty, 2013).

Previous Findings on Students' Coping With Self-Regulated Learning in Times of COVID-19

There is a fast-growing body of research on the topic of students' ability to cope with distance learning in times of COVID-19 (e.g., see the systematic review of Helm et al., 2021). However, these results need further confirmation. To date, they show a wide range of variation. One emerging finding from research conducted so far is that most students coped quite well with the challenges of distance learning in 2020. Analyses of out-of-school learning in German-speaking countries (Germany, Austria, and Switzerland) indicate that 37–70% of students, depending upon study design, age, and school level, liked remote learning at home (Huber et al., 2020: 37%; Trültzsch-Wijnen and Trültzsch-Wijnen, 2020: 46%; Holtgrewe et al., 2020: 55%; Baier and Kamenowski, 2020: 55%; Schwerzmann and Frenzel, 2020: 70%). Moreover, 42% (special school) to 70% (grammar school) of students report having been more self-regulated in times of distance learning than in times of face-to-face teaching (Schwerzmann and Frenzel, 2020).

However, findings also indicate that a substantial number of students had difficulties coping with the different requirements of remote learning. Twenty-two to forty-four percent of the students described that they had to cope with problems during lockdown: Many students declared that they had difficulties organizing their self-regulated learning (Letzel et al., 2020: 35%; Huber and Helm, 2020: 44%), felt overwhelmed by the requirements of distance learning (Holtgrewe et al., 2020: 35%), reported having problems with concentrating on their tasks (Schwerzmann and Frenzel, 2020: 36%) or described that it was difficult for them to do their homework on their own (Holtgrewe et al., 2020: 22%; ADAS and LIFE, 2020: 26%). With regard to school performance, a substantial proportion of students expected distance learning to have negative effects on their academic achievement (Schwerzmann and Frenzel, 2020: 20%; Baier and Kamenowski, 2020: 38%; Refle et al., 2020: 40%; Anger et al., 2020: 45%; Trültzsch-Wijnen and Trültzsch-Wijnen, 2020: 50%). Furthermore, a significant percentage of students from different school phases reported low levels of home learning (a maximum of 2 h a day) during the lockdown (Huber et al., 2020: 24%; Anger et al., 2020: 35%; Wacker et al., 2020: 45%).

Additional research indicated that most students aged 10–19 felt well-supported at home and from school during lockdown (Helm et al., 2021). According to an Austrian study, only 3% of students reported that they did not know how to contact their teachers when they had questions about their distance learning (Schober et al., 2020). Fifty-three percent reported having weekly contact, and 41% having daily contact with their teachers (Trültzsch-Wijnen and Trültzsch-Wijnen, 2020). Nonetheless, a substantial proportion of students missed out on having any contact or support with school-related tasks from their teachers (Letzel et al., 2020: 22%; Holtgrewe et al., 2020: 38%; Wacker et al., 2020: 43%; Baier and Kamenowski, 2020: 42.6–49%). At home, most support (about 60–80%) was provided by mothers (Heller and Zügel, 2020: 84%; Schober et al., 2020: 59%; Wildemann and Hosenfeld, 2020: 81%). One-fifth to one-third of the students reported a lack of support when learning at home (Schober et al., 2020: 21%; Refle et al., 2020: 33%), but only 10% would have appreciated more support from their parents (Letzel et al., 2020).

Previous Findings on Differences in Coping With Self-Regulated Distance Learning

Many scholars have argued that children from families with few resources and support at home and with low academic achievement and learning motivation might be disadvantaged by distance learning in times of COVID-19 (e.g., Grewenig et al., 2020; Huber and Helm, 2020; SRCD, 2020). Out-of-school learning may thus increase educational inequalities and widen the educational gap between children from different family backgrounds and with different school performance prior to the pandemic. Although there are only limited findings available on this topic, existing results lend support to this notion.

Regarding family characteristics, research findings suggest that students from disadvantaged backgrounds experienced more barriers to learning success than students from privileged families (Anger et al., 2020; Baier and Kamenowski, 2020; Steiner et al., 2020; Thies and Klein, 2020; Vuorikari et al., 2020; Wößmann et al., 2021). During home-schooling, socioeconomic status and available resources of the family gained in importance with respect to learning achievement (Berghammer, 2020). In their systematic review, Helm et al. (2021) concluded that there are positive correlations between socioeconomic background and learning success, motivation, technical equipment at home, and parental support during distance learning. Furthermore, studies conducted in the United States indicated that cultural differences and limited linguistic proficiency of students and parents in the national language reduced participation in distance learning during school shutdowns (SRCD, 2020).

However, in the context of distance learning, it could also be shown that not only domestic factors but also school-related factors play a role in connection with disadvantages. The quality of teacher-student interaction and a teacher's competence in applying appropriate distance learning pedagogy as well as to provide timely and informative feedback turned out to be predictive for differences in learning success and learning investment of students during school shutdown (Huber and Helm, 2020).

With respect to gender differences, female students were found to show higher learning engagement and to receive more support from teachers than male students (Korlat et al., 2021). This finding correlates with results from previous studies, which indicate that, in general, girls are more proficient at self-regulated learning than boys (Perry et al., 2018).

Finally, in their study on how school closure affected low- and high-achieving students, Grewenig et al. (2020) demonstrate that while self-regulated learning is feasible for high achieving and high-motivated students, it is especially challenging for students with low academic achievement and learning motivation. The latter often lack the knowledge and skills as well as the energy and persistence in task-oriented behavior necessary to generate additional learning gains through self-regulated distance learning. While students on average reduced their daily learning time during the school shutdown, low-achievers disproportionately lowered their time on task and replaced it with detrimental activities such as TV or computer games (Grewenig et al., 2020).

Research Hypotheses

These initial results suggest that school shutdowns might have exacerbated existing vulnerabilities and led to increased inequalities in education, particularly for those students already at risk of low levels of school achievement and learning motivation. They make a strong case for further focus on students' ability to cope with self-regulation in times of distance learning, specifically examining the possible impact of family background, support from parents and schools, and academic achievement and learning motivation on exacerbating existing educational inequalities. In this study, we will therefore take a closer look at these potential determinants of students' ability to cope with distance learning during school shutdown. Based upon the above findings and theoretical considerations concerning self-regulation and the development of educational inequalities, we propose that academic achievement and learning motivation prior to school shutdown may predict ability to cope with self-regulated learning during distance learning. Furthermore, we anticipate emotional support from parents and accessibility of teachers during lockdown to foster students' capabilities to cope with the self-regulatory demands connected with distance learning. Parental education, students' first language, and gender are included in the analyses to take into account family and child characteristics. We hypothesize that students from more highly educated parents, students with German as their first language, and girls will have an advantage in coping with the challenges of out-of-school self-regulatory learning.

In the results section, we will first present descriptive statistics in order to characterize the students' situation during spring 2020s lockdown and distance learning due to the first wave of COVID-19 in Austria (section "**Students' Perceptions of Lockdown, Distance Learning and Coping With Related Demands**"). This includes information on school-related efforts to support distance learning; the core concept of students' self-regulatory strategies in coping with the demands of distance learning; students' perceptions of loneliness and social isolation during lockdown and factors of general well-being. Additionally, bivariate correlations show how selected variables describing the students' circumstances during lockdown are connected to coping with self-regulated distance learning. In section **"Effects of Learning Motivation and Academic Achievement on Coping With Distance Learning**," differences between mean-scores in coping with self-regulated distance learning by learning motivation as well as academic achievement prior to the lockdown will be analyzed. Finally, in order to test the above-introduced hypotheses, in section "**Effects of Family and Child Characteristics, School Performance, Support at Home and From School on Coping With Distance Learning**," we will estimate the effects of different sets of factors on coping with self-regulated distance learning during the school shutdown.

MATERIALS AND METHODS

Study Design and Research Context

Our analyses are based on data from the first two waves of an Austrian longitudinal study. Overall, the study was designed as a longitudinal project to run for 4 years comprising four points of measurement in total. The project aims to survey adolescent students' transition from lower to upper secondary education. First data collection (T1) took place in May 2019, comprising students in seventh grade from the region of Zillertal in the Province of Tyrol, a rural-alpine region in Austria. The second wave (T2) in eighth grade had originally been scheduled for spring 2020. However, shortly before the data collection was to take place, schools, teachers, and students were faced with the requirement to shift to distance learning mode for several weeks due to the COVID-19 pandemic. Therefore, data collection had to be postponed to June and July 2020 after schools had reopened in Austria. All data were collected using paper-based questionnaires.

The next waves of the longitudinal study (T3 and T4) are planned for the summer terms 2021 and 2022, respectively when students will be in ninth and 10th grades and will have transferred to upper secondary schools.

Sample

In 2019 and 2020, all seven lower secondary schools in the region took part in the study, yielding a response rate of 100% at school level. Approximately 75% of all seventh grade students ($n = 231$) and approx. 75% of the eighth grade students ($n = 234$) participated in the study. One hundred and fifty-five students took part in both waves, providing the database for our analyses. Response rate for participation in both waves amounted to 50%. **Table 1** comprises the demographic characteristics of the achieved sample.

The sample is representative for the population of students in the region being studied (data source: IQS, 2019). However, the population of adults in this region, and thus of parents of the surveyed students, is characterized by a lower level of education, a lower proportion of immigrants and people not speaking the national language (German) as their first language compared to the whole Province of Tyrol as well as to Austrian national levels with, e.g., only 5.6% of the population aged

TABLE 1 | Demographic characteristics of the sample.

Gender, *n* (%)	
Female	79 (51.0)
Male	76 (49.0)
Age, *M* (SD)	
T1 (2019)	13.3 (0.42)
T2 (2020)	14.4 (0.41)
First language, *n* (%)	
German (national language)	148 (95.5)
Other languages	7 (4.5)
Parental education[a], *n* (%)	
Compulsory education only	16 (10.3)
Vocational training	88 (56.8)
School leaving exam K12/13	35 (22.6)
University degree	16 (10.3)

[a]*Highest level of qualification of both parents.*

between 25 and 64 in the region having a university degree compared to 14.1% in the Province of Tyrol and 15.8% nationally (Statistics Austria, 2021). Thus, the sample reflects the specific nature of the sub-region as a model for a rural-alpine area with deep, remote and tourist valleys.

Participants reported on their family situation and parent-child relationships, school experiences and academic performance, as well as on their preparation for the transition to upper secondary education and coping with distance learning during the lockdown. All information collected was self-reported by students.

During the lockdown, participants in our study were nearing completion of their lower secondary education (at the end of grade 8) and would very soon be facing the transition to upper secondary education. In addition to the challenges caused by distance learning, they were also confronted with the demanding situation of having to deal with the uncertainty and potential emotional stress connected with the transition process.

Measures

Coping With Self-Regulated Distance Learning in Times of COVID-19

The scale "Coping with self-regulated distance learning in times of COVID-19," constructed by the authors, was collected in the 2020 survey using four Likert-type four-level items (4 = "often," 3 = "sometimes," 2 = "rarely," 1 = "never"; see **Table 2B**), by using a mean score across the four items. Items 1 and 4 were recoded. Cronbach's α for the scale was 0.79.

Parent's Highest Level of Education

The highest completed education of parents was recorded along the ISCED classification and summarized in four categories (**Table 1**). In two-parent families, the value of the higher educated parent was used. Where necessary, missing values in the 2020 survey year were supplemented by values from the 2019 survey.

First Language and Gender

Information on first language and gender of the students was collected from students at both points of measurement.

Academic Achievement Prior to Pandemic

Academic achievement is measured on the 5-level grading scale, which is officially used in the Austrian school system (RIS, 2020). To take account of the fact that two different ability groups of students were included in the survey, the scale level is shifted by a value of 2 for students who are assessed in the lower ability assessment group (basic general knowledge – "grundlegende Allgemeinbildung") compared to students from the higher ability assessment group (in-depth general knowledge – "vertiefte Allgemeinbildung"; Neuweg, 2014). The scale is constructed by calculating the mean of the grades for the subjects German (language of instruction), English (as the first foreign language), and mathematics taken from the winter term certificate, which was issued by the schools in February 2020. This resulted in a seven-point scale, which was transformed so that higher values represented higher achievement (from 1 = low performance to 7 = high performance; $n = 155$; min = 1, max = 7; M = 4.7; SD = 1.38; SE = 0.11). For group comparisons, students were assigned to one of three groups according to their academic achievement: low (grades up to 3.5; $M = 2.69$, SD = 0.59), medium (grades higher than 3.5 and up to 5.5; $M = 4.62$, SD = 0.55), and high academic achievement (grades above 5.5; $M = 6.30$, SD = 0.49).

Learning Motivation Prior to Pandemic

The scale "Learning motivation" (Fend and Prester, 1986) was collected in the 2019 survey and measures learning and achievement-related attitudes using three Likert-type 5-level items (1 = "not at all," 2 = "not much," 3 = "moderately," 4 = "fairly," 5 = "very much"; example item: "How persistent are you in completing school tasks?"). The scale score was calculated as a mean across the three items. Cronbach's α for the scale was 0.76 ($n = 155$; min/max = 1.33/5.00; $M = 3.48$; SD = 0.80; SE = 0.06). For group comparisons, learning motivation was divided into three categories by dividing the students into three groups of approx. equal size: low learning motivation ($M = 1.61$, SD = 0.22), medium learning motivation ($M = 2.18$, SD = 0.16), and high learning motivation ($M = 3.10$, SD = 0.43).

Perceived Support and Understanding by Parents During Distance Learning

The scale "Perceived support and understanding by parents" consists of eight items – four items in respect of the mother and four items in respect of the father of the student. The scale measures mothers' and fathers' responsiveness to their adolescent child, their understanding and sensitivity to the child's concerns and problems and their willingness to provide support. The items are derived from the LifE study (Berger and Fend, 2005) and collected with the help of Likert-type 5-level items for father and mother, respectively (1 = "do not agree at all," 2 = "agree a little," 3 = "partly/partly," 4 = "agree quite a bit," 5 = "agree completely"; example item: "I feel that I can talk to my father/my mother about anything."). The scale score was calculated as a mean score from all items for

TABLE 2 | Descriptive statistics on students' perceptions of distance learning and lockdown.

	Valid *n*	*M*	SD	% Often	% Sometimes	% Seldom	% Never
A. School-related efforts to support distance learning							
(A1) I could easily get in touch with my teachers	155	1.63	0.83	55.5	29.7	11.0	3.9
(A2) Getting access to necessary learning materials was easy	154	1.86	1.03	50.0	25.3	13.6	11.0
(A3) I struggled with digital media	155	2.71	1.05	15.5	27.1	28.4	29.0
B. Coping with self-regulated distance learning							
(B1) It was difficult for me to structure my everyday learning	155	2.21	1.12	17.4	22.6	23.9	36.1
(B2) Learning was easy for me	155	3.06	0.96	41.9	29.7	21.3	7.1
(B3) I could master the tasks assigned to me without problems	154	3.34	0.74	49.4	36.4	13.6	0.6
(B4) Learning at home was difficult for me	155	2.06	1.03	11.6	21.3	29.0	38.1
Scale: Coping with self-regulated distance learning (B1 and B4 recoded)	155	3.03	0.77				
C. Indicators of loneliness and social isolation during lockdown and home schooling							
(C1) I was bored	155	2.43	1.05	22.6	31.6	25.8	20.0
(C2) I felt lonely	155	3.26	0.81	2.6	14.8	36.1	46.5
(C3) I could maintain contact with my friends well	154	1.47	0.74	64.3	27.3	5.2	3.2
(C4) I was longing to get back to school	155	2.17	1.01	29.7	37.4	18.7	14.2
D. Well-being during distance learning	**Valid *n***	***M***	**SD**	**% very well (5)**	**% (4)**	**% (3)**	**% (2)**	**% very unwell (1)**
(D1) Some people feel comfortable in their own skin, and others feel less comfortable. How about you?	155	4.19	0.87	43.9	36.1	16.1	3.2	0.6

two-parent families and as a mean score from four items for single-parent families (Cronbach's $\alpha = 0.91$; $n = 155$; min/max = 1.50/5.00; $M = 4.19$; SD = 0.80; SE = 0.06).

Teacher Accessibility

The item "I could easily get in touch with my teachers" (1 = "never," 2 = "seldom," 3 = "sometimes," 4 = "often"; $n = 155$, min/max = 1/4, $M = 3.37$, SD = 0.83, SE = 0.07) was constructed by the authors as an indicator of the support that students received from their teachers during distance learning in spring 2020 (see **Table 2A1**).

Single-Item Measures on the Perception of Distance Learning and Lockdown

In addition some single-item measures are used in order to characterize students' perception of their situations during distance learning and lockdown. Well-being during lockdown was measured on a five-point scale (from "very unwell" to "very well" using emoticons in the form of smileys). School-related efforts to provide help with distance learning were measured with two items on four-point likert scales (4 = "often," 3 = "sometimes," 2 = "seldom," 1 = "never"). Possible loneliness and social isolation were assessed by four items on four-point likert scales. The wording and descriptive statistics of all these items are shown in **Tables 2A2,A3,C**.

Procedures of Analyses

In order to provide some background information on how the students perceived their situation during distance learning and the lockdown and to test the proposed hypotheses, we applied different methods of statistical analyses. *T*-tests and Mann–Whitney *U*-tests were used to test for gender differences. Spearman's rho was applied to examine bivariate correlations (section "**Students' Perceptions of Lockdown, Distance Learning, and Coping with Related Demands**").

To test for differences between mean-scores in coping with self-regulated distance learning by learning motivation as well as academic achievement prior to the lockdown, we computed one-way ANOVA in combination with Tukey *post-hoc* tests or Welch-test and Games-Howell *post-hoc* tests. Levene's tests were used to test for homogeneity of variances (section "**Effects of Learning Motivation and Academic Achievement on Coping With Distance Learning**").

In addition, regression analyses were estimated to test the hypotheses formulated (section "**Effects of Family and Child Characteristics, School Performance, and Support at Home and From School on Coping with Distance Learning**"). To take account of the fact that some variables in the regression models are not normally distributed, analyses were conducted using the bootstrap method in Mplus (Muthen and Muthen, 2017) to estimate bias-corrected standard errors.

RESULTS

Students' Perceptions of Lockdown, Distance Learning, and Coping With Related Demands

School-Related Efforts to Facilitate Distance Learning

In spring 2020, teachers and students had to switch to remote teaching and distance learning very quickly and with hardly any time to prepare themselves. Nevertheless, the majority of students in our study (approx. 85%) reported that they could easily contact their teachers for most of the time during

lockdown. Access to necessary learning materials was considered to be easy as well. The largest obstacle seemed to be handling digital media, where over 40% of the students reported frequent struggles (**Table 2A**).

Girls (Mdn = 4.0; IQR = 3.0–4.0) perceived that it was easier to contact their teachers than boys (Mdn = 3.0; IQR = 2.2–4.0) ($N = 155$; $U = 2184.50$; $p < 0.001$; Cohen's $d = 0.54$) and that they (Mdn = 4.0; IQR = 3.0–4.0) had easier access to materials than boys (Mdn = 3.0; IQR = 2.0–4.0) ($N = 154$; $U = 2360.00$; $p < 0.05$; Cohen's $d = 0.39$). With regard to problems using digital media, there were no gender differences ($N = 155$; $U = 2664.99$; $p > 0.05$).

Coping With Self-Regulated Distance Learning

While schools tried to support students learning at home in different ways, the distance-learning situation nevertheless placed specific demands on students. **Table 2B** shows how the students coped with different self-regulatory demands, which they faced during lockdown and the period of distance learning. In general, most students managed quite well to structure their everyday learning and master the tasks given to them by their teachers.

On average, girls coped better with the self-regulatory demands of distance learning than their male peers. Using the combined scale score on coping with self-regulated distance learning in times of COVID-19, girls showed higher average in coping with self-regulated distance learning ($N = 79$; $M = 3.23$; SD = 0.72) than boys [$N = 76$; $M = 2.83$; SD = 0.76; $t(153) = -3.366$; $p < 0.001$; Cohen's $d = 0.54$; variance homogeneity was asserted using the Levene's test ($p > 0.05$)].

Loneliness and Social Isolation During Lockdown

While more than half of the students reported feeling bored during lockdown while distance learning, very few reported feeling frequently lonely or having problems keeping in touch with their friends (**Table 2C**). Nevertheless, the vast majority of students were longing to get back to school.

While girls and boys generally seemed to cope with the social demands of lockdown equally well (being bored: $N = 155$; $U = 2853.50$; $p > 0.05$; maintaining contact with friends: $N = 154$; $U = 2609.00$; $p > 0.05$; feeling lonely: $N = 155$; $U = 2549.5$; $p > 0.05$), girls (Mdn = 3.0; IQR = 3.0–4.0) reported more often than boys (Mdn = 3.0; IQR = 2.0–3.0) that they wished they could go back to school ($N = 155$; $U = 2085.00$; $p < 0.01$; Cohen's $d = 0.57$).

Regarding overall well-being, students were asked how they had felt all in all during distance learning and lockdown (**Table 2D**). The vast majority reported a high level of well-being during this time (43.9% choosing the highest category ("very well") and another 36.1% the second highest on a five-point scale). Only 0.6% of the students reported feeling very unwell (and another 3.2% choosing the second lowest category). There were no gender differences with regard to self-reported well-being ($N = 155$; $U = 3337.00$; $p > 0.05$).

How well students judged coping with self-regulated distance learning during home schooling most strongly correlated with their general well-being during this period of time (rho = 0.520; $p < 0.001$). In addition, a high level of ability to cope with self-regulatory demands corresponded with a comparatively low perception of feeling lonely (rho = −0.277; $p < 0.01$).

Effects of Learning Motivation and Academic Achievement on Coping With Distance Learning

Figure 1 illustrates the distributions of coping with self-regulated distance learning depending on level of learning motivation and academic achievement, each measured prior to the COVID-19 pandemic.

Learning motivation was divided into three groups of approx. equal size (section "**Learning Motivation Prior to Pandemic**"). In the three groups, homogeneity of variance was asserted ($p > 0.05$). The levels of coping with self-regulated distance learning differed statistically significant for the groups [$F(2, 152) = 16.574$, $p < 0.001$]. Tukey *post-hoc* analysis revealed a significant difference ($p < 0.001$) between the mean level of coping with self-regulated distance learning in the low learning motivation group and the high learning motivation group [0.79, 95%-CI (0.46, 1.12)] as well as between the medium and the high learning motivation group [0.46, 95%-CI (0.14, 0.77)]. The low and medium learning motivation groups do not differ significantly in the mean level of coping with self-regulated distance learning. The size of the effect can be described as large (one-way ANOVA: $\eta^2 = 0.18$).

Likewise, an analysis was conducted to assess the effects of academic achievement prior to the pandemic on self-regulated learning during the pandemic. Again, students were assigned to one of three groups according to their academic achievement (section "**Academic Achievement Prior To Pandemic**"). The mean level of coping with self-regulated distance learning differed statistically significant in the three groups [Welch-test $F(2, 79.70) = 27.32$, $p < 0.001$]. Yielding a value of $\eta^2 = 0.21$, the effect of academic achievement was of a similar size to learning motivation. *Post-hoc* analysis using the Games-Howell test revealed a significant difference between coping with self-regulated distance learning for all groups: mean level of coping with self-regulated distance learning increased from low to medium academic achievement [0.57, 95%-CI (0.28, 0.85), $p < 0.001$], from medium to high academic achievement [0.39, 95%-CI (0.05, 0.74); $p < 0.05$], and from low to high academic achievement [0.96, 95%-CI (0.63, 1.29); $p < 0.001$].

Effects of Family and Child Characteristics, School Performance, and Support at Home and From School on Coping With Distance Learning

Finally, **Table 3** shows the standardized β-coefficients as well as the major statistical parameters for the regression analyses, which allow for a multivariate perspective on the effects of different sets of characteristics on how well students coped with the self-regulatory demands of distance learning.

Three models were calculated; with model 1 including solely context variables on the child and their families. The results in model 1 confirm the effect of the student's gender, which

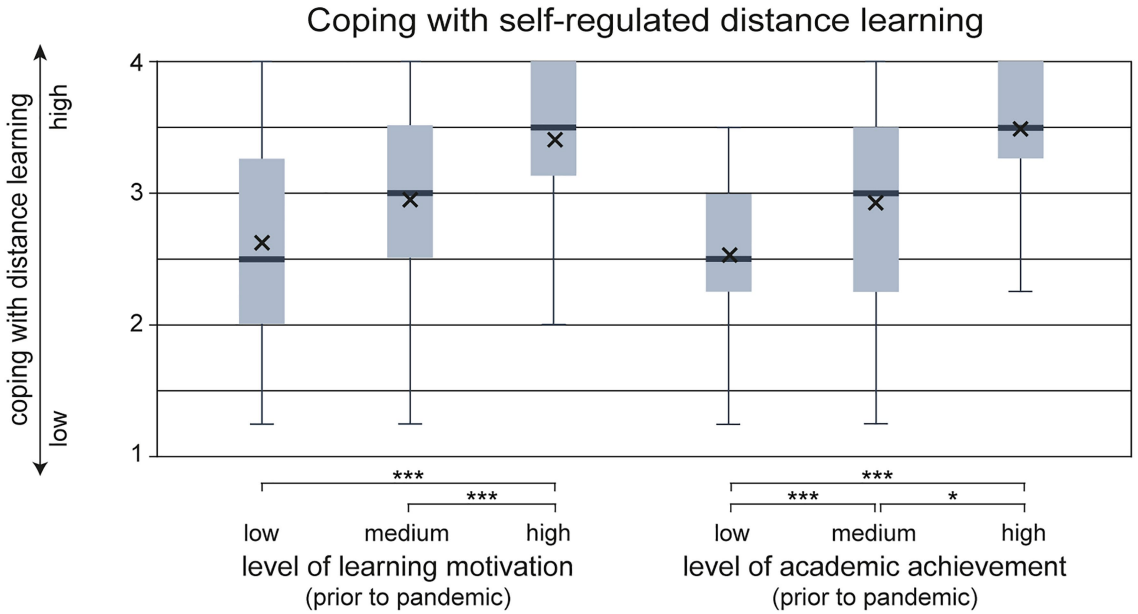

FIGURE 1 | Coping with self-regulated distance learning depending on learning motivation and academic achievement prior to pandemic. Box-and-whisker plots showing the distribution of coping with self-regulated distance learning for three groups each depending on the students' learning motivation and academic achievement prior to the pandemic. Additionally, group mean scores are shown in the form of an x. Significant differences between groups are highlighted below the diagram (*$p < 0.05$ and ***$p < 0.001$).

TABLE 3 | Regression models explaining coping with self-regulated distance learning.

	Model 1		Model 2		Model 3	
	β (SE)	*t*	β (SE)	*t*	β (SE)	*t*
1. Family and child characteristics						
Parental education[a] – level 2 (vocational training)	−0.06 (0.11)	−0.50	−0.03 (0.10)	−0.34	−0.14 (0.10)	−1.39
Parental education[a] – level 3 (school leaving exam K12/13)	−0.10 (0.11)	−0.90	−0.11 (0.10)	−1.17	−0.15 (0.10)	−1.49
Parental education[a] – level 4 (university degree)	−0.06 (0.10)	−0.61	0.00 (0.08)	−0.05	−0.09 (0.07)	−1.25
First language (German)	0.19 (0.07)	2.64**	0.14 (0.06)	2.46*	0.13 (0.05)	2.54*
Gender (female)	0.28 (0.08)	3.69***	0.07 (0.08)	0.93	0.04 (0.07)	0.52
2. School performance prior to lockdown						
Academic achievement			0.38 (0.07)	5.70***	0.22 (0.07)	3.72**
Learning motivation			0.26 (0.08)	3.18**	0.22 (0.08)	2.72**
3. Support at home and from school during lockdown						
Perceived support and understanding by parents					0.22 (0.07)	3.20**
Teacher accessibility					0.29 (0.07)	3.80***
F (df)	18.39 (5)		66.96 (7)		94.64 (9)	
R^2 (adjusted)	8.2%*		32.0%***		42.3%***	
N	155		155		155	

Regression analyses conducted using MPlus, bootstrap = 10,000; dependent variable coping with self-regulated distance learning in times of COVID-19.
[a]Reference category: level 1 – compulsory education on ISCED-level 2 only.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.*

was reported in section "**Coping With Self-Regulated Distance Learning**" above. As expected, girls coped more easily with self-regulated distance learning than boys. Additionally, model 1 shows a positive effect on coping with self-regulated distance learning for students with German as their first language (or one of their first languages). Due to the low numbers of students with different first languages in the region of the study (cf. section "**Sample**"), these findings are to be interpreted

with caution. Contrary to our assumption and previous findings, this study does not show a significant effect of the highest level of parental education on self-regulated learning.

Model 2 expands this perspective by including information on school performance prior to lockdown. In line with our expectations and the findings in chapter **"Effects of Learning Motivation and Academic Achievement on Coping With Distance Learning**," both variables additionally included in model 2 had a significant effect on coping with self-regulated distance learning. The increase in R^2 from model 1 to model 2 by approximately 24 percentage points indicated a large effect of students' school-related performance. Including the information on achievement and learning motivation (as continuous variables) resulted in flattening the effect of gender, implying that the girls' increased capacity to cope with self-regulated distance learning was predominantly due to their higher academic achievement and/or learning motivation prior to lockdown.

In model 3, indicators of support at home and from school during the distance-learning period were included in the analysis. In accordance with our hypotheses, both indicators of support – accessibility of the teachers to the students during lockdown and a supportive and understanding parental behavior at home – show significant effects on coping with self-regulated distance learning. They led to an increase in R^2 by another 10 percentage points, so that the third (full) model explains 42% of the variance in coping with self-regulated distance learning.

DISCUSSION

Major Findings

Teachers, students, and parents suddenly faced fundamental challenges as schools were forced to switch to distance learning in spring 2020 due to the COVID-19 pandemic. Despite having almost no lead-time, our findings suggest that those challenges were met surprisingly well. The vast majority of students in our study reported that they could get in touch with their teachers easily (often and sometimes: 85.2%) and that they could access their learning materials easily (often and sometimes: 75.3%). Regarding self-regulatory demands, between 60 and 85.8% of the students had little or no problem in structuring their everyday learning and were mostly able to master the tasks given to them on their own. With respect to loneliness and social isolation, more than 90% of the students reported having been able to keep in touch with their friends (91.6%) and more than 80% felt lonely only seldom or never (82.6%). These findings also corresponded with the results of an Austria-wide study by Schober et al. (2020). At the same time, more than half of students were bored (often or sometimes: 54.2%), which can be viewed within the context of extremely restricted leisure opportunities due to lockdown, as well as in regard of the findings by Grewenig et al. (2020), Huber and Helm (2020), and Wößmann et al. (2021) pointing to very low daily study time during home schooling for some students. Summing up, students generally coped well with the demands they had to face during the first lockdown, but at the same time, it is evident how demanding the situation was, at least for some young people.

The analyses in this paper point to various groups of students who had comparatively more problems in coping with the demands of distance learning and the circumstances of lockdown and isolation. The most important factors to explain how well students were able to cope with self-regulatory demands during distance learning were their academic achievement and learning motivation prior to lockdown. This can be shown as bivariate relationships between academic achievement and learning motivation and coping with self-regulated distance learning as well as in the multivariate regression model, where school performance prior to lockdown explains by far the largest proportion of variance. Since a high level of school performance is strongly associated with competencies in self-organization (Zimmerman and Schunk, 2011; Jacob and Parkinson, 2015; Edossa et al., 2017), we assume that students with high academic achievement and learning motivation prior to the lockdown could rely on their pre-existing self-organizational skills, desires, and willingness to learn and therefore were better able to cope with the specific self-regulatory demands during distance learning.

Furthermore, this paper shows the significance of support for young people during the lockdown. This concerns firstly teachers not only as important reference points in school-related matters to support students with structuring their learning tasks but also as emotional support. Secondly, parents play an important role, as can be seen in the construct included in the regression model measuring the level of responsiveness, understanding, and willingness to provide support by parents. The present study therefore confirms the relevance of support and relationships for self-regulation (Bembenutty, 2013; Perry et al., 2018) within the context of distance learning due to a pandemic.

Overall, students with more favorable starting conditions with respect to school performance and support at home and from school report, on average, higher levels of coping with the self-regulatory demands of home schooling. Assuming that this also points to higher learning gains during distance learning, prolonged periods of having to learn at home seem to pose a severe risk of further widening educational inequalities.

Strengths and Limitations of the Study

Our analyses are based upon a longitudinal study. Since data collection had already commenced in spring 2019, we can draw on measures for academic achievement and learning motivation collected well in advance of the pandemic. This allows the analysis of the effects of school performance prior to the lockdown on coping with the demands of distance learning.

A systematic review of 97 online studies conducted between March 2020 and November 2020 regarding distance learning during the COVID-19 pandemic (Helm et al., 2021) showed that most of the previous studies used only descriptive analyses. Therefore, this research also makes an important contribution to closing the methodological gap by using multivariate regression analyses and a longitudinal design to explain differences in coping with self-regulated distance learning.

Some limitations that relate to the regional nature of the study and the measures included in the analyses do need to

be mentioned. While the sample underlying this paper is representative for the region examined, as well as for other rural-alpine regions, one must exercise caution when attempting to generalize the findings further. Most noteworthy are the specifics of population composition, resulting in a lower variance with regard to socioeconomic background (parental education) and only a small subsample of students who do not speak German as their first language. Nonetheless, the general picture, which the data show about the students' situation during distance learning and lockdown and the factors that influence coping with the self-regulatory demands of distance learning are very similar to findings in other studies with a wider target population.

Furthermore, the study does only include a measure of coping with self-regulatory demands of distance learning but not a measure of self-regulation itself. There are also no measures of self-regulation prior to the lockdown and academic achievement during home-schooling available that would allow to answer with validity the questions if home learning was disproportionately more difficult than classroom-based learning, or academic progress was disproportionately decelerated by home learning in the low-achieving/low-motivated group of students.

CONCLUSION

This paper has described students' perceptions of the conditions under which they learned during the first strict lockdown due to the COVID-19 pandemic, which led to a complete shift to distance learning in Austrian schools from March 16, 2020. In line with research on distance learning conducted in the past months, self-regulatory demands were deemed to be one of the most important challenges for students when learning at home (e.g., APA, 2020; Grewenig et al., 2020; Huber and Helm, 2020). Hence, the paper focused upon how well students coped with self-regulatory demands during lockdown and distance learning and examined the impact of family and child characteristics, school performance as well as parental and teacher support. The findings support the hypotheses that out-of-school learning was especially challenging for students with low school performance prior to the lockdown and a lack of support at home and from school. Furthermore, they show that girls, as well as students speaking German as their first language, did cope more easily with the demands of self-regulated distance learning than boys and students with less linguistic proficiency in the national language.

In conclusion, results suggest that distance learning due to the COVID-19 pandemic has posed a substantial risk of enhancing any existing educational inequalities between low and high achieving and low- and high-motivated students. This should be taken into account when planning any further distance learning periods or when considering measures to compensate for the effects of prolonged periods of distance learning during the COVID-19 pandemic.

Although the importance of self-regulated learning becomes particularly evident in the context of distance learning, self-organizational skills are not only important in times of crisis. It can therefore be concluded that schools should focus on promoting self-regulated learning in the future.

Future research needs to be conducted in order to examine mid- and long-term effects of distance learning. The study, upon which this paper is based, aims to contribute to closing this research gap with the next survey waves of the longitudinal study to be conducted in the summer terms 2021 and 2022. A joint analysis of the data from all four survey rounds (2019–2022) will permit the examination of mid-term effects of students' coping with the demands of distance learning on their educational attainment and psycho-social well-being.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Department of Education, Government of the Province of Tyrol. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

FUNDING

Support for this research from the Government of the Province of Tyrol and the University of Innsbruck is gratefully acknowledged.

REFERENCES

ADAS and LIFE (2020). Ergebnisse der ADAS-Corona Umfrage. ADAS-Rundbrief vom. Available at: https://adas-berlin.de/wp-content/uploads/2020/06/Ergebnisse-Umfrage-ADAS-LIFE-e.V.pdf (Accessed June 25, 2020).

Anger, S., Bernhard, S., Dietrich, H., Lerche, A., Patzina, A., Sandner, M., et al. (2020). Schulschließungen wegen corona: Regelmäßiger Kontakt zur Schule kann die schulischen Aktivitäten der Jugendlichen erhöhen. *IAB-Forum*, April, 1–11.

APA (2020). Psychology's understanding of the challenges related to the COVID-19 global pandemic in the United States. *APA*.

Baier, D., and Kamenowski, M. (2020). Wie erlebten Jugendliche den Corona-Lockdown? Ergebnisse einer Befragung im Kanton Zürich. Züricher Fachhochschule für Angewandte Wissenschaften. Available at: https://

digitalcollection.zhaw.ch/bitstream/11475/20095/3/2020_Baier-Kamenowski_Jugendliche-Corona-Lockdown.pdf (Accessed April 20, 2021).

Bembenutty, H. (2013). "The triumph of homework completion through a learning academy of self-regulation" in *Application of Self-Regulated Learning across Diverse Disciplines*. eds. H. Bembenutty, T. J. Cleary and A. Kitsantas (New York: Information Age Publishing, Inc.), 153–196.

Berger, F., and Fend, H. (2005). Kontinuität und Wandel in der affektiven Beziehung zwischen Eltern und Kindern vom Jugend- bis ins Erwachsenenalter. [Continuity and change in the affective relationship between parents and children from adolescence to adulthood]. *Z. Soziol. Erzieh. Sozi.* 25, 8–21.

Berghammer, C. (2020). Wie gut gelingt Homeschooling in der Corona-Krise? *Corona-Blog* (blog). Available at: https://viecer.univie.ac.at/corona-blog/corona-blog-beitraege/blog47/ (Accessed April 20, 2021).

BMBWF (2020). Umgang des Bildungssystems mit dem Coronavirus – Eckpunkte [Dealing with the Corona Virus in the Education System].

Cleary, T. J., and Zimmerman, B. J. (2006). Teachers' perceived usefulness of strategy microanalytic assessment information. *Psychol. Sch.* 43, 149–155. doi: 10.1002/pits.20141

Edossa, A. K., Schroeders, U., Weinert, S., and Artelt, C. (2017). The development of emotional and behavioral self-regulation and their effects on academic achievement in childhood. *Int. J. Behav. Dev.* 42, 192–202. doi: 10.1177/0165025416687412

Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: the MASRL model. *Educ. Psychol.* 46, 6–25. doi: 10.1080/00461520.2011.538645

Eisenberg, N., Chang, L., Ma, Y., and Huang, X. (2009). Relations of parenting style to Chinese children's effortful control, ego resilience, and maladjustment. *Dev. Psychopathol.* 21, 455–477. doi: 10.1017/S095457940900025X

Fend, H., and Prester, H.-G. (1986). *Dokumentation der Skalen des Projekts "Entwicklung im Jugendalter." Bericht aus dem Projekt "Entwicklung im Jugendalter"*. Konstanz: Universität Konstanz; Sozialwissenschaftliche Fakultät.

Grewenig, E., Lergetporer, P., Werner, K., Woessmann, L., and Zierow, L. (2020). COVID-19 and educational inequality: how school closures affect low- and high-achieving students. Collaborative Research Center Transregio Rationality & Competition. [Preprint] No. 260, 31.

Heller, S., and Zügel, O. (2020). *"Schule zu Hause" in Deutschland. Bestandsaufnahme im Corona-Lockdown aus Perspektive der Schüler/-innen und Eltern*. Zurich: Deutsche Telekom Stiftung.

Helm, C., Huber, S. G., and Loisinger, T. (2021). Was wissen wir über schulische Lehr-Lern-Prozesse im Distanzunterricht während der Corona-Pandemie? – evidenz aus Deutschland, Österreich und der Schweiz. *Z. Erziehwiss.* 24, 237–311. doi: 10.1007/s11618-021-01000-z

Holtgrewe, U., Lindorfer, M., Siller, C., and Vana, I. (2020). Von Risikogruppen zu Gestaltungschancen: Lernen im Ausnahmezustand. Momentum-Kongress (online). Available at: https://www.zsi.at/object/publication/5699/attach/LiA-Momentum20-final[1_.pdf (Accessed April 20, 2021).

Huber, S. G., Günther, P. S., Schneider, N., Helm, C., Schwander, M., Schneider, J., et al. (2020). *COVID-19 und aktuelle Herausforderungen in Schule und Bildung.* Münster: Waxmann doi: 10.31244/9783830942160.

Huber, S. G., and Helm, C. (2020). COVID-19 and schooling: evaluation, assessment and accountability in times of crises – reacting quickly to explore key issues for policy, practice and research with the school barometer. *Educ. Assess. Eval. Account.* 32, 237–270. doi: 10.1007/s11092-020-09322-y

Illeris, K. (2009). *Contemporary Theories of Learning*. London, New York: Routledge.

IQS (2019). Data provided on request by Institut des Bundes für Qualitätssicherung im österreichischen Schulwesen [Federal Institute for quality assurance in the Austrian school system]. Available at: https://www.iqs.gv.at/fdb.

Jacob, R., and Parkinson, J. (2015). The potential for school-based interventions that target executive function to improve academic achievement. *Rev. Educ. Res.* 85, 512–552. doi: 10.3102/0034654314561338

Jesacher-Rößler, L., and Klein, E. D. (2020). *COVID-19: Strategien der Schulentwicklung in der Krise: Ergebnisse einer Schulleitungsbefragung in Österreich.* Innsbruck: Universität Innsbruck. Available at: https://diglib.uibk.ac.at/5350023 (Accessed April 13, 2021).

Korlat, S., Kollmayer, M., Holzer, J., Lüftenegger, M., Pelikan, E. R., Schober, B., et al. (2021). Gender differences in digital learning during COVID-19: competence beliefs, intrinsic value, learning engagement, and perceived teacher support. *Front. Psychol.* 12:637776. doi: 10.3389/fpsyg.2021.637776

Letzel, V., Pozas, M., and Schneider, C. (2020). Energetic students, stressed parents, and nervous teachers: a comprehensive exploration of inclusive homeschooling during the COVID-19 crisis. *Open Educ. Stud.* 2, 159–170. doi: 10.1515/edu-2020-0122

Maaz, K., Baumert, J., and Trautwein, U. (2010). "Genese sozialer Ungleichheit im institutionellen Kontext der Schule: Wo entsteht und vergrößert sich die soziale Ungleichheit?" in *Bildungsungleichheit revisited: Bildung und soziale Ungleichheit vom Kindergarten bis zur Hochschule*. Studien zur Schul- und Bildungsforschung 30. eds. H.-H. Krüger, U. Rabe-Kleberg, R.-T. Kramer and J. Budde (Wiesbaden: VS, Verl. für Sozialwiss), 69–102.

Muthen, L., and Muthen, B. (2017). *Mplus Version 8 User's Guide*. Los Angeles, CA: Muthen & Muthen.

Neuweg, G. H. (2014). *Schulische Leistungsbeurteilung [Assessment and Grading in Schools]*. Linz: Trauner.

OECD (2020). *How Prepared Are Teachers and Schools to Face the Changes to Learning Caused by the Coronavirus Pandemic? Teaching in Focus 2020/32*. Paris: OECD Publishing.

Pandero, E. (2017). A review of self-regulated learning: six models and four directions for research. *Front. Psychol.* 8:422. doi: 10.3389/fpsyg.2017.00422

Pelikan, E. R., Lüftenegger, M., Holzer, J., Korlat, S., Spiel, C., and Schober, B. (2021). Learning during COVID-19: the role of self-regulated learning, motivation, and procrastination for perceived competence. *Z. Erzieh.* doi: 10.1007/s11618-021-01002-x

Perry, N. E. (2013). Classroom process that support self-regulation in young children. *British Journal of Educational Psychology, Monograph Series II: Psychological Aspects of Education – Current Trends*, no. 10: 45–68.

Perry, N. E., Hutchinson, L. R., Yee, N., and Määttä, E. (2018). "Advances in understanding young children's self-regulation of learning" in *Handbook of Self-Regulation of Learning and Performance*. eds. D. H. Schunk and J. A. Greene (New York and London: Routledge), 457–472.

Refle, J.-E., Voorpostel, M., Lebert, F., Kuhn, U., Klaas, H. S., Ryser, V.-A., et al. (2020). First results of the Swiss household panel—Covid-19 study. *FORS Working Paper Series* paper 2020-1: 1–51.

Rimm-Kaufman, S. E., Curby, T. W., Grimm, K. J., Nathanson, L., and Brock, L. L. (2009). The contribution of children's self-regulation and classroom quality to children's adaptive behaviors in the kindergarten classroom. *Dev. Psychol.* 45, 958–972. doi: 10.1037/a0015861

RIS (2020). Gesamte Rechtsvorschrift für Leistungsbeurteilungsverordnung. Available at: https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10009375&FassungVom=2020-02-01 (Accessed August 13, 2021).

Schober, B., Lüftenegger, M., Spiel, C., Holzer, J., Korlat Ikanovic, S., Pelikan, E., et al. (2020). Lernen unter COVID-19-Bedingungen. Erste Ergebnisse Schüler*innen. Available at: https://lernencovid19.univie.ac.at/fileadmin/user_upload/p_lernencovid19/Zwischenergebnisse_Schueler_innen.pdf (Accessed April 20, 2021).

Schunk, D. H., and Greene, J. A. (2018). "Historical, contemporary, and future perspectives on self-regulated learning and performance" in *Handbook of Self-Regulation of Learning and Performance. Educational Psychology Handbook Series*. 2nd ed (New York, NY: Routledge, Taylor & Francis Group), 1–15.

Schunk, D. H., and Zimmerman, B. J. (1997). Social origins of self-regulatory competence. *Educ. Psychol.* 32, 195–208. doi: 10.1207/s15326985ep3204_1

Schunk, D. H., and Zimmerman, B. J. (eds.) (2008). *Motivation and Self-Regulated Learning: Theory, Research, and Applications*. New York: Taylor & Francis.

Schwerzmann, M., and Frenzel, S. (2020). "Umfrage zum Fernunterricht. Ergebnisse der Befragung im Juni 2020." Presented at Medienkonferenz, Luzern, October 15. Available at: https://www.lu.ch/-/media/Kanton/Dokumente/BKD/Aktuelles/BKD_Fernunterricht_Praesentation_Ergebnisse_an_MK_2020_10_14.pdf?la=de-CH (Accessed April 20, 2021).

SRCD (2020). Addressing inequalities in education during the COVID-19 pandemic. Statement of the evidence.

Statistics Austria (2021). STATatlas. Source. Available at: https://www.statistik.at/atlas/?mapid=them_bildung_bildungsstand&layerid=layer1&sublayerid=sublayer0&languageid=0&bbox=972890,5738748,2027109,6361251,8 (Accessed August 13, 2021).

Steiner, M., Köpping, M., Leitner, A., and Pessl, G. (2020). COVID-19 LehrerInnenbefragung – Zwischenergebnisse. Was tun, damit aus der Gesundheitskrise nicht auch eine Bildungskrise wird? Available at: https://www.ihs.ac.at/index.php?id=1176 (Accessed April 20, 2021).

Thies, L., and Klein, Y. (2020). *Unter Druck. Die Situation von Eltern und ihren schulpflichtigen Kindern während der Schulschließungen*. Düsseldorf: Vodafone-Stiftung. Available at: https://www.vodafone-stiftung.de/wp-content/uploads/2020/04/Vodafone-Stiftung-Deutschland_Studie_Unter_Druck.pdf (Accessed April 20, 2021).

Trültzsch-Wijnen, C., and Trültzsch-Wijnen, S. (2020). Remote Schooling during the Covid-19 Lockdown in Austria (Spring 2020). KiDiCoTi National Report. University of Salzburg. Available at: https://eplus.uni-salzburg.at/obvusboa/content/titleinfo/5566858 (Accessed April 20, 2021).

UNESCO (2021). Education: from disruption to recovery. UNESCO COVID-19 education response. Available at: https://en.unesco.org/covid19/educationresponse#schoolclosures

Usher, E., and Schunk, D. H. (2018). "Social cognitive theoretical perspective on self-regulation" in *Handbook of Self-Regulation of Learning and Performance. Educational Psychology Handbook Series*. eds. D. H. Schunk and J. A. Greene. 2nd ed (New York, NY: Routledge, Taylor & Francis Group), 19–35.

Vuorikari, R., Velicu, A., Chaudron, S., Cachia, R., and Di Gioia, R. (2020). *How Families Handled Emergency Remote Schooling During the Time of Covid Lockdown in spring 2020: Summary of Key Findings From Families With Children in 11 European Countries*. Luxemburg: Publications Office of the European Union. Available at: https://data.europa.eu/doi/10.2760/31977 (Accessed April 13, 2021).

Wacker, A., Unger, V., and Rey, T. (2020). "Sind doch Corona-Ferien, oder nicht?" in *Langsam vermisse ich die Schule ….* eds. D. Fickermann and B. Edelstein (Münster: Waxmann), 79–94.

Wildemann, A., and Hosenfeld, I. (2020). Bundesweite Elternbefragung zu Homeschooling während der Covid 19-Pandemie. Erkenntnisse zur Umsetzung des Homeschoolings in Deutschland. Available at: http://www.zepf.eu/wp-content/uploads/2020/06/Bericht_HOMEschooling2020.pdf (Accessed April 19, 2021).

Wirth, J., and Leutner, D. (2008). Self-regulated learning as a competence: implications of theoretical models for assessment methods. *Z. Psychol.* 216, 102–110. doi: 10.1027/0044-3409.216.2.102

World Health Organization (2020). Coronavirus disease (COVID-2019) situation reports. Available at: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf?sfvrsn=1ba62e57_10 (Accessed August 13, 2021).

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Werner, K., and Zierow, L. (2021). Bildung in der Coronakrise: Wie haben die Schulkinder die Zeit der Schulschließungen verbracht, und welche Bildungsmaßnahmen befürworten die Deutschen? *ifo Schnelldienst* 73, 25–39.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: historical background, methodological developments, and future prospects. *Am. Educ. Res. J.* 45, 166–183. doi: 10.3102/0002831207312909

Zimmerman, B. J., and Schunk, D. H. (Eds). (2011). "Self-regulated learning and performance" in *Handbook of Self-Regulation of Learning and Performance. Educational Psychology Handbook Series*. eds. B. J. Zimmerman and D. H. Schunk (New York, NY: Routledge, Taylor & Francis Group), 1–12.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 09 September 2021
doi: 10.3389/fpsyg.2021.687611

The Impact of COVID-19-Induced Changes at Schools on Elementary Students' School Engagement

Kjærsti Thorsteinsen[1], Elizabeth J. Parks-Stamm[2], Marte Olsen[1], Marie Kvalø[1] and Sarah E. Martiny[1]*

[1] Department of Psychology, UiT The Arctic University of Norway, Tromsø, Norway, [2] Department of Psychology, University of Southern Maine, Portland, ME, United States

In spring 2020, the COVID-19 pandemic led to the shutdown of schools in many countries. Emerging research documents the negative effects of the pandemic and particularly of the shutdown of schools on children's well-being. The present research extends this research by investigating how structural changes made in schools upon reopening to align with COVID-19 restrictions were related to children's emotional school engagement and subjective well-being. An online questionnaire with elementary school children and their parents conducted in Norway in June 2020 (N = 93 parent–child dyads; 46 boys, 47 girls; mean age children = 9.70 years, SD = 1.81) assessed structural changes in schools and children's coping with these changes, emotional school engagement, subjective well-being, self-reported performance in school, and demographics. Results showed that neither receiving a new teacher nor being assigned to a new (smaller) group were associated with negative outcomes. However, children who did not like their new group showed reduced emotional school engagement and subjective well-being, indicating that specific students particularly suffered from the pandemic-induced restrictions. The relationship between liking one's group and SWB was mediated by emotional school engagement. Applied and theoretical implications are discussed.

Keywords: COVID-19 pandemic, school engagement, structural changes, elementary schoolchildren, well-being

OPEN ACCESS

Edited by:
Karin Gehrer,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Lake Lui,
Hong Kong Polytechnic University, Hong Kong, SAR China
Iffat Elbarazi,
United Arab Emirates University, United Arab Emirates

****Correspondence:***
Kjærsti Thorsteinsen
kjarsti.thorsteinsen@uit.no

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *29 March 2021*
Accepted: *13 August 2021*
Published: *09 September 2021*

Citation:
Thorsteinsen K, Parks-Stamm EJ, Olsen M, Kvalø M and Martiny SE (2021) The Impact of COVID-19-Induced Changes at Schools on Elementary Students' School Engagement. Front. Psychol. 12:687611. doi: 10.3389/fpsyg.2021.687611

INTRODUCTION

The emergence of the COVID-19 virus in China in late 2019 was the starting point of a major international health crisis. To restrict the spread of the virus, many countries implemented strict and far-reaching policy regulations including the shutdown of daycare centers and schools. By April 2020, 192 countries had closed their schools, affecting nearly 90% of the world's student population (UNESCO, 2020, as reported by Donohue and Miller, 2020). Depending on the infection rates within countries, the shutdown of schools and daycare centers lasted from several weeks to months, a disruption to students' education that experts have warned could have costly long-term consequences (e.g., Donohue and Miller, 2020; Fore, 2020; Golberstein et al., 2020; Prime et al., 2020). Upon reopening, schools in many countries implemented structural changes in line with strict disease prevention protocols including splitting classes into smaller groups and distancing.

In the present work, we explore how the structural changes implemented by Norwegian schools when reopening in late April 2020 affected elementary school children,

focusing on two important outcome variables: children's attitudes towards school (i.e., emotional school engagement) and their general well-being. School engagement refers to students' commitment, involvement, and participation at school (Fredricks et al., 2004) and is associated with crucial outcomes such as achievement, academic resilience, and dropout rates (for a review see Fredricks et al., 2004). Therefore, school engagement is important to assess given the extensive changes to the school environment following the COVID-19 virus outbreak. Although emerging research shows that children's well-being suffered during the lockdown of society due to the pandemic (e.g., Hoffman and Miller, 2020; Spinelli et al., 2020; Xie et al., 2020; Martiny et al., 2021), little is known about how structural changes made to schools at reopening affected children's well-being. The present study, thus, makes an important contribution to our knowledge of the negative consequences of the pandemic on children.

School Engagement

School engagement includes processes that promote learning and achievement and can be understood as the positive motivational force that ties students to schools (Ladd and Dinella, 2009). School engagement is both malleable and multifaceted (Fredricks et al., 2004). This means that students develop school engagement based on an interaction of individual characteristics and features of the environment, including family, community, culture, and the educational context (Fredricks et al., 2004). Secondly, it contains three components: (1) behavioral engagement, (2) cognitive engagement, and (3) emotional engagement (Fredricks et al., 2004). Behavioral engagement refers to following rules and adhering to norms at school, being involved in academic tasks, and participating in school-related activities. Cognitive engagement is defined as "psychological investment in learning, a desire to go beyond the requirements, and a preference for challenge" (Wehlage et al., 1989 as reported by Fredricks et al., 2004, pp. 63–64). Finally, emotional engagement refers to students' emotional reactions towards school (e.g., enjoyment, liking of school) and thus the emotional connections that tie students to school (Fredricks et al., 2004). Although all three dimensions are correlated among many students, other patterns are observed (e.g., students high in emotional engagement and low cognitive and behavioral engagement; Fredricks, 2011), and thus should be considered independently. Emotional engagement is the focus of the present study as it reflects the child's positive and negative reactions to the school experience (Fredricks, 2011).

Although many studies do not separately measure the individual components of school engagement (Upadyaya and Salmela-Aro, 2013), emotional engagement has been identified as a variable of interest as research suggest it is both directly (Valiente et al., 2007; Li and Lerner, 2011) and indirectly (Ladd et al., 2000; Li et al., 2010) related to academic outcomes (e.g., academic competence), dropping out of school (Fredricks et al., 2004), and well-being (Upadyaya and Salmela-Aro, 2013). Emotional engagement can fluctuate over time (Ladd and Dinella, 2009) and is influenced by features of the educational context like school size, teacher support, and peer acceptance (Fredricks et al., 2004; Li et al., 2010) as well as the home environment (e.g., maternal warmth; Li et al., 2010). The developmental trajectory of emotional engagement (e.g., if it decreases over time or remains high) significantly predicts important outcomes like grades, substance use, delinquency, and depression (Li and Lerner, 2011).

Antecedents of School Engagement: Environmental Factors

Given the malleability of engagement, in the present work, we are particularly interested in the impact of children's classroom environment. Research has shown that the classroom environment, including teachers and interactions with peers, are important determinants of students' school engagement and motivation at school (Ryan and Patrick, 2001), as well as sense of belonging at school (Goodenow, 1993; Skinner and Belmont, 1993). Research further shows that having negative relationships with peers predicts later maladjustment such as dropping out of school (for a review see Parker and Asher, 1987), and positive relationships with peers are positively related to students' school involvement (Berndt and Keefe, 1995) and academic engagement (Guthrie et al., 1995). Thus, earlier research shows that students' relationships with their teachers and peers can have consequences for their engagement in and motivation at school. Therefore, in the present work, we explore the role of both teachers and peers on elementary school children's emotional school engagement by examining how the changes involving grouping children into smaller groups and assigning groups to new teachers (implemented to reduce the spread of the COVID-19 virus in schools in spring 2020) was related to Norwegian elementary children's emotional school engagement.

Consequences of School Engagement: Academic Achievement and Continuance

In the past, research has investigated the achievement-related consequences of the three forms of school engagement (i.e., behavioral, cognitive, and emotional). Research focusing on behavioral and cognitive school engagement has consistently shown positive relationships between engagement and students' achievement and negative relationships with dropping out (Fincham et al., 1989; Skinner et al., 1990; Alexander et al., 1993; Fredricks et al., 2004; Ladd and Dinella, 2009; Lei et al., 2018). Much less is known about the role of emotional school engagement. Some earlier research that combined components of emotional and behavioral engagement showed positive relationships with achievement (e.g., Skinner et al., 1990), but it remains unclear whether emotional or behavioral engagement drives the effect. In addition, earlier research has shown correlations between identification with school (an aspect of emotional school engagement; Fredricks et al., 2004) and performance (Voelkl, 1997). More recently, researchers have used a more clear-cut and narrow definition of emotional school engagement by focusing on students' emotional connection to school. This research shows that students' emotional school engagement is positively related to classroom participation and academic achievement (Ladd et al., 2000; Lei et al., 2018). For example, a longitudinal study with 383 children (Ladd and Dinella, 2009) showed that early emotional school engagement

predicts students' long-term academic growth. Taken together, research shows consistent links between behavioral and cognitive school engagement and students' performance and school continuance, and emerging evidence of positive long-term effects of young students' emotional school engagement. Therefore, in this work we focus on emotional school engagement as an understudied but potentially important concept both as an outcome of structural changes at schools and as a predictor of school performance.

Children's Well-Being

Researchers around the world have documented decreases in children's well-being during the COVID-19 pandemic. In a national survey in the United States, 14% of parents reported a reduction in their children's behavioral health due to the pandemic (Patrick et al., 2020). Two studies from China showed an increase in children's symptoms of depression and anxiety (Duan et al., 2020; Xie et al., 2020). A study from Italy showed that parents' stress during the crisis had a negative impact on children's behavioral and emotional problems (Spinelli et al., 2020). Even in Norway, which experienced a relatively low number of cases and deaths in the first wave of the COVID-19 pandemic in spring 2020, children reported significant costs in well-being when schools were closed during the lockdown (Martiny et al., 2021). Researchers have argued that school closures played a significant role in this decrease in well-being (Hoffman and Miller, 2020), but the impact of the structural changes made to schools to align with COVID-19 restrictions upon reopening have not yet been examined.

Relationships Between School Engagement and Well-Being

The two general outcomes we are interested in—school engagement and well-being—have been linked in past studies. Zhu et al. (2019), for example, showed reciprocal relationships between elementary school children's subjective well-being (SWB) and behavioral school engagement; Datu and King (2018) found a reciprocal relationship between SWB and academic engagement in Filipino high school students. Other studies have looked at school engagement as a mediator between structural factors in school (e.g., specialized vs. regular classes; Orkibi and Tuaf, 2017) and SWB, and between mastery goal orientation and SWB (Yi et al., 2019). Liking school, as a component of students' affective engagement, is an important contributor to children's well-being (Baker and Maupin, 2009; but see Bradshaw et al., 2013).

Structural Changes in Norwegian Schools due to the COVID-19 Pandemic

Elementary schools in Norway include grades 1 to 7. After closing all schools on March 12th, 2020, elementary schools reopened for the younger grades on April 27th (1st−4th grade) and May 11th for 5th−7th grade. At the time of reopening, all classes that contained more than 15 students (for 1st−4th grade) or 20 students (for 5th−7th grade) were split into smaller groups (with their original or new teachers). Practically, schools achieved this by redistributing students in the same year to the minimum number of groups necessary within the guidelines, thus all new groups were relatively similar in size, with 8–15 students per group in the lower grades and 10–20 students in the higher grades. Schools were required to keep the groups separate from each other (e.g., by assigning them to separate rooms and specific areas on the playground) and to maintain one-meter distance between students. Children stayed in the smaller groups for 5 (1st−4th grade) or 3 (5th−7th grade) weeks, until June 2nd. Then, the schools were allowed to go back to their normal classroom structure, such that children returned to their regular classes and teachers, but other restrictions such as distancing and good hand hygiene were still in place.

The Present Research

We conducted an online questionnaire for elementary school children and their parents in Norway between June 8th and June 29th, between 6 and 26 days ($M_{days} = 14$) after the children returned to their regular classes. This means that by the time the questionnaire took place, children were back in their original (regular-sized) classes for an average of 2 weeks. With this questionnaire, we tested whether the temporary structural changes implemented in Norwegian elementary schools when schools reopened after the spring lockdown 2020 were associated with elementary school children's emotional school engagement and subjective well-being reported by both parents and children. We tested the effects of two structural changes on children's emotional school engagement and subjective well-being: (1) being taught by a new teacher and (2) being assigned to a smaller peer group. Next, we tested whether these structural changes had particularly detrimental effects for children who did not like their assigned group. We also explored whether children who reported not liking their new peer group had also shown lower emotional school engagement before the pandemic using retrospective reports from parents. Then we tested whether the relationship between dissatisfaction with the assigned small group and SWB was mediated by emotional school engagement. In addition, as past research has demonstrated that, as an environmental factor, family structure (e.g., single vs. two-parent household) predicts students' school engagement (e.g., through distance regulation and family resources; Bartle-Haring et al., 2012; Havermans et al., 2014), we also explored whether family structure was related to children's emotional school engagement as reported by parents. Finally, we investigated the relationship between emotional school engagement and children's performance and whether the effects of structural changes on performance were mediated by emotional school engagement.

MATERIALS AND METHODS

The study was approved by the Norwegian Center for Research Data and the Department of Psychology's at UiT The Arctic University of Norway's board for research ethics before data collection began.

Participants

The inclusion criterion for the parent sample of the present study was being a parent of an elementary school child in Norway.

The inclusion criterion for the children sample was being an elementary school child in Norway whose parents had answered the parent questionnaire. This study was part of a larger research project investigating parents' and children's well-being during the COVID-19 pandemic (Martiny et al., 2021; Thorsteinsen et al., 2021).

273 elementary school parents and 98 (35.9%) of their elementary school children answered an online questionnaire about school engagement and family well-being after the first outbreak and lockdown due to the COVID-19 pandemic in Norway. To strengthen our design, we asked both parents and children to report on the child's experience. This method allowed us not only to investigate the consistency between the two sources, but also the robustness of our findings (i.e., by running the same analyses with the measures from different sources). Only families in which both one parent and one child completed the questionnaire were included in the present analyses. We excluded three of the 98 parent–child dyads because we were unable to pair the children's questionnaires to their parents' from the self-generated codes. We also excluded two dyads because the children indicated at the end of the questionnaire that they did not understand the questions. The final sample of 93 parent–child dyads had an equal gender distribution for children with 46 boys and 47 girls, but was unbalanced in terms of parents' gender with mothers making up the majority of respondents ($n = 87$). The mean age for the children was 9.70 years ($SD = 1.81$, range 6 years and 5 months−13 years and 3 months) and the mean age of the parents was 39.98 years ($SD = 6.23$, range 26–60 years). Twenty children lived in a single-parent home, whereas 73 children lived in a two-parent home. The median and mode income category for parents in the sample was between NOK 460,000 and NOK 1,200,000; 40 participants reported a lower income and two participants reported earning more. Parents worked a mean of 32.30 ($SD = 13.80$) hours a week and 33 of the parents were classified as being essential workers[1]. One of the parents in the sample was in a same-sex relationship. Three children and ten parents were not born in Norway. Correlation and descriptive statistics for the study variables and additional demographic variables can be found in the **Supplemental Materials.**

Procedure

Invitations were sent to 266 elementary schools across Norway: 40 principals confirmed that they would send the invitation with a link to the study to parents at their school;[2] 17 principals responded that their school would not participate, and the rest did not reply. We additionally distributed the invitation through social media[3] (i.e., an ad on Facebook that targeted 25 to 55-year-old parents and specifically asked for parents of elementary school children). In the parent questionnaire, participants were invited to participate in the study if they had at least one child attending elementary school. When parents had more than one child in elementary school, they were asked to choose one child and report on this child throughout the whole questionnaire. Parents first read detailed information about the study and were asked to give consent for both themselves and their child before completing their questionnaire. Item order was randomized within each measure except for the KIDSCREEN measure.[4] Parents spent on average 15 mins on the questionnaire. At the end of the questionnaire, parents could choose to either have their child complete their questionnaire immediately by being directly redirected to the children's questionnaire or later as they also received the link to the questionnaire *via* e-mail. Parents could participate in a lottery for five gift cards (NOK 500).

Parents were asked to provide their self-generated code in the beginning of the children's questionnaire and encouraged to help their child get started with the questions. They were also given instructions on how children could click on an audio button to have each page read to them (including instructions, items, and scale points) and were asked to be available while their child completed the questionnaire in case there were questions. Before answering the children's questionnaire, children received tailored information about the study and gave their consent by clicking on a consent button. We created a child-friendly online questionnaire by presenting instructions and items in a large font, using short and understandable wording, and presenting one item per page. Most scale points were illustrated with visual images (see **Supplemental Materials**). 53 children reported that they received help from an adult filling in the questionnaire; 40 children reported not receiving help from an adult. Children took on average 15 mins to complete the questionnaire.

Measures

Complete scales can be found in the **Supplemental Materials** in the order presented; additional measures that were assessed in this study are reported in the **Supplemental Materials**. All information was presented in Norwegian.

Structural Changes at School

Three yes/no-questions were used to assess structural changes at the children's schools due to the COVID-19 restrictions and children's reactions. Parents were asked whether their children were assigned to a new teacher after the schools reopened. Children were reminded of potential changes in schools that some children had experienced after the reopening of school (e.g., being divided into smaller groups, having a new teacher, or having to change classrooms) before they were asked "Was your class divided into smaller groups?." If they answered yes, they were asked "Did you want to switch groups in your class?."

[1]Participants reported occupation in open-ended questions coded as 'Essential worker' or not as defined by the Norwegian government (https://www.regjeringen.no/no/tema/samfunnssikkerhet-og-beredskap/innsikt/liste-over-kritiske-samfunnsfunksjoner/id2695609/). The first 10% of the participants were categorized by Author 4 and 5 individually. They showed a high agreement ($\kappa = 0.92$); therefore Author 5 finished the categorization.

[2]All schools in Norway use digital communication with parents, e.g., e-mail or specialized software applications.

[3]At the time the Facebook ad was published, 62 participants of the final sample had already completed the questionnaire (i.e., recruited through their school). As we did not ask participants to indicate how they were recruited, we do not know how many of the remaining 31 participants were recruited via Facebook or school.

[4]Copyright prohibits randomization of KIDSCREEN-10.

Emotional School Engagement

Children's emotional school engagement was measured using items from the School Liking and Avoidance Questionnaire (Ladd and Price, 1987). The questionnaire consists of two subscales—school liking and school avoidance—comprising nine and five items each. In order to keep the questionnaire length reasonable, we only included six items. Both parents and children answered the items about how the child felt about school after the schools had reopened (e.g., "Does your child/Do you like being in school?") on a Likert scale from 1 (never) to 5 (always). In addition, parents were asked to report how the child felt about school before the pandemic (retrospectively). A factor analysis using unweighted least squares extraction and a PROMAX rotation (as the original two subscales correlate) showed that the six items loaded on one factor, but one of the items[5] (i.e., "Do you feel happier when it's time to go home from school") showed low communalities for both parents' and children's reports (h^2 <0.2) and lower factor loadings (<0.4) for both parents' and children's reports. Reliability analyses showed that the Cronbach's alpha increased when this item was excluded. The scale variable was thus constructed without this item and showed good reliability ($\alpha_{parents} = 0.91$ [at both time points]; $\alpha_{children} = 0.85$).

Children's Well-Being

To assess children's subjective well-being, both parents and children completed the cross-culturally validated Norwegian version of the KIDSCREEN-10 index (translated by Haraldstad et al., 2006 as reported by Ravens-Sieberer and the European KIDSCREEN Group, 2006). The measure includes 10 items covering facets of children's well-being with reference to the last week[6] (e.g., "Has your child/Have you felt fit and well?"). Each question is answered on a 1 (never/not at all) to 5 (always/extremely) point Likert scale. After recoding two items, higher values indicated more positive well-being and a Rasch-scaled single score was computed (see Ravens-Sieberer and the European KIDSCREEN Group, 2006 for the procedure). The resulting index can be compared to existing European norm data, with an approximate mean of 50 and standard deviation of 10 (Ravens-Sieberer and the European KIDSCREEN Group, 2006). The scale showed good reliability ($\alpha_{parents} = 0.81$; $\alpha_{children} = 0.79$).

School Performance

We measured performance in mathematics, Norwegian, and English with one item each. Children were asked to think about how they were doing in school and then rate how much they agreed/disagreed with the statement "I am doing well in math/Norwegian/English at the moment" on a scale from 1 (not at all) to 5 (extremely). The three items correlated significantly (see correlation table in **Supplemental Materials**), and a general school performance variable was created ($\alpha = 0.70$).

[5]This item was challenging to translate and we later realized that the Norwegian translation has a slightly different meaning than the original English item.

[6]Two of the items refer to school in the official Norwegian translation (getting on well and being able to pay attention in school).

RESULTS

The data and code can be found on Open Science Framework (link: osf.io/4frk2). Descriptive statistics and correlations between the dependent variables, predictors, and covariates (child gender and age) are presented in **Table 1**. An extended table with additional demographics is presented in the **Supplemental Materials**. In the results section we report the parents' responses. Analyses of children's self-reports show similar patterns and are summarized in the last paragraph (for detailed results see **Supplemental Materials**).

Parents' Reports

Are Structural Changes at School Related to Children's Emotional School Engagement?

First, we tested whether the two structural changes at school (new group and new teacher) made in response to the COVID-19 pandemic related to children's emotional school engagement in a one-way analysis of covariance with child age and gender as covariates. Results showed that 18 children had a new teacher after the reopening, while 75 kept the same teacher as before the lockdown. The children who were taught by a new teacher ($M = 3.81$, $SD = 1.02$) did not significantly differ in emotional school engagement from the children taught by the same teacher ($M = 3.89$, $SD = 0.85$). Thus, students' emotional school engagement was not affected by having a new teacher, $F_{(1, 89)} = 0.08$, $p = 0.778$. Sixty children were assigned to smaller groups after schools reopened and 33 remained in their normal classes. Overall, this structural change was not associated with emotional school engagement, $F_{(1, 89)} < 0.01$, $p = 0.990$. The children who were divided into smaller groups ($M = 3.87$, $SD = 0.96$) did not report a lower level of emotional school engagement than those who remained in their normal class ($M = 3.87$, $SD = 0.74$) as reported by their parents.

Next, we tested whether being happy with the new peer group was related to children's emotional school engagement. Of the 60 children who were divided into smaller groups, 22 children reported that they had wanted to switch groups. These children reported significantly lower emotional school engagement ($M = 3.53$, $SD = 0.95$) than the 38 children who did not want to switch groups ($M = 4.07$, $SD = 0.92$), $F_{(1, 56)} = 4.55$, $p = 0.037$, $\eta_p^2 = 0.08$ (as reported by their parents).

The parents' questionnaire included items both on children's reopening emotional school engagement (reported above) and their emotional school engagement before the pandemic (asked retrospectively). Therefore, to further explore the relationship between satisfaction with the child's peer group and engagement, we conducted an exploratory analysis to test whether children who had reported not liking their new peer group had also shown lower emotional school engagement before the pandemic. Two-way repeated measures ANOVA showed no significant change in emotional school engagement from T1 to T2, $F_{(1, 58)} = 2.28$, $p = 0.126$, but the interaction between children's liking of their new group and time approached significance, $F_{(1, 58)} = 2.92$, $p = 0.093$. Simple slopes analyses revealed that children who did not like their new group descriptively reported lower emotional school engagement prior to the pandemic ($M =$

TABLE 1 | Descriptive statistics and correlations.

Variables	*M*	*SD*	*n*	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Emotional school engagement															
1. Parent-reported	3.87	0.88	93	1											
2. Parent-reported, retrospective	3.91	0.83	93	0.77**	1										
3. Child-reported	3.74	0.90	93	0.71**	0.74**	1									
Well-being															
4. Parent-reported	47.33	10.60	93	0.63**	0.52**	0.42**	1								
5. Child-reported	49.82	10.59	93	0.39**	0.49**	0.56**	0.47**	1							
Other variables															
6. New teacher after reopening	0.81	0.40	93	−0.04	0.07	0.06	0.01	0.02	1						
7. Class divided into smaller groups	0.35	0.48	93	0.00	0.08	−0.06	0.04	0.04	0.25*	1					
8. Wanting to switch groups	0.63	0.49	60	−0.28*	−0.16	−0.17	−0.31*	−0.14	−0.07	–	1				
9. School performance	3.77	0.92	93	0.36**	0.34	0.46**	0.23*	0.45**	−0.03	−0.07	−0.00	1			
10. Child age	9.70	1.81	93	0.04	−0.04	−0.11	−0.01	0.01	−0.13	−0.12	−0.11	−0.04	1		
11. Child gender	0.51	0.50	93	0.03	0.22*	0.13	−0.02	0.06	−0.02	0.21*	0.29*	0.13	−0.02	1	
12. Family structure	0.78	0.41	93	0.29**	0.30**	0.36**	0.25*	0.33**	0.06	−.22*	−0.14	0.17	−0.04	−0s.05	1

Having a new teacher, Class divided into smaller groups, and Wanting to switch groups are coded 1 for yes and 0 for no; Child gender is coded 0, boys; 1, girls; Family structure is coded 0, single-parent families and 1, two-parent families.
**Correlation is significant at the 0.01 level. *Correlation is significant at the 0.05 level (2-tailed).*

3.78, $SD = 0.87$) and this engagement then declined further after schools implemented the pandemic-related changes ($M = 3.53$, $SD = 0.95$), $F_{(1, 58)} = 4.09$, $p = 0.048$. Children who liked their group reported the same level of school engagement prior to the pandemic ($M = 4.06$, $SD = 0.83$) and after the reopening ($M = 4.07$, $SD = 0.92$), $F_{(1, 58)} = 0.27$, $p = 0.870$, indicating that these childrens' emotional school engagement did not change. These patterns remained when including age and gender as covariates, $F_{(1, 56)} = 2.09$, $p = 0.154$. None of the covariates influenced changes in emotional school engagement in this model, *ps* <0.600.

Are Structural Changes at School Related to Children's Well-Being?

Using the same procedure as above, we tested the relationship between structural changes and children's subjective well-being. There were no differences in well-being between children taught by a new teacher ($M = 47.63$, $SD = 10.44$) and children taught by the same teacher ($M = 47.26$, $SD = 10.71$), $F_{(1, 89)} = 0.01$, $p = 0.907$. Children assigned to a new group ($M = 47.68$, $SD = 11.18$) reported the same level of subjective well-being as children staying in the same group ($M = 46.71$, $SD = 9.60$), $F_{(1, 89)} = 0.21$, $p = 0.645$. However, in line with the results on emotional school engagement, children who did not like the groups they were assigned to reported lower well-being ($M = 43.17$, $SD = 9.53$) than children who did not ($M = 50.28$, $SD = 11.34$), $F_{(1, 56)} = 5.75$, $p = 0.020$.

The Relationship Between Emotional School Engagement and Well-Being

As can be seen in **Table 1**, emotional school engagement was positively related to child well-being. This relationship remained stable when tested in a linear regression analysis controlling for child age and gender, $b = 0.63$, $t_{(89)} = 7.63$, $p < 0.001$, $f^2 = 0.65$. We then explored whether the relationship between not liking one's group and well-being was mediated by emotional school engagement (Process model 4, Hayes, 2018, 50,000 bootstrap samples, see **Table 2**). Wanting to switch groups predicted emotional school engagement [$a = -0.57$ (-1.10; -0.04)], which in turn predicted well-being [$b = 7.72$ (5.45; 9.99)]. A bias corrected confidence interval for the indirect effect of switching groups [$ab = -4.39$ (-8.92; -0.10)] did not include zero, meaning that emotional school engagement mediated the relationship between wanting to switch groups and well-being.

Additional Predictors and Outcomes of Emotional School Engagement

Family Structure as a Predictor

In line with earlier studies, correlational analyses showed that family structure was related to emotional school engagement and this relationship remained significant controlling for age and gender, $F_{(1, 89)} = 8.30$, $p = 0.005$, $\eta_p^2 = 0.09$. Children from two-parent families reported higher emotional school engagement ($M = 4.01$, $SD = 0.77$) than children from single-parent families ($M = 3.39$, $SD = 1.09$).

However, the patterns of results in the repeated measure ANOVA of parent-reported emotional school engagement

TABLE 2 | Mediation model for the relationship of wanting to switch groups and well-being *via* emotional school engagement ($n = 60$).

		Emotional school engagement (M)				Well-being (Y)		
		Coeff. (LLCI; ULCI)	***SE***	***p***		**Coeff. (LLCI; ULCI)**	***SE***	***p***
Wanting to switch groups (X)	a	−0.57 (−1.10; −0.04)	0.27	0.037	c'	−2.89 (−7.59; 1.81)	2.34	0.801
Emotional school engagement (M)					b	7.72 (5.45; 9.98)	1.13	< 0.001
Gender		0.11 (−0.41; 0.62)	0.26	0.685		−1.57 (−5.97; 2.83)	2.20	0.478
Age		0.03 (−0.13; 0.18)	0.08	0.728		−1.30 (−2.60; 0.00)	0.65	0.050
Constant	I_M	3.66 (2.02; 5.30)	0.82	< 0.001	I_Y	33.73 (17.54; 49.93)	8.08	< 0.001
		$R^2 = 0.08$				$R^2 = 0.53$		
		$F_{(3, 56)} = 1.66$		0.185		$F_{(4, 55)} = 15.18$		< 0.001

Confidence intervals are displayed at the 95% level.

(presented above) did not change when including family structure as a covariate. Furthermore, family structure did not influence changes in emotional school engagement from before the pandemic to the time of reopening, $F_{(1, 55)} = 0.49$, $p = 0.487$. We therefore did not include it as a covariate in the subsequent analyses.

School Performance as an Outcome

In line with earlier research, we found that children's emotional school engagement was correlated with their school performance and this relationship remained stable when controlling for age and gender, $b = 0.36$, $t_{(89)} = 3.68$, $p < 0.001$, $f^2 = 0.18$. Therefore, we explored whether wanting to switch groups negatively affected children's school performance[7] *via* emotional school engagement (Process model 4, Hayes, 2018, 50,000 bootstrap samples, see **Table 3**). Wanting to switch groups predicted children's emotional school engagement [$a = -0.57$ (−1.10; −0.04)], which in turn predicted children's school performance [$b = 0.48$ (0.24; 0.74)]. There was no direct relationship between wanting to switch groups and school performance, but a bias corrected confidence interval for the indirect effect [$ab = -0.28$ (−0.72; −0.00)] of switching groups did not include zero, meaning that emotional school engagement mediated the relationship.

Children's Self-Reports

Parents' and children's reports correlated strongly for emotional school engagement and moderately for well-being (see **Table 1**). In general, the results for children's self-reported emotional school engagement and well-being showed similar, but partly non-significant, patterns in the same direction as the results reported by the parents. Similar to the results with the parents' report, being assigned to a new group or a new teacher were not associated with lower self-reported emotional school engagement or well-being. Descriptively, children who wanted to switch groups reported lower emotional school engagement and well-being than children who did not. Finally, their emotional school engagement was significantly related to well-being, family structure and school performance, also when controlling for covariates (see **Table 1** and the **Supplemental Materials**).

DISCUSSION

Results of the present study show that whether or not elementary students were temporarily assigned to a new teacher or a new peer group upon their return to school was not necessarily associated with decreases in their emotional school engagement or their SWB. However, the children who did not like their smaller peer group reported reduced emotional school engagement and subjective well-being even after they were back in their regular classes for approximately 2 weeks. In addition, we found that the relationship between liking one's group and subjective well-being was mediated by emotional school engagement. This is in line with earlier work showing school engagement as a mediator between structural factors in school and SWB (e.g., Orkibi and Tuaf, 2017), and the importance of peer acceptance for emotional engagement in school (e.g., Fredricks et al., 2004). In line with past findings (e.g., Bartle-Haring et al., 2012; Havermans et al., 2014), children living in single-parent (vs. two-parent) households also reported lower school engagement after the reopening of schools. However, change in school engagement from before the pandemic (asked retrospectively) to the time of reopening was not influenced by family structure. Instead, the change was associated with not liking one's group. Finally, we found that emotional school engagement was related to children's self-reported performance and mediated the link between not liking one's peer group and performance.

The present study makes an important contribution not only to existing literature on the antecedents and consequences of children's school engagement and well-being under normal circumstances (Fredricks et al., 2004; Upadyaya and Salmela-Aro, 2013), but also to the emerging literature that focuses on the negative consequences of the COVID-19 pandemic on children and parents (Hoffman and Miller, 2020; Spinelli et al., 2020; Martiny et al., 2021). We extend previous work on the effects of lockdowns and school closures on children by examining features of a previously unexplored context: classrooms altered by COVID-related restrictions. By integrating empirical evidence related to school engagement, well-being,

[7]When the performance items were analyzed separately, results were replicated with mathematics and Norwegian, whereas English performance showed the same pattern but did not reach the conventional significance level.

TABLE 3 | Mediation model for the relationship of wanting to switch groups and school performance via emotional school engagement ($n = 60$).

		Emotional school engagement (M)				School performance (Y)		
		Coeff. (LLCI; ULCI)	***SE***	***p***		**Coeff. (LLCI; ULCI)**	***SE***	***p***
Wanting to switch groups (X)	a	−0.57 (−1.10; −0.04)	0.27	0.037	c'	−0.09 (−0.42; 0.60)	0.26	0.736
Emotional school engagement (M)					b	0.48 (0.24; 0.74)	0.13	< 0.001
Gender		0.11 (−0.41; 0.63)	0.26	0.685		−0.55 (0.62; 1.03)	0.24	0.028
Age		0.03 (−0.13; 0.18)	0.08	0.728		−0.02 (−0.26; 0.13)	0.07	0.795
Constant	I_M	3.66 (2.02; 5.30)	0.82	< 0.001	I_Y	1.12 (−0.66; 2.90)	0.89	0.212
		$R^2 = 0.08$				$R^2 = 0.28$		
		$F_{(3, 56)} = 1.66$		0.185		$F_{(4, 55)} = 5.32$		0.001

Confidence intervals are displayed at the 95% level.

and the effects of the pandemic on schoolchildren, the present work demonstrates that specific antecedents of well-being and emotional school engagement continue to play a role during a worldwide health-related crisis, and introduces new insights into factors associated with particularly negative responses to pandemic-related restrictions in schools.

Taken together these results have important implications. Children who were placed into small groups that they did not like reported reduced emotional school engagement even when they were back in their original classes. From an applied perspective, these findings highlight the importance of student placement more broadly. Past research has shown that few administrators use a truly random assignment of students to classrooms, often attempting to "balance" classes by relying on impressions of students' abilities, personalities, learning styles, and potential compatibility with teachers (Paufler and Amrein-Beardsley, 2014). In times of crisis, the present research suggests placing children into small peer groups they are unhappy with can have negative effects on their emotional school engagement that in turn can have consequences for their well-being and performance. These findings also merit attention from a research perspective, as they show that it is important to adopt a differentiated perspective when investigating children's school engagement, well-being, and performance, not unlike research examining outcomes for individuals grouped by their developmental trajectories of engagement (Li and Lerner, 2011). Looking merely at averages underestimates the negative effects experienced by certain individuals.

Further, the pandemic led to mid-year placements into new peer groups that occurred without the normal concomitant changes (e.g., a new school year, grade, performance expectations). Due to the pandemic-related restrictions, classes were divided (or not) purely based on a structural characteristic, namely whether they contained more than 15 students. Focusing on the students who were affected by this change and comparing those who were not happy with the change with those who were, gives us the unique opportunity to compare a target group with a natural control group. The effects of group placement, unadulterated by other concomitant factors, allowed us to focus on the relationships between structural changes in classrooms (and students' satisfaction with these changes) and students' engagement, well-being, and school performance. That dissatisfaction with one's group in these conditions is associated with such negative effects in important outcomes highlights the need to consider peer groups in placement decisions not only in times of crisis but also within regular school routines.

Our findings also suggest that it is important for schools to identify the children who would be most at risk of feeling out of place in school. Children in our sample who were uncomfortable in the new groups reported descriptively lower emotional school engagement prior to the pandemic, and this engagement then declined further when schools implemented the pandemic-related changes. Thus, it appears that the most vulnerable children suffered most from the changes made in school in response to the ongoing pandemic. This finding is in line with earlier research demonstrating that the pandemic had the most detrimental effects on at-risk young children (Dooley et al., 2020; Martin and Sorensen, 2020). Thus, the present work makes an important contribution to existing literature by highlighting specific ways that vulnerable children suffered during the pandemic, even when schools reopened. In addition to these pandemic-specific effects, the present findings highlight the need for more research under normal circumstances on the importance of placing children—particularly high-risk children—into peer groups they are happy about in school, to support their emotional engagement and feelings of belonging.

Limitations and Outlook

In the present study, we had limited time and opportunity to assess additional variables. For example, other mental, psychological, and behavioral factors may have impacted students' well-being, performance, and adjustment during the pandemic, and it is possible that these could serve as confounding variables. In addition, we did not measure the exact size of the smaller groups students were assigned to during the first stage of reopening of schools as we did not want to overwhelm the children and parents with our survey. However, our analyses focused mostly on students who came from a class with more than 15 (1st−4th grade) or 20 (5th−7th grade) students and consequently were divided into groups with a minimum of 8–15 students and 10–20 students, respectively.

In the present study, we used a cross-sectional design that does not allow any causal interpretation. Further research should investigate causal links between structural changes at school, emotional school engagement, well-being, and performance, as well as potential mediators, by using longitudinal or experimental

designs to allow for causal conclusions. The sample size in the present research is relatively small and future research should replicate the present findings with larger sample sizes. In addition, the data were collected online. This is associated with both benefits and limitations (e.g., Heiervang and Goodman, 2011). One limitation of online studies is that error variance is increased since children answered the questionnaire at home and not under controlled conditions in the lab. In addition, there is the potential risk of oversampling students from higher social classes while reaching fewer students with non-traditional backgrounds such as immigrant students and students from families with low socio-economic status. Although selective participation from online questionnaires can affect point estimates, patterns of associations are more robust to this threat (e.g., Heiervang and Goodman, 2011). Furthermore, in the present work, we asked both parents and children to report on the child's experience. This method allowed us not only to investigate the consistency between the two sources, but also the robustness of our findings (i.e., by running the same analyses with the measures from different sources). We found stronger and more consistent patterns with the parents' data than with the children's data, which might be due to the problem mentioned above namely that some children—especially the younger ones—might have had difficulties filling out the online questionnaire. However, the parents' reports and the children's self-reports were highly correlated and we found similar patterns in both data sets, confirming the robustness of the present results and the validity of parental reports for child-related measures. Finally, school performance was assessed subjectively, by asking children how well they are doing in three main subjects (mathematics, Norwegian, and English). As children in Norwegian elementary schools do not receive grades (i.e., only verbal feedback), children may not accurately judge their performance.

CONCLUSION

The present work investigated how structural changes implemented in Norwegian elementary schools to align with COVID-19 restrictions were associated with children's emotional school engagement and subjective well-being. We found that children who were unhappy with the new group they were assigned to showed lower general well-being and emotional school engagement. Reduced emotional school engagement not only mediated the relationship between being unhappy with their peer group and subjective well-being, but was also linked to lower performance. School authorities should consider these differential effects of structural changes at schools, particularly in times of crisis in which children appear to be particularly vulnerable.

DATA AVAILABILITY STATEMENT

The datasets generated for this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: The data and code can be found on Open Science Framework (osf.io/4frk2).

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Department of Psychology's at UiT The Arctic University of Norway's board for research ethics. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

KT, MK, MO, and SEM contributed to conception and design of the study. MO and KT organized the data. KT and SEM performed the statistical analysis. EJP-S, SEM, and KT wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.687611/full#supplementary-material

REFERENCES

Alexander, K. L., Entwisle, D. R., and Dauber, S. L. (1993). First-grade classroom behavior: its short-and long-term consequences for school performance. *Child Dev.* 64, 801–814. doi: 10.2307/1131219

Baker, J. A., and Maupin, A. N. (2009). "School satisfaction and children's positive school adjustment," in *Handbook of Positive Psychology in Schools*, eds R. Gilman, E. S. Huebner, and M. J. Furlong (New York, NY: Routledge), 189–196.

Bartle-Haring, S., Younkin, F. L., and Day, R. (2012). Family distance regulation and school engagement in middle-school-aged children. *Fam. Relat.* 61, 192–206. doi: 10.1111/j.1741-3729.2011.00698.x

Berndt, T. J., and Keefe, K. (1995). Friends' influence on adolescents' adjustment to school. *Child Dev.* 66, 1312–1329. doi: 10.2307/1131649

Bradshaw, J., Martorano, B., Natali, L., and De Neubourg, C. (2013). Children's subjective well-being in rich countries. *Child Indic. Res.* 6, 619–635. doi: 10.1007/s12187-013-9196-4

Datu, J. A. D., and King, R. B. (2018). Subjective well-being is reciprocally associated with academic engagement: a two-wave longitudinal study. *J. Sch. Psychol.* 69, 100–110. doi: 10.1016/j.jsp.2018.05.007

Donohue, J. M., and Miller, E. (2020). COVID-19 and school closures. *JAMA* 324, 845–847. doi: 10.1001/jama.2020.13092

Dooley, D. G., Bandealy, A., and Tschudy, D. M. M. (2020). Low-income children and coronavirus disease 2019 (COVID-19) in the US. *JAMA Pediatr.* 174, 922–923. doi: 10.1001/jamapediatrics.2020.2065

Duan, L., Shao, X., Wang, Y., Huang, Y., Miao, J., Yang, X., et al. (2020). An investigation of mental health status of children and adolescents in China during the outbreak of COVID-19. *J. Affect. Disord.* 275, 112–118. doi: 10.1016/j.jad.2020.06.029

Fincham, F. R., Hokoda, A., and Sanders, R. (1989). Learned helplessness, test anxiety, and academic achievement: a longitudinal analysis. *Child Dev.* 60, 138–145. doi: 10.2307/1131079

Fore, H. H. (2020). A wake-up call: COVID-19 and its impact on children's health and wellbeing. *Lancet Global Health* 8, 861–862. doi: 10.1016/S2214-109X(20)30238-2

Fredricks, J. A. (2011). Engagement in school and out-of-school contexts: a multidimensional view of engagement. *Theory Pract.* 50, 327–335. doi: 10.1080/00405841.2011.607401

Fredricks, J. A., Blumenfeld, P. C., and Paris, A. H. (2004). School engagement: potential of the concept, state of the evidence. *Rev. Educ. Res.* 74, 59–109. doi: 10.3102/00346543074001059

Golberstein, E., Wen, H., and Miller, B. F. (2020). Coronavirus disease 2019 (COVID-19) and mental health for children and adolescents. *JAMA Pediatr.* 174, 819–820. doi: 10.1001/jamapediatrics.2020.1456

Goodenow, C. (1993). Classroom belonging among early adolescent students: relationships to motivation and achievement. *J. Early Adolesc.* 13, 21–43. doi: 10.1177/0272431693013001002

Guthrie, J. T., Schafer, W., Wang, Y. Y., and Afflerbach, P. (1995). Relationships of instruction to amount of reading: an exploration of social, cognitive, and instructional connections. *Reading Research Q.* 1995, 8–25. doi: 10.2307/747742

Haraldstad, K., Eide, H., og Helseth, S. (2006). *KIDSCREEN Questionnaire*. Available online at: https://www.kidscreen.org/english/language-versions/norway/

Havermans, N., Botterman, S., and Matthijs, K. (2014). Family resources as mediators in the relation between divorce and children's school engagement. *Soc. Sci. J.* 51, 564–579. doi: 10.1016/j.soscij.2014.04.001

Hayes, A. F. (2018). *Introduction to Mediation, Moderation, and Conditional Process Analysis. (2nd Ed.)*. New York: The Guilford Press.

Heiervang, E., and Goodman, R. (2011). Advantages and limitations of web-based surveys: evidence from a child mental health survey. *Soc. Psychiatry Psychiatr. Epidemiol.* 46, 69–76. doi: 10.1007/s00127-009-0171-9

Hoffman, J. A., and Miller, E. A. (2020). Addressing the consequences of school closure due to COVID-19 on children's physical and mental well-being. *World Med. Health Policy* 12, 300–310. doi: 10.1002/wmh3.365

Ladd, G., Buhs, E., and Seid, M. (2000). Children's initial sentiments about Kindergarten: is school liking an antecedent of early classroom participation and achievement? *Merrill-Palmer Q.* 46, 255–279. Available online at: http://www.jstor.org/stable/23093716

Ladd, G.W., and Price, J.M. (1987). Predicting children's social and school adjustment following the transition from preschool to kindergarten. *Child Dev.* 58, 1168–1189. doi: 10.2307/1130613

Ladd, G. W., and Dinella, L. M. (2009). Continuity and change in early school engagement: predictive of children's achievement trajectories from first to eighth grade? *J. Educ. Psychol.* 101, 190–206. doi: 10.1037/a0013153

Lei, H., Yunhuo, C., and Zhou, W. (2018). Relationship between student engagement and academic achievement: a meta-analysis. *Soc. Behav. Pers.* 46, 517–528. doi: 10.2224/sbp.7054

Li, Y., Lerner, J. V., and Lerner, R. M. (2010). Personal and ecological assets and academic competence in early adolescence: the mediating role of school engagement. *J. Youth Adolesc.* 39, 801–815. doi: 10.1007/s10964-010-9535-4

Li, Y., and Lerner, R. M. (2011). Trajectories of school engagement during adolescence: implications for grades, depression, delinquency, and substance use. *Dev. Psychol.* 47, 233–247. doi: 10.1037/a0021307

Martin, E. G., and Sorensen, L. C. (2020). Protecting the health of vulnerable children and adolescents during COVID-19–related K-12 school closures in the US. *JAMA Health Forum* 1, e200724–e200724. doi: 10.1001/jamahealthforum.2020.0724

Martiny, S. E., Thorsteinsen, K., Parks-Stamm, E. J., Olsen, M., and Kval,ø, M. (2021). Children's Well-being during the COVID-19 pandemic: relationships with attitudes, family structure, and mothers' Well-being. *Eur. J. Dev. Psychol.* 2021, 1–21. doi: 10.1080/17405629.2021.1948398

Orkibi, H., and Tuaf, H. (2017). School engagement mediates well-being differences in students attending specialized versus regular classes. *J. Educ. Res.* 110, 675–682. doi: 10.1080/00220671.2016.1175408

Parker, J. G., and Asher, S. R. (1987). Peer relations and later personal adjustment: are low-accepted children at risk? *Psychol. Bull.* 102, 357–389. doi: 10.1037/0033-2909.102.3.357

Patrick, S. W., Henkhaus, L. E., Zickafoose, J. S., Lovell, K., Halvorson, A., Loch, S., et al. (2020). Well-being of parents and children during the COVID-19 pandemic: a national survey. *Pediatrics* 146:e2020016824. doi: 10.1542/peds.2020-016824

Paufler, N. A., and Amrein-Beardsley, A. (2014). The random assignment of students into elementary classrooms: implications for value-added analyses and interpretations. *Am. Educ. Res. J.* 51, 328–362. doi: 10.3102/0002831213508299

Prime, H., Wade, M., and Browne, D. T. (2020). Risk and resilience in family well-being during the COVID-19 pandemic. *Am. Psychol.* 75, 631–643. doi: 10.1037/amp0000660

Ravens-Sieberer, U., and the European KIDSCREEN Group. (2006). *The KIDSCREEN Questionnaires—Quality of Life Questionnaires for Children and Adolescents—Handbook*. Lengerich: Pabst Science Publisher.

Ryan, A. M., and Patrick, H. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *Am. Educ. Res. J.* 38, 437–460. doi: 10.3102/00028312038002437

Skinner, E. A., and Belmont, M. J. (1993). Motivation in the classroom: reciprocal effects of teacher behavior and student engagement across the school year. *J. Educ. Psychol.* 85, 571–581. doi: 10.1037/0022-0663.85.4.571

Skinner, E. A., Wellborn, J. G., and Connell, J. P. (1990). What it takes to do well in school and whether I've got it: a process model of perceived control and children's engagement and achievement in school. *J. Educ. Psychol.* 82, 22–32. doi: 10.1037/0022-0663.82.1.22

Spinelli, M., Lionetti, F., Pastore, M., and Fasolo, M. (2020). Parents' stress and children's psychological problems in families facing the COVID-19 outbreak in Italy. *Front. Psychol.* 11:1713. doi: 10.3389/fpsyg.2020.01713

Thorsteinsen, K., Parks-Stamm, E. J., Kvalø, K., Olsen, M., and Martiny (2021). The well-being of Norwegian mothers during the COVID-19 pandemic: gender ideologies moderate the relationship between share of domestic work and well-being. Manuscript under review.

UNESCO (2020). *COVID-19 Impact on Education*. Available online at: https://en.unesco.org/covid19/educationresponse

Upadyaya, K., and Salmela-Aro, K. (2013). Development of school engagement in association with academic success and well-being in varying social contexts: a review of empirical research. *Eur. Psychol.* 18, 136–147. doi: 10.1027/1016-9040/a000143

Valiente, C., Lemery-Chalfant, K., and Castro, K. S. (2007). Children's effortful control and academic competence: mediation through school liking. *Merrill-Palmer Q.* 53, 1–25. Available online at: https://www.jstor.org/stable/23096289

Voelkl, K. E. (1997). Identification with school. *Am. J. Educ.* 105, 294–318. doi: 10.1086/444158

Wehlage, G. G., Rutter, R. A., Smith, G. A., Lesko, N., and Fernandez, R. R. (1989). *Reducing the Risk: Schools as Communities of Support*. Farmer Press.

Xie, X., Xue, Q., and Zhou, Y. (2020). Mental health status among children in home confinement during the coronavirus disease 2019 outbreak in Hubei Province, China. *JAMA Pediatr.* 174, 898–900. doi: 10.1001/jamapediatrics.2020.1619

Yi, H., Tian, L., and Huebner, E. S. (2019). Mastery goal orientations and subjective well-being in school among elementary school students: the mediating role of school engagement. *Eur. J. Psychol. Educ.* 35, 429–450. doi: 10.1007/s10212-019-00431-x

Zhu, X., Tian, L., Zhou, J., and Huebner, E. S. (2019). The developmental trajectory of behavioral school engagement and its reciprocal relations with subjective well-being in school among Chinese elementary school students. *Child. Youth Serv. Rev.* 99, 286–295. doi: 10.1016/j.childyouth.2019.01.024

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 14 September 2021
doi: 10.3389/feduc.2021.700441

Parents' Perceptions of School Support During COVID-19: What Satisfies Parents?

Teresa Haller[1]* *and Shally Novita*[1,2]

[1]Department of Competencies, Personality, Learning Environments, Leibniz Institute for Educational Trajectories (LIfBi), Bamberg, Germany, [2]Department of Developmental Psychology and Center for Psychological Innovation and Research, Faculty of Psychology, Universitas Padjadjaran, Jatinangor, Indonesia

During the COVID-19 pandemic lockdown, face-to-face schooling could not be performed continuously, and alternative ways of learning had to be organized. Parents had to act as their children's home schooling tutors while working from home, and schools had to deal with various alternatives to distance education. Since parents are by all means both important school users and partners, their perceptions of schools can be considered a central indicator for assessing school quality. In this respect, during school lockdown, parents' school satisfaction may reflect schools' ability to adjust and react to fast social changes with almost no time for preparation. To date, there is nearly no knowledge about school satisfaction or school support during this challenging situation. Using data from the COVID-19 survey of the German National Educational Panel Study, we identified central predictors of parents' perceptions of school support during the national lockdown in Germany in spring 2020. All students (N = 1,587; M_{age} = 14.20; SD = 0.36; 53% girls) and their parents (M_{age} = 47.36; SD = 4.99; 91% women) have participated in the longitudinal survey for at least 8 years. The results of the structural equation model indicate that the perceived support and abilities of teachers have been especially relevant for parents' school satisfaction during the time of the school lockdown. In contrast, factors relating to parents' and children's backgrounds seem to be less important.

Keywords: COVID-19, school lockdown, home schooling, perception of school support, parent-school relationship, school satisfaction (min 5–max 8)

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Nadia Rania, University of Genoa, Italy
Estrella Romero, University of Santiago de Compostela, Spain
Beatriz Domínguez Álvarez, University of Santiago de Compostela, Spain in collaboration with reviewer ER

***Correspondence:**
Teresa Haller
teresa.haller@lifbi.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *26 April 2021*
Accepted: *15 July 2021*
Published: *14 September 2021*

Citation:
Haller T and Novita S (2021) Parents' Perceptions of School Support During COVID-19: What Satisfies Parents?. Front. Educ. 6:700441. doi: 10.3389/feduc.2021.700441

INTRODUCTION

The COVID-19 pandemic has had a major effect on nearly all aspects of life. During the first lockdown in Spring 2020, teachers, students and parents had to face the challenge of maintaining learning processes *via* remote schooling in Germany, as in almost all European countries (DW 2020). Short-term modifications without sufficient experience were necessary and forced all providers and users of the educational system to adjust to a sudden and completely new situation of home schooling. While teachers and schools had to provide students with learning materials, instructions and assistance by distance, parents had to function as home schooling tutors for their children while maintaining their regular jobs at the same time (Lagomarsino et al., 2020: 851f; Parczewska 2020). In such critical times, where parents have to be more actively engaged in their children's learning programs (Bubb and Jones 2020), parents' satisfaction with school becomes a crucial factor, reflecting schools' ability to adjust and react towards fast social changes. Generally speaking, the construct accounts for a state in which parents are content with the way how schools handle the teaching of

their child or with more general characteristics and performance of schools such as school infrastructures and school communication (Friedman et al., 2006). There is no universal definition for parents' satisfaction with school and studies investigate the construct with a varying focus (Mossi et al., 2019: 1f). While successful parent-school cooperation and the perception of mutual support are always important for students' educational outcomes (Dusi 2012: 20ff), they are especially vulnerable during times like this. Therefore, one indicator of a good school may be its ability to organize and deliver supportive, effective learning material (Giovannella et al., 2020), thus enabling parents and children to assess and comprehend the materials as well as possible. Accordingly, a perception of strong school support of overburdened parents during the school lockdown may serve as a critical benchmark of school quality. In addition to official measures, parents' satisfaction with school could be one potential criterion for assessing the larger societal validity of school performance (Charbonneau et al., 2012). Parents' school satisfaction demonstrated a significant relationship with the official measures of school performance, including schools' characteristics and students' performance (ebd.).

To our knowledge, so far, there is very limited research on parents' satisfaction in the special situation of the COVID-19 pandemic, mainly focusing on a descriptive reporting of the status quo (Andresen et al., 2020; Anger et al., 2020; Huebner et al., 2020; Wildemann and Hosenfeld 2020; Thorell et al., 2021). Moreover, research on parents' satisfaction with school in the German educational system in general is relatively scarce, and if existing, studies focus on the parents of younger children (Cryer et al., 2002). To date, no study has examined the predictors of parents' school perceptions if their children belong to the adolescence cohort. However, knowledge about parents' satisfaction with school is also important for older children, as especially during the sensible time of the adolescent phase a coherent social environment is important for the development of a young person (Perry et al., 1993). Prior studies also confirmed that generally during adolescence, parents continue to provide important developmental contexts for their children, particularly in form of discussion as well as role model (Behnke et al., 2004). The parents' satisfaction with school expresses the quality dimension of the family-school relationship, which is associated with the educational development of students in general (Khajehpour and Ghazvini 2011; Charbonneau et al., 2012: 60f). Further, from an economic angle, parents are seen as important users of schools. Schools operate as institutions within an educational market and have the responsibility to meet the needs of their users or customers (Matland 1995; Fend 2008: 109ff). As parents are one relevant user group, their satisfaction should be of great interest for schools to maintain and report high-quality levels (Charbonneau et al., 2012; Peters 2015: 342f).

With this paper, we contribute to enhancing knowledge about parents' satisfaction with school during the exceptional time of the school lockdown due to the COVID-19 pandemic. We assume that the critical situation during the school lockdown in Spring 2020, with highly necessary adjustments in schooling, has had a relatively deep effect on parents' satisfaction. We further posit that there are special factors associated with the challenging situation during the school lockdown. Moreover, this is the first study on predictors of parents' perceptions of school support in the German context if their children are in secondary school. Therefore, this article investigates central predictors of parents' satisfaction with school support during the German school lockdown in Spring 2020.

We proceed as follows: First, we briefly summarize the current state of research on parents' satisfaction with school, and give an overview of already identified predictors of parents' satisfaction during regular times of schooling. There are a few published reports and first results on parents' satisfaction with school during the pandemic, which we will introduce briefly. We then argue theoretically by using an economic and developmental approach to explain what influences parents' views of school support during the lockdown, and conduct a theoretically driven hypothesis. In the data and methods section, we first introduce the used dataset, the German National Educational Panel Study (NEPS). We then define key variables and present the analytical approach of the structural equation model. The third section demonstrates the results, which are discussed in the final section.

State of Research

Parents are highly relevant educational actors, as they are both the actual consumers of the school and in charge of their children's education (Fend 2000: 66f; Fend 2008: 109ff). However, many studies on school satisfaction focus on students' rather than on parents' satisfaction (Okun et al., 1990; Zullig et al., 2011; Casas et al., 2013; Weber and Huebner 2015; Arciuli et al., 2019; Arciuli and Emerson 2020). Studies on parents' satisfaction usually refer to parents of younger cohorts who attend kindergarten or elementary school (Ulrey et al., 1982; Griffith 2000; Cryer et al., 2002; Bailey et al., 2003; Thompson 2003; Fantuzzo et al., 2006; Bassok et al., 2018). In general, parents of older children seem less satisfied with schools than parents of younger students (Thompson 2003: 280f; Fantuzzo et al., 2006), which may signal that parents of older children are likely to have higher educational expectations than parents of younger children (Stull 2013).

Most of the studies measure satisfaction with instruments that were constructed for more general purposes, and their psychometric properties were not structurally proven for assessing school users' customer satisfaction (Mossi et al., 2019: 2). Therefore, inconsistent measurement of parents' satisfaction with school is a challenge for comparing studies (Fantuzzo et al., 2006: 144; Mossi et al., 2019).

Generally, the relevant predictors for parents' satisfaction with school of their adolescent children are far from clear. Above all, an in-depth analysis of relevant factors explaining parents' satisfaction during the challenging situation of home schooling during the school lockdown in Spring 2020 is not yet available. There are some descriptive reports on learning processes during home schooling (Andresen et al., 2020; Andrew et al., 2020; Attig et al., 2020; Garbe et al., 2020; Parczewska 2020; Wildemann and Hosenfeld 2020; Wößmann et al., 2020; Zhao et al., 2020), but no study examines predictors of parents' perceptions of school

support during the school lockdown. Descriptive reports show a tendency towards parents' dissatisfaction with school and teachers in Germany during home schooling (Andresen et al., 2020: 17; Attig et al., 2020: 2f). However, parents report disagreement in satisfaction with the support they receive from teachers (Andresen et al., 2020: 17). A similar pattern can be seen for satisfaction with the information on the current situation on the part of the schools (Andresen et al., 2020: 17), implying that parents' satisfaction during home schooling is influenced by various factors. Attig et al. (2020) found that the level of parental satisfaction with information provided by the school depends on the type of secondary school the children attend, with higher levels of satisfaction in academic track schools compared to non-academic track schools (Attig et al., 2020: 4). Interestingly, empirical evidence suggests a unique link between parents' satisfaction and learning outcomes perceived by parents (Attig et al., 2020). More than half of the parents who were very dissatisfied with school support reported that their children were learning less during home schooling, while only 11% of parents with greater satisfaction reported similar learning feedback (Attig et al., 2020: 6ff). However, it is still unclear whether those differences in satisfaction are significant.

Prior research conducted before home schooling due to COVID-19 has reported that parents' satisfaction is significantly affected by diverse factors, such as parents' and children's characteristics (Fantuzzo et al., 2006; Friedman et al., 2006), as well as by the programs and policies implemented by the schools (Bailey et al., 2003; Bassok et al., 2018; Perry et al., 2020). The literature denotes that cooperation between family and school is both a critical dimension of parents' satisfaction (Tuck 1995; Smit et al., 2007; Sheridan et al., 2016) and an indicator of children's cognitive outcomes (Christenson 2003). A good-quality parent-teacher relationship demonstrated a significant (indirect) link with high academic performance (Hughes and Kwok 2007), which in turn influenced parents' satisfaction (Tuck 1995). Tuck (1995) investigated different areas of parental satisfaction in the US using primarily descriptive statistics, and found a unique connection between parents' satisfaction and numerous school factors such as staff quality, school climate, academic programs, social development, and extracurricular activities. During the school lockdown due to COVID-19 in Spring 2020, parents reported in a survey that they would like to obtain more feedback from teachers (Wildemann and Hosenfeld 2020: 26f). This suggests that parent-school cooperation during home schooling may require some improvements.

Another focus of studies on parent satisfaction with school is the investigation of perceptions depending on specific group membership such as ethnicity, socioeconomic background, or the child's special educational needs. With respect to ethnic backgrounds, the results are rather mixed. On the one hand, studies have reported different perceptions of schools across ethnic groups (Erickson et al., 1996; Griffith 2000; Thompson 2003; van Ryzin et al., 2004; Friedman et al., 2006), with a lower level of satisfaction demonstrated by ethnic minority parents than by ethnic majority parents (Friedman et al., 2006). On the other hand, Erickson et al. (1996) did not find any significant differences in satisfaction between white and ethnic minority parents, although non-minority parents showed more favorable attitudes towards teachers than ethnic minority parents did. Teacher effectiveness, school budget, parental involvement, facilities, and equipment are identified as essential aspects of schools reported by ethnic minority parents (Friedman et al., 2006). van Ryzin et al. (2004) found that black and Hispanic parents are less satisfied with public schools in the US than White and Asian parents, although socioeconomic status (SES) was controlled for. Interestingly, the differences diminish if neighborhood and trust are controlled for (van Ryzin et al., 2004: 622). Specifically, in Germany, children's migration backgrounds were reported to be confounded by their parents' SES (Dubowy et al., 2008). However, most studies seem to treat migrants as a homogenous group and do not differentiate between the social status of the families, although social status influences parent-school cooperation more than a migration background (Neumann 2012: 367). There is no report or study on school perceptions during the school lockdown of migrant or ethnic minority parents available yet.

With respect to the relationship between school satisfaction and SES (Griffith 2000; Chambers and Michelson 2020), prior studies document favorable attitudes, especially of parents with low income, towards their neighborhood schools, but weak connections to objective ratings of school performance (Chambers and Michelson 2020). During the first school lockdown in Germany, parents without academic backgrounds demonstrated higher satisfaction with school support than parents with academic backgrounds (Attig et al., 2020), suggesting that school satisfaction is a product of the level of education. However, parents with and without academic backgrounds reported similar levels of satisfaction with respect to the sharing of information and the delivery of learning material by schools (Attig et al., 2020: 4f). Further, since home learning qualities are greatly influenced by SES (Anders et al., 2012; Weinert et al., 2012), it is very likely that during home schooling, educational inequalities become larger as a consequence of distinct social backgrounds (Bol 2020; Dietrich et al., 2020; Lancker and Parolin 2020; Pensiero et al., 2020).

Previous studies revealed that parents of children with special educational needs are less satisfied with schools than parents of children without them (Ginieri-Coccossis et al., 2011; Beck et al., 2014; Perry et al., 2020). Families with children with special educational needs require more assistance from school. Therefore, school characteristics and structures seem to play an important role for this group; that is, the percentage of students with special educational needs in a school is negatively connected to parent satisfaction (Charbonneau et al., 2012: 61; Beck et al., 2014). Parents of children with special educational needs reported some negative experiences with home schooling more frequently (Thorell et al., 2021). However, those differences between families with and without children with special educational needs seem relatively small, indicating that parents in general had negative experiences.

In sum, empirical studies show that a key element of parent satisfaction with school is the cooperation between family and

schools, including both good contact with the teacher and school (Griffith 1997; Griffith 2001) and favorable attitudes towards them (Patrikakou 2016: 115; Berkowitz et al., 2017). However, different effects exist, depending on individual characteristics, not solely from the parent but also from their children, teachers, and schools (Griffith 1997). Thus, these actors' characteristics are assumed to determine parents' school satisfaction during home schooling due to the lockdown.

Theory and Hypothesis

This study uses two theoretical approaches to explain parents' satisfaction with school. First, an economic perspective explains user satisfaction in the educational market (Matland 1995; Fend 2008: 109ff). Currently, schools are increasingly seen as institutions of an educational market with a responsibility to fulfill the needs of their users or customers, and to show good results in comparison to other educational institutions (Bejou 2012). The economic approach strengthens the meaning of a competitive educational market in which customer-oriented offers of schools are in focus (Matland 1995). Parents' satisfaction is predictive of school quality measures (Charbonneau et al., 2012: 61). As parents are a relevant group of school users, schools should have great interest in their satisfaction to maintain high quality (Wilson 2009: 574f; Charbonneau et al., 2012; Peters 2015: 342f). However, schools differ in how they can meet their users' needs (Bejou 2012: 60). As the German school lockdown in Spring 2020 put the educational market in a challenging situation with short-handed major shifts in schooling, the fulfillment of users' needs became a challenge for schools (Giovannella et al., 2020; Verma, 2020). With no time for sound preparation, schools and teachers had to provide students and their families with efficient distance learning materials, online teaching formats, and new exchange opportunities about learning processes at home (Bubb and Jones 2020; König et al., 2020). Notwithstanding, at the beginning of the school lockdown, many German schools were already lagging behind the transformation process regarding digitalization (Fraillon et al., 2019: 37f; König et al., 2020: 610f). Hence, proper family-school exchange and the maintenance of high school satisfaction are especially difficult. It makes sense that schools' and teachers' ability to react to such fast changes during the school lockdown in Spring 2020 would be important for parents' satisfaction (Attig et al., 2020: 5). The better that schools and teachers can support home schooling during the school lockdown *via* remote and digital learning opportunities, the higher the level of parents' satisfaction that can be expected. Therefore, the following hypotheses regarding the effects of school and teacher characteristics on parents' satisfaction with school are formulated:

Hypothesis 1: The offer of distant learning materials and online teaching formats has a positive effect on parents' satisfaction with school during the school lockdown.

Hypothesis 2: Teachers' abilities, especially in terms of digital teaching formats, have a positive effect on parents' satisfaction with school during the school lockdown.

The ecosystem framework is a second theoretical approach referring to the importance of a good family-school relationship in the child's education from a developmental angle (Bronfenbrenner 1992; Christenson 2003: 458ff). Students grow up and learn within different microsystems (e.g., family or school). The relation between those different microsystems (e.g., the interaction between school and family) is reflected by the mesosystem (Bronfenbrenner 1992; Patrikakou 2016: 111). A successful and coherent interaction between the different systems both fosters students' educational development and strengthens parents' satisfaction with school (Friedman et al., 2007; Sheridan et al., 2016: 3). Thus, the better the actual cooperation between the child's two most proximate microsystems (i.e., family and school), the better the mesosystem functions with the abovementioned positive implications for both the child's development and the parents' perception of school. Parents who show more favorable attitudes towards school and teachers have higher general school satisfaction (Tuck 1995), are more likely to become more involved in their children's learning process, and have children with better learning outcomes than parents who show less favorable attitudes (Hughes and Kwok 2007).

The school lockdown due to the COVID-19 pandemic in Spring 2020 can be seen as a critical situation during which the well-experienced interaction between family and school was disrupted in comparison to times of regular schooling with a higher probability. However, empirical evidence has revealed that past family-school cooperation influences future cooperation (Tabellini 2008); therefore, the functioning of the interaction between family and school in the past should have had implications for such interaction during the school lockdown. Accordingly, a high level of parents' satisfaction during the school lockdown was to be expected if there was high satisfaction in the past. Consequently, we formulate the following hypothesis regarding the relationship between parental satisfaction before and during the school lockdown:

Hypothesis 3: A high level of parental satisfaction with school in the past had a positive effect on parents' satisfaction with school during the school lockdown.

One condition for successful parental support of the learning process at home is the existence of relevant home schooling resources (Andrew et al., 2020: 11ff), such as the availability of a certain amount of time to support the child's home schooling; social support from other adults or one's workplace, as an important element of the exosystem (Bronfenbrenner 1992); the parents' own competencies and knowledge (e.g., educational backgrounds or knowledge of the majority language) (Dietrich et al., 2020: 4; Wolter et al., 2020: 2ff); and parents' ability to manage stress due to overloaded role (Spinelli et al., 2020). Pre-COVID literature suggests that the organization of work based on flexibility with time and space (smart working trend) usually comes with higher satisfaction and better work-life balance of parents (Angelici and Profeta 2020). Though, during the school lockdown, working from home and simultaneously supporting home schooling became highly stressful for parents (Lagomarsino et al., 2020: 851f). Parents with lower access to temporal, social, and cultural home schooling relevant resources can support their children's learning to a lesser extent (Bol 2020: 12; Dietrich et al., 2020: 9). Most likely, they both feel more

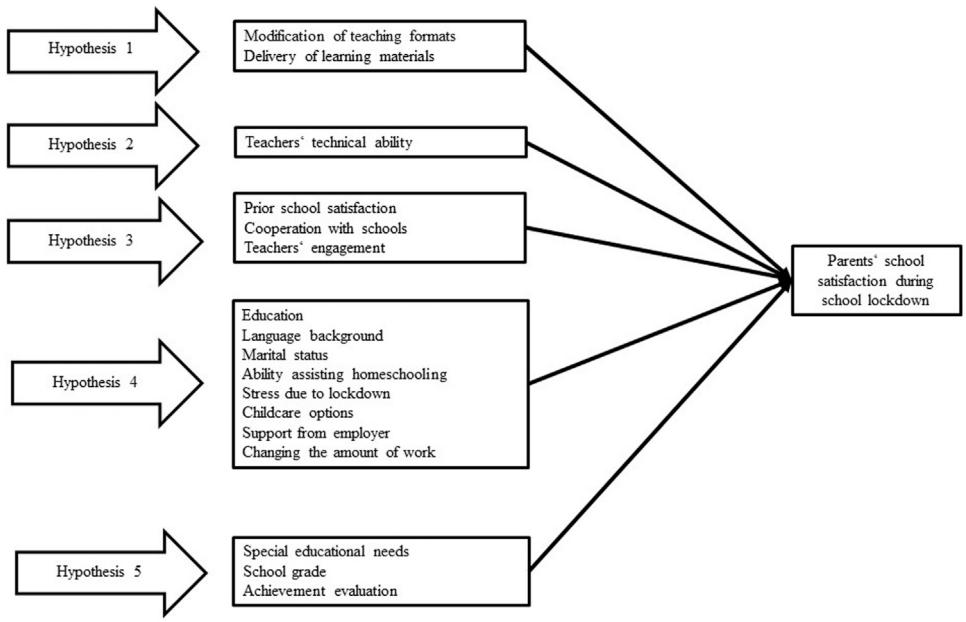

FIGURE 1 | Hypotheses and constructs that relate to them.

overloaded and need more support from the school in facilitating their children's learning than parents with a higher number of pertinent resources. In those cases, the family needs more support from the school to foster the child's educational development. Nevertheless, as descriptive analysis shows, there was reduced teacher-student contact compared to other times, and online teaching was infrequent during the school lockdown in Germany (Wößmann et al., 2020: 32ff). In this respect, "the lack of teachers' assistance" experienced by children during the school lockdown had to be fulfilled by parents. If schools cannot support parents in the way they need, then microsystems do not sufficiently work together (Bronfenbrenner 1992; Christenson 2003: 461f), resulting in a high risk for both parents' satisfaction and children's learning outcomes.

Parents' overload should then become apparent in their lower satisfaction with school. Hence, the following hypothesis regarding parents' resources can be formulated:

Hypothesis 4: Parents' limited access to temporal, social, and cultural home schooling resources had a negative effect on parents' satisfaction with school during the school lockdown.

Further, student characteristics can play a role in parents' satisfaction with school (Griffith 1997; Charbonneau et al., 2012). If a student needs more learning assistance during home schooling, for example, due to special educational needs or poor school performance, the parent has to support the student's learning to a greater extent. In such cases, an overload of the parent during the home schooling phase becomes more likely, and more support from other relevant parties such as school are needed. If the school cannot fulfill these needs, parents may view themselves as single actors in the learning process and therefore develop unfavorable attitudes and perspectives towards school. Hence, the following hypothesis regarding the child's need for learning assistance can be formulated:

Hypothesis 5: The child's comprehensive need for additional learning assistance at home had a negative effect on parents' satisfaction with school during the school lockdown.

Figure 1 presents a brief description about constructs that relate to the hypotheses.

The following sections examine the hypotheses empirically.

DATA AND METHODS

Sample

This study uses the national representative German longitudinal dataset of the National Educational Panel Study (NEPS) Starting Cohort Kindergarten, Version 9.0.0 (Blossfeld et al., 2011). Children were originally recruited 2 years before school entry (first wave) with additional sampling in the first year of elementary school (third wave). In addition to competence measures and children's questionnaires, teachers completed a series of questionnaires, and caregivers were interviewed by phone (CATI) every year. In most of the states in Germany, students will be assigned to a specific school track after their fourth year of elementary school. Therefore, although school was originally applied as a sampling criterion, the nested structure of the data no longer exists if the children enter secondary school (for more details about sampling and the interview procedure, visit www.neps-data.de).

In this study, most of the students were in their eighth year of schooling or in the 10th wave of NEPS. In this unordinary time, there were no additional protocols implemented during data collection since the caregivers were interviewed by phone

(CATI) as in the previous waves. The inclusion criterion was participation in the additional corona survey (May to June 2020) during the school lockdown from March to June 2020. The participants were 1,587 students (mean age of 14.23 and SD = 0.36 with 53% girls) and their parents (mean age of 46.99 and SD = 4.99, and 91% were women), while the number of participants in the first year of elementary school comprised 6,733 children and their parents (third wave). There are two important points that one should bear in mind with respect to the data. First, the data come from different measurement times (second year of schooling or fourth wave to eighth year of schooling or 10th wave. For more details about measurement time points and construct measured **Supplementary Appendix S3**). Second, the drop-out rate is related to socioeconomic status and migration backgrounds (see Würbach et al., 2006), which are also the subject of our analysis.

Measures

In this chapter, the operationalization of relevant constructs is addressed. Parents' school satisfaction was implemented as the dependent variable, while other factors were modeled as predictors.

Parents' School Satisfaction as an Outcome Variable

Parents' school satisfaction has been implemented as a crucial factor for school assessment (Charbonneau et al., 2012). In this regard, parents' perception of school is claimed to serve as a proper assessment of school quality (Charbonneau et al., 2012). Whether this thesis can be implemented for the assessment of satisfaction during school lockdown is rather questionable. Without a doubt, the school lockdown has had an enormous effect on school practices. All active participants in distance learning, including parents and schools, had to adjust to the new situation without sufficient time for preparation. It is unrealistic to expect that schools were comprehensively informed about all potential problems that parents could face during home schooling and vice versa.

In this study, parents' school satisfaction during school lockdown is modeled as a latent variable with three indicators: general school satisfaction, satisfaction with the delivery of information, and satisfaction with learning materials. The first two items were rated on a 4-point scale ranging from 1 = "not good" to 4 = "very good." The last item was rated on an 11-point scale ranging from 0 = "very dissatisfied" to 10 = "very satisfied." The caregivers were administered those three items during the school lockdown between May and June 2020.

Parents' Background Characteristics

Parents' background characteristics were measured at distinct time points due to the structure of missing values. The years of formal education of the interviewed parents, as classified by the Comparative Analysis of Social Mobility in Industrial Nations (CASMIN) (Brauns et al., 2003), was implemented as the operationalization of educational level and measured at their children's fourth year of elementary school. In this study, the CASMIN score of the parents ranged between 9 and 18.

The language background of the interviewed parents was measured in the children's second year of elementary school and recoded into 0 = native German speaker and 1 = non-native German speaker. Information on parents' gender (0 = men and 1 = women) was obtained from data in the children's second year of elementary school, while information about income (ranging between 0 and 10,000,000 per year) was collected during school lockdown. Parents were asked about their marital status during their child's first year of secondary school (fifth year of schooling). The original six-scale item of marital status was recoded into three categories: 0 = married and/or living together, 1 = married and separated, and 2 = single or divorced.

Parents' Perceptions of Schools and Teachers Prior to School Lockdown

Prior to the pandemic, parents were administered various items related to their satisfaction with the elementary school their children were attending, their perception of teachers' engagement, and their perception of cooperation with schools. All three constructs were modeled as latent variables.

Parents' satisfaction with elementary school was reported in their children's final year of elementary school (fourth year of schooling). Hence, this report does not represent satisfaction with the same school during the pandemic, when children were in their eighth year of schooling in secondary school. However, satisfaction may relate to personal characteristics (DeNeve and Harris 1998; Suldo et al., 2015), and we still expect a significant amount of variance to be explained by this construct. The indicators of school satisfaction prior to the pandemic include school time, infrastructure and rooms, fair child treatment, achievement expectations, and general satisfaction. Parents were asked to rate the items that had four categories, ranging from 1 = strongly disagree 4 = to strongly agree.

Both parents' perceptions of teachers' engagement and cooperation with schools were measured in the fifth year of schooling (the children's first year of secondary school). However, there is no possibility to track whether the teachers that parents rated in the fifth year of schooling are similar to teachers that parents evaluated during the official school lockdown. Parents' perceptions of teachers' engagement have seven indicators: professionalism, enjoyment in learning, tedious responsibility, respect for children, the importance of teaching, teachers know the students personally, and parents can rely on the teachers. Parents' perceptions of cooperation with school consists of two indicators: parents are welcome at school, and parents are well-informed. All indicators of both teachers' engagement and cooperation with schools were rated using a 4-point Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (4).

Parents' Perceptions During the School Lockdown

In addition to their satisfaction with school, parents were also administered items about teachers' technical capability, as well as their own capability in assisting their children during distance learning during the school lockdown. Both items were rated on a 4-point scale ranging from 1 = "very insufficient" to 4 = "very sufficient". Parents also reported their assessment of the modifications of teaching formats implemented by the schools,

as well as the delivery of learning materials organized by the schools. The construct of modifications of teaching formats was modeled as a latent variable that originally had six indicators (i.e., online coursework including interactive learning, learning software or apps, learning using reference books, learning through videos, using public-service broadcasting, and virtual learning). Due to low factor loadings, the items learning using reference books and learning through videos were excluded for further analysis. Parents were asked to rate the likelihood of each teaching format during the official school lockdown compared to prior to the pandemic (i.e., the scale ranged from 1 = "much less often" to 5 = "much more often"). To assess the delivery of learning materials, parents were asked to rate the most implemented method used by the schools in delivering learning materials to their students. To enable a more straightforward interpretation, the original scales (including 1 = "using an online platform, an online course, or a school app"; 2 = "virtual conference or video chat with teachers"; 3 = "email"; 4 = "brief messages such as WhatsApp or SMS"; 5 = "phone calls with teachers"; and 6 = "postal letters") were recoded into 3 = "online course" (including the original scales of 1 and 2), 2 = "emails and letters" (including the original scales of 3 and 6), and 1 = "other" (the rest).

Parent-Related Factors During the School Lockdown

To account for parents' risk of overload, other parent-related factors during the pandemic that are considered in this paper are parents' working conditions, such as support from their employer (measured using a 4-point Likert-scale, ranging from 1 = "very bad" to 4 = "very good") and changing the amount of work (0 = "not working at all," 1 = "less," 2 = "similar," 3 = "more"). Parents were also asked to report their stress due to the school lockdown (measured using a 5-point Likert scale ranging from 1 = "strongly disagree" to 5 = "strongly agree"). Further, 6 items regarding childcare options were included in the parents' survey. Specifically, parents were asked to rate whether the following statements were 1 = "correct" or 0 = "not correct": I took care of my child, my partner took care of my child, older siblings helped to take care of my child, someone else helped to take care of my child, my child took care of him/herself, and emergency daycare. Based on these 6 items, a variable called childcare options was built on the assumption that the more childcare options parents had during the school lockdown, the fewer problems they needed to deal with during this particular time.

The Child's Characteristics and School Achievement

The child's characteristics include gender, age, special educational needs status, and school achievements. Parents were administered items about gender and special educational needs status in the second and fourth years of elementary school, respectively. Information about children's birthdays was provided by the school, while information about the school achievement scores (grades) in German and mathematics was obtained from parents' reports in the fifth year of schooling (i.e., the first year in the secondary school tracking system). In the same time, parents were asked to report their perceptions about the school achievement demonstrated by their children. In this regard, parents were administered 5 items as latent indicators: satisfaction with the grades obtained by their child, whether their child could obtain a good school certificate, whether their child was overstrained (recoded), whether their child could obtain a good school certificate and a good job, and whether their child was one of the best in school. All items were rated on a 5-point scale ranging from 1 = "strongly disagree" to 5 = "strongly agree."

TABLE 1 | Factor loadings of indicators of latent variables.

Latent variables and indicators	Factor loadings
Parents' school satisfaction during corona	
General satisfaction	0.88
Delivery information	0.73
Learning materials	0.77
Parents' school satisfaction prior to corona	
School time	0.30
Infrastructure and Rooms	0.39
Fair child treatment	0.77
Achievement expectation	–0.26
General satisfaction	0.80
Perception about cooperation with schools	
Parents are welcome at school	0.76
Parents are well-informed	0.64
Perceptions about teachers' engagement	
Professionalism	0.58
Enjoyment in learning	0.72
Tedious responsibility	–0.46
Respect for children	0.70
Importance of teaching	0.69
Teachers know children personally	0.65
Parents can rely on teachers	0.67
Modifications of teaching formats	
Online course, interactive	0.71
Learning software of apps	0.80
Reference books	0.46
Videos	0.49
Public-service broadcasting	0.57
Virtual learning	0.52
School achievement scores	
Grade in mathematics	0.71
Grade in German	0.76
Perception about achievement evaluation	
Grade obtained by the child	0.71
Child could Obtain good school certificate	0.38
Child is overstrained	0.63
School certificate And good job	0.30
Child is one of the best at school	0.71

Note. N = *1,587. Indicators in italics were excluded from further analysis.*

School Characteristics

In this paper, school characteristics that are recognized as possibly important determinants of parents' expectations include school track ("academic" vs. "non-academic"), state (i.e., 0 = "former West Germany" vs. 1 = "former East Germany") and school funding (consisting of two categories: 0 = "public" and 1 = "other"). The measurement time of each construct is presented in **Supplementary Appendix S3**.

Statistical Analysis

Researchers working with large datasets very likely have to deal with incomplete observations. Accordingly, the methodological literature considers complete case analysis to be generally inappropriate, since

TABLE 2 | Descriptive of parents' characteristics and perceptions.

Variable (min.—max.)	N (% missing)	Weighted M (SD)/% frequency	Variable (min.—max.)	N (% missing)	Weighted M (SD)/% frequency
Dependent variable	—	—	Teachers' engagement (L)	—	—
School satisfaction during lockdown (L)[a]	—	—	Professionalism	1,410 (11)	3.44 (0.51)
General satisfaction	1,586 (<1)	2.20 (0.89)	Enjoyment in learning	1,418 (11)	3.15 (0.56)
Delivery information	1,586 (<1)	2.52 (0.90)	Tedious responsibility	1,422 (10)	1.36 (0.61)
Learning materials	1,585 (<1)	5.64 (2.59)	Respect for children	1,423 (10)	3.39 (0.55)
Parents' characteristics	—	—	Importance of teaching	1,410 (11)	3.17 (0.58)
Education (CASMIN)[b]	1,446 (9)	15.14 (2.15)	Teacher know children personally	1,400 (12)	3.11 (0.58)
Gender of parents	1,485 (6)	90; 10	Parent can rely on teacher	1,413 (11)	3.37 (0.55)
Women; men	—	—	Perception during lockdown	—	—
Income (during lockdown)	1,407 (11)	5,692 (13,639) 91; 9	Teachers' technical capability	1,582 (<1)	2.86 (0.86)
Language	1,467 (8)		Assisting home schooling	1,578 (<1)	1.90 (0.80)
German; non-German	—	—	Delivery learning materials	1,587 (0)	8; 24; 68
Marital status	1,433 (10)	82; 3; 15	Others; emails; online course	—	—
Have partner; separate; single	—	—	Teaching formats (L):	—	—
Perception prior to lockdown	—	—	Online course, interactive	1,551 (2)	3.11 (1.12)
School satisfaction (L)	—	—	Learning software or apps	1,544 (3)	2.92 (0.97)
School time	1,447 (9)	3.66 (0.63)	Reference books	1,579 (<1)	2.93 (0.85)
Infrastructure	1,447 (9)	3.33 (0.74)	Videos	1,578 (<1)	3.74 (0.97)
Fair child treatment	1,448 (9)	3.53 (0.69)	Public-service broadcasting	1,546 (3)	2.72 (0.93)
Achievement expectation	1,448 (9)	1.46 (0.69)	Virtual learning	1,560 (2)	3.11 (1.12)
General satisfaction	1,450 (9)	3.58 (0.65)	Other parents-related factors during lockdown	—	—
Cooperation with school (L)	—	—	Support from employer	1,144 (28)	2.91 (0.90)
Parents are welcome	1,393 (12)	3.30 (0.72)	Changing the amount of work	1,289 (23)	1.87 (0.87)
Parents are well-informed	1,433 (10)	3.41 (0.71)	Stress due to lockdown	1,585 (<1)	2.79 (1.32)
—	—	—	Childcare options	1,579 (<1)	1.49 (0.82)

[a]Note. *L = latent variable.*

[b]*CASMIN = Comparative Analysis of Social Mobility in Industrial Nations (Brauns et al., 2003).*

inferences can be made only about a part of the target population that provides complete responses (Little and Rubin 2020). To address this specific problem, we performed multiple imputations in RStudio Version 1.3.959 (RStudio Team 2020) using the mice Package, Version 3.8.0 (van Buuren and Groothuis-Oudshoorn 2011).

As mentioned above, the outcome variable and several predictors were modeled as latent variables. Confirmatory factor analysis (CFA) was conducted prior to primary analysis to check whether the indicators had suitable psychometric properties. We performed this method in RStudio, Version 1.3.959 (RStudio Team, 2020) using the lavaan Package, Version 0.6–7 (Rosseel 2012). Due to low factor loadings, several indicators were excluded from further analysis (see also **Table 1**).

After ensuring the quality of the latent factors, a structural equation model (SEM) was specified and examined. This analysis was also conducted in RStudio, Version 1.3.959 (RStudio Team, 2020) using the lavaan Package, Version 0.6–7 (Rosseel, 2012). Parents' school satisfaction was regressed on all mentioned predictors. Model fit was evaluated with reference to the RMSEA, SRMR, CFI and TLI, following criteria proposed by Hu and Bentler (1999a).

RESULTS

Descriptive Report

The descriptive report of all relevant variables is presented in **Table 2** and **Table 3**. All variables except for the delivery of learning materials suffer from missing values, with the highest missing rate of 27.91% demonstrated by the construct of support from one's employer. We performed additional analysis using weighted data to address the longitudinal selectivity issue (see **Supplementary Appendix S1** and **Supplementary Appendix S2** for unweighted descriptive report).

Overall, the parents' school satisfaction during the school lockdown yielded modest results, with means of 2.21 and 2.51 (from a maximum of 4 points) for general satisfaction and the delivery of information, respectively. Moreover, satisfaction with learning materials demonstrated a median result with a mean of 5.70 out of a maximum of 10 possible obtained scores. In this regard, parents' school satisfaction seems slightly lower than parents' school satisfaction prior to the pandemic (with a mean score of more than 3 out of a maximum of 4 points). However, since the period between the time points of measurement of the parents' ratings is a few years, parents rated different schools prior to the pandemic (elementary school) and during the school lockdown (secondary school). Therefore, we cannot perform specific analysis to compare these results.

Further, the relatively low proportion of non-native individuals, in addition to the relatively high means of income and educational level, indicates the sample's longitudinal selectivity compared to the originally nationally representative sample (Würbach et al., 2006) in the non-weighted sample. That said, since additional analysis with weighted data was also conducted, concern about drop-out patterns had to be solved.

TABLE 3 | Descriptive of child and school characteristics.

Variable (min—max.)	N (% missing)	Weighted M (SD)/% frequency	Variable	N (% missing)	Weighted M (SD)/% frequency
Child characteristics	—	—	School characteristics	—	—
Gender: Girls; boys	1,485 (6)	50; 50	School track: Academic; non-academic	1,350 (15)	63; 37
Special educational needs: Without; with special educational needs	1,449 (9)	96; 4	State: Former west; former east Germany	1,364 (14)	80; 20
School grade (L)[a] (1–4)	—	—	School funding: Public vs. others	1,431 (10)	88; 12
Grade in mathematics	1,381 (13)	2.02 (0.77)			
Grade in German	1,383 (13)	2.06 (0.72)	—	—	—
Achievement evaluation (L) (1–5)					
Grade obtained by the child	1,316 (17)	4.43 (0.78)	—	—	—
Good school certificate	1,320 (17)	4.75 (0.57)	—	—	—
Child is overstrained	1,320 (17)	4.46 (0.83)	—	—	—
School certificate and good job	1,313 (17)	4.50 (0.70)	—	—	—
Child is one best at school	1,295 (18)	3.54 (1.01)	—	—	—

[a]Note. *L = latent variable.*

During the school lockdown, almost half of the parents rated their capability in assisting with home schooling, as well as teachers' technical capability, as insufficient. At this time, it was also reported that the majority of learning materials were distributed online. Approximately 40% of parents said they obtained good support from their employer and worked a similar amount compared to prior to the pandemic. Perhaps more importantly, approximately one-third of parents reported having stress due to the school lockdown.

Structural Equation Model

Generally, the model fit yielded favorable results with CFI = 0.99, TLI = 0.99, SRMR = 0.06, and RMSEA = 0.04. The ratio between $\chi 2$ and degrees of freedom of 2.33 is located in an acceptable range between 5.00 and 2.00 (Wheaton et al., 1977; Tabacknick et al., 2007; see also; Hooper et al., 2008). The R square yielded a score of 47%, indicating relatively high variance explained by the model.

In the measurement model, several indicators are excluded from further analysis due to low factor loadings (see **Table 1**). Although (Hu and Bentler 1999b; Hu and Bentler 1998) recommended factor loadings between 0.70 and 0.80, the loadings reported by many studies in psychology range between 0.40 and 0.60 (e.g., Church and Burke 1994; Haynes et al., 2000; Ferrando and Chico 2001, see also; Beauducel and Wittmann 2005). Accordingly, Merenda (1997) recommended a lower threshold of 0.30, Hair et al. (2014) recognized factor loadings greater than 0.50 as "salient." This view is shared by several studies that implemented a cutoff of 0.50 as the lowest acceptable factor loading (Afthanorhan and Ahmad 2013). In this study, all factor loadings higher than 0.50 were considered acceptable. Using this cutoff score, three indicators of parents' school satisfaction prior to the pandemic (i.e., school time, infrastructure, and rooms and achievement expectations), one indicator of teachers' engagement prior to the pandemic (i.e., tedious responsibility), two indicators of modifications of teaching formats (i.e., reference books and videos), and two indicators of perceptions of achievement evaluation (i.e., the child could obtain a good school certificate and the child could obtain a good school certificate and a good job) were excluded from further analysis. The factor loadings of all indicators of parents' satisfaction during the pandemic, parents' perceptions of cooperation with schools, and the achievement scores exceed the value of 0.50 and therefore are included in the model.

TABLE 4 | Results of SEM analysis.

	B(*SE*)	*β*
Parents' characteristics		
Gender of parents	−0.00 (0.07)	−0.01
Education (CASMIN)a	−0.00 (0.01)	−0.00
Income	0.00 (0.00)	0.00
Language (ref: native German)	0.02 (0.09)	0.03
Marital status	0.02 (0.04)	0.03
Parents' report prior to corona		
School satisfaction (latent)	0.07 (0.05)	0.06
Cooperation with schools (latent)	0.01 (0.09)	0.00
Teachers' engagement (latent)	0.42** (0.12)	0.21
Parents' report during corona		
Teachers' technical ability	0.39** (0.03)	0.55
Capability assisting home schooling	−0.03 (0.03)	−0.04
Modification of teaching formats (latent)	0.12** (0.03)	0.14
Delivery of learning material	0.13** (0.04)	0.19
Support from employer	0.04 (0.02)	0.05
Changing the amount of work	0.02 (0.03)	0.03
Stress due to lockdown	−0.15** (0.02)	−0.22
Childcare options	0.02 (0.02)	0.02
Child characteristics		
Age	−0.00 (0.06)	−0.00
Gender (ref: boys)	0.09* (0.04)	0.12
Special educational needs (ref: none)	−0.04 (0.14)	−0.01
School achievement scores (latent)	0.06 (0.07)	0.05
Achievement evaluation (latent)	−0.07 (0.07)	−0.06
School characteristics		
School track (ref: academic school track)	0.00 (0.05)	0.00
State (ref: prior west Germany)	−0.01 (0.08)	−0.01
School funding (ref: public school)	0.05 (0.07)	0.07

Note. N = *1,587*. B and ß, regression and standardized regression coefficient; SE, standard error of regression coefficient.

[a]*CASMIN = Comparative Analysis of Social Mobility in Industrial Nations (Brauns et al., 2003).*

** = p < *0.01*, * = p < *0.05*.

In the structural model, all parents and school characteristics yielded insignificant results (see **Table 4**). Parents' perceptions about teachers prior to the school lockdown seems to have made a significant contribution to their school satisfaction during the pandemic (B = 0.42, SE = 0.14, $p < 0.01$), while the effect of parents' satisfaction and perceptions about cooperation with school seem to be negligible. Again, it is worth mentioning that the school satisfaction parents reported prior to and during the school lockdown refer to different schools, while the teachers they rated prior to the school lockdown *could* be the same teachers they rated during the pandemic. As mentioned above, parents' perceptions about school were measured during the fourth year of elementary school, while their views about teachers were collected during the fifth year of schooling (the first year of secondary school). Unfortunately, there is no possibility to track whether parents rated the same teachers during the school lockdown as they did in the fifth year of schooling. In this regard, there is no possibility to compare parents' perceptions about teachers prior to and during the school lockdown. However, the general results suggest that parents are likely to be satisfied during school lockdowns when they have positive attitudes towards teachers prior to school lockdowns.

Compared to other factors, such as the characteristics of various actors (i.e., parents, children, and schools), parents' perceptions during the pandemic seem to have made the highest contribution in explaining parents' satisfaction during school lockdown. The effects of teachers' technical ability (B = 0.39, SE = 0.03, $p < 0.01$), the modification of teaching formats (B = 0.12, SE = 0.03, $p < 0.01$), the delivery of learning materials (B = 0.13, SE = 0.04, $p < 0.01$), and stress due to school lockdown (B = −0.15, SE = 0.02, $p < 0.01$) are statistically meaningful, indicating that these aspects have a significant relationship with parents' satisfaction during school lockdown. These results imply that parents who rated the teachers to have high technical ability or reported less stress during the pandemic were more likely to have higher school satisfaction than those who had other points of view. Parents' satisfaction was also likely to be higher if they observed various modifications of teaching formats to have been done, rather than if they thought too few modifications were implemented by the school. A positive outcome is likely to be obtained if parents reported that the school delivered the learning materials *via* online platforms (e.g., school apps and video conferences) rather than through other means (e.g., emails, letters, telephone, short messages). Further, in accordance with the effect of teachers' engagement prior to the school lockdown, the effect of teachers' technical ability was relatively higher compared to other significant effects. This finding indicates that teachers play a key role in assessing parents' school satisfaction.

Most effects of child characteristics yielded insignificant findings, with gender as the only exception. The outcomes suggest that the parents of girls were more likely to be satisfied during the school lockdown than the parents of boys (B = 0.09, SE = 0.04, $p < 0.05$). The effect of age, special educational needs, achievement scores, and parents' perceptions of their children's achievement cannot be distinguished from those obtained by chance.

DISCUSSION

This paper aims to examine various factors, including parents, teachers', schools', and children's characteristics that were likely to influence parents' school satisfaction during the first German school lockdown in Spring 2020. Using a structural equation model, we tested five hypotheses related to a school's ability to support distance learning (Hypothesis 1), teachers' technical abilities (Hypothesis 2), prior parents' perceptions of school and teachers (Hypothesis 3), parents' resources to assist with home schooling (Hypothesis 4), and children's prior cognitive performance and special educational needs status (Hypothesis 5)

First, our results suggest that teachers' engagement before the school lockdown and teachers' technical ability during the time of home schooling are the most important factors, showing the strongest effects on parents' school satisfaction. This shows that overall, it was mainly the teachers' or schools' characteristics that were relevant for parents' school satisfaction during the lockdown. *Hypothesis 1*, referring to the positive effect of the offer of distance learning materials and teaching formats, *and Hypothesis 2*, referring to teachers' abilities, *can both be confirmed*. In this respect, our data showed that parents were likely to demonstrate high satisfaction if schools implemented more online-based teaching formats (e.g., interactive online courses or learning software) during the school lockdown than before; this seems to have been done by most schools in Germany (see Wolter et al., 2020). Parents also reported high satisfaction if the learning materials were delivered *via* an online platform compared to other methods. There are thus clear preferences towards online teaching and communication during the lockdown. One possible explanation is that other teaching methods may give parents more tasks to do than the online approach (e.g., collecting learning materials from schools means parents should plan for some extra time to go to school compared to receiving learning materials through email or online platforms). In addition, during the pandemic, online delivery has been more secure than other options. Due to the demand for an online approach, teachers' technical capabilities and the school's technical infrastructure become crucial (see also: Eickelmann et al., 2019; Ames et al., 2021). When teachers cannot deal with the *new* teaching method, parents' satisfaction seems to be at risk (with β = 0.55, the highest standardized coefficient in the model). This result suggests that it is imperative that teachers continuously develop their technical abilities, as well as knowledge about information and technology through, for example, participation in further training and education.

Further, we assumed in *Hypothesis 3* that a parent's higher school satisfaction in the past would have a positive effect on satisfaction with school during the lockdown. The results *partly confirm* this expectation: While a higher perception of teachers' engagement in the past had a positive effect (with β = 0.21, the second highest standardized coefficient), the parent's higher school satisfaction from the past shows no effect (please note

that prior school satisfaction refers to elementary instead of secondary school). As the teacher is the direct and often only contact between family and school, it is plausible that parents may primarily think about the teacher's activities when they are asked about their satisfaction with school. Accordingly, a previous study on African-American parents showed a similar outcome: parents' attitudes towards teachers were the strongest indicators of how they rated public schools (Thompson 2003). In addition, Friedman et al. (2007) reported that 41% of the variance in parents' satisfaction was explained by the way schools and teachers inform parents about their children's learning progress. Our results imply that parents' views during the lockdown were affected by their prior knowledge about teachers. This indicates that although parents' satisfaction is multidimensional (Friedman et al., 2007), this construct seems to be relatively stable and is not solely affected by time-specific aspects (even in a very unordinary event such as the school lockdown), such as teachers' technical capabilities or the delivery of learning materials during the lockdown.

In *Hypothesis 4,* we further assumed that parents' lower access to temporal, social, and cultural resources with relevance for home schooling had a negative effect on parents' satisfaction with school during the lockdown. As the parents were not well-equipped with the capabilities needed for home schooling, they may have felt (or come to feel) overburdened. This can lead to lower satisfaction with school. We identified no effects for cultural resources such as "parents' education" and "language" or for further indicators of social support and temporal resources such as "marital status," "childcare options," "support from one's employer," or "changing the amount of work." We therefore cannot *confirm* Hypothesis 4. However, the effect of "stress due to lockdown" yielded a significant outcome (with a standardized coefficient of −0.22, yielding a modest result). This signals that parents' well-being is a key element in their assessment of a school. There is a high likelihood that stressful and overwhelmed parents are indicators of poor school quality. More specifically, parental stress due to the lockdown is related to a school's capability of performing its duties during home schooling.

Finally, we assumed in *Hypothesis 5* that the child's comprehensive need for additional learning assistance at home could more likely make the parents feel overburdened and therefore, the child's characteristics should have an effect on parents' satisfaction with school during the school lockdown as well. Since in the results, no characteristics of the child (apart from a positive effect of the female gender) showed any impact on parents' school satisfaction during the lockdown, *Hypothesis 5 must be denied*. As parents' satisfaction is due to their subjective perceptions (Oliver and Swan 1989; Omar et al., 2009), gender stereotypes seem to play a significant role (see also Friedman et al., 2007). In this respect, favorable attitudes towards girls over boys have been documented in past research (e.g., Zukauskiene et al., 2003; Prinzie et al., 2006).

Overall, the results suggest that various learning offers through the use of modern technology and the knowledge of how to use it are especially important for parents' satisfaction during periods of home schooling. At the macro-level, educational policy in Germany should therefore focus more on improving framework conditions for schools to develop high standards in the use of modern technology. At the lower level, schools should invest in the support of teachers' competencies with regard to the comprehensive use of modern technology.

Limitations

There are a few limitations to this study. While it was possible to use survey data from different measurement time points before the school lockdown, restrictions in the panel-data structure did not allow us to perform longitudinal analysis. The relevant predictors we used in this study were collected at different time points, which means that indicators collected at a time point closer to the survey may show stronger effects. Therefore, it is not possible to compare the different effect sizes directly.

Unfortunately, due to data restrictions, there was no indicator of school satisfaction with the same school before and during the lockdown available. Information on school satisfaction before the pandemic was collected during the children's last year of elementary school, while school satisfaction during the pandemic was collected during the children's time in secondary school. The indicators of school satisfaction before and during the lockdown therefore refer to different schools. Thus, we might underestimate the effect of former school satisfaction.

A further drawback is the lack of data on teachers' or students' evaluations of the school lockdown in Spring 2020. In this study, we could only use parents' reports and perceptions of home schooling processes, teachers' activities, and school characteristics during the lockdown. It would be interesting to examine the perspectives of other relevant actors more in the account, and to explore how they influence parents' school satisfaction.

Future research should hence focus not only on the parents' perspective, but also analyze students' and teachers' perceptions and activities. For example, a focus on factors assessing school quality during challenging times can shed light on the question of what crucial features schools need to get through a crisis well. On behalf of families, future research could focus on the satisfaction and situation of special groups who probably face higher challenges to maintain the learning progress of the students at home (e.g., families with a lower socioeconomic background or a migrant background). In addition, longitudinal analyses should analyze changes in parents' satisfaction with school before, during, and after the school lockdown.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://www.neps-data.de.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

Introduction and theoretical part: TH; methodological and result part: SN; Discussion: TH and SN.

FUNDING

The publication of this article was funded by the Open Access Fund of the Leibniz Association.

ACKNOWLEDGMENTS

This paper uses data from the National Educational Panel Study (NEPS): Starting Cohort Kindergarten, Version 9.0.0, doi:10.5157/NEPS:SC2:9.0.0. From 2008 to 2013, NEPS data were collected as part of the Framework Program for the Promotion of Empirical Educational Research, funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, the NEPS was conducted by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2021.700441/full#supplementary-material

REFERENCES

Afthanorhan, W., and Ahmad, S. (2013). Modelling the Multigroup Moderator-Mediator on Motivation Among Youth in Higher Education Institution towards Volunteerism Program. *Int. J. Scientific Enginieering Res.* 4 (7), S. 5.

Ames, K., Harris, L. R., Dargusch, J., and Bloomfield, C. (2021). 'So You Can Make it Fast or Make it up': K-12 Teachers' Perspectives on Technology's Affordances and Constraints when Supporting Distance Education Learning. *Aust. Educ. Res.* 48 (2), 359–376. doi:10.1007/s13384-020-00395-8

Anders, Y., Rossbach, H.-G., Weinert, S., Ebert, S., Kuger, S., Lehrl, S., et al. (2012). Home and Preschool Learning Environments and Their Relations to the Development of Early Numeracy Skills. *Early Child. Res. Q.* 27 (2), 231–244. doi:10.1016/j.ecresq.2011.08.003

Andresen, S., Lips, A., Möller, R., Rusack, T., Schröer, W., Thomas, S., et al. (2020). *Kinder, Eltern und ihre Erfahrungen während der Corona-Pandemie. Erste Ergebnisse der bundesweiten Studie KiCo*. Hildesheim: Universitätsverlag Hildesheim.

Andrew, A., Cattan, S., Costa-Dias, M., Farquharson, C., Kraftman, L., Krutikova, S., et al. (2020). Learning during the Lockdown. Real-Time Data on Children's Experiences during home Learning. IFS Briefing Note BN288. Institute for Fiscal Studies.

Angelici, M., and Profeta, P. (2020). *Smart-Working: Work Flexibility without ConstraintsConstraints (CESifo Working Paper No. 8165)*. Munich: Munich Society for the Promotion of Economic Research.

Anger, S., Dietrich, H., Patzina, A., Sandner, M., Lerche, A., Bernhard, S., et al. (2020). School Closings during the COVID-19 Pandemic. Findings from German High School Students. *Hg. V. Iab-forum.*, Online verfügbar unter. Available at: https://www.iab-forum.de/en/school-closings-during-the-covid-19-pandemic-findings-from-ger.

Arciuli, J., Emerson, E., and Llewellyn, G. (2019). Adolescents' Self-Report of School Satisfaction: The Interaction between Disability and Gender. *Sch. Psychol.* 34 (2), 148–158. doi:10.1037/spq0000275

Arciuli, J., and Emerson, E. (2020). Type of Disability, Gender, and Age Affect School Satisfaction: Findings from the UK Millennium Cohort Study. *Br. J. Educ. Psychol.* 90 (30), S. 870–885. doi:10.1111/bjep.12344)

Attig, M., Wolter, I., and Nusser, L. (2020), Zufriedenheit in unruhigen Zeiten. Welche Rolle die Kommunikation zwischen Eltern und Schulen während der Schulschließungen gespielt hat. *Einschätzung von Eltern zur Unterstützung durch die Schule und zum Lernerfolg ihrer Kinder während des Lockdowns*, 4. Bamberg: Leibniz-Institut für Bildungsverläufe e.V. (NEPS Corona & Bildung.

Bailey, D., Scarborough, A., and Hebbeler, K. (2003), Families' First Experiences with Early Intervention. National Early Intervention Longitudinal Study. *NEILS Data Report*. Menlo Park: SRI International.

Bassok, D., Markowitz, A. J., Player, D., and Zagardo, M. (2018). Are Parents' Ratings and Satisfaction with Preschools Related to Program Features?. *AERA Open* 4 (1), S. 233285841875995–17. doi:10.1177/2332858418759954

Beauducel, A., and Wittmann, W. W. (2005). Simulation Study on Fit Indexes in CFA Based on Data with Slightly Distorted Simple Structure. *Struct. Equation Model. A Multidisciplinary J.* 12 (1), S. 41–75. doi:10.1207/s15328007sem1201_3

Beck, D. E., Maranto, R., and Lo, W.-J. (2014). Determinants of Student and Parent Satisfaction at a Cyber Charter School. *J. Educ. Res.* 107 (3), S. 209–216. doi:10.1080/00220671.2013.807494

Behnke, A. O., Piercy, K. W., and Diversi, M. (2004). Educational and Occupational Aspirations of Latino Youth and Their Parents. *Hispanic J. Behav. Sci.* 26, S. 16–35. Online verfügbar unter. doi:10.1177/0739986303262329

Bejou, A. (2012). Customer Relationship Management, Exit-Voice-Loyalty, and Satisfaction: The Case of Public Schools. *J. Relationship Marketing* 11 (2), 57–71. doi:10.1080/15332667.2012.686386

Berkowitz, R., Astor, R. A., Pineda, D., DePedro, K. T., Weiss, E. L., and Benbenishty, R. (2017). Parental Involvement and Perceptions of School Climate in California. *Urban Educ.* 56 (3), S. 393–423. doi:10.1177/0042085916685764

Blossfeld, H.-P., Roßbach, H.-G., and Maurice, J. V. (2011). Education as a Lifelong Process. The German National Educational Panel Study (NEPS). *Z. für Erziehungswissenschaft* 14 (2), S. 19–34. Online verfügbar unter. doi:10.1007/s11618-011-0179-2

Bol, T. (2020). *Inequality in Homeschooling during the Corona Crisis in the NetherlandsFirst Results from the LISS Panel (Working Paper)*. Amsterdam: University of Amsterdam.

Brauns, H., Scherer, S., and Steinmann, S. (2003). "The CASMIN Educational Classification in International Comparative Research," in *Hoffmeyer-Zlotnik und Christof Wolf (Hg.): Advances in Cross-National Comparison: A European Working Book for Demographic and Socio-Economic Variables*. Editor H. P. Jürgen (Boston, MA: Springer US), S. 221–244. Online verfügbar unter. doi:10.1007/978-1-4419-9186-7_11

Bronfenbrenner, U. (1992). "Ecological Systems Theory," in *Annals of Child Development. Six Theories of Child Development: Revised Formulations and Current Issues*. Editor R. Vasta (Hg (London: Jessica Kingsley, S), 187–249.

Bubb, S., and Jones, M.-A. (2020). Learning from the COVID-19 home-schooling Experience: Listening to Pupils, Parents/carers and Teachers. *Improving Schools* 23 (3), S. 209–222. doi:10.1177/1365480220958797

Casas, F., Bălţătescu, S., Bertran, I., González, M., and Hatos, A. (2013). School Satisfaction Among Adolescents: Testing Different Indicators for its Measurement and its Relationship with Overall Life Satisfaction and Subjective Well-Being in Romania and Spain. *Soc. Indic Res.* 111 (3), S. 665–681. doi:10.1007/s11205-012-0025-9

Chambers, S., and Michelson, M. R. (2020). School Satisfaction Among Low-Income Urban Parents. *Urban Educ.* 55 (2), S. 299–321. doi:10.1177/0042085916652190

Charbonneau, É., van Ryzin, G. G., and Gregg, G. (2012). Performance Measures and Parental Satisfaction with New York City Schools. *Am. Rev. Public Adm.* 42 (1), S. 54–65. doi:10.1177/0275074010397333

Christenson, S. L. (2003). The Family-School Partnership: An Opportunity to Promote the Learning Competence of All Students. *Sch. Psychol. Q.* 18 (4), S. 454–482. Online verfügbar unter. doi:10.1521/scpq.18.4.454.26995

Church, A. T., and Burke, P. J. (1994). Exploratory and Confirmatory Tests of the Big Five and Tellegen's Three- and Four-Dimensional Models. *J. Pers Soc. Psychol.* 66 (1), S. 93–114. doi:10.1037//0022-3514.66.1.93

Cryer, D., Tietze, W., and Wessels, H. (2002). Parents' Perceptions of Their Children's Child Care: a Cross-National Comparison. *Early Child. Res. Q.* 17 (2), S. 259–277. doi:10.1016/s0885-2006(02)00148-5

DeNeve, K. M., and Cooper, H. (1998). The Happy Personality: A Meta-Analysis of 137 Personality Traits and Subjective Well-Being. *Psychol. Bull.* 124 (2), 197–229. doi:10.1037/0033-2909.124.2.197

Dietrich, H., Patzina, A., and Lerche, A. (2020). Social Inequality in the Homeschooling Efforts of German High School Students during a School Closing Period. *Eur. Societies* 23, S348–S369. Online verfügbar unter. doi:10.1080/14616696.2020.1826556

Dubowy, M., Ebert, S., von Maurice, J., and Weinert, S. (2008). Sprachlich-kognitive Kompetenzen Beim Eintritt in Den Kindergarten. *Z. für Entwicklungspsychologie Pädagogische Psychol.* 40 (3), S. 124–134. doi:10.1026/0049-8637.40.3.124

Dusi, P. (2012). The Family-School Relationships in Europe. A Research Review. *CEPS J.* 2 (1), S. 13–33.

DW (2020). Coronavirus: What Are the Lockdown Measures across Europe?. Online verfügbar unter Available at: https://p.dw.com/p/3Zz2f, zuletzt geprüft am 04.01.2021.

Eickelmann, B., Bos, W., Gerick, J., Goldhammer, F., Schaumburg, H., Senkbeil, M., et al. (2019). *ICILS 2018 #DeutschlandComputer- und informationsbezogene Kompetenzen von Schülerinnen und Schülern im zweiten internationalen Vergleich und Kompetenzen im Bereich Computational Thinking*. New York: MünsterWaxmann.

Erickson, C. D., Rodriguez, M. A., Hoff, M. O., and Garcia, J. C. (1996). *Parent Satisfaction and Alienation from Schools. Examination Ethnic Differences*. Fresno: California State University.

Fantuzzo, J., Perry, M. A., and Childs, S. (2006). Parent Satisfaction with Educational Experiences Scale: A Multivariate Examination of Parent Satisfaction with Early Childhood Education Programs. *Early Child. Res. Q.* 21 (2), S. 142–152. doi:10.1016/j.ecresq.2006.04.002

Fend, H. (2000). Qualität und Qualitätssicherung im Bildungswesen. Wohlfahrtsstaatliche Modelle und Marktmodelle. *Z. für Pädagogik* (Beiheft 41), S. 55–72.

Fend, H. (2008). *Schule gestalten. Systemsteuerung, Schulentwicklung und Unterrichtsqualität*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Ferrando, P. J., and Chico, E. (2001). The Construct of Sensation Seeking as Measured by Zuckerman's SSS-V and Arnett's AISS: a Structural Equation Model. *Personal. Individual Differences* 31 (7), S. 1121–1133. doi:10.1016/s0191-8869(00)00208-7

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., and Duckworth, D. (2019). "Preparing for Life in a Digital World," in *IEA International Computer and Information Literacy Study 2018. International Report* (Cham: Springer).

Friedman, B. A., Bobrowski, P. E., and Geraci, J. (2006). Parents' School Satisfaction: Ethnic Similarities and Differences. *J. Educ. Admin* 44 (5), 471–486. doi:10.1108/09578230610683769

Friedman, B. A., Bobrowski, P. E., and Markow, D. (2007). Predictors of Parents' Satisfaction with Their Children's School. *J. Educ. Adm.* 45 (No. 3), 278–288. doi:10.1108/09578230710747811

Garbe, A., Ogurlu, U., Logan, N., and Cook, P. (2020). COVID-19 and Remote Learning. Experiences of Parents with Children during the Pandemic. *Am. J. Qual. Res.* 4 (3), S. 45–65. doi:10.29333/ajqr/8471

Ginieri-Coccossis, M., Rotsika, V., Skevington, S., Papaevangelou, S., Malliori, M., Tomaras, V., et al. (2011). Quality of Life in Newly Diagnosed Children with Specific Learning Disabilities (SpLD) and Differences from Typically Developing Children. A Study of Child and Parent Reports. *Child. Care Health Development* 39 (4), S. 581–591. doi:10.1111/j.1365-2214.2012.01369.x

Giovannella, C., Passarelli, M., and Persico, D. (2020). Measuring the Effect of the Covid-19 Pandemic on the Italian Learning Ecosystems at the Steady State. A School Teachers' Perspective. *Interact. Des. Arch. J.* 45, S. 1–9.

Griffith, J. (2001). Do satisfied Employees Satisfy Customers? Sopport-Services Staff Morale and Satisfaction Among Public School Administrators, Students, and Parents. *J. Appl. Soc. Psychol.* 31 (No. 8), S. 1627–1658. doi:10.1111/j.1559-1816.2001.tb02744.x

Griffith, J. (2000). School Climate as Group Evaluation and Group Consensus. Student and Parent Perception of the Elementary School Environment. *Elem. Sch. J.* 101 (No. 1), S. 35–61. doi:10.1086/499658

Griffith, J. (1997). Student and Parent Perceptions of School Social Environment: Are They Group Based?. *Elem. Sch. J.* 98 (2), S. 135–150. doi:10.1086/461888

Hair, J. F., Anderson, R. E., Tatham, R. L., and William, C. (2014). *Multivariate Data Analysis*. Harlow: Pearson Education.

Haynes, C. A., Miles, J. N. V., and Clements, K. (2000). A Confirmatory Factor Analysis of Two Models of Sensation Seeking. *Personal. Individual Differences* 29 (5), S. 823–839. doi:10.1016/S0191-8869(99)00235-4

Hooper, Daire., Coughlan, Joseph., and Mullen, Michael. R. (2008). Structural Equation Modelling. Guidlines for Determining Model Fit. *Electron. J. Business Res. Methods* 6 (1), S. 53–60.

Hu, L.-t., and Bentler, P. M. (1998). Fit Indices in Covariance Structure Modeling: Sensitivity to Underparameterized Model Misspecification. *Psychol. Methods* 3 (4), S. 424–453. Online verfügbar unter. doi:10.1037/1082-989X.3.4.424

Hu, L. t., and Bentler, P. M. (1999a). Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria versus New alternativesStructural Equation Modeling. *Struct. Equation Model. A Multidisciplinary J.* 6 (1), S. 1–55. doi:10.1080/10705519909540118

Hu, L. t., and Bentler, P. M. (1999b). Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria versus New alternativesStructural Equation Modeling. *Struct. Equation Model. A Multidisciplinary J.* 6 (1), S. 1–55. Online verfügbar unter. doi:10.1080/10705519909540118

Huebner, M., Spieß, K. C., Siegel, N. A., and Wagner, G. G. (2020). *Wohlbefinden von Familien in Zeiten von Corona: Eltern mit jungen Kindern am stärksten beeinträchtigt*. DIW Wochenbericht Weekly Report No. 30-(31). Available at https://pure.mpg.de/rest/items/item_3245199/component/file_3245200/content

Hughes, J., and Kwok, O. M. (2007). Influence of Student-Teacher and Parent-Teacher Relationships on Lower Achieving Readers' Engagement and Achievement in the Primary Grades. *J. Educ. Psychol.* 99 (1), S. 39–51. Online verfügbar unter. doi:10.1037/0022-0663.99.1.39

Khajehpour, M., and Ghazvini, S. D. (2011). The Role of Parental Involvement Affect in Children's Academic Performance. *Proced. - Soc. Behav. Sci.* 15, S. 1204–1208. doi:10.1016/j.sbspro.2011.03.263

König, J., Jäger-Biela, D. J., and Glutsch, N. (2020). Adapting to Online Teaching during COVID-19 School Closure: Teacher Education and Teacher Competence Effects Among Early Career Teachers in Germany. *EUROPEAN JOURNAL TEACHER EDUCATION* 43 (4), S. 608–622. doi:10.1080/02619768.2020.1809650

Lagomarsino, F., Coppola, I., Parisi, R., and Rania, N. (2020). Care Tasks and New Routines for Italian Families during the COVID-19 Pandemic: Perspectives from Women. *Ital. Sociological Rev.* 10 (3S), S. 847–868.

Lancker, W. V., and Parolin, Z. (2020). COVID-19, School Closures, and Child Poverty. A Social Crisis in the Making. *The Lancet Public Health* 5 (5), S. 243–244. Online verfügbar unter. doi:10.1016/s2468-2667(20)30084-0

Little, R. J. A., and Rubin, D. B. (2020). *Statistical Analysis with Missing Data*. 3rd edition. Hoboken: Wiley Intersience (Wiley Series in Probability and Statistics).

Matland, R. E. (1995). Exit, Voice, Loyalty and Neglect in an Urban School System. *Soc. Sci. Q.* 76 (3), S. 506–512.

Merenda, P. F. (1997). A Guide to the Proper Use of Factor Analysis in the Conduct and Reporting of Research: Pitfalls to Avoid. *Meas. Eval. Couns. Develop.* 30 (3), S. 156–164. doi:10.1080/07481756.1997.12068936

Mossi, P., Ingusci, E., Tonti, M., and Salvatore, S. (2019). QUASUS. A Tool for Measuring the Parents' School Satisfaction. *Front. Psychol.* 10 (13), S. 1–12. doi:10.3389/fpsyg.2019.00013

Neumann, U. (2012). Zusammenarbeit mit Eltern in interkultureller Perspektive. Forschungsüberblick und das Modell der Regionalen Bildungsgemeinschaften. *DDS - Die Deutsche Schule* 104 (4), S. 363–373.

Okun, M. A., Braver, M. W., and Weir, R. M. (1990). Grade Level Differences in School Satisfaction. *Soc. Indic Res.* 22 (4), S. 419–427. doi:10.1007/bf00303835

Oliver, R. L., and Swan, J. E. (1989). Consumer Perceptions of Interpersonal Equity and Satisfaction in Transactions: A Field Survey Approach. *J. Marketing* 53 (2), S. 21–35. doi:10.1177/002224298905300202

Omar, N. A., Nazri, M. A., Abu, N. K., and Omar, Z. (2009). Parents' Perceived Service Quality, Satisfaction and Trust of a Child Care centre. Implication on Loyalty. *Int. Rev. Business Res. Pap.* 5 (5), S. 299–314.

Parczewska, T. (2020). Difficult Situations and Ways of Coping with Them in the Experiences of Parents Homeschooling Their Children during the COVID-19 Pandemic in Poland. *Education* 3-13, S. 1–12. doi:10.1080/03004279.2020.1812689

Patrikakou, Eva. N. (2016). "Contexts of Family–School Partnerships. A Synthesis," in *Family-School Partnerships in Context. 1*. Editors Susan. M. M. Sheridan und Elizabeth and Hg. Kim (New York, Dordrecht, London: Aufl. HeidelbergSpringer International Publishing Switzerland (Research on Family-School Pertnerships), 3, S. 109–120.

Pensiero, N., Kelly, T., and Bokhove, C. (2020): University of Southampton Research Report. Learning Inequalities during the Covid-19 Pandemic. How Families Cope with home-schooling. Online verfügbar unter. University of Southampton. doi:10.5258/SOTON/P0025

Perry, A., Charles, M., Zapparoli, B., and Weiss, J. A. (2020). School Satisfaction in Parents of Children with Severe Developmental Disabilities. *J. Appl. Res. Intellect. Disabilities* 33 (6), 1448–1456. doi:10.1111/jar.12772

Perry, C. L., Kelder, S., and Komro, K. (1993). "The Social World of Adolescents: Families, Peers, Schools, and the Community," in *Susan Millstein, Anne Petersen und Elena Nightingale (Hg.): Promoting the Health of Adolescence* (New York, Oxford: Oxford University Press), S. 73–96.

Peters, S. (2015). "Eltern als Stakeholder von Schule. Erkenntnisse über die Sichtweise von Eltern durch die Hamburger Schulinspektion," in *Marcus Pietsch, Barbara Scholand und Klaudia Schulte (Hg.): Schulinspektion in Hamburg. Der erste Zyklus 2007 - 2013. Grundlagen, Befunde und Perspektiven* (Münster: Waxmann, S), 341–365.

Prinzie, P., Onghena, P., and Hellinckx, W. (2006). A Cohort-Sequential Multivariate Latent Growth Curve Analysis of Normative CBCL Aggressive and Delinquent Problem Behavior: Associations with Harsh Discipline and Gender. *Int. J. Behav. Develop.* 30 (5), S. 444–459. doi:10.1177/0165025406071901

Rosseel, Yves. (2012). Lavaan. An R Package for Structural Equation Modeling and More. Version 0.5-12 (BETA). *J. Stat. Softw.* 48 (2), S. 1–36. Online verfügbar unterAvailable at: https://users.ugent.be/~yrosseel/lavaan/lavaanintroduction.pdf. doi:10.18637/jss.v048.i02

RStudio Team (2020). RStudio. Integrated Development for R. RStudio. Boston: PBC. Available at: http://www.rstudio.com/(Online verfügbar unter.

Sheridan, S. M., Holmes, S. R., Smith, T. E., and Moe, A. L. (2016). "Complexities in Field-Based Partnership Research: Exemplars, Challenges, and an Agenda for the Fiel," in *Family-School Partnerships in Context. 1*. Editors S. M. Sheridan und Elizabeth and Hg. Kim (New York, Dordrecht, London: Aufl. HeidelbergSpringer International Publishing Switzerland (Research on Family-School Pertnerships), 3, S. 1–24.

Smit, F., Driessen, G., Sluiter, R., and Sleegers, P. (2007). Types of Parents and School Strategies Aimed at the Creation of Effective Partnerships. *Int. J. about Parents Educ.* 1 (0), S. 45–52.

Spinelli, M., Lionetti, F., Pastore, M., and Fasolo, M. (2020). Parents' Stress and Children's Psychological Problems in Families Facing the COVID-19 Outbreak in Italy. *Front. Psychol.* 11, S. 1–7. Online verfügbar unter. doi:10.3389/fpsyg.2020.01713

Stull, J. C. (2013). Family Socioeconomic Status, Parent Expectations, and a Child's Achievement. *Res. Educ.* 90 (1), S. 53–67. Online verfügbar unter. doi:10.7227/RIE.90.1.4

Suldo, S. M., R. Minch, D., and Hearon, B. V. (2015). Adolescent Life Satisfaction and Personality Characteristics: Investigating Relationships Using a Five Factor Model. *J. Happiness Stud.* 16 (16), S. 965–983. Online verfügbar unter. doi:10.1007/s10902-014-9544-1

Tabacknick, B. G., Fidell, L. S., and Ullman, J. B. (2007). *Using Multivariate Statistics*. 5th ed.. New York: Pearson. Online verfügbar unter Available at: https://www.pearsonhighered.com/assets/preface/0/1/3/4/0134790545.pdf.

Tabellini, G. (2008). The Scope of Cooperation: Values and Incentives*. *Q. J. Econ.* 123, 905–950. doi:10.1162/qjec.2008.123.3.905

Thompson, G. (2003). Predicting African American Parents' and Guardians' Satisfaction with Teachers and Public Schools. *J. Educ. Res.* 96 (5), S. 277–285. doi:10.1080/00220670309597640

Thorell, L. B., Skoglund, C., Gimenez de la Pena, A., Baeyens, D., Fuermaier, A. B. M., Groom, M. J., et al. (20212021). Parental Experiences of Homeschooling during the COVID-19 Pandemic. Differences between Seven European Countries and between Children with and without Mental Health Conditions. *Eur. Child Adolesc. Psychiatry*, 1–13. doi:10.1007/s00787-020-01706-1

Tuck, K. D. (1995). *Parent Satisfaction and Information. A Customer Satisfaction Survey*. Washington, DC: District of Columbia public schools.

Ulrey, G. L., Alexander, K., Bender, B., and Gillis, H. (1982). Effects of Length of School Day on Kindergarten School Performance and Parent Satisfaction. *Psychol. Schs.* 19 (2), S. 238–242. doi:10.1002/1520-6807(198204)19:2<238::aid-pits2310190217>3.0.co;2-z

van Buuren, S., and Groothuis-Oudshoorn, C. G. (2011). Mice: Multivariate Imputation by Chained Equations in R. *J. Stat. Softw.* 45 (3), 1–67. doi:10.18637/jss.v045.i03

van Ryzin, G. G., Muzzio, D., Immerwahr, S., and Immerwahr, Stephen. (2004). Explaining the Race gap in Satisfaction with Urban Services. *Urban Aff. Rev.* 39 (5), S. 613–632. doi:10.1177/1078087404264218

Verma, G. (2020). COVID-19 and Teaching. Perception of School Teachers on Usage of Online Teaching Tools. *Mukt Shabd J.* 9 (6), S. 2492–2503.

Würbach, A., Zinn, S., and Aßmann, C. (2006): Samples, Weights, and Nonresponse: The Early Childhood Cohort of the National Educational Panel Study (Wave 1 to 3). (NEPS Survey Paper No. 8). Online verfügbar unter Bamberg: Leibnizs Institute for Educational Trajectories. doi:10.5157/NEPS:SP08:1.0

Weber, M., and Huebner, E. S. (2015). Early Adolescents' Personality and Life Satisfaction: A Closer Look at Global vs. Domain-specific Satisfaction. *Personal. Individual Differences* 83, S. 31–36. doi:10.1016/j.paid.2015.03.042

Weinert, S., Ebert, S., Lockl, K., and Kurger, S. (2012). Disparitäten im Wortschatzerwerb. Zum Einfluss des Arbeitsgedächtnisses und der Anregungsqualität in Kindergarten und Familie auf den Erwerb lexikalischen Wissens. *Unterrichtswissenschaft : Z. für Lernforschung* 40, S. 4–25.

Wheaton, B., Muthén, B., Alwin, D. F., and Summers, G. F. (1977). Assessing Reliability and Stability in Panel Models. *Sociological Methodol.* 8, S. 84–136. doi:10.2307/270754

Wildemann, A., and Hosenfeld, I. (2020). "Bundesweite Elternbefragung zu Homeschooling während der Covid 19 Pandemie Erkenntnisse zur Umsetzung des Homeschoolings in Deutschland," in *Hg. v. Institut für Bildung im Kindes- und Jugendalter und Zentrum für Empirische Pädagogische Forschung*.

Wilson, D. (2009). Exit, Voice and Quality in the English Education Sector. *Soc. Polidy Adm.* 43 (6), S. 571–584. doi:10.1111/j.1467-9515.2009.00681.x

Wolter, I., Nusser, L., Attig, M., and Fackler, S. (2020). "Corona-bedingt Schulschließungen - und nun funktioniert alles digital? Wie Eltern mit Kindern in der 8. Klasse die Zeit der Schulschließungen in Deutschland erlebt haben," in *Leibniz-Institut für Bildungsverläufe e.V* (Bericht Nr: NEPS Corona & Bildung), 1.

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Werner, K., and Zierow, L. (2020). *Bildung in der Coronakrise. Wie haben die Schulkinder die Zeit der Schulschließungen verbracht, und welche Bildungsmaßnahmen befürworten die Deutschen? ifo Schnelldienst*, 73. Jahrgang: ifo Institute.

Zhao, Y., Guo, Y., Xiao, Y., Zhu, R., Sun, W., Huang, W., et al. (2020). The Effects of Online Homeschooling on Children, Parents, and Teachers of Grades 1-9

during the COVID-19 Pandemic. *Med. Sci. Monit.* 26, e925591. doi:10.12659/MSM.925591

Zukauskiene, R., Ignataviciene, K., and Daukantaite, D. (2003). Subscales Scores of the Lithuanian Version of CBCL. *Eur. Child Adolesc. Psychiatry* 12 (3), S. 136–143. doi:10.1007/s00787-003-0321-7

Zullig, K. J., Huebner, E. S., and Patton, J. M. (2011). Relationships Among School Climate Domains and School Satisfaction. *Psychol. Schs.* 48 (2), S. 133–145. doi:10.1002/pits.20532

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 17 September 2021
doi: 10.3389/fpsyg.2021.712447

Teacher Expectations and Parental Stress During Emergency Distance Learning and Their Relationship to Students' Perception

Ariana Garrote, Edith Niederbacher, Jan Hofmann, Ilona Rösti and Markus P. Neuenschwander*

School of Education, University of Applied Sciences and Arts Northwestern Switzerland, Brugg, Switzerland

School closures in spring 2020 caused by the COVID-19 pandemic were an unprecedented and drastic event for students, parents, and teachers. The unplanned adaptation of classroom instruction to emergency distance learning was necessary to ensure continued education. In this new learning environment, teachers formed expectations for student academic achievement gains, which in turn affected the opportunities for students to learn. Parents faced new challenges in supporting their children's learning. According to parenting stress models, such drastic events can be a stress factor for parents, which in turn affects their children's adjustment. This study analyzed the extent to which parents and teachers affected the perceptions of students in compulsory school toward distance learning through processes at home (individual level) and at the class level with data from multiple informants. On an individual level, the relationship between parents' perceived threat of COVID-19 and their stress due to distance learning and students' perceived threat of COVID-19 and their perception of distance learning were examined. Students' learning behavior was accounted for as a variable related to their perception of distance learning. At the class level, the explanatory character of teacher expectations and class-aggregated achievement gains were examined. Data on students in grades 4 to 8, parents, and teachers in Switzerland were collected with standardized online questionnaires after the period of school closures. A subsample of 539 students, 539 parents, and 83 teachers was analyzed. The results of multilevel structural equation modeling suggested that students had a more positive perception of distance learning if they were able to learn more autonomously (i.e., more motivated and concentrated than in regular classroom instruction) and if their parents felt less stressed in the distance learning setting. Parents were more stressed if they perceived COVID-19 as a threat. Students' perception of the COVID-19 threat was related to their parents' perception but did not explain students' learning behavior. At the class level, if teachers expected high academic achievement gains in distance learning, the average academic achievement gains of a class were greater. The greater the achievement gains were, the more positive the collective student perception of distance learning was.

Keywords: distance learning, COVID-19 pandemic, school closures, parental stress, teacher expectations, student learning behavior

OPEN ACCESS

Edited by:
Karin Gehrer,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Laura Beckmann,
University of Duisburg-Essen, Germany
Anna Volodina,
University of Bamberg, Germany

****Correspondence:***
Ariana Garrote
ariana.garrote@fhnw.ch

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *20 May 2021*
Accepted: *17 August 2021*
Published: *17 September 2021*

Citation:
Garrote A, Niederbacher E, Hofmann J, Rösti I and Neuenschwander MP (2021) Teacher Expectations and Parental Stress During Emergency Distance Learning and Their Relationship to Students' Perception. Front. Psychol. 12:712447. doi: 10.3389/fpsyg.2021.712447

INTRODUCTION

In response to the COVID-19 pandemic, the learning environments of students around the world drastically changed: school closures were implemented in March 2020, and the classroom as a learning and social environment was dissolved. This unprecedented event had a significant impact on parents and teachers and, as consequence, on the well-being of students (Jiao et al., 2020; Letzel et al., 2020; Spinelli et al., 2020). Socioecological models of development stress the impact of learning environments on the development of children (Bronfenbrenner, 1979). School is the most important learning environment for students in addition to the family (Eccles and Roeser, 2011). These two learning environments (microsystems) are part of the mesosystem of school-aged children and they interact with each other (Bronfenbrenner, 1979). Accordingly, the development and psychological well-being of students is shaped by interactions and experiences with teachers, peers, and parents. In light of the drastic event of emergency distance learning, it is of interest to investigate how students have experienced the new learning environment, mostly shaped by their parents and teachers.

In most European countries, emergency distance learning was established at the beginning of the COVID-19 outbreak to ensure the education of students. The primary objective of this unplanned distance learning was to provide temporary access to education that was reliable and immediately available (Hodges et al., 2020). Many students were able to continue learning remotely from home with the benefit of adapted curricula and access to smart technology and internet bandwidth (Hughes, 2020). However, the short preparation time available to teachers and schools affected the quality of instruction and students' learning opportunities (Andrew et al., 2020; Bonal and González, 2020; Kuhfeld et al., 2020). While in a substantial number of countries schools returned to classroom instruction from May 2020, some countries maintained distance learning, albeit in a more planned and structured manner (UNICEF, 2021). In line with the regulations taken in most countries, the Swiss government implemented school closures between March and May 2020, and all schools in compulsory education provided emergency distance learning arrangements. Long-term effects are expected for both planned and unplanned distance learning. However, studies have shown that unplanned emergency distance learning required a particularly high adaptation of teachers (Hodges et al., 2020) and significantly affected the daily routines of students and their parents (Spinelli et al., 2020; Viner et al., 2020).

Although the COVID-19 pandemic has impacted everyone, children and adolescents are a particularly vulnerable group. Studies have reported parents' observations of emotional and behavioral problems (i.e., anxiety, irritability, distraction) in their children and adolescents due to the pandemic (Jiao et al., 2020; Spinelli et al., 2020). Other studies have found significant effects of emergency distance learning in compulsory education on students' academic achievement gains (Tomasik et al., 2020). However, less is known about students' perspectives and, more specifically, about their perception of emergency distance learning. Gaining knowledge of their perceptions can help in understanding the impact of this unprecedented learning arrangement on their subjective well-being and in predicting the psychological effects of the implementation of distance learning in future emergency situations. In addition, there is a lack of studies on the impact of the COVID-19 pandemic considering multiple informants. Using data from multiple informants allows for a more comprehensive understanding of the situation. Further, it is important to stress that there is a lack of comprehensive theoretical models describing the novel situation of emergency distance learning during pandemics. However, certain theoretical approaches can help in understanding some of the processes involved. In this study, the aim was to evaluate emergency distance learning in compulsory schools from the perspectives of teachers, parents, and students in Switzerland. To this end, the theoretical considerations were based on theoretical models describing processes in which teachers and parents have an impact on their students and their children, respectively.

A central characteristic of distance learning is that students learn at home. In this learning environment, students are mainly supported by their parents in their learning activities. Studies report that the responsibility and involvement of parents in their children's learning are greater in distance learning settings than in regular classroom instruction (Hasler-Waters et al., 2014; Wößmann et al., 2020). Parents organize children's learning, instruct their children, motivate and supervise them (Hasler-Waters et al., 2014). A study conducted in Germany on emergency distance learning, due to COVID-19, has provided further evidence for a greater parental involvement in students' learning activities compared with regular classroom instruction (Wößmann et al., 2020). This increased parental involvement has a downside, as it generated additional stress for parents and conflicts with their children (Wößmann et al., 2020). In addition to the challenges of distance learning, parents and their children were exposed to the threat of the COVID-19 pandemic. The perceived threat can cause negative emotions in individuals, which in turn can influence their social environment (Bavel et al., 2020). For example, the perceived threat of parents may affect their children's perception of threats. In a study from China based on parents' reports, the results indicated that children and adolescents (6 to 18 years old) showed high levels of inattention, clinging, and irritability during the COVID-19 pandemic. In particular, younger children were worried that a family member could contract the coronavirus (Jiao et al., 2020). Whether children's behavior and perception were influenced by their parents' perception remains unanswered. The results show, however, that the COVID-pandemic had an impact on the behavior of children and adolescents. Behavioral changes such as a significant decrease in attention can be expected to affect how well students were able to learn in distance learning during the COVID-19 pandemic.

The extent to which parents had an impact on their children's well-being during the COVID-19 pandemic was investigated in a study conducted in Italy. Parents who had difficulties dealing with stress factors during the lockdown felt more stressed. This stress was found to be related to an increase in problem behavior in children and to have a negative impact on children's well-being (Spinelli et al., 2020). These findings

are in line with theorized models of parenting stress (Belsky, 1984; Abidin, 1992). These models suggest that parenting stress is influenced by relevant stressors, such as live events (e.g., COVID-19 pandemic). Parenting stress in turn affects their children's adjustment and development (Abidin, 1992; Morgan et al., 2002). In this process, family resources such as high socioeconomic status are crucial. Based on this research, the threat of COVID-19 can be regarded as a stressor that affected parental stress levels during distance learning. In this unprecedented learning environment, a low socioeconomic status has been found to be an aggravating factor (Bonal and González, 2020). Parental stress in turn could have affected how students experienced the new learning environment: the more stressed their parents felt, the more negatively they perceived distance learning.

The most important difference between regular classroom instruction and distance learning is the spatial distance between students and teachers (Gorsky and Caspi, 2005). Studies have shown that in distance learning, students can make gains in academic achievement comparable to regular classroom instruction (Cavanaugh, 2001; Cavanaugh et al., 2004; Rice, 2006). Similar to regular classroom instruction, students need teachers' guidance to effectively learn in distance learning arrangements (Lehmann, 2012). However, in distance learning, teachers have reduced possibilities to supervise and scaffold their students (Stevens and Borup, 2015). In this learning environment, students are required to work and learn with a high degree of autonomy. They also need to be able to evaluate themselves and to ask appropriate questions (Offir et al., 2003). This holds especially true for the learning arrangement of emergency distance learning, in which teachers lacked experience and had to adapt their teaching practices in a very short period of time. Research on emergency distance learning, due to the COVID-19 pandemic has shown that teacher–student interactions were reduced (Wößmann et al., 2020) and students' ability to learn autonomously and to be motivated was found to be crucial for students' academic performance (Pelikan et al., 2021). The level of student motivation and ability to learn autonomously thus affected how students experienced emergency distance learning. In addition, not all students had the same learning opportunities and were equally able to learn with a high degree of autonomy. In particular, younger students (Tomasik et al., 2020; Blume et al., 2021), students with migration backgrounds (Manca and Delfino, 2021), and students of families with low socioeconomic status (Bonal and González, 2020) experienced more difficulties in distance learning.

Although students learned at home, teachers continued shaping their learning environment in emergency distance learning based on their expectations of gains in academic achievement. Extensive research on teacher expectations indicates that when teachers have high expectations of achievement for their students, they provide appropriate learning opportunities and support (Brophy and Good, 1970; Babad, 1993; Jussim and Harber, 2005; Wang et al., 2019). In such a learning environment, students are likely to gain academic achievement (Brophy and Good, 1970; Friedrich et al., 2015; Wang et al., 2018). This effect of teacher expectations can be observed on an individual level: students for whom teachers hold high expectations make more gains in academic achievement than students for whom teachers hold low expectations (Kuklinski and Weinstein, 2001; Hinnant et al., 2009). The effects of teacher expectations on student academic outcomes can be explained by mechanisms of self-fulfilling prophecy (Brophy and Good, 1970). Furthermore, teacher expectations have been investigated on a classroom level (Rubie-Davies, 2007; Wang et al., 2019). Studies have shown that students enrolled in classrooms with high expectations from their teachers receive a large number of instructions, explanations, scaffolding, and feedback (e.g., Rubie-Davies, 2007). These teaching practices facilitate learning processes in classroom instruction and have a positive impact on gains in student academic achievement (Rubie-Davies et al., 2006; Hattie and Timperley, 2007). In emergency distance learning, it can be assumed that the effect of teacher expectations was similar, meaning that students were more likely to make gains in academic achievement if they were taught by teachers with high expectations.

In regular classroom instruction, the individual perception of students toward their learning environment is mainly shaped by the context of their class and school (Koth et al., 2008; Modin and Östberg, 2009). How students perceive their learning environment (e.g., school) is, in turn, related to their well-being (Gietz and McIntosh, 2014; Govorova et al., 2020). For instance, the high academic achievement of students has been found to be associated with a positive student perception of school and student satisfaction with the learning environment (DeWitz and Walsh, 2002; Gietz and McIntosh, 2014). This means that students who can perform well perceive their learning environment more positively. Furthermore, classroom-aggregated perceptions have been found to affect students. More specifically, students' collective perception that they had access to practical teacher support with schoolwork was positively related to the well-being of the classroom as a whole (Modin and Östberg, 2009). These results indicate that students enrolled in the same class can have a collective perception of their learning environment. In the context of distance learning, the question arises as to whether a collective student perception of the learning environment can be found considering that there is a spatial distance between students and social interactions among students are reduced (Flottemesch, 2000). However, there are factors in distance learning that could cause the formation of a collective perception. For instance, an exclusive use of asynchronous communication by teachers *via* e-mail (e.g., instructions, feedback) directed to the whole class could reduce individual teacher–student interactions and could result in a homogeneous perception of the learning environment among students taught by the same teacher. However, whether a collective perception of students can be found in the context of distance learning needs to be empirically tested.

In summary, social interaction among students was reduced during distance learning, mostly to interactions with parents and to a lesser extent with teachers (Wößmann et al., 2020). The reduced social interactions with teachers required students to learn more autonomously (Offir et al., 2003; Blume et al., 2021; Pelikan et al., 2021). Students who were able to work

more autonomously performed better in distance learning (Pelikan et al., 2021). Considering that academic self-efficacy is related to student satisfaction with the learning environment (DeWitz and Walsh, 2002), students who performed well in distance learning because they were able to learn autonomously can be expected to have a more positive perception of distance learning (H1). More particularly, native speakers, students of families with a high socioeconomic status, and older students in secondary school were more likely to benefit from distance learning (Bonal and González, 2020; Tomasik et al., 2020; Manca and Delfino, 2021). Furthermore, as students learned from home, the parents' role in their children's learning was greater than in regular classroom instruction (Hasler-Waters et al., 2014; Wößmann et al., 2020). It can be assumed that parents felt stressed by the unprecedented distance learning situation at home. Based on parenting stress models (e.g., Abidin, 1992), the stress perceived by parents due to distance learning was likely to affect students' perception of distance learning (H2), and the perceived threat of COVID-19 was a stressor for parents which affected their stress due to distance learning (H3). In the same vein, a relationship can be assumed between the threat of COVID-19 perceived by parents and students (H4). Considering the impact that the COVID-19 pandemic has had on the behavior of children and adolescents (Jiao et al., 2020; Spinelli et al., 2020), the threat of COVID-19 perceived by students can be expected to explain their learning behavior (H5). Finally, the distance learning situation at home was likely affected by the socioeconomic status of the family and the family language. At the classroom level, it can be assumed, based on an extensive body of research on expectancy effects (e.g., Wang et al., 2018), that teacher expectations of their students' academic achievement were significant variables in the class-aggregated academic achievement of students in distance learning (H6). Finally, in line with findings on self-efficacy, the academic achievement of the class was expected to be related to the collective perception of distance learning by the class (H7).

MATERIALS AND METHODS

Participants and Procedure

In this study, the aim was to describe emergency distance learning during March to May 2020 in four German-speaking cantons of Switzerland. All primary and lower-secondary schools in these cantons with classes in grades 4 to 8 were asked to participate in the study. After school principals gave their consent to participate in the study, teachers could voluntarily enroll in the study. Teachers asked parents to participate in the study and to give their written informed consent for the participation of students. Data were collected retrospectively after the end of school closures with standardized online questionnaires (June/July 2020). School principals, teachers, and parents received personalized links to the questionnaires. Students filled out the questionnaires in school with a personalized link the research team provided *via* the teachers.

A total of 1,321 students (50% female) in 108 classes and 62 schools completed the student questionnaire. More than half of the participants (58%, $n = 875$) were enrolled in grades 4, 5, and 6 of primary school (average age: 11.67 years, $SD = 0.98$). The rest of the participants (42%, $n = 641$) were lower secondary school students in grade 7 and 8 (average age: 14.21 years, $SD = 0.71$). The majority of students indicated the instruction language of German as the language spoken at home (93%), and 7% reported another language as spoken at home.

A total of 875 parents or other reference persons completed the parent questionnaire (86% mothers, 13% fathers, 1% other adults; 58% parents of primary school students, 42% parents of lower secondary school students). Parent data was available for 66% of the students. A high percentage of parents (83%) were born in Switzerland. To measure socioeconomic status, the parents indicated their occupations. The families' average socioeconomic status [Highest International SocioEconomic Index of Occupation Status (HISEI); Ganzeboom and Treiman, 2010] was 65.74 ($SD = 15.61$, $n = 857$).

Furthermore, 108 class teachers (63% female; average age: 41.2 years, $SD = 11.58$, $min = 24$, $max = 65$) from primary school (58%) and lower secondary school (42%) completed the teacher questionnaire. Teachers answered student-specific questions for 1,040 students (79% of the student sample). On average, teachers had 13.70 years of work experience ($SD = 11.02$, $min = 1$, $max = 45$). Teachers had few experiences using different digital technologies (measured by 8 items) in their classes before the period of distance learning ($n = 108$, 5-point Likert scale ranging from never (1) to always (5); $M = 2.01$, $S = 0.46$, $min = 1.25$, $max = 3.13$). Their attitude towards digital technologies regarding their impact on student learning was rather positive ($n = 108$, 6-point Likert scale ranging from strongly disagree (1) to strongly agree (6), Cronbach's $\alpha = 0.87$, $M = 4.50$, $S = 0.69$, $min = 3$, $max = 6$).

For the present study, data from students, parents, and teachers were matched. A subsample of 539 students included data from all three informants (female students = 50%; school level: primary school = 61%, lower secondary school = 39%; family HISEI: $M = 66.06$, $SD = 15.18$; language spoken at home: German = 96%, other home language = 4%). The excluded subsample had data from either one or two informants' perspectives and comprised classes with fewer than three students participating in the study. Response rate analyses, performed with *t*-tests in SPSS 27, showed no significant differences between the subsamples in the study variables, with only one exception: one item measuring students' perception of distance learning ("How was your experience of distance learning?") was rated lower by students, if students, parents, or both did not fill out the questionnaire in comparison to the subsample, where all data were available. The difference was significant, $t(1194.25) = -2.15$, $p = 0.032$, but with a small effect size (Cohen's $d = -0.121$). These results show no or negligible differences in the response rates between the groups. Therefore, a subsample of 539 students nested in 83 classrooms was used in the present study.

Measures

Student Variables

The students' *perception of distance learning* was measured with two items. Students rated the question "How was your experience of distance learning?" on a 5-point-Likert scale with smileys

ranging from very bad (1) to very good (5) as well as the statement "I prefer distance learning over regular classroom instruction" (Huber et al., 2020) on a 6-point Likert scale ranging from strongly disagree (1) to strongly agree (6). The mean value of the two items was $M = 3.53$ ($SD = 1.10$, $min = 1$, $max = 5.5$, $n = 537$).

To measure students' *learning behavior* in the period of distance learning, students were asked to rate two items retrospectively (Item 1: "Compared to regular classroom instruction, I was more motivated."; Item 2: "Compared to regular classroom instruction, I concentrated more") on a 6-point-Likert scale ranging from strongly disagree (1) to strongly agree (6). The mean value of the two items was $M = 3.25$ ($SD = 0.94$, $min = 1$, $max = 5$, $n = 532$).

Students rated the *perceived threat of COVID-19* in the period of distance learning retrospectively with three items (Item 1: "I was worried about contracting the coronavirus myself."; Item 2: "I was worried that someone in my family could contract the coronavirus."; Item 3: "I was worried about the spread of the coronavirus in Switzerland."). Items were adapted from Wong and Tang (2005) and rated on a 6-point-Likert scale ranging from strongly disagree (1) to strongly agree (6). The mean value of the three items was $M = 3.40$ ($SD = 1.22$, $min = 1$, $max = 6$, $n = 539$, Cronbach's $\alpha = 0.77$).

Parent Variables

Parents rated their *perceived threat of COVID-19* in the period of distance learning retrospectively with the same three items as students on a 6-point Likert scale ranging from strongly disagree (1) to strongly agree (6). The mean value of the three items was $M = 3.60$ ($SD = 1.12$, $min = 1$, $max = 6$, $n = 534$, Cronbach's $\alpha = 0.84$).

Parents rated the *stress due to distance learning* retrospectively with three items (Item 1: "I felt an additional burden due to the change to distance learning."; Item 2: "Giving learning support in distance learning took up much additional time."; Item 3: "Giving learning support in distance learning led to additional conflicts with my child.") on a 6-point Likert scale ranging from strongly disagree (1) to strongly agree (6). The mean value of the three was $M = 3.38$ ($SD = 1.30$, $min = 1$, $max = 6$, $n = 498$, Cronbach's $\alpha = 0.81$).

Teacher Variables

Teachers rated their *students' gain in academic achievement* in the period of distance learning retrospectively with one item for each student ("What was the student's achievement gain during the period of distance learning?") on a 6-point -Likert scale ranging from very low (1) to very large (6). The mean value was $M = 3.96$ ($SD = 1.11$, $min = 1$, $max = 6$, $n = 499$). The teacher-rated student academic achievement gains were aggregated on a classroom level, resulting in one value per class.

Teachers rated their *expectation of achievement by the class* retrospectively with a single item "Compared to regular classroom instruction, I expected my students' achievement gain during distance learning to be …" on a six-point Likert scale ranging from much smaller (1) to much larger (6). The mean value was $M = 3.35$ ($SD = 0.77$, $min = 1$, $max = 6$, $n = 83$).

Analytical Strategy

In the first step, descriptive analyses and correlations were calculated using raw data with SPSS 26. The percentage of missing values per variable ranged from 0 to 8%. The data were hierarchically structured, with students nested within classes. Multilevel modeling offers an appropriate framework to examine this hierarchical data structure (Hox et al., 2017). In a second step, the multilevel structure of the data was verified. Classroom differences for the dependent variable (i.e., student perception of distance learning) were examined by calculating intraclass correlations with the R package multilevel 2.6 (Bliese, 2016). The intraclass correlation coefficient (ICC) represents the proportion of the variance explained by the grouping structure (i.e., classroom). Coefficients greater than 10–25% are reported in educational studies (Hedges and Hedberg, 2007). In a third step, multilevel structural equation modeling was performed using the R package lavaan 0.6-5 (Rosseel, 2012; Rosseel et al., 2019). In this analysis step, only clusters with more than two units were included to prevent biased estimates (Maas and Hox, 2005). Fifteen classes with fewer than three students did not fulfill this criterion and were excluded, resulting in a sample of $n = 539$ in 83 classrooms. The average classroom size was of 21.71 students ($min = 10$, $max = 26$). The average number of participants per class was of 6.5 students ($min = 3$, $max = 16$). Multilevel modeling enables the investigation of the extent to which classroom differences (between-classroom variation) in teacher expectations explain the average achievement gain of the classroom and the extent to which the collective perception of distance learning is explained by the average achievement gain in the classroom. At the individual level (within-classroom variation), the extent to which students' perception of distance learning was explained by parents' stress due to distance learning and students' learning behavior was examined. In addition, students' and parents' perceived threat of COVID-19 were included as variables related to students' learning behavior and parents' stress, respectively. Finally, the school level (primary vs. secondary), student gender, family HISEI, and language reported by students as spoken at home (German or other) were included as control variables at the individual level. Family HISEI and home language were included as predictors of all variables related to distance learning (i.e., parental stress due to distance learning, students' learning behavior, and students' perception of distance learning). Student gender and school level were included as predictors of student variables (i.e., students' perceived threat of COVID-19, students' learning behaviors, and students' perception of distance learning). Full information likelihood estimation with robust standard errors (MLR) was employed to make use of all available data. The goodness of fit for the estimated multilevel structural equation model was evaluated using the following indicators: robust chi-square value (χ^2), degrees of freedom (df), level of significance (p), robust comparative fit index (CFI ≥ 0.95), robust root mean square error of approximation (RMSEA ≤ 0.08), and robust standardized root mean square residuals (SRMR ≤ 0.10) at the within and between levels (Schermelleh-Engel et al., 2003).

RESULTS

Bivariate and Intraclass Correlations

Bivariate correlations (**Table 1**) showed that students' perception of distance learning correlated significantly with the threat of COVID-19 perceived by students ($r = -0.12$, $p = 0.005$) but not by parents ($r = 0.01$, $p = 0.757$). The threat of COVID-19 perceived by students correlated significantly with that perceived by parents ($r = 0.25$, $p < 0.001$). Female students reported significantly greater levels of threat from COVID-19 than male students ($r = -0.102$, $p = 0.018$), and primary school students found COVID-19 more threatening than secondary school students ($r = -0.098$, $p = 0.023$). Students' perception of distance learning was positively correlated with their learning behavior ($r = 0.66$, $p < 0.001$) and negatively with parents' perceived stress due to distance learning ($r = -0.15$, $p < 0.001$). Parents' perceived stress was positively correlated with students' gender ($r = 0.103$, $p = 0.017$) and was negatively correlated with students' school level ($r = -0.24$, $p < 0.001$) and family HISEI ($r = -0.11$, $p = 0.014$). This means that parents of male students and primary school students, and with a lower family HISEI, reported higher stress levels than parents of female students and of secondary school students, and with a higher family HISEI. At the class level (not shown in **Table 1**), students' perception of distance learning was not correlated with teachers' expected gains in student achievement ($r = -0.12$, $p = 0.006$). Students' perceptions of distance learning correlated significantly with the average gain in achievement as rated by teachers ($r = 0.18$, $p < 0.001$). A significant correlation was also found between teachers' expectations of achievement for the class and students' average achievement gain ($r = 0.37$, $p < 0.001$).

In the next step, the multilevel structure of the dependent variable (i.e., student perception of distance learning) was tested. The ICC showed that 8% of the total variance in students' experience of distance learning and 13% of the total variance in students' preference for distance learning over regular classroom instruction were explained at the classroom level. Furthermore, 15% of the total variance in teacher-rated gains by students in academic achievement in distance learning was explained by the classroom level. The two items of student perception of distance learning were included as a latent level 2 variable in the multilevel structural equation model. The teacher-rated gains in academic achievement were aggregated as a manifest level 2 variable.

Multilevel SEM

The hypothesized multilevel model fit the data well, $\chi^2(101, n = 453 \text{ in } 78 \text{ clusters}) = 296.5$, $p < 0.001$, CFI = 0.96, RMSEA = 0.07 (90% CI: 0.05, 0.08), $SRMR_{within} = 0.04$, $SRMR_{between} = 0.05$ (**Figure 1**). On the individual level, the results revealed that students' perception of distance learning was significantly explained by their learning behavior ($\beta = 0.65$, $p = 0.001$) and their parents' stress level ($\beta = -0.16$, $p = 0.017$). Students had a more positive perception of distance learning if they were highly concentrated and motivated to learn and if their parents were less stressed in the distance learning setting. The threat of COVID-19 perceived by parents explained the parental stress due to distance learning ($\beta = 0.16$, $p = 0.011$) as well as the threat perceived by students ($\beta = 0.35$, $p < 0.001$). In other words, the more parents perceived COVID-19 as a threat, the more they felt stressed due to distance learning and the more their children felt threatened by COVID-19. However, the threat of COVID-19 that students perceived did not explain their learning behavior ($\beta = 0.09$, $p = 0.211$). Furthermore, the parents of primary school students felt more stressed than the parents of secondary school students ($\beta = -0.34$, $p < 0.001$). Student gender explained the threat of COVID-19 perceived by students ($\beta = -0.13$, $p = 0.016$) and their perceptions of distance learning ($\beta = 0.23$, $p = 0.031$). This means that female students felt more threatened by COVID-19 and experienced distance learning less positively than male students. All standardized factor loadings of the latent variables on level 1 ranged from 0.56 to 0.93. At the class level, teachers' expectations about the achievement gain of their classes during distance learning explained the average achievement gain of the class ($\beta = 0.42$, $p = 0.001$): High expectations positively correlated with high gains in class-aggregated academic achievement. The collective perception of distance learning in the class was in turn explained by the average achievement gain of the class ($\beta = 0.15$, $p = 0.037$). Thus, higher gains in class-aggregated academic achievement were related to more positive collective perceptions of distance learning.

TABLE 1 | Zero-order correlations among study items at the individual level.

S. no.		1	2	3	4	5	6	7	8	9
1.	S: COVID	1								
2.	P: COVID	0.25***	1							
3.	S: Distance learning	−0.12**	0.01	1						
4.	S: Learning behavior	0.08	0.05	0.66***	1					
5.	P: Stress	0.06	0.16***	−0.15***	−0.06	1				
6.	S: Gender	−0.1*	−0.01	0.06	−0.05	0.1*	1			
7.	S: School level	−0.1*	0.01	0.06	−0.07	−0.24***	−0.05	1		
8.	S: Home language	−0.02	0.09	−0.03	−0.04	−0.02	−0.01	−0.05	1	
9.	P: Family HISEI	−0.06	−0.004	−0.003	−0.06	−0.11*	−0.02	0.05	−0.07	1

*N = 531–539; S, student reported; P, parent reported; COVID, perceived threat of COVID-19; Distance learning, perception of distance learning; Stress, perceived stress due to distance learning; Gender: 0 = female, 1 = male; School level: 0 = primary, 1 = secondary; Home language: 0 = instruction language (German), 1 = other language. *p < 0.05 (two-tailed), *p < 0.01 (two-tailed); ***p < 0.001 (two-tailed).*

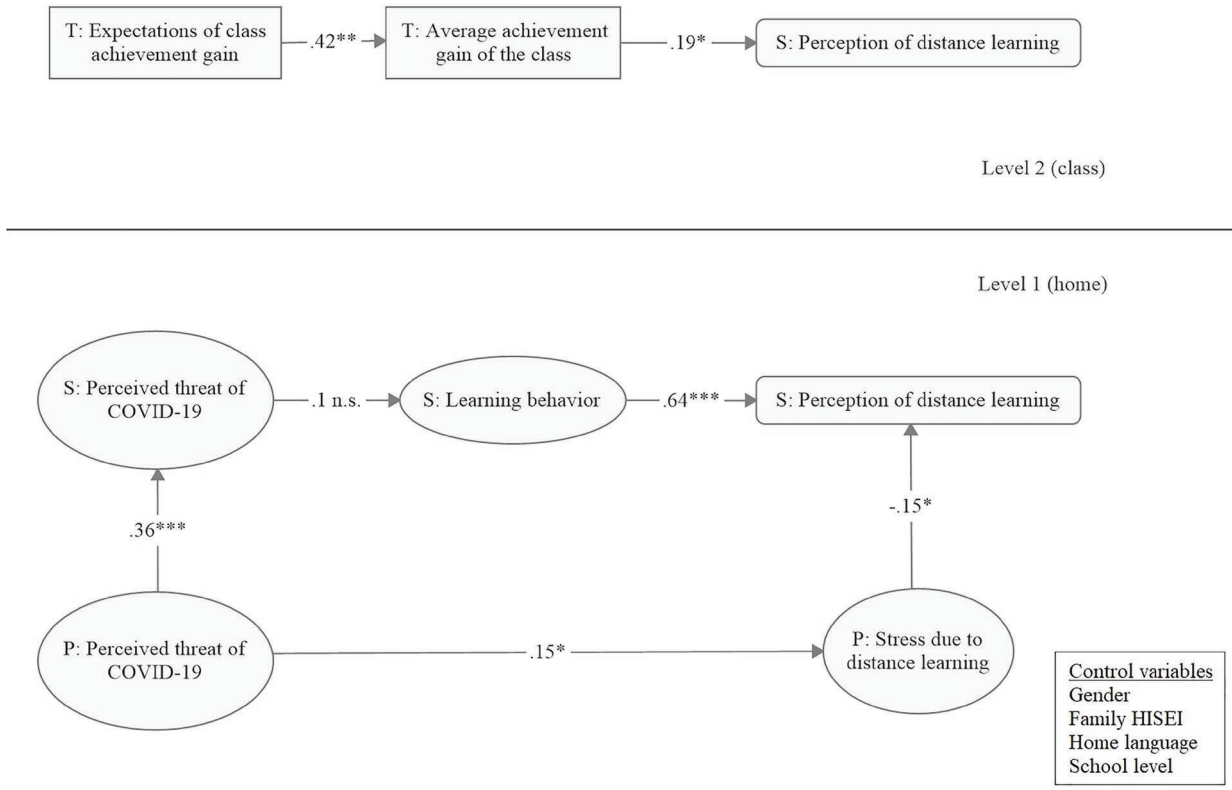

FIGURE 1 | Path diagram of the hypothesized model. S = student, P = parent, T = teacher; standardized coefficients. *$p < 0.05$ (two-tailed), **$p < 0.01$ (two-tailed), ***$p < 0.001$ (two-tailed).

DISCUSSION

The goal of this study was to investigate student perceptions of emergency distance learning during the COVID-19 pandemic in light of their learning environment as shaped by their parents and teachers. Based on empirical research and theoretical models for teacher expectations and parenting stress, the impact of teachers and parents on students' perceptions of distance learning was examined using data from all three informants and controlling for gender, family HISEI, home language, and school level. As important factors in distance learning, students' learning behavior and average achievement gain at the classroom level were accounted for.

As hypothesized, the results showed that students experienced emergency distance learning more positively and preferred it over regular classroom instruction if they were able to learn more autonomously (i.e., more concentrated and motivated) than in regular classroom instruction, even after controlling for gender, family HISEI, home language, and school level. Thus, being able to learn successfully was positively related to students' perception of distance learning. This study extends findings of previous studies on the effects of autonomous learning abilities. Other studies on distance learning and emergency distance learning have stressed the importance of autonomous learning for students' academic success (Offir et al., 2003; Pelikan et al., 2021). These learning abilities are related to self-regulatory competencies, such as planning, goal setting, and self-monitoring, which have an impact on students' academic achievement (Dent and Koenka, 2016). Thus, fostering self-regulated learning is important not only for students in regular classroom instruction but also for their academic success in learning environments that require high autonomy from learners, such as emergency distance learning. In this vein, self-regulated learning has also proven to be highly relevant for the perception of emergency distance learning (Blume et al., 2021).

Contrary to the hypothesis, students' autonomous learning was not related to how threatened students felt by COVID-19. This result could mean that being able to learn autonomously remains unaffected by some stressors and is a resource that can help students to cope with a situation (Smith and Prior, 1995). In this case, fostering this ability is crucial. This would also mean that students lacking such stable learning abilities would be disadvantaged in distance learning arrangements and would require additional support from teachers, such as simple instructions and extensive reinforcement systems (Cavanaugh et al., 2004; Blume et al., 2021). Longitudinal studies on student learning behavior before, during, and after emergency distance learning could shed light on the extent to which stressful life events influence it. In addition, research on the effects of teacher support during emergency distance learning could provide important insights.

Parents' impact on students' experiences in the learning environment of emergency distance learning was confirmed by the significant relationship between parental stress due to distance learning and students' perception of distance learning. The less parents felt stressed, the more positive their children's experience in the novel learning arrangement was and the more they preferred distance learning over regular classroom instruction. Parental stress was in turn explained by parents' perception of the threat of COVID-19. In addition, the threat of COVID-19 perceived by parents was related to their children's perception of COVID-19: the higher parents estimated the threat of COVID-19, the more their children felt threatened by the pandemic. These results are in line with study findings on parental stress in the COVID-19 pandemic (Spinelli et al., 2020). They also confirm parenting stress models suggesting that life events (e.g., COVID-19 pandemic) cause parenting stress that affects the development of children (Abidin, 1992). This means that to facilitate positive experiences for students in distance learning, it is crucial to give support to their parents to cope with the stressors of live events. For instance, a way of dealing with threat is to give a sense of efficacy to deal with the situation (Bavel et al., 2020). With regard to distance learning, more interactions between teachers and students and the provision of more teacher support to students have been suggested as possible strategies to facilitate the learning of students at home (Blume et al., 2021) and to reduce parental stress in the pandemic crisis (Andrew et al., 2020; Wößmann et al., 2020). In addition, researchers in the field of distance learning have stressed the importance of clarifying the role of parents in the support of their children in distance learning settings (Hasler-Waters et al., 2014).

At the classroom level, the analyses revealed – according to the hypothesis – that teacher expectations were positively related to the average achievement gains of their classes. This finding provides evidence for the importance of teacher expectations in emergency distance learning, where teachers had to be highly adaptive to fit their teaching to the new learning environment. This is in line with research findings on teacher expectation profiles (i.e., high-expectations vs. low-expectations teachers) and on the effects of teacher expectations on student outcomes at the classroom level in classroom instruction (Wang et al., 2018, 2019). As predicted, expectations were related to students' gains in academic achievement, and it can be assumed that teaching practices mediated this relationship between teacher expectations and student gains in academic achievement. Thus, similar to the teacher-expectation effects found in regular classroom instruction (Wang et al., 2018, 2019), students who were enrolled in a classroom with a teacher having high expectations were more likely to make gains in academic achievement during emergency distance learning than students enrolled in a class with a teacher holding lower expectations. This further indicates that the differences in terms of academic achievement gains between classes were significant and supports the observation of highly heterogeneous learning opportunities provided to students during school closures (Andrew et al., 2020).

Furthermore, the class-aggregated academic achievement gains were, as hypothesized, positively related to a collective positive perception of distance learning. In other words, students enrolled in a class that performed well during emergency distance learning were more likely to experience distance learning more positively and prefer this learning environment over regular classroom instruction. In these classrooms, teachers probably provided a learning environment that facilitated students' ability to succeed. This mastery experience might have had an impact on collective self-efficacy beliefs at a class level (Bandura, 2000), which in turn positively affected their collective perception of emergency distance learning. This collective perception might have been enhanced through the asynchronous communication of teachers with the class, for example, *via* e-mail correspondence directed to all students jointly. However, this is an untested assumption that needs further examination. In conclusion, expecting that students are able to learn despite the difficulties caused by the pandemic and by the school closures was crucial to students' academic success and well-being in distance learning. To form high expectations in unprecedented situations and with a lack of experience, teachers need technical and pedagogical resources from their schools, local administrations, and governments (Andrew et al., 2020).

This study provides empirical evidence for the mechanisms explaining students' experiences during the implementation of emergency distance learning in spring 2020 using data from multiple informants. However, there are several limitations that need to be considered when interpreting the results. The first limitation concerns the cross-sectional design. All variables were collected in one wave. Unidirectional paths in the SEM were specified solely based on the theoretical rationale, and causality cannot be inferred. Longitudinal data would strengthen the significance of the results. A second limitation concerns data collection. All data were collected after the period of school closures in May 2020. Collecting data at the time of school closure was not possible as schools were busy implementing emergency distance learning. Thus, teachers, parents, and students completed their questionnaires retrospectively. As a result, information may be distorted. The third limitation is related to the variables at the classroom level. Teacher expectation was a single-item construct, and average classroom achievement was included in the structural equation model as a class-aggregated variable. Latent variables would have improved the validity of these constructs. Fourth, student gains in academic achievement were rated by teachers and not assessed with standardized tests. While teachers are very well suited to provide information on their students' achievement gains, there is a risk that their estimations might be biased by student characteristics, such as their socioeconomic status (Wang et al., 2018). The fifth limitation concerns the COVID-19 specific variables and scales (i.e., parent stress, COVID threat, student perception of distance learning, student learning behavior). All scales were created with a limited number of items and were new, hence not validated. This was due to the short preparation time for the study, the novelty of the situation, and constraints during the period of assessment

(i.e., short time period, reduced time capacities of participants). A sixth limitation is related to the control variables of socioeconomic status and home language. The percentage of families with low socioeconomic status and of families with a home language other than German was very low. This could explain why no significant relationships were found between these control variables and the study variables. The limitation section concludes with a sixth limitation on dealing with missing values. Only cases with complete information from students, parents, and teachers were analyzed; thus, the sample size was reduced to approximately one-third of the original study sample. Multilevel multiple imputations with the R package mitml 0.4-1 (Grund et al., 2016) did not result in satisfactory imputed datasets because of a large fraction of missing information (FMI). The FMI represents the loss of information due to missingness, while accounting for the amount of information retained in other variables within the data set (Madley-Dowd et al., 2019). Further studies including multiple respondents with larger samples are needed to support the use of the suggested theoretical models in emergency distance learning.

CONCLUSION

To conclude, students' perception of emergency distance learning was on one hand affected by how autonomously they could learn and by whether they were academically successful. Specifically, students with teachers holding high expectations were more likely to benefit from distance learning. This finding highlights the importance of teacher expectations, academic performance, and success even in unprecedented learning arrangements, such as emergency distance learning. On the other hand, students' perception of the distance learning environment was related to parental stress. To ensure students' well-being in case of the future implementation of emergency distance learning, it is crucial to reduce parental stress with social and material support from teachers, schools, and local governments. In addition, teachers need technical and pedagogical support so they can heighten their expectations of gains in academic achievement and provide students with a stimulating distance learning environment that enables them to effectively learn with greater autonomy.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AG and MN conceptualized the research. AG performed the statistical analyses. AG, EN, and JH wrote the first draft. MN contributed to the first draft, supervised the analyses, revised, and helped to finalize the manuscript. All authors organized and conducted the data collection and finalized the manuscript.

FUNDING

This project was funded by the Swiss cantons of Aargau, Basel-Stadt, Basel-Landschaft, and Solothurn.

REFERENCES

Abidin, R. R. (1992). The determinants of parenting behavior. *J. Clin. Child Psychol.* 21, 407–412. doi: 10.1207/s15374424jccp2104_12

Andrew, A., Cattan, S., Dias, M. C., Farquharson, C., Kraftman, L., Krutikova, S., et al. (2020). Inequalities in children's experiences of home learning during the COVID-19 lockdown in England. *Fisc. Stud.* 41, 653–683. doi: 10.1111/1475-5890.12240

Babad, E. (1993). Teachers' differential behavior. *Educ. Psychol. Rev.* 5, 347–376. doi: 10.1007/BF01320223

Bandura, A. (2000). Exercise of human agency through collective efficacy. *Curr. Dir. Psychol. Sci.* 9, 75–78. doi: 10.1111/1467-8721.00064

Bavel, J. J. V., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., et al. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nat. Hum. Behav.* 4, 460–471. doi: 10.1038/s41562-020-0884-z

Belsky, J. (1984). The determinants of parenting: a process model. *Child Dev.* 55, 83–96. doi: 10.2307/1129836

Bliese, P. (2016). Multilevel modeling in R: a brief introduction to R, the multilevel package, and the Nlme package. Available at: https://cran.r-project.org/doc/contrib/Bliese_Multilevel.pdf (Accessed February 19, 2021).

Blume, F., Schmidt, A., Kramer, A. C., Schmiedek, F., and Neubauer, A. B. (2021). Homeschooling during the SARS-CoV-2 pandemic: the role of students' trait self-regulation and task attributes of daily learning tasks for students' daily self-regulation. *Z. Erzieh.* 24, 367–391. doi: 10.1007/s11618-021-01011-w

Bonal, X., and González, S. (2020). The impact of lockdown on the learning gap: family and school divisions in times of crisis. *Int. Rev. Educ.* 66, 635–655. doi: 10.1007/s11159-020-09860-z

Bronfenbrenner, U. (1979). *The Ecology of Human Development: Experiments by Nature and Design.* Cambridge MA: Harvard University Press.

Brophy, J. E., and Good, T. L. (1970). Teachers' communication of differential expectations for children's classroom performance: some behavioral data. *J. Educ. Psychol.* 61, 365–374. doi: 10.1037/h0029908

Cavanaugh, C. S. (2001). The effectiveness of interactive distance education technologies in K-12 learning: a meta-analysis. *Int. J. Educ. Telecommun.* 7, 73–88.

Cavanaugh, C. S., Gillan, K. J., Kromrey, J., Hess, M., and Blomeyer, R. (2004). *The Effects of Distance Education on K-12 Student Outcomes: A Meta-Analysis.* Naperville: North Central Regional Educational Lab.

Dent, A. L., and Koenka, A. C. (2016). The relation between self-regulated learning and academic achievement across childhood and adolescence: a meta-analysis. *Educ. Psychol. Rev.* 28, 425–474. doi: 10.1007/s10648-015-9320-8

DeWitz, S. J., and Walsh, W. B. (2002). Self-efficacy and college student satisfaction. *J. Career Assess.* 10, 315–326. doi: 10.1177/10672702010003003

Eccles, J. S., and Roeser, R. W. (2011). Schools as developmental contexts during adolescence. *J. Res. Adolesc.* 21, 225–241. doi: 10.1111/j.1532-7795.2010.00725.x

Flottemesch, K. (2000). Building effective interaction in distance education: a review of the literature. *Educ. Technol.* 40, 46–51.

Friedrich, A., Flunger, B., Nagengast, B., Jonkmann, K., and Trautwein, U. (2015). Pygmalion effects in the classroom: teacher expectancy effects on students' math achievement. *Contemp. Educ. Psychol.* 41, 1–12. doi: 10.1016/j.cedpsych.2014.10.006

Ganzeboom, H. B. G., and Treiman, D. J. (2010). *International Stratification and Mobility File: Conversion Tools*. Amsterdam: Department of Social Research Methodology.

Gietz, C., and McIntosh, K. (2014). Relations between student perceptions of their school environment and academic achievement. *Can. J. Sch. Psychol.* 29, 161–176. doi: 10.1177/0829573514540415

Gorsky, P., and Caspi, A. (2005). A critical analysis of transactional distance theory. *Q. Rev. Dist. Learn.* 6, 1–11.

Govorova, E., Benítez, I., and Muñiz, J. (2020). How schools affect student well-being: a cross-cultural approach in 35 OECD countries. *Front. Psychol.* 11:431. doi: 10.3389/fpsyg.2020.00431

Grund, S., Lüdtke, O., and Robitzsch, A. (2016). Multiple imputation of multilevel missing data: an introduction to the R package pan. *SAGE Open* 6, 1–17. doi: 10.1177/2158244016668220

Hasler-Waters, L., Menchaca, M. P., and Borup, J. (2014). "Parental involvement in K-12 online and blended learning" in *Handbook of Research on K-12 Online and Blended Learning*. eds. K. Kennedy and R. E. Ferdig, 303–324.

Hattie, J., and Timperley, H. (2007). The power of feedback. *Rev. Educ. Res.* 77, 81–112. doi: 10.3102/003465430298487

Hedges, L. V., and Hedberg, E. C. (2007). Intraclass correlation values for planning group-randomized trials in education. *Educ. Eval. Policy Anal.* 29, 60–87. doi: 10.3102/0162373707299706

Hinnant, J. B., O'Brien, M., and Ghazarian, S. R. (2009). The longitudinal relations of teacher expectations to achievement in the early school years. *J. Educ. Psychol.* 101, 662–670. doi: 10.1037/a0014306

Hodges, C., Moore, C., Lockee, B., Trust, T., and Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educ. Rev.* 27, 1–9.

Hox, J. J., Moerbeek, M., and van de Schoot, R. (2017). *Multilevel Analysis, 3rd Edn*. New York, NY: Routledge.

Huber, S. G., Günther, P. S., Schneider, N., Helm, C., Schwander, M., Schneider, J., et al. (2020). *COVID-19 und Aktuelle Herausforderungen in Schule und Bildung*. Münster, New York: Waxmann Verlag GmbH.

Hughes, C. (2020). Some implications of COVID - 19 for remote learning and the future of schooling. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000373229 (Accessed February 19, 2021).

Jiao, W. Y., Wang, L. N., Liu, J., Fang, S. F., Jiao, F. Y., Pettoello-Mantovani, M., et al. (2020). Behavioral and emotional disorders in children during the COVID-19 epidemic. *J. Pediatr.* 221, 264–266. doi: 10.1016/j.jpeds.2020.03.013

Jussim, L., and Harber, K. D. (2005). Teacher expectations and self-fulfilling prophecies: knowns and unknowns, resolved and unresolved controversies. *Personal. Soc. Psychol. Rev.* 9, 131–155. doi: 10.1207/s15327957pspr0902_3

Koth, C. W., Bradshaw, C. P., and Leaf, P. J. (2008). A multilevel study of predictors of student perceptions of school climate: the effect of classroom-level factors. *J. Educ. Psychol.* 100, 96–104. doi: 10.1037/0022-0663.100.1.96

Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E., and Liu, J. (2020). Projecting the potential impact of covid-19 school closures on academic achievement. *Educ. Res.* 49, 549–565. doi: 10.3102/0013189X20965918

Kuklinski, M. R., and Weinstein, R. S. (2001). Classroom and developmental differences in a path model of teacher expectancy effects. *Child Dev.* 72, 1554–1578. doi: 10.1111/1467-8624.00365

Lehmann, B. (2012). "Aus der Ferne Lehren und Lernen: Zu den Grundzügen eines aussergewöhnlichen Bildungsformats," in *Bildungsberatung im Fernlernen: Beiträge aus Wissenschaft und Praxis*. ed. A. Fogolin (Bielefeld: Bertelsmann), 19–41.

Letzel, V., Pozas, M., and Schneider, C. (2020). Energetic students, stressed parents, and nervous teachers: a comprehensive exploration of inclusive homeschooling during the COVID-19 crisis. *Open Educ. Stud.* 2, 159–170. doi: 10.1515/edu-2020-0122

Maas, C. J. M., and Hox, J. J. (2005). Sufficient sample sizes for multilevel modeling. *Methodology* 1, 86–92. doi: 10.1027/1614-2241.1.3.86

Madley-Dowd, P., Hughes, R., Tilling, K., and Heron, J. (2019). The proportion of missing data should not be used to guide decisions on multiple imputation. *J. Clin. Epidemiol.* 110, 63–73. doi: 10.1016/j.jclinepi.2019.02.016

Manca, S., and Delfino, M. (2021). Adapting educational practices in emergency remote education: continuity and change from a student perspective. *Br. J. Educ. Technol.* 2021, 1–20. doi: 10.1111/bjet.13098

Modin, B., and Östberg, V. (2009). School climate and psychosomatic health: a multilevel analysis. *Sch. Eff. Sch. Improv.* 20, 433–455. doi: 10.1080/09243450903251507

Morgan, J., Robinson, D., and Aldridge, J. (2002). Parenting stress and externalizing child behaviour. *Child Family Social Work* 7, 219–225. doi: 10.1046/j.1365-2206.2002.00242.x

Offir, B., Barth, I., Lev, Y., and Shteinbok, A. (2003). Teacher-student interactions and learning outcomes in a distance learning environment. *Internet High. Educ.* 6, 65–75. doi: 10.1016/S1096-7516(02)00162-8

Pelikan, E. R., Lüftenegger, M., Holzer, J., Korlat, S., Spiel, C., and Schober, B. (2021). Learning during COVID-19: the role of self-regulated learning, motivation, and procrastination for perceived competence. *Z. Erzieh.* 24, 393–418. doi: 10.1007/s11618-021-01002-x

Rice, K. L. (2006). A comprehensive look at distance education in the K-12 context. *J. Res. Technol. Educ.* 38, 425–448. doi: 10.1080/15391523.2006.10782468

Rosseel, Y. (2012). Lavaan: an R package for structural equation modeling. *J. Stat. Softw.* 48, 1–36. doi: 10.18637/jss.v048.i02

Rosseel, Y., Jorgensen, T. D., Oberski, D., Bymes, J., Vanbrabant, L., Savalei, V., et al. (2019). Package 'Lavaan'. Latent variable analysis. Version 0.6-5. Available at: https://lavaan.ugent.be/tutorial/tutorial.pdf (Accessed April 3, 2020).

Rubie-Davies, C. (2007). Classroom interactions: exploring the practices of high- and low-expectation teachers. *Br. J. Educ. Psychol.* 77, 289–306. doi: 10.1348/000709906X101601

Rubie-Davies, C., Hattie, J., and Hamilton, R. (2006). Expecting the best for students: teacher expectations and academic outcomes. *Br. J. Educ. Psychol.* 76, 429–444. doi: 10.1348/000709905X53589

Schermelleh-Engel, K., Moosbrugger, H., and Müller, H. (2003). Evaluating the fit of structural equation models: test of significance and descriptive goodness-of-fit measures. *Methods Psychol. Res. Online* 8, 23–74.

Smith, J., and Prior, M. (1995). Temperament and stress resilience in school-age children: a within-families study. *J. Am. Acad. Child Adolesc. Psychiatry* 34, 168–179. doi: 10.1097/00004583-199502000-00012

Spinelli, M., Lionetti, F., Pastore, M., and Fasolo, M. (2020). Parents' stress and children's psychological problems in families facing the COVID-19 outbreak in Italy. *Front. Psychol.* 11:1713. doi: 10.3389/fpsyg.2020.01713

Stevens, M., and Borup, J. (2015). "Parental engagement in online learning environments: a review of the literature," in *Exploring Pedagogies for Diverse Learners Online (Advances in Research on Teaching)*. eds. M. Stevens and J. Borup (Bingley: Emerald Group Publishing Limited), 99–119.

Tomasik, M. J., Helbling, L. A., and Moser, U. (2020). Educational gains of in-person vs. distance learning in primary and secondary schools: A natural experiment during the COVID-19 pandemic school closures in Switzerland. *Int. J. Psychol.* 56, 566–576. doi: 10.1002/ijop.12728

UNICEF (2021). COVID-19 and school closures: one year of education disruption. Available at: https://data.unicef.org/resources/one-year-of-covid-19-and-school-closures/ (Accessed February 19, 2021).

Viner, R. M., Russell, S. J., Croker, H., Packer, J., Ward, J., Stansfield, C., et al. (2020). School closure and management practices during coronavirus outbreaks including COVID-19: a rapid systematic review. *Lancet Child Adolesc. Health* 4, 397–404. doi: 10.1016/S2352-4642(20)30095-X

Wang, S., Rubie-Davies, C. M., and Meissel, K. (2018). A systematic review of the teacher expectation literature over the past 30 years. *Educ. Res. Eval.* 24, 124–179. doi: 10.1080/13803611.2018.1548798

Wang, S., Rubie-Davies, C. M., and Meissel, K. (2019). Instructional practices and classroom interactions of high and low expectation teachers in China. *Soc. Psychol. Educ.* 22, 841–866. doi: 10.1007/s11218-019-09507-4

Wong, C. Y., and Tang, C. S. K. (2005). Practice of habitual and volitional health behaviors to prevent severe acute respiratory syndrome among Chinese adolescents in Hong Kong. *J. Adolesc. Health* 36, 193–200. doi: 10.1016/j.jadohealth.2004.02.024

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Zierow, L., and Werner, K. (2020). Bildung in der Coronakrise: Wie haben die Schulkinder Die Zeit der Schulschließungen Verbracht, und welche Bildungsmaßnahmen Befürworten die Deutschen? *Ifo Schnelldienst* 73, 25–39.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 05 October 2021
doi: 10.3389/fpsyg.2021.728408

"You Are Not Alone"–Opportunities and Challenges for University Students' Collaborative Engagement When Dealing With Online Information About COVID-19

Elisabeth Mayweg-Paus[1]†, Maria Zimmermann[1]† and Claudia Lefke[2]*

[1] Digital Knowledge Management in Higher Education, Institute for Educational Studies, Department of Educational Studies, Humboldt-University of Berlin, Berlin, Germany, [2] University of Duisburg-Essen, Duisburg-Essen, Germany

OPEN ACCESS

Edited by:
Sina Fackler,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Silvio Ionta,
University of Lausanne, Switzerland
Ya Ping (Amy) Hsiao,
Tilburg University, Netherlands

***Correspondence:**
Elisabeth Mayweg-Paus
elisabeth.mayweg@hu-berlin.de

†These authors share first authorship

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: 21 June 2021
Accepted: 16 September 2021
Published: 05 October 2021

Citation:
Mayweg-Paus E, Zimmermann M and Lefke C (2021) "You Are Not Alone"–Opportunities and Challenges for University Students' Collaborative Engagement When Dealing With Online Information About COVID-19. Front. Psychol. 12:728408. doi: 10.3389/fpsyg.2021.728408

In view of the COVID-19 pandemic, students had to cope with the challenging situation of handling a vast amount of potentially conflicting online information while staying informed. Reading conflicting scientific information has been shown to require cognitive effort for one to integrate it successfully, but reading such information during a crisis–such as the COVID-19 pandemic–may cause additional emotional stress, as students also had to cope with critical aspects of the pandemic (e.g., physical distancing and uncertainty). Different studies have indicated that in crises, stress can be relieved by seeking online social support (as a coping strategy). Similarly, working together (as collaborative learning) can also help people more critically discuss information on a cognitive level. Based on the approaches of online collaborative learning and online social support seeking, we were interested in whether an individual vs. collaborative communication setting would lead to any differences in students' cognitive as well as emotional engagement with conflicting information about COVID-19. In a 2 × 2 mixed design, N = 109 education science students were exposed to two conflicting texts regarding COVID-19 testing that contained current scientific information. The online experiment was conducted in Germany in April 2020, which was the beginning of lockdown in that country. After reading the two texts, participants were asked to reflect on their engagement with the conflicting information either individually (individual group, n = 49) or via chat collaboratively (collaboration group, n = 60 in 30 dyads). With respect to participants' written reflections (content-analyzed regarding cognitive as well as emotional engagement), participants in the collaborative group, compared to those in the individual group, more often discussed the pandemic in general and less often engaged emotionally when discussing the evidence from texts. All participants reported higher perceived information overload, lower self-efficacy in sourcing information about COVID-19, and higher active coping strategies after the reflection task compared to

before reading the information, with no significant differences between the collaborative and individual groups. We discuss these findings regarding any opportunities and challenges that arise in online collaboration between students for cognitive and emotional engagement when handling conflicting information about COVID-19.

Keywords: online engagement with scientific information, collaborative learning, information about COVID-19, cognitive and emotional engagement with online information, online support seeking, information seeking abilities

INTRODUCTION

In spring 2020, the COVID-19 pandemic affected various life contexts including educational institutions like universities, which were immediately forced to react to the challenges by shifting their activities to the digital sphere (Adedoyin and Soykan, 2020; Watermeyer et al., 2020). This had major consequences for students (Day et al., 2021): First, students could not go about their normal social lives at university, and instead they had to deal with social isolation, which can evoke stress-related emotions and reduce well-being (Beaunoyer et al., 2020; Miller, 2020; Osimo et al., 2021). Furthermore, regarding their degree of digital readiness, learning in a purely digital environment can be challenging for students and affect their emotional perceptions, resulting in overload, worries, and social and emotional loneliness (Händel et al., 2020).

Additionally, under these pressing circumstances, students have been confronted with a vast amount of science-related online information regarding COVID-19 that can lead to confusion, stress, or disinformation (Ferrara et al., 2020), especially because during the beginning of the pandemic, information concerning the virus was rather vague and diverging, since no one had expertise or experience in dealing with this new situation (Nagler et al., 2020). Furthermore, as shown in a study by Mason et al. (2017) dealing with conflicting science-related information has the potential to elicit physiological stress reactions in students. Apparently, integrating science-related information–such as on COVID-19–seems to be characterized by cognitive efforts and, at the same time, might also include affective reactions. However, while considerable research is concerned with the constraints and affordances of cognitively engaging with scientific information (e.g., List and Alexander, 2017; Hendriks et al., 2020), the emotional processing and emotional effects that online information might have on students require further investigation.

In this context, dealing with science-related online information should not only be viewed as an individual challenge but can also be approached in communication with others, such as in social media contexts. Indeed, studies have shown that students sought help and support from others in online contexts to cope with stress and negative emotions during the pandemic (Eden et al., 2020). Moreover, previous research has highlighted the role of collaborative interaction for cognitive elaboration and critical reflection of science-related online information (Zimmermann and Mayweg-Paus, 2021). However, in the specific situation of university students dealing with online COVID-19 information during physical isolation, collaborative exchange might also serve emotional regulation.

The present study aims at gaining a better understanding of university students' cognitive and emotional engagement with conflicting COVID-19 information. As the European Digital Competence Framework suggests, being able to evaluate and deal with online information is a crucial component of media competence (Carretero et al., 2017) that needs to be addressed in all areas of formal education (such as in schools or higher education). Further, the specific conditions at the beginning of the lockdown in April 2020 in Germany allow us to analyze students' behaviors and skills not only on the cognitive level but also on the emotional level, as we can investigate the role of (socio-)emotional dimensions in the processing of science-related online information. Drawing on the literature on how people deal with online scientific information, collaborative argumentation, and (socio)-emotional coping, we strive to examine how university students handle COVID-19 information on the cognitive as well as on the emotional level. This study compares individual vs. collaborative reflection to identify the opportunities and challenges surrounding students' cognitive as well as emotional engagement with conflicting online information about COVID-19.

Dealing With Online Scientific Information About COVID-19

In the following, we will first provide literature that describes persons' individual engagement with online information and, in particular, how dealing with any experienced information overload and conflicting information about COVID-19 might require both cognitive and emotional effort.

When sourcing scientific online information (i.e., seeking, evaluating, and using online information about science-related topics: e.g., Zimmermann and Mayweg-Paus, 2021), students need to handle a vast amount of complex and uncertain information. Online, many possibly relevant information sources exist that also vary in format (e.g., text or video), in genre (e.g., scientific or journalistic), in their explanatory power (e.g., relevance or scientificness), or in their interconnectivity to other online documents (e.g., when a medical expert is interviewed by conspiracy-affiliated news sites) (Goldman and Scardamalia, 2013).

During the COVID-19 pandemic, many people experienced *information overload* (Hong and Kim, 2020; Mohammed et al., 2021), which in health information-related contexts is often defined as the feeling of being overwhelmed by the sheer amount of information (Jensen et al., 2014). Importantly, information overload can also be felt when information about COVID-19 is provided offline via broadcast–in this case, people have

little control over what information they take in compared to when they seek information on social media (Mohammed et al., 2021). During the pandemic, people often consumed information from several sources–such as broadcast in addition to social media–and often on a daily basis or even every minute, which can increase feelings of information overload (Hong and Kim, 2020; Motta Zanin et al., 2020; Mohammed et al., 2021). One's perceived information overload can also be specifically related to one's actions: For instance, students and university staff who felt overwhelmed by the amount of information they read on COVID-19 also felt less self-efficient in terms of taking measures to avoid COVID-19 (Farooq et al., 2020).

However, these challenges faced by people during the pandemic do not merely encompass the amount of information nor the frequency of retrieving information. Additionally, misinformation was spread on social media, such as that ingesting bleach might help kill the virus (Gharpure et al., 2020). In an analysis of 69 videos about COVID-19 on YouTube, Li et al. (2020) identified that more than 25% of the videos contained misleading information. Additionally, during the pandemic, information seekers were often confronted with the fact that scientific findings may be provisional and open to scientific discussion, such as when scientists openly disagreed with statements by the WHO about the effectiveness of wearing face masks to protect against COVID-19 (Howard et al., 2020). Accordingly, processing (conflicting) online scientific information requires cognitive effort in order to derive appropriate decisions for one's personal life, such as whether to wear a mask in public.

This is in line with the assumptions of the MD-Trace (multiple-document task-based relevance assessment and content extraction) model (Rouet and Britt, 2012), which describes individuals' cognitive efforts when processing multiple pieces of information such as in online contexts. The model describes how cognitively demanding it might be to successfully integrate multiple pieces of information; for instance, someone would need to mentally represent the read information together with their meta-information (information about the source, rank of the search result, or interconnectedness to other information, especially if information conflicts) in order to evaluate the quality of information appropriately. In this sense, evaluating a single piece of online information is a complex process that requires people not only to assess the information based on whether it is complete, correct, and appropriate but also to identify whether they can rely on the provider of the information (Bromme and Goldman, 2014; Bråten et al., 2014).

However, when engaging with online information, other processes are at play in addition to cognitive ones. Regarding research approaches to examine multiple text comprehension (e.g., MD-Trace model: Rouet and Britt, 2012), the cognitive affective engagement model of multiple source use (CAEM) (List and Alexander, 2017) describes students' cognitive as well as emotional engagement when reading different texts. It, thus, expands approaches that focus on the cognitive handling of multiple information with important motivational aspects (such as one's personal relevance to seek appropriately). In the context of COVID-19, interest in the topic and other motivational aspects become evident as COVID-19 poses various risks to one's personal health: In addition to the cognitive effortful evaluation of the mere complexity of online scientific information, a student assessing COVID-related information would need to evaluate what personal or societal risks any decision may entail. According to research that considers cognitively more effortful vs. more effortless processes of dealing with information (e.g., the information seeking and processing model: Griffin et al., 1999; or trust in online information: Metzger and Flanagin, 2013), during the high-risk situation of the pandemic, students' uncertainty likely drove them to use more cognitive effort when engaging with information. With respect to citizens' uncertainty during the pandemic, initial studies reported that during March 2020 (at the beginning of the pandemic) in Italy, more than 30% of surveyed citizens reported feelings of uncertainty (Motta Zanin et al., 2020). However, while the perception of high risk may lead people to cognitively effortfully engage with (conflicting) scientific information, such risk perception and conflicting information may also cause confusion, anxiety, and stress (e.g., Mason et al., 2017; Li and Lyu, 2021; Oyetunji et al., 2021). Further, strong emotional reactions (e.g., stress) occurring while reading conflicting information about COVID-19 may have affected students' sourcing abilities (e.g., their ability to say who had said what, which is crucial to coherently represent conflicting information: Bråten et al., 2014) (Mason et al., 2017).

Importantly, the described challenges one might face while cognitively and emotionally engaging with online information may become particularly relevant during the pandemic, since exposure to COVID-19 misinformation may lead people to avoid information (Kim et al., 2020) or may even cause health problems. Hence, it is particularly important that students can engage with online scientific information about COVID-19 competently. As such, students need to overcome certain challenges when sourcing online information about COVID-19. Further, engaging with such information may require effort, so to be successful students may depend on their *self-efficacy in sourcing online information* (Andreassen and Bråten, 2013; Caena and Redecker, 2019; Hendriks et al., 2020; Zimmermann and Mayweg-Paus, 2021). According to Bandura (1997), self-efficacy refers to one's belief in one's own capabilities to organize and execute the courses of action required to attain particular goals. Thus, students' self-efficacy in sourcing online information about COVID-19 reflects how they interpret their own competencies around sourcing such information (Kurbanoglu, 2003). While self-efficacy in sourcing information is considered an important aspect of students' digital competence (Carretero et al., 2017), initial studies empirically indicate that students' self-efficacy in sourcing online information is actually related to their skillful sourcing behavior: For instance, students who had higher self-efficacy used online library databases rather than Google to search for information (Tang and Tseng, 2013).

Collaborative Engagement When Dealing With Online Information

Considering that dealing with online information requires effort and skill, here we discuss how engaging with online information

in a collaborative manner (with other people) might help students to reflect on their cognitive as well as emotional engagement with online information.

With regard cognitive levels during learning processes, collaborative interaction used in learning and skill development has been shown to be beneficial for various educational contexts (Chen et al., 2018). In particular, collaborative engagement seems to provide a promising setting for sharing, interpreting and critically examining scientific/science-related information in online contexts (Hendriks et al., 2020). In such contexts, a person is subject to others' scrutiny of their own position, which, in turn, enhances one's need to be more critical not only toward one's own position but also the opposing position. As research shows, the dialogic nature of the interaction directly affects how people handling evidence: In a collaborative setting, students seem to use evidence more often to address opposing viewpoints in an elaborated way, whereas in an individual setting they are more likely to stick to the information given to them (shared evidence) instead of integrating new information (Kuhn and Moore, 2015; Mayweg-Paus and Macagno, 2016). The potential of collaborative engagement for helping people deal with scientific online information efficiently lies in specific communicative moves (such as exchanging multiple perspectives) that can elicit (deeper) cognitive processing of information and a critical reflection of sources. Furthermore, collaborative engagement fosters critical elaboration not only of the information itself but also of the sources from where such information comes: In a study on students' critical reasoning about their own information sourcing strategies, the students who worked collaboratively reasoned more frequently in an elaborated way about the information and their selection of information than the students who worked individually. At the same time, however, in that study, students' self-efficacy in sourcing online information increased after both forms of reasoning, namely students' individual reasoning as well as collaborative reasoning about their own selection (Zimmermann and Mayweg-Paus, 2021). This means that individual and collaborative engagement with online information are both advantageous for activating reflection about one's sourcing skills.

Thus, studies have indicated that, in contrast to individual reflection settings, collaborative reflection settings may be beneficial in order to promote students' elaboration of their own thinking and challenging of the other's idea (Kuhn and Moore, 2015), their elaborated reasoning of their own sourcing strategies (Zimmermann and Mayweg-Paus, 2021), as well as their analysis and reflection of problems (Csanadi et al., 2020). However, in direct comparisons of individual and collaborative communicative settings wherein students engaged in cognitive reasoning processes, dyads have been shown to spend more time and effort than individuals: Collaboration requires time to explain possible causes of a problem (Csanadi et al., 2020); in collaboration there is a risk that some partners may move more quickly through the phases of the collaboration task, before everyone is ready (Mullins et al., 2011); and in collaborative settings, partners spend more time on managing the task (Zimmermann and Mayweg-Paus, 2021).

Besides the role of cognitive processing of science-related online information in collaborative engagement, the particular situation of dealing with COVID-19-related information while interacting with others should also serve functions on socio-emotional levels (i.e., the socio-relational, socio-emotional, and motivational aspects of dialogs) that often have been largely neglected in research on collaborative learning (Asterhan, 2013). In this sense, students may profit from the collaboration in at least two ways: (1) They may deal better with the information itself, allowing them to find the "best" solution–especially in dialogs with collaborative goal orientation that cause speakers to take a cooperative stance on what they see as a shared enterprise (e.g., Asterhan, 2013), and (2) they may support each other in coping with the (potentially highly negative) emotions the information might cause.

During the pandemic, students had to face several negative emotions such as feelings of loneliness, fear, and stress triggered by physical isolation during lockdowns, quarantines, or the measures implemented by governments (Wang et al., 2020; Awoke et al., 2021). A study at universities in the Philippines showed social and emotional support are important factors for reducing these negative feelings (De Los Santos et al., 2021).

Searching online for social and emotional support is often considered to fall under the concept of *online support seeking as coping strategies*. According to Zimmer-Gembeck and Skinner (2016, p. 2) *coping* is "a fundamental human adaptive process that involves the regulation of multiple subsystems (e.g., emotion and attention) that are activated by stress and that also show regular age-graded developments in how such regulation is accomplished." While research has investigated hundreds of ways people cope (Skinner et al., 2003), they are often categorized into two common types (Zimmer-Gembeck and Skinner, 2016), namely *active strategies* and *avoidance strategies*. Active strategies involve cognitive and behavioral processes that actively respond to the situation that cause stress (e.g., seeking emotional support or positive reappraisal of the situation). In contrast, avoidance strategies are characterized by disengagement or passive responses toward the stressor (e.g., distraction from the problem, cognitive avoidance, and social withdrawal). Often, the avoidance strategies are associated with more negative outcomes, such as distress (Zimmer-Gembeck and Skinner, 2016).

Importantly, due to the special situation during the COVID-19 pandemic, most students were only able to seek support in online contexts. van Ingen et al. (2016, p. 512) defined online coping as "thoughts and behaviors facilitated by the Internet that people use to manage stressful situations." An example of online coping is seeking social support in social network services (SNS), such as an online support group. Such active forms of coping can empower people in many ways: They may help one get important information (informational support), and they may help people express emotions and share experiences (emotional support) (Barak et al., 2008). Social support, as one of many coping strategies, is characterized by forms of collaborative support in the emotional as well as the cognitive processes one faces during a stressful situation (e.g., when reading conflicting information about COVID-19 during the pandemic). In such a context, one study at universities in Italy has shown that the

feeling of togetherness and the feeling of being a part of an academic community, especially in the COVID-19 pandemic, reduced perceived stress (Procentese et al., 2020).

However, current research on coping online in the context of SNS indicates that the mere use of SNS may also induce stress and may lead to emotional exhaustion or even increase the perceived information overload (Lim and Choi, 2017; Hong and Kim, 2020). Nonetheless, users who have high levels of coping resources (such relying on others to make them feel better or trying to get advice) have shown they can better manage the stress brought on by SNS (Lim and Choi, 2017).

To our knowledge, so far no research has investigated whether collaborative engagement with conflicting information has any impact on students' active and avoidance coping strategies in terms of engaging with such information. However, during the difficult time at the beginning of the pandemic, students may have been able to overcome the challenges associated with online information by collaborating with others as well as seeking social support when reading information about COVID-19 (e.g., regarding how to decide whom to trust and what information to rely on).

Rationale for the Study

During the beginning of the pandemic, students' success in sourcing information about COVID-19 was confronted with various challenges, such as their perceived overload of information about COVID-19 (e.g., Hong and Kim, 2020), their emotional reactions caused by any conflicting information about COVID-19 (e.g., Mason et al., 2017; Ferrara et al., 2020), as well as any feelings of loneliness or anxiety at large, which may have been caused, for example, by government measures instituted to prevent the spread of the virus (Beaunoyer et al., 2020; Miller, 2020; Awoke et al., 2021). Accordingly, in this study we investigate students' engagement with conflicting information about COVID-19 by considering not only indicators for their cognitive engagement but also for their emotional engagement with this information. As research on online collaboration and online social coping indicate that collaboration in this manner offers opportunities as well as challenges for both students' cognitive and emotional engagement with scientific online information, this study further aims at investigating the opportunities and challenges related to collaborative communication settings wherein students can reflect together with someone else about how they engage with conflicting information on COVID-19 tests.

Based on research approaches to collaboration and argumentation, collaborative argumentation settings tend to encourage people to engage with evidence more reflectively and in a more differentiated way (e.g., Chin and Osborne, 2008; Kuhn and Moore, 2015; Mayweg-Paus and Macagno, 2016), which may help students critically question the evidence presented in the conflicting information (e.g., Mayweg-Paus and Macagno, 2016; Mayweg-Paus et al., 2016). However, individual reflection settings may also have advantages, as they are much more easy to manage and may help students reflect on their sourcing competencies (Mullins et al., 2011; Zimmermann and Mayweg-Paus, 2021). This leads to our first research question:

RQ1: How do students cognitively engage with conflicting information about COVID-19 in an individual compared to a collaborative reflection setting, and how does the setting affect students' perception of information overload, their self-efficacy in sourcing COVID-19 information, and their communicative reflection behavior?

However, since during the pandemic it was likely that students did not engage with information purely rationally, detached from any emotional reactions, this study also focuses on students' emotional engagement with the information (Mason et al., 2017) as well as on whether collaboration as applied to seeking social support has an impact on their perceived coping strategies (Lim and Choi, 2017). Given the research on online support seeking as a coping strategy, taking part in a community and receiving forms of social support may prevent feelings of stress and loneliness during a crisis (e.g., the pandemic) (Procentese et al., 2020; De Los Santos et al., 2021); but, online coping may also induce stress or even increase the perceived information overload (Hong and Kim, 2020). This leads to our second research question:

RQ2: How do students emotionally engage with conflicting information about COVID-19 in an individual compared to a collaborative reflection setting, and how does the setting affect students' perceived coping strategies as well as their communicative reflection behavior?

Hence, to gain deep insights into the potential opportunities and challenges of either collaborative or individual reflection settings, this study focuses on students' cognitive as well as their emotional engagement with COVID-19 information as well as on various quantitative and qualitative indicators of their success in engaging with information about COVID-19.

MATERIALS AND METHODS

Participants

Overall N = 122 students initially participated in the study voluntarily and were reimbursed with 15 euros. Participants were studying various disciplines, at either the bachelor's or the master's level. They were recruited from different German universities via email lists. We excluded data from n = 13 participants whose Internet connectivity failed during the investigation. Hence, we analyzed data from N = 109 participants (73 female and 2 diverse) aged 18 to 48 (M = 24.13, SD = 5.08), with n = 49 participants in the individual group (group$_{in}$) and n = 60 participants in the discourse group (group$_{coll}$) (paired in n = 30 dyads). Of these 109 participants, 103 indicated German as their first language. Those six participants whose first language was not German had been speaking German for on average M = 11.33 years (SD = 7.69). At the time of the investigation, participants had been studying for an average of M = 4.12 semesters (M = 2.06 years) (SD = 2.52). N = 39 from the group$_{coll}$ and n = 39 from the group$_{in}$ were studying at the bachelor's level, while n = 10 from the group$_{coll}$ and n = 21 from the group$_{in}$ were studying at the master's level. In terms of participants' gender, n = 37 participants in the group$_{coll}$ and n = 36 in the group$_{in}$

were female (differences between experimental conditions were not significant; study level: $\chi^2(1) = 2.82$, $p = 0.09$; and gender: $\chi^2(2) = 3.88$, $p = 0.14$). The average duration of participation for all participants was $M = 48.49$ min ($SD = 17.85$), and this duration did significantly differ between the experimental conditions ($group_{coll}$: $M = 55.6$, $SD = 16.37$; $group_{in}$: $M = 42.87$, $SD = 17.09$), $F(1, 84) = 3.5 = p = 0.001$.

Participants reported that they used a computer, notebook, or tablet for an average of $M = 4.21$ ($SD = 2.78$) hours per day and spent on average $M = 5.66$ ($SD = 3.45$) hours per day on the Internet. Participants reportedly sought general online information for an average of $M = 2.20$ ($SD = 1.51$) hours per day and searched specifically for online information about COVID-19 for an average of $M = 0.84$ ($SD = 2.45$) hours per day, with no significant differences between experimental conditions, all $F(1, 100) \leq 1.82$, $p \geq 0.18$, $\eta^2 \geq 0.0.18$).

Regarding their prior knowledge about COVID-19, participants gave a score, on average, of $M = 3.51$ ($SD = 0.86$), meaning that they reported to have rather high knowledge (four items: e.g., "I often do research about the topic COVID-19 on the Internet"). Furthermore, on average all participants reported to find the COVID-19 measures by the government as relevant ($M = 3.91$, $SD = 0.62$) (four items: e.g., "I think the measures are reasonable.") (all eight items used five-point Likert scales, with 1 = strongly disagree to 5 = strongly agree). Lastly, all participants reported that they sought support on social media a "few times" to "from time to time" ($M = 2.65$; SD = 0.81) (four items: e.g., "How often do you seek support for issues in your preferred social media networks.") (items were on a five-point Likert scale, with 1 = never to 5 = very often).

Design

In a 2 × 2 mixed design, with the between-participants factor experimental condition (individual vs. collaborative reflection) and the within-participants factor time (pre- vs. post-measure), we assessed the participants' self-reported (1) information overload, (2) information sourcing self-efficacy, and (3) active as well as avoidance coping strategies before and after the reflection task. Participants were instructed to individually read two conflicting texts on "tests for COVID-19." Afterward, all participants were asked to reflect about how they engage with such conflicting information about COVID-19. Participants were randomly assigned to one of the two experimental conditions (i.e., individual vs. collaborative reflection task). After reading the two texts, participants in the groupin individually reflected, while participants in the groupcoll engaged in a collaborative discourse via chat and reflected collaboratively about how they engage with such conflicting information (see Supplementary Material 1 for the instructions). In the groupcoll, they were randomly paired into 30 dyads.

Procedure

Participants performed the experiment online at any place where they could connect to the Internet on their own digital device. Each participant was invited to take part in the online experiment via email list invitations. Before the experiment, all participants were introduced to the experimenters via video call application (i.e., https://www.edudip.com/de), where they received information about how participants can conduct the online survey and, for the collaborative group, how they can chat with each other. During the experiment participants worked at their own pace and were guided through the experiment by the online survey (unipark.com by Questback EFS Surveys).

First, participants answered items relating to demographic variables. They were then asked to report their perceived information overload about COVID-19 information, their self-perceived COVID-19 information sourcing self-efficacy, as well as their coping strategies when reading unpleasant information (pre-measure). Afterward, participants received a fictional scenario: They were asked to imagine themselves searching for information on the topic of "tests for COVID-19" and finally finding two online articles. All participants were instructed to read the same articles. The groupcoll was further instructed to subsequently discuss these search results with another person. The participants in the groupcoll had to open a window of the open-source chat application (i.e., https://discordapp.com/) for chatting with another participant. The participants were asked to reflect–either individually or collaboratively–on how they engage with such information about tests for COVID-19. Afterward, all participants were again asked to rate their perceived information overload, their self-perceived information sourcing self-efficacy, and their coping strategies (post-measure).

Materials

We created the two online articles regarding tests for COVID-19 in order to control for any aspects that may have influenced how students judged the credibility of the texts (e.g., expertise of the provider of information, technical terminology, or one-sided vs. two-sided argumentation of providers; e.g., Mayweg and Jucks, 2017; Zimmermann and Jucks, 2018). As such, we included information that came from real online articles published at the end of March 2020 in connection with COVID-19 testing. Both texts entailed the same amount of scientific information and referred to actual scientific evidence about COVID-19 tests with information about what was known at the time the experiment was conducted. The information summarized in the two articles reflected the findings of two scientific studies about COVID-19 tests. Both texts were provided by supposed medical doctors. Both providers explained that the tests were either valid or not valid and drew different conclusions about the social measures during the pandemic derived from the tests (see Supplementary Materials 2, 3).

Measurements

Communicative Reflection Behavior

To assess participants' communicative reflection behavior as an indicator for participants' cognitive and emotional engagement with conflicting information about COVID-19, we analyzed their communicative behavior in the reflection task (i.e., individual and collaborative reflection about their engagement with the conflicting information about COVID-19 tests). Participants' reflection behavior was divided into units of meanings, where each unit contained a participant's semantic description of a

distinct theme or idea (Clarà and Mauri, 2010). To code the units of meanings (coding scheme described below), a rater assessed all of the $N = 78$ texts that emerged from the reflection task. The level of agreement between two independent raters, in terms of $n = 21$ (26.6%) of all texts (randomly and equally distributed from the $N = 49$ individual and $N = 30$ collaborative texts), was Cohen's Kappa = 0.94. The percentage of agreement between these two independent raters was PA = 87.32–100% for all coding at the level of the categories. Furthermore, the coders' coding reached 100% agreement for 12 out of the 21 documents at the levels of the units of meanings.

From participants' individual and collaborative communicative reflection behavior, we determined the relative frequencies of the coding categories that were discussed by participants in relation to the overall frequencies of on-task units (i.e., comments made about the reflection task). These relative frequencies thus represent the relative numbers regarding all task-related comments and not the total number of comments made (there were also off-task comments, e.g., related to the management of the reflection task).

The coding scheme aimed to describe how participants reflected (1) cognitively and (2) emotionally about their engagement with the conflicting information and about evidence and information from and beyond the read information. In terms of participants' cognitive engagement, the first coding category relates to participants' discussion about evidence read in the presented information, (i.e., regarding the credibility of information, such as whether the information was considered scientific or recent, and the trustworthiness of the providers, such as whether they are benevolent and competent: Bromme and Goldman, 2014). Furthermore, also related to participants' cognitive engagement, the second coding category relates to comments about how they deal with evidence beyond the information they read (i.e., when participants mentioned or questioned other aspects relevant for their engagement with evidence, such as the scientificness of evidence, the authority behind the evidence, anecdotal-related evidence, or how they deal with the credibility of information in general: Bromme and Goldman, 2014; Mayweg-Paus and Macagno, 2016). Furthermore, participants also discussed the pandemic in general without providing any evidence at all (e.g., they discussed pandemic-related measures: "I think consequences should have been implemented sooner"). Hence, in a third coding category, we coded participants' comments related to discussions about the pandemic in general.

In terms of participants' emotional engagement, the fourth coding category relates to criteria associated with participants' discussion on how reading the presented conflicting information affected them emotionally (e.g., when they were confused by the texts) (Mason et al., 2017). Furthermore, with respect to participants' emotional engagement, we also assessed whether participants emotionally discussed the pandemic beyond the read information (e.g., when they reported anxiety that loved ones might become infected) (e.g., Awoke et al., 2021). Finally, remaining categories referred to comments that did not match the previously reported categories.

The coding scheme derived from participants' reflection task is given in Supplementary Material 4. Examples of reflective communication behavior for the individual as well as collaborative reflection task are given in **Tables 1**, **2**.

Perceived COVID-19 Information Overload

To assess participants' perceived information overload when sourcing information about COVID-19 as an indicator for their cognitive engagement with this information, we adapted items to assess health-related information overload by Ramondt and Ramírez (2018) (e.g., "The point has come where I no longer even bother to get the latest information about the corona virus" or "There are so many recommendations about the corona virus, it is difficult to decide which recommendation to follow."). The items refer to participants' perceived information overload not only in the context of perceived overload while seeking information but also in the context of perceived information overload when it comes to the evaluation of information about the corona virus in general. The internal consistency for the eight items at the pre-measure was Cronbach's $\alpha = 0.56$. At the post-measure, it was Cronbach's $\alpha = 0.53$. The removal of any individual item would not have resulted in a significant increase of the internal consistency. The five-point Likert scale ranged from 1 = strongly disagree to 5 = strongly agree.

COVID-19 Information Sourcing Self-Efficacy

To assess participants' self-efficacy when sourcing information about COVID-19 as another indicator for their cognitive and emotional engagement with this information, we adapted items from the Information Seeking Self-Efficacy Scale (IRSES) (Bronstein, 2014: adapted by Hinson et al., 2003). All items focused on the sourcing of COVID-19 information. The scale incorporates three dimensions related to one's personal self-evaluation [e.g., "If I don't know how to assess information about

TABLE 1 | Example of an individual reasoning behavior (translation in brackets).

Code	Person	Comment
Cognitive comment on text	A	- Widersprüchliche Informationen regen an noch mehr Informationen einzuholen. - (Contradicting information encourages you to obtain even more information.)
Emotional comment on text		- Beide Texte klangen an und für sich logisch und in sich schlüssig, jedoch ist es aufwühlend und regt an noch mehr Informationen einzuholen. - (Both texts sounded logical and coherent in themselves, but it is overwhelming and encourages you to get even more information.)
Cognitive comment beyond text		- Ich persönlich würde lediglich aus Sympathieempfinden mich für die weitere Recherche für den 1. Text entscheiden und unterstützende Literaturen suchen. - (Personally, I would decide to research the first text simply out of sympathy and look for supporting literature.)
Emotional comment on text		- Dennoch ist es ein zwiegespaltenes Gefühl/hin und her gerissen wem man bezüglich des COVID-19 trauen kann. - (Nevertheless, it is with mixed feeling/torn back and forth who can be trusted with regard to COVID-19.)

TABLE 2 | Example of a collaborative reasoning behavior (translation in brackets).

Code	Speaker	Comment
Cognitive comment on text	A	- So, ich bin etwas hin- und hergerissen, was die beiden Artikel angeht. Beim ersten Artikel dachte ich noch: Interessant! Eine Kontaktsperre scheint also sinnvoll, um das Virus wirklich einzudämmen. Der Artikel rechtfertigt ja auch die Verlängerung einer Kontaktsperre. - (So, I'm a bit torn about the two articles. With the first article, I still thought: Interesting! A contact ban seems to make sense in order to really contain the virus. The article also justifies the extension of a contact ban.)
Emotional comment on text	A	- Nach dem Lesen des zweiten Artikels war ich wieder verunsichert und dachte: Okay, die radikalen Maßnahmen sind vielleicht doch nicht so sinnvoll. - (After reading the second article, I was unsure again and thought: Okay, maybe the radical measures are not so sensible after all.)
Cognitive comment on text	A	- Jedoch sehe ich keinen Gegenvorschlag in diesem Artikel, außer weiterzuleben wie gewohnt. Kann das wirklich der richtige Ansatz sein? - (However, I don't see any counter suggestion in this article, except to continue living as usual. Can this really be the right approach?)
Cognitive comment about the pandemic in general	A	- Ich bin wirtschaftlich nicht besonders bewandert, so dass mir die weitreichenden Konsequenzen der Kontakt- und Berufssperre nicht wirklich bewusst sind. Ich kann persönlich also nicht abwägen, was schlimmer wäre: Wirtschaftliche Folgen oder gesundheitliche Folgen. - (I'm not very economically experienced, so I'm not really aware of the far-reaching consequences of being barred from contact and work. I personally can't weigh what would be worse: economic consequences or health consequences.)
Cognitive comment on text	B	- Der erste Artikel hat auch eher das wiedergegeben, was man ja schon so kannte: viele asymptotisch (hoffentlich korrekt geschrieben) und somit eine hohe Dunkelziffer. Was ich mir auch gut vorstellen kann. - (The first article also rather reflected what was already known: many asymptotically (hopefully spelled correctly) and thus a high number of unreported cases. What I can also well imagine.)
Cognitive comment on text	B	- Der zweite Text hat mich dann erst darauf aufmerksam gemacht, dass der Test wohl recht unzuverlässig ist. Da würde ich jetzt eher nochmal hinterherrecherchieren, ob das auch tatsächlich so stimmt. - (The second text only made me aware that the test is probably quite unreliable. Now I would rather do more research to find out if this is really true.)
Cognitive comment about the pandemic in general	B	- Wirtschaftliche gegen gesundheitliche Folgen abwägen, ist halt auch schwierig. - (Weighing economic against health consequences is also difficult.)

the corona virus, I give up quickly." or "I do not understand most of the information about the corona virus." (11 items)]; one's comparison with others [e.g., "Most other people know better than me how to evaluate certain information about the corona virus" (4 items)]; and one's physical state while seeking [e.g., "I feel stressed when seeking information about the corona virus." (5 items)]. The consideration of seeking in this scale, hence, refers to this study's concept of sourcing online information, as the items assess aspects related to seeking information and aspects related to the evaluation and usage of information. The internal consistency for the 20 items at the pre-measure was Cronbach's $\alpha = 0.77$. At the post-measure, it was Cronbach's $\alpha = 0.85$. The five-point Likert scale ranged from 1 = strongly disagree to 5 = strongly agree.

Coping With Information About COVID-19

To assess the participants' coping strategies when reading information about COVID-19 as another indicator for their emotional engagement, we adapted two subscales from Lim and Choi (2017). The items address participants' active coping strategies (e.g., "I ask friends for help" or "I ask friends who have similar experiences how they deal with it.") (seven items) and participants' avoidance coping strategies ("I avoid thinking about it") (three items). Participants were asked to state on all items how they handle unpleasant information about COVID-19. Internal consistency at the pre-measure was Cronbach's $\alpha = 0.79$. At the post-measure, it was Cronbach's $\alpha = 0.81$. The five-point Likert scale ranged from 1 = strongly disagree to 5 = strongly agree.

Affective State as Preparatory Variable

Because we carried out the study at a time when the pandemic itself may have strongly influenced the participants' emotions, it is important to control for any variance among the individual or collaborative reflection that could been caused by the basic current affective state of the participants. Thus, to assess participants' affective state before reading COVID-19 information, participants reported their affective state based on PANAS (Janke and Glöckner-Rist, 2014). The PANAS is a widely used measurement to assess persons' affective state, and it uses 20 items (e.g., "interested," or "attentive"). The PANAS includes two subscales (PANAS-Positive affect and PANAS-Negative affect). The five-point Likert scale ranged from 1 = slightly or not at all to 5 = very much. Internal consistency was Cronbach's $\alpha = 0.88$. Participants' values in terms of the subscale PANAS-Negative affect were on average rather low (i.e., at the beginning of the study, participants were very slightly or not at all to a little, e.g., "scared" or "upset"). On average, participants' values in terms of the subscale PANAS-Positive affect were $M = 2.63$ (i.e., participants were to some extent, e.g., "interested" or "attentive") (see **Table 3**). In a ANOVA with affective state as the dependent variable and the experimental conditions as the independent variable, there were no significant differences between the experimental groups with regard to participants' affective state, both subscales $F(1,76) \leq 0.201$, $p \leq 0.655$, $\eta^2 \geq 0.002$ (see **Table 4**). Hence, this variable was not included in our main analysis as a control variable.

TABLE 3 | Descriptive values in terms of the scales.

Dependent Measure	Experimental Condition	*M*	*SD*
Scale overload pre	Individual	2.56	0.65
	Collaborative	2.49	0.61
	Total	2.52	0.62
Scale overload post	Individual	2.66	0.59
	Collaborative	2.63	0.61
	Total	2.64	0.60
Scale sourcing self-efficacy pre	Individual	3.43	0.51
	Collaborative	3.53	0.54
	Total	3.48	0.52
Scale sourcing self-efficacy post	Individual	3.35	0.54
	Collaborative	3.37	0.59
	Total	3.36	0.57
Scale coping avoidance pre	Individual	3.20	0.78
	Collaborative	3.01	0.75
	Total	3.10	0.77
Scale coping avoidance post	Individual	3.11	0.82
	Collaborative	3.08	0.70
	Total	3.10	0.75
Scale coping active pre	Individual	3.22	0.75
	Collaborative	3.35	0.80
	Total	3.29	0.78
Scale coping active post	Individual	3.27	0.76
	Collaborative	3.59	0.79
	Total	3.45	0.79
Scale PANAS negative affect pre	Individual	1.74	0.70
	Collaborative	1.79	0.71
	Total	1.77	0.70
Scale PANAS positive affect pre	Individual	2.61	0.61
	Collaborative	2.65	0.69
	Total	2.63	0.65

Individual group n = 49; collaborative group n = 60; NTotal = 109. Relative frequencies in ratio to all on-task units.

Main Analyses

Two generalized linear models were conducted to test whether participants' pre- and post-measures for participants' information overload, information sourcing self-efficacy, active as well as avoidance coping strategies, as well as their relative frequencies of emotional and cognitive engagement in terms of participants' reflection behavior differed between the experimental conditions. We set an α error of $\alpha = 0.01$.

RESULTS

Results of Participants' Communicative Reflection Behavior

We conducted a linear model, including the between factor *experimental condition* and the dependent variables *relative frequencies of types of reflection* (i.e., comments about evidence on and beyond text, as well as about the pandemic in general; and emotional comments on texts and in terms of the pandemic in general). Participants in the $group_{coll}$ more often discussed the pandemic in general–without providing or discussing any evidence (M = 37.1%, SD = 25.54)–and less often engaged emotionally when discussing the evidence related to the read texts (M = 3.45%, SD = 4.62) compared to the $group_{in}$ (discussions about pandemic in general: M = 15.5%, SD = 18.6; emotional discussion about evidence from text: M = 12.8%, SD = 19.13), both $F(1,76) \geq 6.84$, $p \leq 0.01$, $\eta^2 \geq 0.08$. Participants in both groups discussed evidence from the texts with the same frequency ($group_{coll}$: M = 33.7%, SD = 26.5; $group_{in}$: M = 33.4%, SD = 27.3), $F(1,76) = 0.002$, $p = 0.97$, $\eta^2 < 0.01$). Similarly, there were no significant differences in terms of participants' cognitive reflection about evidence beyond the text or their comments related to emotions about the pandemic in general (see **Tables 5**, **6**). Putting together all the comments that are characterized either by cognitive or emotional engagement, participants in the $group_{coll}$ more often engaged cognitively (M = 88.8%, SD = 13.5) and less often engaged emotionally (M = 11.2%, SD = 13.5), compared to the $group_{in}$ (cognitively: M = 76.9%, SD = 20.78; emotionally: M = 23.1%, SD = 20.8), both $F(1,76) = 7.73$, $p = 0.007$, $\eta^2 = 0.09$.

Furthermore, the $group_{coll}$ significantly more often made comments related to the management and coordination of the task (i.e., relative frequencies of off-task units in relation to overall units) (M = 34.15%, SD = 12.2), compared to those in the $group_{in}$ (M = 0%, SD = 0.0), $F(1,76) = 379.07$, $p < 0.001$, $\eta^2 = 0.83$. Descriptive statistics related to the relative frequencies of types of reflections are presented in **Table 5**. The results of the multivariate ANOVA to test for differences between the experimental conditions regarding the relative frequencies of cognitive and emotional reflection are presented in **Table 6**.

Results in Terms of Information Overload, Information Sourcing Self-Efficacy, and Coping Strategies

We conducted a multivariate generalized linear model, including the between factor *experimental condition* and the within factor *time of measurement* with the dependent variables (1) information overload, (2) information sourcing self-efficacy, and (3) active as well as avoidance coping strategies.

In terms of participants' reported information overload, the analysis revealed a significant main effect of *time* and no significant main effect of *experimental conditions*, as well as no significant interaction effect between time and experimental conditions. Overall, participants reported higher information overload after the reflection task (M_{pre} = 2.52, SD_{pre} = 0.62; M_{post} = 2.64, SD_{post} = 0.60; $F(1, 105) = 8.52$, $p = 0.004$, $\eta^2 = 0.08$) (see **Table 4**).

In regard to participants' reported information sourcing self-efficacy, the analysis again revealed a significant main effect of *time* and no significant main effect of *experimental conditions*, as well as no significant interaction effect between time and experimental conditions. Overall, participants reported lower self-efficacy after the reflection task (M_{pre} = 3.48, SD_{pre} = 0.52; M_{post} = 3.36, SD_{post} = 0.57; $F(1, 105) = 11.19$, $p = 0.001$, $\eta^2 = 0.10$) (see **Table 4**).

TABLE 4 | MANOVA to test for differences between the experimental conditions and within subjects (time) regarding the scales.

Source	Measure	Type III Sum of Squares	*df*	*Mean Square*	*F*	*p*	η^2*part*
Time	Information overload	0.700	1	0.70	8.52	0.00	0.08
	Sourcing self-efficacy	0.685	1	0.69	11.19	0.00	0.10
	Coping avoidance	0.004	1	0.00	0.03	0.87	0.00
	Coping active	1.108	1	1.11	6.34	0.01	0.06
Condition	Information overload	0.100	1	0.10	0.15	0.70	0.00
	Sourcing self-efficacy	0.205	1	0.21	0.38	0.54	0.00
	Coping avoidance	0.642	1	0.64	0.63	0.43	0.01
	Coping active	2.811	1	2.81	2.73	0.10	0.03
	PANAS negative affect (preparatory analysis)	0.187	1	0.19	0.20	0.66	0.00
	PANAS negative affect (preparatory analysis)	0.006	1	0.01	0.01	0.93	0.00
Time × condition	Information overload	0.045	1	0.05	0.54	0.46	0.01
	Sourcing self-efficacy	0.080	1	0.08	1.30	0.26	0.01
	Coping avoidance	0.341	1	0.34	2.56	0.11	0.02
	Coping active	0.454	1	0.45	2.60	0.11	0.02

Similarly, with reference to the active coping strategies reported by the participants, the analysis revealed a significant main effect of *time* and no significant main effect of *experimental conditions*, as well as no significant interaction effect between time and experimental conditions. All participants reported higher active coping strategies after the reflection task (M_{pre} = 3.29, SD_{pre} = 0.78; M_{post} = 3.45, SD_{post} = 0.79; $F(1, 105) = 6.34$, $p = 0.01$, $\eta^2 = 0.06$). In terms of participants' self-reported coping as avoidance, there were no significant differences between time and experimental groups, as well as in terms of an interaction of time and experimental conditions (see **Table 4**).

DISCUSSION

Main Findings

The findings of the present study shed light on how students reflect about their engagement with conflicting scientific information regarding COVID-19 during the beginning of the pandemic, when they had to handle many (conflicting) pieces of information about COVID-19 and had to cope with feelings of uncertainty, loneliness, stress, and anxiety caused by the pandemic (e.g., lockdown). Under these circumstances, the study investigated whether students' individual and collaborative reflection about their engagement with conflicting information on COVID-19 testing had different impacts on their perceived information overload, their self-efficacy in sourcing information about COVID-19, their coping strategies, as well as their reflective communication behavior. Thus, the study used a combination of quantitative and qualitative data to assess not only important aspects of students' cognitive processing of information but also their emotions caused by conflicting information.

First, the study provides insights into participants' cognitive engagement with the information (RQ1).

As we analyzed the content of participants' reflection around their engagement with the conflicting information in the texts, this study provides insights about the frequencies with which participants engaged in reflections about the evidence in and beyond the texts and the frequencies with which they discussed the pandemic in general (see Supplementary Material 4 for coding scheme). Interestingly, taking all the comments together, participants more often discussed at the cognitive level when they reflected on their engagement collaboratively. The reason for this might be that the participants in the collaborative group more often discussed aspects of the pandemic in general but without referring to specific evidence to support either an opinion or statement (e.g., they more often discussed the government's pandemic-related measures). In this vein, for instance, speaker B (see excerpt of the communicative reflection behavior presented in **Table 2**) responded to the comment of speaker A who shared her/his thoughts about any economic or health consequences due to the measures of COVID-19, and thus, speaker A and B both discussed aspects related to the pandemic in more general. In line with approaches on collaborative learning and argumentation, a collaborative setting may support the exchange of multiple views on a topic, having led this study's students to talk about information related to the pandemic in general (Noroozi et al., 2012). While this may have helped the students in the collaborative condition exchange at an informational level–which might be a form of support seeking (Barak et al., 2008)–they did not more often cognitively engage in discussions about the evidence in the texts, nor beyond the texts. This is contrary to previous findings (e.g., Kuhn and Moore, 2015; Mayweg-Paus and Macagno, 2016). Notably, the critical reasoning of evidence is an important aspect of competently reflecting on the quality of information (Chin and Osborne, 2008; Kuhn and Moore, 2015; Mayweg-Paus and Macagno, 2016; Hendriks et al., 2020) as well as of providing reasons for one's own and another's argument (Mayweg-Paus and Macagno, 2016).

Additionally, we assessed two further indicators for participants' cognitive engagement with conflicting information about COVID-19: With respect to participants' perceived information overload as well as their self-efficacy in sourcing

information about COVID-19, interestingly, participants in both the individual and collaborative groups reported higher information overload and lower self-efficacy after the reflection task, but without any significant differences between the experimental conditions. As participants in the two experimental conditions did not differ in terms of their reported self-efficacy, the reflection task may have led both groups of participants to feel less competent around sourcing information about COVID-19 in general. This is contrary to previous findings on students' information sourcing self-efficacy, where participants perceived their self-efficacy as higher after reflecting on students' handling of online information, regardless of whether they were reflecting in an individual or collaborative reflection setting (Zimmermann and Mayweg-Paus, 2021). According to our earlier argumentation (Zimmermann and Mayweg-Paus, 2021), future research is needed to investigate whether reflecting on one's own competencies (such as inducted by a reflection task) ultimately leads one to perceive their own competencies more realistically or in a more biased manner, leading to an under- or overestimation of oneself. Furthermore, studies indicate that the more information people read, the higher their perceived information load might be (Hong and Kim, 2020; Motta Zanin et al., 2020; Mohammed et al., 2021). In this sense, merely reading additional (new) information presented during the study may have increased participants' perceived information overload.

TABLE 5 | Descriptive statistics of the relative frequencies of cognitive and emotional reflection around the engagement with conflicting information and the pandemic in general.

Relative frequency of	Experimental condition	*M*	*SD*
Cognitive comments on text	Individual	0.33	0.27
	Collaborative	0.34	0.27
	Total	0.34	0.27
Cognitive comments beyond text	Individual	0.28	0.26
	Collaborative	0.18	0.14
	Total	0.24	0.22
Cognitive comments on pandemic without evidence	Individual	0.15	0.19
	Collaborative	0.37	0.26
	Total	0.24	0.24
Emotional comments on text	Individual	0.13	0.19
	Collaborative	0.04	0.05
	Total	0.09	0.16
Emotional comments beyond text	Individual	0.02	0.05
	Collaborative	0.04	0.10
	Total	0.03	0.07
All off-task	Individual	0.00	0.00
	Collaborative	0.34	0.12
	Total	0.13	0.18
All on-task	Individual	1.00	0.00
	Collaborative	0.66	0.12
	Total	0.87	0.18
All cognitive comments	Individual	0.77	0.21
	Collaborative	0.89	0.14
	Total	0.82	0.19
All emotional comments	Individual	0.23	0.21
	Collaborative	0.11	0.14
	Total	0.19	0.19

Individual group n = 49; collaborative group n = 30; NTotal = 79.
Relative frequencies in ratio to all on-task units.

Second, the study provides insights into participants' emotional engagement with the information (R2). Taking together all the emotional comments from the written reflections, those participants who reflected individually more often made emotional comments compared to those participants who reflected collaboratively. The reason for this is that participants in the individual group more often reflected on how the evidence read in the text affected them emotionally (e.g., they more often stated that the information in the texts led to uncertainty or confusion). In this sense, for instance, person A (see example of individual reflection in **Table 1**), as well as other participants in the individual reflection tasks, explained his/her feelings when reading such contradicting information about COVID-19 and expressed that he/she felt overwhelmed and had mixed feelings about the trustworthiness of the provider of such information.

In terms of participants' active coping strategies as another indicator of participants' emotional engagement, all participants reported after the reasoning task that they perform more active coping strategies (i.e., that they ask friends for help or express their feelings to someone they respect and trust when reading unpleasant information about COVID-19), no matter whether they reflected collaboratively or individually about their engagement with the information. This is interesting, as participants in the collaborative as well as individual setting may have become able to activate a set of potential active coping strategies after they reflected on how they engage with conflicting information. First, in the individual reflection group, participants more frequently discussed their stress and confusion caused by the texts, which might have made them more clearly realize that they need to cope with these emotions. Further, in the collaborative reflection group, participants more frequently discussed the pandemic in general, which again might have made them realize that they need to cope with the pandemic in general. Overall, however, future research is needed to investigate what exactly activates students' reported use of coping strategies.

In this study, we assessed students' self-reported self-efficacy in sourcing online information about COVID-19, their perceived information overload, their reported coping strategies, as well as their emotional and cognitive engagement with information by analyzing their communicative reflection behavior during the highly externally valid circumstances of the beginning of the pandemic. Yet, even though the time the study was conducted represents a realistic situation for investigating students' engagement with conflicting online information about science, neither

experimental communicative setting was shown to impact the relevant measures for assessing indicators related to students' information competences (i.e., self-efficacy in sourcing information, information overload) or related to students' emotional regulation (i.e., coping in a stressful situation because of reading conflicting information). In fact, in terms of students' rather medium reported negative affect, the findings of the present study contradicted our expectation about students' negative affective state during such a challenging time of a pandemic (c.f., Wang et al., 2020).

In sum, in terms of the opportunities and challenges of collaboration for students' cognitive as well as emotional engagement with conflicting information during a reflection task, this study's findings indicate that only students' written reflections were influenced by the way participants reflected (individually or collaboratively), whereas for participants in both groups, being presented with new information and performing the reflection task itself increased their perceived information overload, decreased their self-efficacy in sourcing information on COVID-19, and increased their activation of active coping strategies.

Limitations

With respect to the measurements of the study, the scale to assess participants' perceived information overload was of low internal consistency, indicating that the items were inconsistent with one another and probably measuring different aspects of or related to information overload (e.g., the perceived overload of information or the perceived overload of recommendations read in the information). Thus, the results in terms of an increased perceived information overload after the reflection task should be interpreted by having the limitation of this measurement in mind: This means that future research may focus on the investigation of whether the validity of measures related to perceived information overload is effected by different types of information (e.g., information about COVID-19 or diet information) or the complexity of the situation in which someone read such information (e.g., during a crisis). In addition, future research may consider additional aspects that have shown to be relevant for students' emotional engagement during such challenging times (e.g., students' concerns about any risk of infection: Wang et al., 2020) as well as a diverse methodological approach to assess persons' emotional engagement–beyond their self-reported assessments or analysis of written reflections (e.g., facial physiology such as EMG measures). In this sense, future research is needed to conclusively explain the relation between persons' emotional engagement processes when reading (conflicting or unpleasant) scientific information that can be used to derive important actions for their personal life. However, it is interesting to see that when bringing in the qualitative data (in addition to the quantitative data), participants in the individual setting in particular often reflected their uncertainty due to reading the conflicting texts. This may indicate that it is important to assess emotional engagement with information while focusing on specific aspects (e.g., uncertainty when reading information, as well as anxiety due to social measures supported by the information).

While the topic of testing for the virus was highly relevant for students during the pandemic–because students as well as all citizens needed to establish scientifically grounded opinions about COVID-19 information in general–our study only focused on one of many topics. This means that our findings cannot necessarily be generalized. Therefore, future research could expand the picture of students' emotional as well as cognitive engagement with online scientific information by focusing on different topics.

Implications

Despite these limitations, this study contributes to research on multiple text comprehension and has further implications for future research and for university students' education.

Taken together, the findings of this study clearly emphasize the importance of also considering–beyond cognitive processes–students' emotional engagement with science-related online information. In line with previous research that emphasizes the importance of considering emotional aspects when processing information (e.g., List and Alexander, 2017; Mason et al.,

TABLE 6 | Multivariate ANOVA to test for differences between the experimental conditions, regarding the relative frequencies of cognitive and emotional reflection around the engagement with conflicting information and the pandemic in general, as well as between all on-task and all off-task comments.

Source	Relative frequencies of	Type III sum of squares	*df*	*Mean Square*	*F*	*p*	η^2*part*
Experimental conditions	Cognitive comments on text	0.00	1	0.00	0.00	0.97	<0.01
	Cognitive comments beyond text	0.18	1	0.18	3.81	0.06	0.05
	Cognitive comments on pandemic without evidence	0.86	1	0.86	18.61	<0.00	0.20
	Emotional comments on text	0.16	1	0.16	6.84	0.01	0.08
	Emotional comments beyond text	0.01	1	0.01	1.56	0.22	0.02
	All off-task comments	2.15	1	2.15	379.07	<0.00	0.83
	All on-task comments	2.15	1	2.15	379.07	<0.00	0.83
	All cognitive comments	0.26	1	0.26	7.74	0.01	0.09
	All emotional comments	0.26	1	0.26	7.74	0.01	0.09

Relative frequencies in ratio to all on-task units.

2017), in this study students showed cognitive as well as emotional engagement with conflicting information. In future research, it appears valuable to examine the differences the two forms of processing may have, their interfaces, and whether they are relevant in different ways for different situations. Interestingly, the collaborative and individual reflection settings led students to differently often referred to emotional or cognitive aspects in connection with their engagement with the information. Thus, future research aiming to consider emotional processes of engaging with online information may also investigate how different forms of communicative settings (i.e., collaborative and individual reflection tasks) can help to take both aspects into account (e.g., through interventional studies that examine how instructions can help to increase students' critical reflection about information on the cognitive as well as emotional level and in diverse communicative settings). Importantly, in this study neither the individual nor the collaborative group received any additional instructions on how to reflect effectively. Thus, future research may investigate whether any instructional support would guide collaborative communication processes more effectively (e.g., with regular instructions on how to focus on the task, on how to consider that everyone is ready to move on, or on how to question the other's arguments constructively and critically: Noroozi et al., 2012; Mayweg-Paus et al., 2016).

Considering the complexity of processes for engaging with online scientific information–as mentioned above (e.g., List and Alexander, 2017), as well as when engaging collaboratively in discussions with others (e.g., Kuhn and Moore, 2015; Mayweg-Paus and Macagno, 2016)–this study focused on those processes related to participants' cognitive as well as emotional reflections after they were confronted with only two articles that provided conflicting information. While research focusing on the investigation of students' actual sourcing of scientific information on the Internet (e.g., Zimmermann and Mayweg-Paus, 2021) may increase the external validity, as it may represent search processes wherein more diverse information can be found in a more valid way, in this study, we used a fictitious scenario in which we presented only two prepared online articles. In this sense, we controlled for the influence of any differences in the found information thus increased the internal validity in terms of students' evaluation of the read information. However, the study was conducted during a highly confusing social situation–the beginning of the pandemic. Hence, this possibly means that we were nevertheless unable to take other possible influencing factors into account. Future research may additionally investigate students' engagement with such information under more controllable situations by also considering other aspects: For instance, the results of a recent study on persons' mental health during COVID-19 lockdown showed that personality traits (e.g., extraversion and neuroticism) were strongly related to psychological well-being during the pandemic (Osimo et al., 2021). Thus, future research may consider personality traits too when investigating whether any personality differences among students may also determine students' engagement with conflicting information.

In terms of the practical implications for students' education, the findings reveal that dealing with conflicting science-related information in the context of a crisis seems to be particularly challenging for students (e.g., as all participants reported higher information overload after the reflection task). Consequently, they might need additional guidance and support while engaging with such information, either individually or collaboratively. Our findings provide first insights into what aspects of students' reflection behavior hold potential for being addressed explicitly in training on digital competence or as an additional support function in social media contexts. First, to help students develop reflection skills for both levels of information processing–the emotional as well as cognitive level–, specific attention must be paid to the communicative settings when discussing digital competence in higher education (Carretero et al., 2017). In this study, for instance, participants in the individual setting more often reflected their uncertainty due to reading the conflicting texts, while participants in the collaborative condition more often reflected the pandemic in general. Thus, university educators as well as students themselves may consider both forms of communicative settings to reflect on the multiple aspects that could ultimately lead to a more competent sourcing of information.

Furthermore, the effect of collaborative reflection on participants' active coping strategies points to the supporting function of online communities in times of a crisis (for school contexts, Borup et al., 2020) as well as to the pivotal role of social presence in online contexts more generally (see also Richardson et al., 2017). Thus, it would be possible to specifically implement such collaborative support structures, which on the one hand take into account the (1) emotional states of the students and (2) how to provide adequate interventions (e.g., inform about that reading conflicting information may lead to confusion and stress and show possibilities on what to do to reduce this confusion). Accordingly, this would raise the question of how students' emotional states as well as their cognitive capabilities can be assessed adequately and how they can be approached individually in such interventions.

As we might all agree, studying at university goes beyond academic learning and skill development in a specific domain; rather, universities typically serve the additional function of creating a space for social interaction and exchange regarding topics that are important for students' everyday life contexts. This understanding suggests that it is critical to implement social spaces in online learning environments at universities that go beyond collaborative learning in official courses of the curriculum. However, students do not seem to automatically profit from the mere presence of another person with regard to emotional coping; thus, educators should be highly attentive to how to match students in social groups and should also be aware of their own role in shaping social support settings or interventions on how to promote students' successful cognitive as well as emotional engagement with online information.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EM-P and MZ conceived and presented the idea of the study, analyzed the data, were supported by CL in the analysis of data, and equally took the lead in writing the manuscript. CL was responsible for data collection. All authors engaged in writing sections of the manuscript and provided feedback and ideas.

FUNDING

This research was supported by the Einstein Center Digital Future (ECDF). We acknowledge support by the German Research Foundation (DFG) and the Open Access Publication Fund of Humboldt-Universität zu Berlin.

ACKNOWLEDGMENTS

We thank Thu Trang Phi and Lisa Ann Tinkl for their help in data collection and coding. We also thank Celeste Brennecka for language editing.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.728408/full#supplementary-material

REFERENCES

Adedoyin, O. B., and Soykan, E. (2020). Covid-19 pandemic and online learning: the challenges and opportunities. *Interact. Learn. Environ.* 1–13. doi: 10.1080/10494820.2020.1813180

Andreassen, R., and Bråten, I. (2013). Teachers' source evaluation self-efficacy predicts their use of relevant source features when evaluating the trustworthiness of web sources on special education. *Br. J. Educ. Technol.* 44, 821–836. doi: 10.1111/j.1467-8535.2012.01366.x

Asterhan, C. S. C. (2013). "Epistemic and interpersonal dimensions of peer argumentation: conceptualization and quantitative assessment," in *Affective Learning Together,* eds M. Baker, J. Andriessen, and S. Jarvela (New York, NY: Taylor & Francis Group), 251–272.

Awoke, M., Mamo, G., Abdu, S., and Terefe, B. (2021). Perceived stress and coping strategies among undergraduate health science students of jimma university amid the COVID-19 outbreak: online cross-sectional survey. *Front. Psychol.* 12:639955. doi: 10.3389/fpsyg.2021.639955

Bandura, A. (1997). *Self-efficacy: The Exercise of Control*. New York, NY: W H Freeman/Times Books/ Henry Holt & Co.

Barak, A., Boniel-Nissim, M., and Suler, J. (2008). Fostering empowerment in online support. *Comput. Hum. Behav.* 24, 1867–1883. doi: 10.1016/j.chb.2008.02.004

Beaunoyer, E., Dupéré, S., and Guitton, M. J. (2020). COVID-19 and digital inequalities: reciprocal impacts and mitigation strategies. *Comput. Hum. Behav.* 111:106424. doi: 10.1016/j.chb.2020.106424

Borup, J., Jensen, M., Archambault, L., Short, C. R., and Graham, C. R. (2020). Supporting students during COVID-19: developing and leveraging academic communities of engagement in a time of crisis. *J. Technol. Teach. Educ.* 28, 161–169.

Bråten, I., Anmarkrud, O., Brandmo, C., and Strømsø, H. I. (2014). Developing and testing a model of direct and indirect relationships between individual differences, processing, and multiple-text comprehension. *Learn. Instr.* 30, 9–24. doi: 10.1016/j.learninstruc.2013.11.002

Bromme, R., and Goldman, S. R. (2014). The public's bounded understanding of science. *Educ. Psychol.* 49, 59–69. doi: 10.1080/00461520.2014.921572

Bronstein, J. (2014). The role of perceived self-efficacy in the information seeking behavior of library and information science students. *J. Acad. Librarianship* 40, 101–106. doi: 10.1016/j.acalib.2014.01.010

Caena, F., and Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: the case for the European Digital Competence Framework for Educators (Digcompedu). *Eur. J. Educ.* 54, 356–369. doi: 10.1111/ejed.12345

Carretero, S., Vuorikari, R., and Punie, Y. (2017). *DigComp 2.1: The Digital Competence Framework for Citizens with Eight Proficiency Levels and Examples of Use.* JRC106281/EUR 28558 EN. Seville: Joint Research Centre.

Chen, J., Wang, M., Kirschner, P. A., and Tsai, C.-C. (2018). The role of collaboration, computer use, learning environments, and supporting strategies in CSCL: a meta-analysis. *Rev. Educ. Res.* 88, 799–843. doi: 10.3102/0034654318791584

Chin, C., and Osborne, J. (2008). Students' questions: a potential resource for teaching and learning science. *Stud. Sci. Educ.* 44, 1–39. doi: 10.1080/03057260701828101

Clarà, M., and Mauri, T. (2010). Toward a dialectic relation between the results in CSCL: three critical methodological aspects of content analysis schemes. *Int. J. Comput.-Support. Collab. Learn.* 5, 117–136. doi: 10.1007/s11412-009-9078-4

Csanadi, A., Kollar, I., and Fischer, F. (2020). Pre-service teachers' evi-dence-based reasoning during pedagogical problem-solving: better together? *Eur. J. Psychol. Educ.* 36, 147–168. doi: 10.1007/s10212-020-00467-4

Day, T., Chang, I.-C. C., Chung, C. K. L., Doolittle, W. E., Housel, J., and McDaniel, P. N. (2021). The immediate impact of COVID-19 on postsecondary teaching and learning. *Prof. Geogr.* 73, 1–13. doi: 10.1080/00330124.2020.1823864

De Los Santos, J. A. A., Labrague, L. J., and Falguera, C. C. (2021). Fear of COVID-19, poor quality of sleep, irritability, and intention to quit school among nursing students: a cross-sectional study. *Perspect. Psychiatr. Care [Online ahead of print]* doi: 10.1111/ppc.12781

Eden, A. L., Johnson, B. K., Reinecke, L., and Grady, S. M. (2020). Media for Coping During COVID-19 social distancing: stress, anxiety, and psychological well-being. *Front. Psychol.* 11:577639. doi: 10.3389/fpsyg.2020.577639

Farooq, A., Laato, S., and Islam, A. K. M. N. (2020). Impact of online information on self-isolation intention during the COVID-19 pandemic: cross-sectional study. *J. Med. Internet. Res.* 22:e19128. doi: 10.2196/19128

Ferrara, E., Cresci, S., and Luceri, L. (2020). Misinformation, manipulation, and abuse on social media in the era of COVID-19. *J. Comput. Soc. Sci.* 3, 271–277. doi: 10.1007/s42001-020-00094-5

Gharpure, R., Hunter, C. M., Schnall, A. H., Barrett, C. E., Kirby, A. E., Kunz, J. (2020). Knowledge and practices regarding safe household cleaning and disinfection for COVID-19 Prevention — United States, May 2020. *MMWR Morb. Mortal. Wkly. Rep.* 69, 705–709. doi: 10.15585/mmwr.mm6923e2

Goldman, S. R., and Scardamalia, M. (2013). Managing, understanding, applying, and creating knowledge in the information age: next-generation challenges and opportunities. *Cogn. Instr.* 31, 255–269. doi: 10.1080/10824669.2013.773217

Griffin, R. J., Dunwoody, S., and Neuwirth, K. (1999). Proposed model of the relationship of risk information seeking and processing to the development of preventive behaviors. *Environ. Res.* 80, S230–S245. doi: 10.1006/enrs.1998.3940

Händel, M., Stephan, M., Gläser-Zikuda, M., Kopp, B., Bedenlier, S., and Ziegler, A. (2020). Digital readiness and its effects on higher education students' socio-emotional perceptions in the context of the COVID-19 pandemic. *J. Res. Technol. Educ.* 1–13. doi: 10.1080/15391523.2020.1846147

Hendriks, F., Mayweg-Paus, E., Felton, M., Iordanou, K., Jucks, R., and Zimmermann, M. (2020). Constraints and affordances of online engagement with scientific information—a literature review. *Front. Psychol.* 11:572744. doi: 10.3389/fpsyg.2020.572744

Hinson, J., Distefano, C., and Daniel, C. (2003). The internet self-perception scale: measuring elementary students' levels of self-efficacy regarding internet use. *J. Educ. Comput. Res.* 29, 209–228. doi: 10.2190/BWGN-84AE-9AR6-16DY

Hong, H., and Kim, H. J. (2020). Antecedents and consequences of information overload in the COVID-19 pandemic. *Int. J. Environ. Res. Public. Health* 17:9305. doi: 10.3390/ijerph17249305

Howard, J., Huang, A., Li, Z., Tufekci, Z., Ždímal, V., Westhuizen, H.-M., et al. (2020). Face masks against COVID-19: an evidence review. *Gen. Med. Res. [preprint]* doi: 10.20944/preprints202004.0203.v3

Janke, S., and Glöckner-Rist, A. (2014). "Deutsche version der positive and negative affect schedule (PANAS)," in *Zusammenstellung Sozialwissenschaftlicher Items Skalen ZIS,* eds D. Danner, and A. Glöckner-Rist (Mannheim: GESIS), 1–14. doi: 10.6102/ZIS146

Jensen, J. D., Carcioppolo, N., King, A. J., Scherr, C. L., Jones, C. L., and Niederdeppe, J. (2014). The cancer information overload (CIO) scale: establishing predictive and discriminant validity. *Patient Educ. Couns.* 94, 90–96. doi: 10.1016/j.pec.2013.09.016

Kim, H. K., Ahn, J., Atkinson, L., and Kahlor, L. A. (2020). Effects of COVID-19 misinformation on information seeking, avoidance, and processing: a multicountry comparative study. *Sci. Commun.* 42, 586–615. doi: 10.1177/1075547020959670

Kuhn, D., and Moore, W. (2015). Argumentation as core curriculum. *Learn. Res. Pract.* 1, 66–78. doi: 10.1080/23735082.2015.994254

Kurbanoglu, S. (2003). Self-efficacy: a concept closely linked to information literacy and lifelong learning. *J. Doc.* 59, 635–646. doi: 10.1108/00220410310506295

Li, H. O.-Y., Bailey, A., Huynh, D., and Chan, J. (2020). YouTube as a source of information on COVID-19: a pandemic of misinformation? *BMJ Glob. Health* 5:e002604. doi: 10.1136/bmjgh-2020-002604

Li, X., and Lyu, H. (2021). Epidemic risk perception, perceived stress, and mental health during COVID-19 pandemic: a moderated mediating model. *Front. Psychol.* 11:563741. doi: 10.3389/fpsyg.2020.563741

Lim, M. S., and Choi, S. B. (2017). Stress caused by social media network applications and user responses. *Multimed. Tools Appl.* 76, 17685–17698. doi: 10.1007/s11042-015-2891-z

List, A., and Alexander, P. A. (2017). Cognitive affective engagement model of multiple source use. *Educ. Psychol.* 52, 182–199. doi: 10.1080/00461520.2017.1329014

Mason, L., Scrimin, S., Tornatora, M. C., and Zaccoletti, S. (2017). Emotional reactivity and comprehension of multiple online texts. *Learn. Individ. Differ.* 58, 10–21. doi: 10.1016/j.lindif.2017.07.002

Mayweg, E., and Jucks, R. (2017). Conflicting evidence or conflicting opinions? Two-Sided expert discussions contribute to experts' trustworthiness. *J. Lang. Soc. Psychol.* 37, 203–223. doi: 10.1177/0261927X17716102

Mayweg-Paus, E., and Macagno, F. (2016). How dialogic settings influence evidence use in adolescent students. *Z. Für Pädagog. Psychol.* 30, 121–132. doi: 10.1024/1010-0652/a000171

Mayweg-Paus, E., Thiebach, M., and Jucks, R. (2016). Let me critically question this! – Insights from a training study on the role of questioning on argumentative discourse. *Int. J. Educ. Res.* 79, 195–210. doi: 10.1016/j.ijer.2016.05.017

Metzger, M. J., and Flanagin, A. J. (2013). Credibility and trust of information in online environments: the use of cognitive heuristics. *J. Pragmat.* 59, 210–220. doi: 10.1016/j.pragma.2013.07.012

Miller, E. D. (2020). Loneliness in the Era of COVID-19. *Front. Psychol.* 11:2219. doi: 10.3389/fpsyg.2020.02219

Mohammed, M., Sha'aban, A., Jatau, A. I., Yunusa, I., Isa, A. M., Wada, A. S., et al. (2021). Assessment of COVID-19 information overload among the general public. *J. Racial Ethn. Health Disparities [Online ahead of print]* doi: 10.1007/s40615-020-00942-0

Motta Zanin, G., Gentile, E., Parisi, A., and Spasiano, D. (2020). A Preliminary evaluation of the public risk perception related to the COVID-19 health emergency in Italy. *Int. J. Environ. Res. Public. Health* 17:3024. doi: 10.3390/ijerph17093024

Mullins, D., Rummel, N., and Spada, H. (2011). Are two heads always better than one? Differential effects of collaboration on stu- dents' computer-supported learning in mathematics. *Int. J. Comput.-Supported Collaborat. Learn.* 6, 421–443. doi: 10.1007/s11412-011-9122-z

Nagler, R. H., Vogel, R. I., Gollust, S. E., Rothman, A. J., Fowler, E. F., and Yzer, M. C. (2020). Public perceptions of conflicting information surrounding COVID-19: results from a nationally representative survey of U.S. adults. *PLoS One* 15:e0240776. doi: 10.1371/journal.pone.0240776

Noroozi, O., Weinberger, A., Biemans, H. J. A., Mulder, M., and Chizari, M. (2012). Argumentation-Based Computer Supported Collaborative Learning (ABCSCL): a synthesis of 15 years of research. *Educ. Res. Rev.* 7, 79–106. doi: 10.1016/j.edurev.2011.11.006

Osimo, S. A., Aiello, M., Gentili, C., Ionta, S., and Cecchetto, C. (2021). The influence of personality, resilience, and alexithymia on mental health during COVID-19 pandemic. *Front. Psychol.* 12:630751. doi: 10.3389/fpsyg.2021.630751

Oyetunji, T. P., Ogunmola, O. A., Oyelakin, T. T., Olorunsogbon, O. F., and Ajayi, F. O. (2021). COVID-19-related risk perception, anxiety and protective behaviours among Nigerian adults: a cross-sectional study. *J. Public Health [Online ahead of print]* doi: 10.1007/s10389-021-01502-4

Procentese, F., Capone, V., Caso, D., Donizzetti, A. R., and Gatti, F. (2020). Academic community in the face of emergency situations: sense of responsible togetherness and sense of belonging as protective factors against academic stress during COVID-19 outbreak. *Sustainability* 12:9718. doi: 10.3390/su12229718

Ramondt, S., and Ramírez, A. S. (2018). Assessing the impact of the public nutrition information environment: adapting the cancer information overload scale to measure diet information overload. *Patient Educ. Couns.* 102, 37–42. doi: 10.1016/j.pec.2018.07.020

Richardson, J. C., Maeda, Y., Lv, J., and Caskurlu, S. (2017). Social presence in relation to students' satisfaction and learning in the online environment: a meta-analysis. *Comput. Hum. Behav.* 71, 402–417. doi: 10.1016/j.chb.2017.02.001

Rouet, J., and Britt, M. (2012). *Relevance Processes in Multiple Document Comprehension*. Available online at: /paper/Relevance-processes-in-multiple-document-Rouet-Britt/3915f5c4f3fd4b6d60f396410913ff846a66f05c (accessed April 23, 2021).

Skinner, E. A., Edge, K., Altman, J., and Sherwood, H. (2003). Searching for the structure of coping: a review and critique of category systems for classifying ways of coping. *Psychol. Bull.* 129, 216–269. doi: 10.1037/0033-2909.129.2.216

Tang, Y., and Tseng, H. W. (2013). Distance Learners' Self-efficacy and information literacy skills. *J. Acad. Librariansh.* 39, 517–521. doi: 10.1016/j.acalib.2013.08.008

van Ingen, E., Utz, S., and Toepoel, V. (2016). Online coping after negative life events: measurement, prevalence, and relation with internet activities and well-being. *Soc. Sci. Comput. Rev.* 34, 511–529. doi: 10.1177/0894439315600322

Wang, Y., Jing, X., Han, W., Jing, Y., and Xu, L. (2020). Positive and negative affect of university and college students during COVID-19 outbreak: a network-based survey. *Int. J. Public Health* 65, 1437–1443. doi: 10.1007/s00038-020-01483-3

Watermeyer, R., Crick, T., Knight, C., and Goodall, J. (2020). COVID-19 and digital disruption in UK universities: afflictions and affordances of emergency online migration. *High. Educ.* 81, 623–641. doi: 10.1007/s10734-020-00561-y

Zimmermann, M., and Jucks, R. (2018). How experts' use of medical technical jargon in different types of online health forums affects perceived information

credibility: randomized experiment with laypersons. *J. Med. Internet Res.* 20:e8346. doi: 10.2196/jmir.8346

Zimmermann, M., and Mayweg-Paus, E. (2021). The role of collaborative argumentation in future teachers' selection of online information. *Z. Pädagog. Psychol.* 35, 1–14. doi: 10.1024/1010-0652/a000307

Zimmer-Gembeck, M. J., and Skinner, E. A. (2016). "The development of coping: implications for psychopathology and resilience," in *Developmental Psychopathology,* ed. D. Cicchetti (Atlanta, GA: American Cancer Society), 1–61. doi: 10.1002/9781119125556.devpsy410

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 11 October 2021
doi: 10.3389/fpsyg.2021.733554

Impact of Synchronous and Asynchronous Settings of Online Teaching and Learning in Higher Education on Students' Learning Experience During COVID-19

Sabine Fabriz, Julia Mendzheritskaya and Sebastian Stehle*

Department of Educational Psychology, Institute of Psychology, Goethe University, Frankfurt, Germany

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Franco Zengaro, Jacksonville State University, United States
Lori Xingzhen Gao, Taiyuan University of Technology, China
Kerry Shephard, University of Otago, New Zealand

***Correspondence:**
Sabine Fabriz
fabriz@psych.uni-frankfurt.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *15 September 2021*
Published: *11 October 2021*

Citation:
Fabriz S, Mendzheritskaya J and Stehle S (2021) Impact of Synchronous and Asynchronous Settings of Online Teaching and Learning in Higher Education on Students' Learning Experience During COVID-19. Front. Psychol. 12:733554. doi: 10.3389/fpsyg.2021.733554

The sudden impact of the COVID-19 pandemic challenged universities to provide students with online teaching and learning settings that were both immediately applicable and supportive of quality learning. This resulted in a broad variety of synchronous and asynchronous online settings of teaching and learning. While some courses balanced both kinds, others offered either predominantly synchronous or asynchronous teaching and learning. In a survey study with students ($N = 3{,}056$) and teachers ($N = 396$) from a large German university, we explored whether a predominance of synchronous or asynchronous teaching and learning settings in higher education was associated with certain student experiences and outcomes. Additionally, we examined how well these two types of teaching and learning settings support students' basic psychological needs for autonomy, competence, and relatedness proposed by self-determination theory (SDT). Data were collected after the first online semester due to the COVID-19 pandemic. The results imply that from the students' perspective, the teaching methods involved in the two settings of teaching and learning differ with regard to their potential to support social interaction and to support basic psychological needs as proposed by SDT. Students who studied mostly in synchronous settings reported more peer-centered activities such as feedback in comparison to students in mostly asynchronous settings. In contrast, teachers perceived fewer differences between teaching methods in synchronous and asynchronous settings, especially regarding feedback activities. Further, students in mostly synchronous settings reported greater support of their basic psychological needs for competence support and relatedness as well as a greater overall satisfaction with the online term compared to students in mostly asynchronous settings. Across all students, greater fulfillment of psychological needs and higher technology acceptance coincided with outcomes that are more favorable. Implications for the post-pandemic classroom are drawn.

Keywords: higher education, self-determination theory (SDT), COVID-19, teaching and learning settings, online learning

INTRODUCTION

The sudden need to adapt to online teaching and learning due to the COVID-19 pandemic challenged the digital readiness of teachers and students all over the world (Bao, 2020; Crawford et al., 2020; Demuyakor, 2020; Händel et al., 2020; International Association of Universities, 2020). The result, called *emergency remote teaching* (ERT, Hodges et al., 2020), included a great amount of improvisation and *ad hoc* strategies that need to be contrasted to well-planned online learning scenarios (e.g., Rapanta et al., 2020). The initial emergency state has since transitioned into the *post-pandemic* or *post-COVID classroom* (Curtin, 2021), in which higher education institutions have the opportunity to integrate those remote teaching practices which have proven their worth into thoroughly planned online or blended learning arrangements while refining or omitting ineffective practices.

In ERT, almost all face-to-face teaching was substituted through online teaching formats (Zawacki-Richter, 2020; Cicha et al., 2021; Goertz and Hense, 2021). This transition was accompanied by the awareness that the pedagogy needed to be adapted to the new medium in the sense that simply moving pedagogy from one medium into another was not enough to ensure quality learning (Henriksen et al., 2020). In addition, students and teachers not only needed new skills in handling technology but also in interacting with each other, resulting in newly shaped roles (Coppola et al., 2002; Arbaugh, 2004; Granitz and Koernig, 2011; Blumentritt et al., 2020). During the pandemic, the social aspect of university learning was especially challenging, resulting in reports of anonymity and a lack of social presence. In a study prior to the pandemic, Daigle and Stuvland (2020) found this lack to account for differences between modalities regarding, for example, lower satisfaction with online learning. They described this as the *social presence gap* and claimed that teachers should invest in overcoming this gap to equalize outcomes across modalities. For many students, the unaccustomed distance in their learning was challenging, for example, Bedenlier et al. (2020) found that students felt uncomfortable using their webcams in synchronous settings. The authors attributed this to the unfamiliar setting, in which they constantly see themselves, and it remains unclear who can see them. Also, students perceived diffuse relationships to their peers and were less likely to experience social support in settings of online learning compared to traditional settings (Bedenlier et al., 2020). In addition, many students also reported an increased workload (Aristovnik et al., 2020). Overall, these findings stress the importance to carefully consider students' learning experience when tackling the question of how to engage them in online learning.

In online learning, two basic settings are often compared, asynchronous and synchronous. They differ in terms of time and place of teaching and learning activities: Asynchronous settings are temporally and geographically independent and defined as more individually based and self-paced as well as less instructor-dependent (Bernard et al., 2004; Murphy et al., 2011; Clark and Mayer, 2016; Xie et al., 2018). They, however, also bear challenges, as also implied by the media richness (Daft and Lengel, 1984; Blau et al., 2017) and media naturalness (Blau et al., 2017) approaches. The media richness approach describes the "capability of a medium to (1) provide immediate feedback (2) transmit verbal and non-verbal communication cues (3) provide a sense of personalization, and (4) simulate a natural language" (Blau et al., 2017), whereas for the degree of medium naturalness, face to face is considered to be the most natural form of communication. This results in synchronous learning environments to be less natural and less "rich" than face-to-face synchronous learning environments. The authors therefore claim that this leads to higher cognitive load, greater communication ambiguity, and lower activation. And albeit asynchronous teaching can enable students to work self-paced and independently of time and place (van der Keylen et al., 2020), not all learners are equipped with the according strategies to benefit from this potential advantage: Learning at home, especially in asynchronous contexts, requires more self-study skills to stay on track, including enough motivation and will to follow learning goals (*cf.* Hartnett, 2015). Also, students must be equipped with strong digital skills to perform academic work and successfully complete learning activities (Kim et al., 2019).

The main strengths of synchronous online learning are the real-time interpersonal communication, the use of natural language, and immediate feedback (Blau et al., 2017). These attributes can diminish the difference between online and face-to-face learning in this manner and provide a sense of personalization. In contrast, synchronous communication has been found to be less useful for discussing complex ideas or deep reflection (for a review, see Hrastinski, 2010). For students, learning experience, positive outcomes, and the type of performance matter: They acquire practical skills better when they are taught in a synchronous online setting (Nsa et al., 2012; Ogbonna et al., 2019), whereas cognitive achievement, such as producing meaningful and thoughtful contributions, is greater in asynchronous settings (Hrastinski, 2008; Garrison, 2011; Ogbonna et al., 2019). Also, synchronous learning positively impacts learners' commitment and their task motivation (Hrastinski, 2008). At the same time, similar to face-to-face settings, the danger of disengaged participation in class (e.g., passive listening or watching the teacher's lecture, silently reading peer statements in the chat) has to be considered (Smith and Smith, 2014). According to an interview study with experts on online teaching by Rapanta et al. (2020), videoconferencing decreases the fluency of interaction and makes interactions slower and attention lower compared to traditional teaching (Rapanta et al., 2020). Another challenge of synchronous learning relates to the technical infrastructure that has to allow for participation in live remote settings in a sufficient quality (i.e., internet bandwidth; Xie et al., 2018).

Research findings regarding the impact of synchronous and asynchronous teaching settings on student performance are not without ambiguity. Nieuwoudt (2020) found that it did not make a difference for student achievement whether students attended synchronous virtual classes or watched the recordings of the virtual classes. However, the sheer time students participated in and interacted with the online learning system

did significantly affect their academic success. Also, active participation in both synchronous and asynchronous online learning opportunities has been found to result in higher engagement and better academic outcomes than attending face-to-face classes only (Northey et al., 2015).

In order to scrutinize the impacts of synchronous and asynchronous online teaching and learning on student variables, it is necessary to consider the role of specific teaching methods and the underlying pedagogy of the online courses (Murphy et al., 2011). Synchronous and asynchronous settings differ in the choice of tools used and their pedagogical objectives. Xie et al. (2018) identified five variables to differentiate between synchronous and asynchronous settings: communication tools, feedback types, input methods, collaboration modes, and the skills targeted. The researchers find that while students are more satisfied with asynchronous communication tools (such as discussion forums or email communication), they also appreciate the possibility of direct instructor feedback in synchronous settings. Also, both the quality of learner-content interaction (i.e., reading interactive texts, watching videos, and completing assignments), and learner-teacher interaction (i.e., providing feedback, providing summative and formative assessments, and documenting students' progress) have a strong effect on satisfaction with learning and perceived learning, especially in asynchronous formats (Kuo et al., 2014; Nandi et al., 2015; Alqurashi, 2019; Fredericksen et al., 2000). Activities, such as online discussions, are perceived as more individualistic and less cooperative by students in asynchronous compared to synchronous settings and are also associated with greater negative effects and a decreased sense of belonging (Peterson et al., 2018). In contrast, learners characterize participation in online synchronous discussions as more focused, having a stronger sense of contribution, increasing motivation, and supporting better course performance than asynchronous discussions (Chen and You, 2007; Hrastinski, 2008, 2010; Malkin et al., 2018). Discussing teaching and learning methods to facilitate communication within synchronous and asynchronous educational settings, researchers stress the necessity to differentiate between various types of activation and interaction and ways how students are engaged in the learning process as more crucial for study success compared to the form of course delivery (Zhu, 2006; Skylar, 2009; Nieuwoudt, 2020; Rapanta et al., 2020; Sweetman, 2021).

Applying criteria for interactivity, teaching and learning methods can be classified in methods with higher versus lower interaction potential. Interactivity in this context refers to the possibility for learners to be socially and cognitively engaged in (1) interaction with content through learning materials, (2) interaction with peers, and (3) interaction with teachers (Anderson, 2003). According to this classification, collaborative formats as discussion, feedback, and working in small groups have higher potential to support social interaction and engagement of students in contrast to lecturing, self-assessments, or individual work which have higher potential for content-oriented interaction in online learning (Rapanta et al., 2020). Similar aspects of student activation and interaction are considered in a well-established classification of student-centered and teacher-centered teaching and learning methods that are usually linked to different degrees of active or correspondently passive learning (Kain, 2003; Chi, 2009; Biggs and Tang, 2011; Wright, 2011) including online learning as well (e.g., Reaburn et al., 2009). A distinguishing parameter of asynchronous versus synchronous online learning is the prevailing learner-content (*via* learning materials) interaction in asynchronous settings in comparison with learner-instructor or learner-learner interaction (Alqurashi, 2019).

Engaging students in online learning is considered a pivotal prerequisite for their success (Chiu, 2021). Also, learners' motivational characteristics, such as technology acceptance, are often considered factors that can influence achievement or learning satisfaction in synchronous versus asynchronous online courses. The self-confidence in utilizing technologies used in the online course or communicating with a teacher or peers *via* tools is strongly linked to perceived learning and satisfaction (Shen et al., 2013; Alqurashi, 2016; Malik and Fatima, 2017). In general, the facets of technology acceptance – *perceived ease of use* (PEOU) and *perceived usefulness* – are considered significant factors for adopting online teaching and learning environments (see Šumak et al., 2011 for a meta-analysis), irrespective to the type of online resource (e-learning system or single e-learning tool/technology). Recent studies add evidence on the role of technology acceptance in adoption of specific technology-based activities such as online collaboration for problem-based scenarios (Cheung and Vogel, 2013). Very few studies pay attention to the role of technology acceptance in utilizing online learning under the circumstances of the COVID-19 pandemic (i.e., Cicha et al., 2021) showing new patterns of interrelations between technology acceptance, computer anxiety, and self-efficacy.

To investigate prerequisites for learning motivation in synchronous and asynchronous online learning, the self-determination theory (SDT, Ryan and Deci, 2000) presents a befitting framework (Hartnett, 2015; Chiu, 2021). SDT argues that three fundamental psychological needs have to be satisfied for people to act intrinsically motivated in a given environment and to engage with learning: First, people need to feel self-determining or autonomous in their decisions and, through this experience, a sense of control. Second, they need to feel competent or capable to comply with the demands of a given task. Third, they have to feel socially related to or included in a group of others. If a learning context satisfies these basic psychological needs, learners are likely to act intrinsically motivated by, for example, engaging actively in the learning tasks, showing enhanced performance and demonstrating greater endurance when faced with obstacles (Schunk et al., 2014). The key concept for supporting motivation in SDT is the social context. In learning settings, social interactions with the teacher and fellow students can all provide the basic needs of autonomy, competence, and relatedness. One of the benefits of SDT is that it equips teachers with practical advice regarding the kinds of social interactions that students need in order to provide sufficient support for all three basic needs (e.g., granting choice regarding contents or the execution of tasks, offering informational feedback, and assigning group tasks; e.g., Reeve

and Jang, 2006). SDT has been successfully applied to classic face-to face-educational settings (Niemiec et al., 2006): Previous studies show that SDT can predict a range of learning outcomes, such as performance, persistence, and course satisfaction (Deci and Ryan, 1985). The social context of online learning differs fundamentally from that of traditional face-to-face learning: Communication takes place through video conferencing tools, forums, chat tools, or email in asynchronous settings, because learners and teachers in online settings of teaching and learning are separated by time, distance, or both. Thus, it seems reasonable to pay special attention to the social context when investigating the link between online learning and teaching settings and learning motivation. For example, previous studies have shown that lack of teacher input, not having a genuine reason to communicate online with peers, low self-efficacy, and time and technology constraints can lower motivation (Xie et al., 2006; Artino, 2007; Cheung et al., 2008; Moos and Azevedo, 2008; Hartnett et al., 2011). By emphasizing the importance of the social context for motivation, SDT is particularly suited to the context of online learning. Some research has previously applied SDT to online learning and learning: A recent study by Chiu (2021) investigated how SDT could explain engagement of students in high school during COVID-19 and found that especially the support of relatedness was important. Also, Hartnett (2015) adopted SDT to an online environment and identified several influences that might undermine the psychological needs: high workload, assessment pressure, perceptions that the learning activity lacked relevance (autonomy-undermining), unclear and complicated guidelines, insufficient guidance and feedback from the teacher (competence-undermining), and communication issues with peers (relatedness-undermining). Chen and Jang (2010) used structural equation modeling to test a model for online learner motivation based on SDT. While they found support for the association of contextual support, satisfaction of the three basic needs and student motivation, self-reported motivation failed to predict learning outcomes. However, in a similar approach, Hsu et al. (2019) showed that satisfying the basic needs enhances self-regulated motivation, which is associated with higher perceived knowledge transfer and increased achievement of course objectives. Various studies showed that self-reported student motivation is positively associated with the quantity as well as quality of learning behavior in online teaching and learning settings, such as actively posting messages to an online learning platform (Xie et al., 2006; Hartnett, 2012). Xie et al. (2006) also found that student motivation is associated with teacher behavior, as for example, participation, guidance, and feedback.

The present study investigates how synchronous and asynchronous settings of teaching and learning during the 2020 lockdown affected student learning experience, including learning motivation, but also general satisfaction, learning behavior, and reported learning outcomes. The presented prior research on synchronous and asynchronous online learning stressed potentials and challenges of either setting, leading us to a partly explorative approach in this research to be able to provide a description of how synchronous and asynchronous teaching and learning settings in ERT were characterized by students and teachers regarding the applied teaching methods. A potential distinguishing factor between synchronous and asynchronous teaching and learning is how they facilitate social interaction between agents, why we chose to explore whether the settings differed in teaching methods and whether prerequisites for students engagement as proposed by SDT, (Ryan and Deci, 2000) are met differently between settings. Summarizing the above-mentioned studies on factors influencing online learning, we can classify them mainly in three groups – (1) learner-related variables (i.e., satisfaction, needs, and skills) (2) learning environment-related variables (i.e., synchronicity and potential for interactivity of online courses), and (3) teacher-related variables (i.e., applied teaching methods and teaching practices). Overall, we assume that a greater fulfillment of SDT needs should be associated with as more positive learning experience, as for example, a higher satisfaction with online learning and a higher reported support of SDT needs. Also, we assume that students who are more likely to accept online tools as useful and easy to use experience online learning during the pandemic as more positive.

Therefore, the following research questions frame our study:

Q1 a How are synchronous and asynchronous teaching and learning settings characterized by students and teachers regarding the applied teaching methods?

Q1 b Based on the proposed classification of methods regarding their potential to facilitate social interaction: What types of interaction are promoted in synchronous and asynchronous teaching and learning settings as reported by students and teachers?

Q2 Do students who experienced mostly asynchronous online teaching and learning report different overall evaluations of the online semester, fulfillment of basic psychological needs (SDT) as well as different learning gains compared to their peers who experienced mostly synchronous online teaching and do the teachers' views validate students' evaluations?

Q3 Is a more positive learning experience (overall evaluations of the online semester, self-reported learning gain) associated with
   a) greater fulfillment of students' basic psychological needs proposed by SDT?
   b) greater acceptance of online tools?

MATERIALS AND METHODS

Sample

The study reports data from both a student and a teacher online survey from a large German public university. The surveys were initiated by the university's department of teaching and quality assurance in collaboration with representatives of other departments associated with teaching and learning. About 46,000 students are enrolled at the university, which employs about 3,500 research and teaching faculty. For the surveys, a randomly selected 50% percent of the student body and the teaching faculty were contacted, while making sure that teachers

and students from all faculties received invitations. The other 50% of students and faculty were invited to participate in another survey focusing on examinations during COVID-19, the results of which are not part of the present paper. A total of 3,056 students completed the survey (return rate = 15%, female = 65.8%) as well as 396 teaching faculty (return rate = 33%, female = 39.1%). **Table 1** contains further information about the student and teacher samples, including disciplinary clusters and students' expected degrees. Both groups showed representativeness for the disciplines involved. On average, participating students were enrolled in their 4.9th semester ($SD = 3.34$), and teachers reported an average number of 20.01 semesters ($SD = 17.43$) of teaching experience. Note that students and teachers represent independent samples within the university and are not matched.

Context of the Study

The surveys aimed to provide the university with a comprehensive feedback from students and teaching faculty on their experiences with the first online study term during the 2020 lockdown in Germany. This paper mainly reports select results from the student survey, but also refers to additional variables from the teacher survey to add a complementary perspective.

Material

The student and the teacher surveys were carried out in German and were administered using EvaSys 7.0 software. The participation was voluntary and not linked to any credit. After providing their informed consent, participants anonymously answered the survey questions. Data were collected after the lecture period of the summer term; the survey was online from August until mid of September in 2020. All data were handled confidentially and securely on EvaSys and archived on a password-protected server. Due to the overall length of the surveys, all applied scales had to be shortened and were also adapted to fit the context of the study; other variables were measured through single items only. This article focuses on a number of selected variables that will be explained in further detail in the following.

Student Survey

The student survey was designed to cover students' views on the first online semester during the 2020 pandemic. It comprised background variables as well as evaluations of their study experience.

Teaching and Learning Methods

Students were asked to rate the frequency (1 = *never* to 4 = *very frequent*) of 11 different teaching and learning methods across all their courses. Teaching and learning methods were identified based on Alqurashi (2019) and included synchronous and asynchronous activities as well as methods that could be used in either setting (see **Table 2**). Following approaches differentiating learning activities in accordance with interaction types (Anderson, 2003; Chi, 2009), we propose a classification aimed to classify teaching and learning methods regarding their potential to facilitate social interaction (comprising learner-learner and learner-teacher interaction, see **Table 2**).

Individual Assessment of the Study Term

In single items, students were asked to evaluate their overall *satisfaction with the online term* (1 = *strongly disagree* to 6 = *strongly agree*), whether they experienced – in comparison with traditional teaching – *additional strains* (1 = *strongly disagree* to 6 = *strongly agree*) and additional workload through the online teaching. Students were also asked in which ratio they experienced *synchronous teaching and learning* across all their courses (1 = *all synchronous* to 5 = *all asynchronous*). Following the operationalization by Murphy et al. (2011), synchronous online teaching was understood as a temporally dependent arrangement between students and teachers, defined as weekly courses with fixed timeslots, whereas asynchronous teaching was defined by the absence of fixed weekly time slots, that is, temporally independent.

TABLE 1 | Student and teacher samples by disciplinary cluster and expected degree (for students).

	Students		Teachers	
	n	**%**	***n***	**%**
Disciplinary cluster				
Humanities	786	25.7	136	34.3
Social sciences	882	28.9	126	31.8
Natural sciences	768	25.1	120	30.3
Teacher education	548	17.9	–[a]	–
Other (interdisciplinary, "I do not know," n.s.)	72	2.4	14 (n.s.)	3.5
Expected degree				
BA	1,374	45		
MA	481	15.7		
State examination teacher	548	17.8		
State examination other	613	20.1		
Other (e.g., Magister, n.s.)	40	1.4		

[a]*All faculty members in teacher education are associated through their disciplinary faculty and listed thereunder.*

TABLE 2 | Classification of teaching and learning methods classified regarding their synchronicity and potential to facilitate social interaction.

Synchronicity/ delivery form	Teaching and learning methods	Potential to facilitate social interaction	
		Lower	Higher
Synchronous	discussions *via* chat tools or videoconferencing/breakout rooms		●
	practical work/labs		●
	group work		●
	(online) office hours		●
	lectures or student presentations *via* videoconferencing	●	
	discussions *via* forums		●
Asynchronous	self-tests or self-assessments *via* LMS	●	
	recorded lectures or student presentations	●	
Both synchronous and asynchronous	teacher feedback to students		●
	peer feedback		●
	student feedback to teacher		●

Self-Determination

To assess the perceived fulfillment of the base psychological needs proposed by SDT, we applied a questionnaire by Rösler et al. (2016). In three subscales, *autonomy support, competence support, and relatedness* were assessed by three items each:

- Autonomy support: (1) *I was able to complete assigned tasks my way.* (2) *I was able to manage time in my studies myself.* (3) *I had the opportunity to engage with contents I found interesting more intense.*
- Competence support (1) *I received clear and detailed feedback on my learning results.* (2) *I was provided with distinct information on how to improve.* (3*) When there were difficulties, I was able to get support at any given time.*
- Relatedness (1) *Overall, I experienced a feeling of belonging in my virtual courses*. (2) *The atmosphere amongst students was friendly and relaxed*. (3) *I felt comfortable amongst my fellow students.*

All items were answered on a 6-point rating scale (1 = *does not apply* to 6 = *fully applies*; autonomy support: $\alpha = 0.75$; competence support: $\alpha = 0.86$; relatedness: $\alpha = 0.81$).

Learning Gain

Students were asked to rate their *overall gain* in five distinct learning areas: content-related skills, method-related skills, digital skills, content interest, and autonomous learning (1 = *very little* to 6 = *considerably*).

Learning With Digital Tools

To assess the quality of learning with digital tools, we included a single item: Whether the constant availability of learning material led students to procrastinate (1 = *does not apply* to 6 = *fully applies).* We also included a shortened version of the *learning content interaction* subscale from a questionnaire by Alqurashi (2019) to measure how students judged their learning with online material (learner-content interaction, LCI). The three items were rated from 1 = *does not apply* to 6 = *fully applies* ($\alpha = 0.91$): (1) O*nline course materials helped me to understand better the class content.* (2) *Online course materials stimulated my interest for this course.* (3) *Online course materials helped relate my personal experience to new concepts or new knowledge.* Referring to the Technology Acceptance model (Davis, 1989; Davis et al., 1989), we assessed the *perceived ease of use* (PEOU) as well as the *perceived usefulness* (PU) of online tools in teaching by each two items, that were answered on a 6-point rating scale (1 = *does not apply* to 6 = *fully applies* (PEOU: $\alpha = 0.82$; PU: $\alpha = 0.85$).

- Perceived ease of use: (1) *I find the online tools in teaching easy to use*. (2) *I find online tools in teaching to be flexible to interact with.*
- Perceived usefulness: (1) *Using online tools in teaching makes my learning more effective.* (2) *I find the online tools in teaching useful in structuring my learning.*

Teacher Survey

From the comprehensive teacher survey, we focus on the following selection of single items:

Evaluation of own teaching. Teachers were asked to rate their *overall satisfaction* with the online term (1 = *strongly disagree* to 6 = *strongly agree*) and to compare the *effort to prepare and perform teaching* with their usual experience (1 = *far less* to 6 = *far more*). Furthermore, they were asked to state whether their *digital competences* enhanced during the online semester (1 = *very little* to 6 = *considerably*). As with the students, teachers were asked to rate whether they taught more synchronously or asynchronously on a 5-point rating scale (1 = *all synchronous* to 5 = *all asynchronous*) as well to rate the frequency (1 = *never* to 4 = *very frequent*) of teaching and learning methods across all their courses (see **Table 2**).

Evaluation of student variables. Teachers were asked to rate whether students seemed to be more burdened in this semester than they usually are, whether students seemed to be overwhelmed by the number of digital tools, and whether

the teacher thought that most of their students had problems in organizing their own learning at home. All three items were answered on a 6-point rating scale from 1 = *does not apply* to 6 = *fully applies*.

Analyses

Based on the nature of our research questions, we included descriptive analyses (Q1a and Q1b), as well as analyses of group differences (Q1a, Q1b, and Q2), and the evaluation of associations between variables (Q3). To address possible group differences, we computed univariate ANOVAs. For associations between variables, we applied two-sided Pearson's correlations. Data were analyzed using SPSS (Version 26).

RESULTS

In preparation to further analyses, we dichotomized *synchronicity of teaching* for students and teachers to enable a comparison of extreme groups. For both samples, we merged the lower two (= mostly synchronous, students; $n = 1{,}020$; 33.4%; teachers: $n = 149$; 37.6%) and the upper two values (= mostly asynchronous, students: $n = 825$; 27%; teachers: $n = 130$; 32.9%) while omitting the middle category (= "a bit of both," students: $n = 999$; 32.7%; teachers: $n = 100$; 25.3%)

(1a) To answer the research question how synchronous and asynchronous teaching and learning settings are characterized by students and teachers regarding the applied teaching methods, we first viewed the reported frequencies as a function of the two teaching and learning settings (see **Figure 1**, for the exact descriptive statistics, see **Tables 3, 4**). The descriptive results show that lectures and presentations were by far the most common method – videotaped for the mostly asynchronous groups and live *via* videoconferencing for the mostly synchronous groups. Unsurprisingly, practical work was reported as least frequent in all groups. We followed up with a more detailed analysis of the descriptive results.

We conducted two univariate ANOVAs to test the assumption that the frequency of reported teaching and learning methods is dependent on the synchronicity of courses participated in (for students) or conducted (for teachers). The results revealed that students in the mostly asynchronous group reported significantly more recorded lectures or student presentations, as well as more discussions *via* online forums (LMS), with both methods being an integral part of the concept of asynchronous settings (see **Table 3**). Students in the mostly synchronous group reported significantly more lectures or student presentations *via* videoconferencing as well as more discussions *via* chat tools or breakout rooms, with both methods being an integral part of the concept of synchronous settings. As expected, students experiencing mostly synchronous settings also reported significantly more practical or lab work. They also reported higher frequencies for all the three forms of feedback activities (peer feedback, teacher feedback, and student feedback to the teacher) which are not conceptually tied to a specific setting. No significant differences could be found in reported frequencies of group work, self-assessments, and (online) office hours between synchronous and asynchronous groups.

In addition, teachers in the mostly asynchronous group reported high frequencies of recorded lectures or student presentations and organizing discussions *via* forum (LMS; **Table 4**). Additionally, the offer of online office hours was significantly higher in the mostly asynchronous group compared to the mostly synchronous. Similar to the student perspective, lecturing and organizing discussions *via* videoconferencing were also perceived by teachers in the mostly synchronous group as significantly more prevalent. No significant differences from the teachers' perspective could be found for the reported frequencies of group work, self-assessments, and practical work/laboratories as well as for all three types of feedback (peer feedback, teacher feedback, and student feedback to the teacher) between synchronous and asynchronous groups.

Thus, students and teachers perceived the teaching and learning methods in synchronous and asynchronous settings differently: Teachers perceived fewer difference between teaching and learning methods in synchronous and asynchronous settings compared to students, especially in relation to feedback activities, which students reported as more frequent in synchronous settings. Another difference relates to (online) office hours that teachers offer more frequently when they teach more asynchronously compared to the mostly synchronous group. Here, students reported no difference

(1b) To answer the research question concerning prevailing types of interaction (lower vs. higher potential to facilitate social interaction) in synchronous and asynchronous teaching and learning settings, we qualitatively analyzed the reported teaching and learning methods, based on the proposed classification of their potential to facilitate social interaction displayed in **Table 2**. In summary, students in the mostly synchronous group experienced more teaching and learning activities with higher potential to support social (practical or lab work as well as the three types of feedback activities) as opposed to methods with lower potential to support social interaction (e.g., lectures *via* videoconferencing). In contrast, students in the mostly asynchronous group reported more methods with lower potential to facilitate social interaction (e.g., tests and recorded lectures) as opposed to methods with higher potential to support social interaction (e.g., forums and feedback activities). At the same time, teachers perceived teaching and learning methods in both learning environments as balanced in facilitating all types of interaction

(2) Regarding the second research question, student variables on the individual learning experience, SDT, and the reported learning gain were compared for group differences. For an overview, descriptive results of student variables are displayed in **Table 5** across all students together with their intercorrelations. Almost all of the intercorrelations are significant indicating a likely overall factor behind the student ratings.

Table 6 displays the descriptive results for the two student groups with primarily synchronous and asynchronous teaching. Descriptive statistics for the selected teacher variables can be found in **Table 7**. The results suggest an overall medium

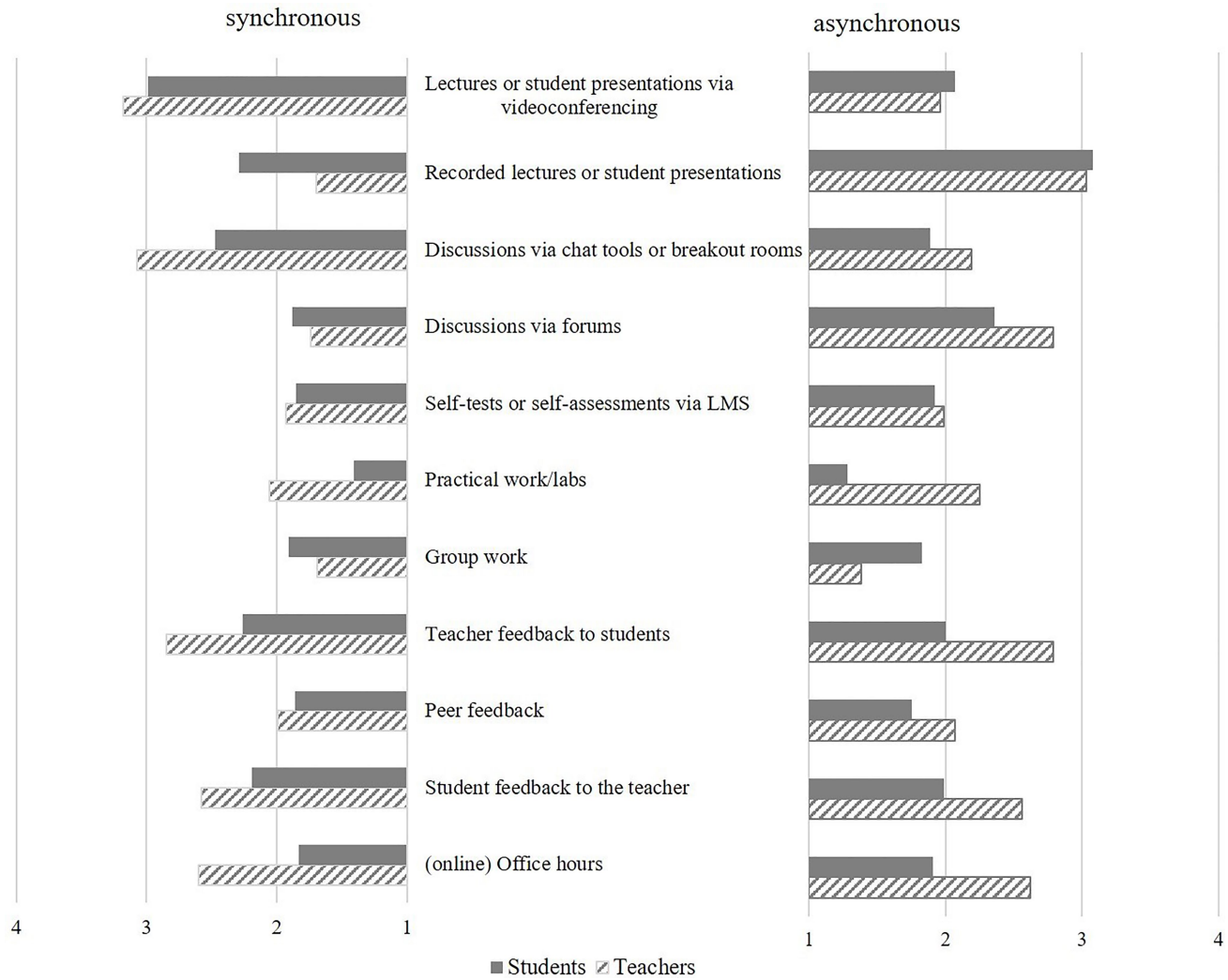

FIGURE 1 | Reported mean frequencies of teaching and learning methods (1 = *never* to 4 = *very frequent*) in synchronous vs. asynchronous settings by students and teachers.

to high satisfaction in both groups but also relatively high absolute ratings for additional strains and additional workload. To test for significant group differences, we conducted a univariate ANOVA for the student variables (see **Table 6** for a summary of results) as well as one for the teacher variables (see **Table 7**). While the focus lied on students' results, we report corresponding results from the teacher survey to add another perspective wherever possible. Students in mainly synchronous settings were significantly more satisfied with teaching across all their courses. It may be interesting to add that teachers mostly involved in synchronous settings were themselves more satisfied with the online term than those teaching in mostly asynchronous settings were. Students in mostly asynchronous settings reported a higher additional workload compared to teaching in face-to-face settings than did their peers in the synchronous group. We also found a significant difference between the two groups of students in terms of the perceived additional strains during the online term, even though the question was not directly related to teaching scenarios. Students in the asynchronous group report higher scores, which is also confirmed by the corresponding result from the teacher survey (see **Table 7**). For the SDT-related variables, we find significant differences between the two groups with higher values for competence support and relatedness in the synchronous group and higher values for autonomy support in the asynchronous group. The group with mostly synchronous teaching also reports significantly higher ratings in gaining procedural and social skills, as well as in their interest in the disciplinary content. Students with mostly asynchronous teaching report greater gains in self-directed learning compared to the other group. No differences were found in students' learning gains regarding content skills, vocational skills, and digital skills. About half of teachers reported that most of their students had problems with self-organizing their learning at home

(3) To answer Q3, we refer to the correlational data reported in **Table 5**. We were interested in whether higher

TABLE 3 | Descriptive results for groups and group comparisons of student perceptions of teaching and learning methods.

	Mostly synchronous			Mostly asynchronous			
Measure	***n***	***M***	***SD***	***n***	***M***	***SD***	**ANOVA**
Lectures or student presentations *via* videoconferencing	999	2.99	0.88	811	2.07	0.75	$F(1, 1{,}808) = 558.25$, $p = 0.00$, $\eta^2 = 0.24$
Recorded lectures or student presentations	978	2.29	0.97	807	3.08	0.97	$F(1, 1{,}783) = 292.57$, $p = 0.00$, $\eta^2 = 0.14$
Discussions *via* chat tools or breakout rooms	978	2.47	0.96	807	1.89	0.73	$F(1, 1{,}783) = 198.84$, $p = 0.00$, $\eta^2 = 0.10$
Discussions *via* forums	973	1.88	0.85	807	2.36	0.98	$F(1, 1{,}778) = 123.74$, $p = 0.00$, $\eta^2 = 0.07$
Self-tests or self-assessments *via* LMS	981	1.85	0.89	812	1.92	0.90	$F(1, 1{,}791) = 2.30$, $p = 0.09$, $\eta^2 = 0.00$
Practical work/labs	966	1.41	0.81	801	1.28	0.62	$F(1, 1{,}765) = 14.22$, $p = 0.00$, $\eta^2 = 0.01$
Group work	978	1.91	0.96	810	1.83	0.93	$F(1, 1{,}786) = 3.26$, $p = 0.07$, $\eta^2 = 0.00$
Teacher feedback to students	978	2.26	0.86	804	2.00	0.76	$F(1, 1{,}780) = 45.73$, $p = 0.00$, $\eta^2 = 0.03$
Peer feedback	986	1.86	0.88	801	1.75	0.82	$F(1, 1{,}785) = 8.28$, $p = 0.00$, $\eta^2 = 0.01$
Student feedback to the teacher	975	2.19	0.77	806	1.99	0.74	$F(1,1{,}779) = 31.64$, $p = 0.00$, $\eta^2 = 0.02$
(online) Office hours	955	1.83	0.85	788	1.91	0.82	$F(1, 1{,}741) = 3.16$, $p = 0.08$, $\eta^2 = 0.00$

values in SDT as well as in PEOU and PU are associated with a more positive learning experience and can therefore act as protective factors for students. For these analyses, we refer to the complete set of students' data. Following the assumptions of SDT, we expected that students whose basic psychological needs of autonomy, competence, and relatedness were more satisfied in the online semester also report greater overall satisfaction with the online semester as well as greater learning gains. Correlations between students' overall satisfaction and the three basic needs range from 0.48 to 0.56 and were all significant, confirming our expectation. Correlations between the three basic needs and self-reported learning gains were also all positive and significant, ranging from 0.30 to 0.57, with the associations between the perceived support of autonomy and the different kinds of self-reported learning being the strongest. All three basic needs were also significantly negative associated with perceived additional strains during the online semester as well as with procrastination behavior. We further assumed that high technology acceptance should ease students learning experience in the online semester. Correlations between PEOU and student variables ranged from 0.17 to (−)0.43 and were all significant ($p < 0.001$), with the highest coefficients for the association with overall satisfaction ($r = 0.43$), LCI ($r = 0.40$) and autonomy support ($r = 0.42$). The perceived usefulness of online tools showed correlations between $r = 0.28$ and $r = 0.66$. All correlations were significant ($p < 0.001$), and none of the directions was counterintuitive. Yet, we only found moderate to strong correlations. Students high in perceived usefulness judged their overall satisfaction with the online term positive as well ($r = 0.66$) and reported less additional strain ($r = -47$). PU also positively correlates with higher perceived quality of learner-content interaction (LCI, $r = 0.66$) as well with the three SDT needs (autonomy support: $r = 0.59$; competence support: $r = 0.48$; relatedness: $r = 0.53$). Moderate positive correlations occurred also with reported learning gains for content skills ($r = 0.56$), method skills ($r = 0.49$), vocational skills ($r = 0.4$), interest ($r = 0.55$), and autonomous learning ($r = 0.46$).

DISCUSSION

Through the work presented in this article, we aim to understand better, how university students and teachers experienced different settings of online teaching and learning during the online semester due to the COVID-19 lockdown. In particular, this study aims to comprehend the effects of mostly synchronous and mostly asynchronous teaching and learning settings on students and at providing insight into possible implications for future online teaching and learning in higher education. Based on the results of a university-wide survey, we analyzed whether synchronous and asynchronous teaching and learning settings were associated with different teaching methods as well as differences in various student variables.

Discussion of Results

Teaching and learning activities in synchronous and asynchronous setting involve less interaction inducing methods than input methods.

The first research question explores which teaching methods were reported by students (and teachers) who experienced mostly synchronous or asynchronous online teaching and learning. Results show that considerable groups of students experienced teaching that was predominantly either synchronous or asynchronous. Only about one-third of students reported equal ratios of both settings. Even though a wide variety of methods was reported, results show that synchronous and asynchronous online courses were dominated by prepared inputs by students, teachers, or both, such as live presentations during video conferencing or previously recorded lectures or screencasts.

However, the frequency of the methods reported by students and teachers depended on the synchronicity of the courses. Unsurprisingly, students and teachers who studied or taught mostly asynchronous reported more methods that are conceptually tied to asynchronous settings (e.g., recorded lectures or student presentations and discussions *via* online forums) compared to students and teachers in mostly synchronous settings. Vice versa, students and teachers in mostly synchronous

TABLE 4 | Descriptive results for groups and group comparisons of teacher perceptions of teaching and learning methods.

	Mostly synchronous			Mostly asynchronous			
Measure	***n***	***M***	***SD***	***n***	***M***	***SD***	**ANOVA**
Lectures or student presentations *via* videoconferencing	147	3.18	1.05	75	1.96	0.83	$F(2, 269) = 89.34$, $p = 0.00$, $\eta^2 = 0.40$
Recorded lectures or student presentations	146	1.70	0.95	75	3.03	1.10	$F(2, 272) = 47.81$, $p = 0.00$, $\eta^2 = 0.26$
Discussions *via* chat tools or breakout rooms	146	3.07	1.02	74	2.19	0.84	$F(2, 267) = 65.92$, $p = 0.00$, $\eta^2 = 0.33$
Discussions *via* forums	145	1.74	0.91	75	2.79	1.00	$F(2, 269) = 34.33$, $p = 0.00$, $\eta^2 = 0.20$
Self-tests or self-assessments *via* LMS	146	1.93	0.98	75	1.99	1.05	$F(2, 271) = 0.79$, $p = 0.46$, $\eta^2 = 0.01$
Practical work/labs	143	2.06	1.07	75	2.25	1.02	$F(2, 268) = 1.34$, $p = 0.26$, $\eta^2 = 0.01$
Group work	141	1.69	1.03	73	1.38	0.86	$F(2, 262) = 2.66$, $p = 0.07$, $\eta^2 = 0.02$
Teacher feedback to students	147	2.85	0.92	72	2.79	0.90	$F(2, 269) = 0.13$, $p = 0.88$, $\eta^2 = 0.00$
Peer feedback	145	1.99	1.00	74	2.07	1.04	$F(2, 264) = 0.13$, $p = 0.88$, $\eta^2 = 0.00$
Student feedback to the teacher	141	2.58	0.94	73	2.56	0.76	$F(2, 263) = 2.41$, $p = 0.09$, $\eta^2 = 0.02$
(online) Office hours	145	2.60	1.02	73	2.62	0.86	$F(2, 268) = 6.28$, $p = 0.00$ $\eta^2 = 0.05$

settings reported more synchronous methods (e.g., presentations *via* videoconferencing, discussions *via* chat tools or breakout rooms) compared to students and teachers in mostly asynchronous settings. These results were expected because methods such as recorded lectures are inevitably applied more often in asynchronous settings while videoconferencing can only be realized in synchronous settings. Nevertheless, these results may serve as confirmation that our segmentation of the sample into a *mostly synchronous group* and a *mostly asynchronous group* was admissible.

Our findings reveal discrepancies regarding student and teacher perceptions of the frequency of methods that facilitate interaction in synchronous and asynchronous settings.

It has to be noted that synchronous and asynchronous settings differ in principle regarding their potential to facilitate social interaction: Synchronous environments allow for teaching methods such as group work or video discussions, which inherently support social interaction of students as well as student-teacher interaction. In comparison, asynchronous environments are more content-oriented and teaching methods conceptually tied to asynchronous settings have a focus on facilitating student interaction with the learning materials. Asynchronous methods that facilitate social interaction such as discussions in online forums require more attention as well as a more thorough planning in order to support social interaction compared to for example discussions in video conferences. However, all three forms of feedback activities (peer feedback, teacher feedback to students, and student feedback to the teacher) can be realized in both synchronous and asynchronous settings. Yet, our data suggest that students in mostly synchronous settings experience more feedback compared to students in mostly asynchronous settings.

Interestingly, the students' perception of feedback activities in synchronous and asynchronous settings in our study is not confirmed from the teachers' perspective: Teachers reported to apply all three feedback activities (as well as group work and practical work/labs) equally in both asynchronous and synchronous settings. One likely explanation for this discrepancy is that teachers are just not aware that they allow for less feedback in asynchronous settings compared to synchronous settings. Maybe some of the feedback activities that take place in synchronous settings occur unintentionally without being deliberately planned by teachers. In any case, given the pivotal role of informative feedback in (not only) higher education learning in order to assure motivation and learning outcomes (Biggs and Tang, 2011; Hattie, 2011), this finding may suggest a disadvantage for students experiencing mostly asynchronous teaching and learning settings. Similar differences in teacher and student perceptions were found earlier regarding preferences for interaction-based and input-based settings by Struyven et al. (2008). The authors found that these preferences were able to influence students' overall perceptions of learning environments as well as their learning strategies and their performance, while it is known that for learning success, input formats usually depend on both attention and interest from the students (Rapanta et al., 2020).

Students in synchronous settings report a more positive learning experience as well as greater support of their basic psychological needs.

The second research question compares the two groups' learning experiences. We find satisfaction rates for synchronous settings to be higher, indicating that the social aspects of teaching and learning (e.g., feedback and interaction), which from the students' perspective are more prevailing in synchronous settings, play an important role for student satisfaction. Regarding the support of the three basic psychological needs as described by SDT, our presumption is confirmed that students' needs to feel competent as well as socially related cannot be taken for granted, especially for asynchronous settings. This study thereby contributes further empirical evidence for the appropriateness of applying the SDT to online teaching and learning in higher education. Future research that systematically varies teaching methods could provide further insight as well as intervention studies in which teachers are trained to apply the principles suggested by SDT in their teaching.

Regarding the students' self-reported learning gains, synchronicity of the online setting seems to be of minor importance: While unsurprisingly, a majority of students reported improving their digital skills – as did more than 80% of the teachers – there was no difference between synchronous and

TABLE 5 | Descriptive results and intercorrelations of student variables included.

Variable	*n*	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Satisfaction overall	2,937	3.79	1.41	–																
2. Additional strains	2,922	4.14	1.69	−0.54																
3. Additional workload	2,725	4.09	1.45	−0.36	0.49															
4. Procrastination	2,746	3.46	1.66	−0.24	0.28	0.12														
5. LCI	2,828	3.69	1.27	0.66	−0.46	−0.32	−0.24													
6. Autonomy support	2,848	4.23	1.06	0.56	−0.49	−0.36	−0.25	0.60												
7. Competence support	2,816	3.08	1.25	0.48	−0.38	−0.26	−0.15	0.49	0.46											
8. Relatedness	2,805	3.84	1.25	0.52	−0.39	−0.26	−0.23	0.52	0.49	0.53										
9. Content skills	2,881	3.87	1.31	0.56	−0.38	−0.24	−0.27	0.64	0.57	0.41	0.47									
10. Method skills	2,827	3.48	1.35	0.51	−0.32	−0.21	−0.21	0.56	0.50	0.44	0.45	0.70								
11. Vocational skills	2,746	2.75	1.45	0.36	−0.26	−0.18	−0.15	0.41	0.35	0.34	0.34	0.46	0.50							
12. Social skills	2,840	2.24	1.28	0.33	−0.25	−0.14	−0.13	0.37	0.30	0.35	0.43	0.35	0.42	0.49						
13. Digital skills	2,883	3.91	1.32	0.37	−0.21	−0.12	−0.09	0.39	0.36	0.30	0.36	0.38	0.40	0.33	0.38					
14. Interest	2,826	3.71	1.34	0.54	−0.38	−0.27	−0.22	0.63	0.56	0.43	0.48	0.72	0.59	0.46	0.39	0.45				
15. Autonomous learning	2,872	4.45	1.36	0.41	−0.27	−0.13	−0.24	0.45	0.47	0.27	0.36	0.53	0.48	0.34	0.31	0.48	0.56			
16. Perceived ease of use	2,860	4.39	0.99	0.43	−0.30	−0.22	−0.15	0.40	0.42	0.30	0.38	0.36	0.31	0.21	0.17	0.24	0.33	0.26		
17. Perceived usefulness	2,843	3.53	1.20	0.61	−0.47	−0.33	−0.28	0.66	0.59	0.48	0.53	0.56	0.49	0.40	0.36	0.37	0.55	0.46	0.57	–

LCI = Learner-content Interaction. All correlations (Pearson's r) are significant ($p < 0.001$)

asynchronous settings. Likewise, students self-reported learning gains did not significantly differ with regard to content-related skills and vocational skills. However, students who experienced mostly asynchronous teaching report greater gains in autonomous learning and smaller gains in social skills, both results being immediately plausible since asynchronous settings are characterized by high degrees of autonomy and fewer possibilities for social exchange. In contrast, students who mostly experienced synchronous teaching reported a greater increase in interest in the course content than students in asynchronous settings, suggesting that the content-related exchange with others supports the evolvement of interest for a certain topic. In addition, students in mostly synchronous settings reported higher gains in methodological skills. These results complement the findings by Nguyen (2021), who found that students prefer synchronous settings. While these results suggest a superiority of synchronous teaching and may be interpreted in such way that more video conferences are needed in higher education, one could also conclude that for the particular case of emergency remote teaching due to the COVID-19 pandemic, teachers had difficulties tapping the full potential of asynchronous teaching and learning arrangements. With more time for thorough course planning, teachers have the possibility to incorporate intelligent opportunities for both teacher-student and student–student interactions and collaboration into their online courses (Alqurashi, 2019). In this sense, results should be used to optimize both types of learning arrangements and allow for their purposeful use. Hrastinski (2010) suggests that synchronous communication may be used to foster personal participation and to allow convergence on meaning as well as provide task-related and social support, especially when applied in smaller group settings and for less complex tasks. Also, according to Daft and Lengel's (1984) media richness theory, media Daft and Lengel (1984), mediums differ in their capability to transmit information with while face-to-face communication being the richest medium. Reflected knowledge of the different capabilities of different media should allow teachers to rationalize their choices to enhance their students' learning.

Overall, greater fulfillment of psychological needs and higher acceptance of online tools go along with a more positive learning experience.

The third research question investigates whether higher SDT values were also associated with a more positive learning experience and whether greater technology acceptance also served as a protective factor for students in that sense. Indeed, we found that higher satisfaction scores regarding the three basic needs according to SDT correlated positively with overall satisfaction and negatively with the perception of additional strains and reported procrastination. The differences between synchronous and asynchronous settings stress the importance of the support of relatedness (see also Chiu, 2021), to make up for the disadvantages that go along with asynchronous settings. Similar to the results by Hsu et al. (2019), we also found that needs fulfillment were positively correlated with all of the facets of self-reported competence gain. Together with the results from our second research question, this indicates that the satisfaction of basic psychological needs enhances

TABLE 6 | Descriptive results for groups and group comparisons of student variables.

	Mostly synchronous			Mostly asynchronous			
Measure	***n***	***M***	***SD***	***n***	***M***	***SD***	**ANOVA**
Satisfaction	1,001	4.02	1.39	816	3.73	1.40	$F(1, 1{,}815) = 20.25$, $p = 0.00$, $\eta^2 = 0.01$
Additional strains	978	3.92	1.73	795	4.17	1.67	$F(1, 1{,}771) = 9.59$, $p = 0.00$, $\eta^2 = 0.01$
Additional workload	956	3.76	1.49	788	4.20	1.38	$F(1, 1{,}742) = 41.15$, $p = 0.00$, $\eta^2 = 0.02$
Procrastination	923	3.41	1.65	802	3.47	1.73	$F(1, 1{,}723) = 0.62$, $p = 0.43$, $\eta^2 = 0.00$
LCI	974	3.74	1.31	811	3.73	1.27	$F(1, 1{,}783) = 0.06$, $p = 0.81$, $\eta^2 = 0.00$
SDT							
Autonomy support	994	4.27	1.11	809	4.38	1.02	$F(1, 1{,}801) = 4.64$, $p = 0.03$, $\eta^2 = 0.00$
Competence support	980	3.33	1.31	798	2.90	1.21	$F(1, 1{,}776) = 51.28$, $p = 0.00$, $\eta^2 = 0.03$
Relatedness	990	4.02	1.28	786	3.72	1.29	$F(1, 1{,}774) = 23.88$, $p = 0.00$, $\eta^2 = 0.01$
Learning gain							
Content skills	977	3.95	1.31	789	3.95	1.26	$F(1, 1{,}764) = 0.01$, $p = 0.93$, $\eta^2 = 0.00$
Method skills	952	3.61	1.35	777	3.48	1.35	$F(1, 1{,}727) = 4.08$, $p = 0.04$, $\eta^2 = 0.00$
Vocational skills	922	2.79	1.47	745	2.75	1.43	$F(1, 1{,}665) = 0.36$, $p = 0.55$, $\eta^2 = 0.00$
Social skills	956	2.35	1.34	774	2.11	1.19	$F(1, 1{,}728) = 15.67$, $p = 0.00$, $\eta^2 = 0.01$
Digital skills	976	3.99	1.36	783	3.92	1.29	$F(1, 1{,}757) = 1.30$, $p = 0.25$, $\eta^2 = 0.00$
Interest	954	3.84	1.37	775	3.69	1.31	$F(1, 1{,}727) = 5.53$, $p = 0.02$, $\eta^2 = 0.00$
Self-directed learning	969	4.41	1.39	787	4.57	1.30	$F(1, 1{,}754) = 5.92$, $p = 0.02$, $\eta^2 = 0.00$

LCI = Learner-content interaction. All variables were rated from 1 to 6, with 6 indicating higher values.

students' learning experience comprising higher satisfaction, less procrastination, and greater learning gains. At the same time, students reported more support for their three basic needs in synchronous learning settings. Aside from synchronicity, we also found a positive correlation between autonomy support and the PEOU of technology. It could be argued that through this, also the interaction with online learning content could be eased, resulting in the experience of more autonomy support. With these results, this study contributes to the existing evidence for the application of SDT in online learning and it provides a good starting point for theoretical and practical implications. Even though SDT-related results in this study may suggest that synchronous settings outperform asynchronous settings, there are many good reasons why higher education should not completely abandon asynchronous teaching and learning. In the correlative results, we found strong associations between the perceived usefulness of given online tools and a positive learning experience, implying that teachers in general should allow their students to experience the usefulness of the chosen tools.

Limitations

Several limitations of the current study should be noted. As many other studies on experiences with remote learning due to the pandemic, the results rely on data that are derived from a single German university; therefore, the results can only be generalized to a limited extent. However, the university is large and includes a wide variety of disciplines and study programs. Universities in Germany are equipped similarly when it comes to basic infrastructure and the challenges of the COVID-19 pandemic created a comparable interruption of regular teaching and learning for everyone. Therefore, we assume that results should be transferrable, at least for the German context. The relatively low response rate might also have resulted in a self-selection bias of students and teachers with regard to possible systematic differences to the non-responding groups. The representativeness for the faculties still is encouraging as well as the variance in variables' scores. Also, the SDT describes the needs as universal across individuals (Deci and Ryan, 2000). From this point of view, the aggregation of data across courses and disciplines as well as grouping teachers and students according to the synchronicity of online learning can compensate the absence of matching between student and teacher samples on the course level. Another challenge is the quality of data, in regard to known problems of self-report measures, which are susceptible to memory distortions and do not equal actual performance (Schellings and van Hout-Wolters, 2011). And while, as mentioned by Pekrun (2020), self-reports can deliver data of high validity in investigating motivational, cognitive, or emotional aspects of learning but they should be enhanced by other data sources. Albeit the validity of the data was partially increased be integrating responses from teacher survey and student survey – allowing to some extent the cross verification of the findings from teacher and student perspectives, it would still be desirable in the sense of data triangulation for future research to integrate other sources of data related to online learning. These could include, for example, the frequency and real-time use of LMS, chats, or videoconferencing as well as the number of downloads of recorded lectures or podcasts. Another possibility of data triangulation could be a better integration of qualitative data in addition to quantitative data enabling stronger validation of results. As a further limitation, it should be mentioned that in student evaluations of teaching, high intercorrelations are well-known, indicating a central factor that influences a student's evaluation of the lecturer (Shevlin et al., 2000). Still, self-reports provide an opportunity for insight into cognitive, motivational, and behavioral processes on a broad level that can help to detect systematic correlations.

TABLE 7 | Descriptive results for groups and group comparisons of teacher variables.

	All			Mostly synchronous			Mostly asynchronous			ANOVA
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	
Evaluation of own teaching										
Overall satisfaction	274	4.28	1.07	147	4.47	1.04	73	4.17	1.03	$F(2, 271) = 6.61$, $p = 0.00$, $\eta^2 = 0.04$
Additional effort	272	4.79	0.92	146	4.66	0.92	72	5.00	0.85	$F(2, 269) = 3.56$, $p = 0.03$, $\eta^2 = 0.02$
Gain digital competence	246	4.36	1.05	130	4.43	1.08	71	4.46	1.02	$F(2,243) = 2.98$, $p = 0.05$, $\eta^2 = 0.02$
Evaluation of students										
Additional strains	228	4.27	1.27	125	4.06	1.30	68	4.51	1.21	$F(2, 225) = 3.79$, $p = 0.02$, $\eta^2 = 0.03$
Overburdening by number of tools	246	3.12	1.34	134	2.80	1.27	73	3.50	1.25	$F(2, 243) = 8.56$, $p = 0.00$, $\eta^2 = 0.06$
Problems in organizing learning at home	222	3.48	1.23	119	3.31	1.31	67	3.76	1.03	$F(2, 219) = 2.79$, $p = 0.06$, $\eta^2 = 0.02$

All variables were rated from 1 to 6, with 6 indicating higher values.

Another limitation is the instruments used for this study: Scales had to be shortened in order to be included in the comprehensive student and teacher survey. Some information had to be collected through single-item measures. However, the internal consistencies of scales applied were good or very good and therefore ensure a certain psychometric quality. A general challenge of one-shot studies is that they only have a correlational scope and do not allow causal relationships to be established even if the theoretical assumptions suggest them. And while we were able to harness data from both the student and teacher surveys, we are unable to link both data sources so we do not know whether potential differential effects are covered. All of these limitations connote future research strategies, where, for example, fewer courses are researched in more depth.

Conclusion

Overall, our findings contribute to theory because they further indicate that the synchronous and asynchronous settings are no uniform environments but offer a variety of different options for teaching and learning. Also, our results offer evidence for an association between these settings and prerequisites for student engagement and indicators for satisfaction and learning behavior and perceived learning outcomes. Our research focused on teaching and learning during the 2020 lockdown, but even if the post-COVID classroom will differ from the *ad hoc* circumstances experienced during the first lockdown, the experience has produced a vast amount of insights into opportunities, potentials and risks of digitally organized learning (Aristovnik et al., 2020). These highly valuable first-hand experiences with online teaching and learning under real life conditions need to be integrated with existing findings from systematic research on online learning to help to refine future higher education online teaching and learning. However, it should be kept in mind that cultural differences might affect learning experience when interpreting findings that stem from specific national contexts (Chiu, 2021). We have found SDT to serve as a valuable model in interpreting results, and we would encourage further research to add to empirical evidence of SDT in higher education and specifically in online learning.

The universal necessity to engage with online learning for the majority of teachers and students was challenging, but further strengthened the topic not only for those with a specific interest in digital media. Besides the boost in digital skills for students and teachers (and most likely for universities as institutions as well), it has become even more obvious that teaching in higher education should support active learner-centered learning, especially for online settings. The purposeful and intentional use of technologies to allow for adaptive and fair learning opportunities in higher education is of ongoing and even growing importance. It is upon teachers to successfully implement online tools into their teaching and to develop teaching and learning arrangements with tools that serve a transparent purpose and also do not neglect student interactions with teachers, as well as with fellow students and with content. With asynchronous teaching formats in particular, we conclude that teachers need to put extra effort into providing sufficient

opportunities for students to interact not only with the learning content but also with the teacher and their fellow students. Online settings of teaching and learning hold potential, not only for self-pacing studying, but also for flipped learning arrangements, adaptivity for individual needs, cooperative tasks like wikis or blogs and for automated assessments. All of this should be accompanied by continuous support, not only for technical issues but also for quality teaching and learning in online environments. Therefore, teachers need to be empowered to make the most of digital advances (OECD, 2020) while having enough room to autonomously make their own decisions and relate to others in this process (Moorhouse and Kohnke, 2021).

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because they resulted from the extraordinary evaluation of online teaching at Goethe university which was developed by a joint group of researchers and officials; for further use of the dataset, consent of the group has to be obtained. Requests to access the datasets should be directed to the authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the data security officer of Goethe university Frankfurt. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SF, JM, and SS contributed to conception and design of the study and wrote sections of the manuscript. SF and JM performed the statistical analysis. All authors contributed to manuscript revision, read, and approved the submitted version.

ACKNOWLEDGMENTS

We would like to thank the team, namely (in alphabetical order), Michael Eichhorn, Nicola Meier, Dr. Philipp Nolden, Lena Opitz, Jana Niemeyer, and Prof. Dr. Alexander Tillmann for their collaboration in designing the study and for discussing obtained results.

REFERENCES

Alqurashi, E. (2016). Self-efficacy in online learning environments: A literature review. *Cont. Issues Educ. Res.* 9, 45–52. doi: 10.19030/cier.v9i1.9549

Alqurashi, E. (2019). Predicting student satisfaction and perceived learning within online learning environments. *Distance Educ.* 40, 133–148. doi: 10.1080/01587919.2018.1553562

Anderson, T. (2003). "Modes of interaction in distance education: recent developments and research question," in *Handbook of Distance Education*. eds. M. G. Moore and T. Anderson (New Jersey: Lawrence Erlbaum Associates), 129–144.

Arbaugh, J. B. (2004). Learning to learn online: A study of perceptual changes between multiple online course experiences. *Internet High. Educ.* 7, 169–182. doi: 10.1016/j.iheduc.2004.06.001

Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., and Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education students: A global perspective. *Sustain. For.* 12:8438. doi: 10.3390/su12208438

Artino, A. R. (2007). Online military training: using a social cognitive view of motivation and self-regulation to understand students' satisfaction, perceived learning, and choice. *Quarterly Review of Distance Education* 8, 191–202. doi: 10.1037/e509112008-001

Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies* 2, 113–115. doi: 10.1002/hbe2.191

Bedenlier, S., Wunder, I., Gläser-Zikuda, M., Kammerl, R., Kopp, B., Ziegler, A., et al. (2020). "Generation invisible". Higher education students' (non)use of webcams in synchronous online learning. *Inter. J. Educ. Res. Open* 2:100068. doi: 10.1016/j.ijedro.2021.100068

Bernard, R. M., Abrami, P. C., Lou, Y., Borokhovski, E., Wade, A., Wozney, L., et al. (2004). How does distance education compare with classroom instruction? A meta-analysis of the empirical literature. *Rev. Educ. Res.* 74, 379–439. doi: 10.3102/00346543074003379

Biggs, J. B., and Tang, C. S. (2011). *Teaching for Quality Learning at University: What the Student Does. 4th Edn.* Maidenhead, England, New York: McGraw-Hill/Society for Research into Higher Education/Open University Press.

Blau, I., Weiser, O., and Eshet-Alkalai, Y. (2017). How do medium naturalness and personality traits shape academic achievement and perceived learning? An experimental study of face-to-face and synchronous e-learning. *Res. Learn. Technol.* 25. doi: 10.25304/rlt.v25.1974

Blumentritt, M., Schwinger, D., and Markgraf, D. (2020). ""Lernpartnerschaften – Eine vergleichende Erhebung des Rollenverständnisses von Lernenden und Lehrenden im digitalen Studienprozess," [partnerships of learning - a study in the understanding of roles of teachers and students in digital learning]" in *Digitale Bildung und Künstliche Intelligenz in Deutschland*. ed. R. A. Fürst (Wiesbaden: Springer Fachmedien Wiesbaden), 475–499.

Chen, K.-C., and Jang, S.-J. (2010). Motivation in online learning: testing a model of self-determination theory. *Comput. Hum. Behav.* 26, 741–752. doi: 10.1016/j.chb.2010.01.011

Chen, W., and You, M. (2007). "The differences between the influences of synchronous and asynchronous modes on collaborative learning project of industrial design," in *Online Communities and Social Computing*. eds. D. Hutchison, T. Kanade, J. Kittler, J. M. Kleinberg, F. Mattern and J. C. Mitchellet al. (Berlin, Heidelberg: Springer), 275–283.

Cheung, W. S., Hew, K. F., and Ng, C. S. L. (2008). Toward an understanding of why students contribute in asynchronous online discussions. *J. Educ. Comput. Res.* 38, 29–50. doi: 10.2190/EC.38.1.b

Cheung, R., and Vogel, D. (2013). Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning. *Comput. Educ.* 63, 160–175. doi: 10.1016/j.compedu.2012.12.003

Chi, M. T. H. (2009). Active-constructive-interactive: a conceptual framework for differentiating learning activities. *Top. Cogn. Sci.* 1, 73–105. doi: 10.1111/j.1756-8765.2008.01005.x

Chiu, T. K. F. (2021). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *J. Res. Technol. Educ.*, 1–17. doi: 10.1080/15391523.2021.1891998 [Epub ahead of print]

Cicha, K., Rizun, M., Rutecka, P., and Strzelecki, A. (2021). COVID-19 and higher education: first-year students' expectations toward distance learning. *Sustain. For.* 13:1889. doi: 10.3390/su13041889

Clark, R. C., and Mayer, R. E. (2016). *E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*. Hoboken, New Jersey, US. John Wiley & Sons, Ltd.

Coppola, N. W., Hiltz, S. R., and Rotter, N. G. (2002). Becoming a virtual professor. Pedagogical roles and asynchronous learning networks. *J. Manag. Infor. Systems* 18, 169–189. doi: 10.1080/07421222.2002.11045703

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., et al. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *J. Appl. Learn. Teach.* 3, 1–20. doi: 10.37074/jalt.2020.3.1.7

Curtin, R. (2021). Reimagining higher education: The post-Covid classroom. Educause Review. Available at: https://er. educause.edu/articles/2021/4/reimagining-higher-education-the-post-covid-classroom.

Daft, R. L., and Lengel, R. H. (1984). Information richness. A new approach to managerial behavior and organization design. *Res. Organ. Behav.* 6, 191–233. doi: 10.21236/ada128980

Daigle, D. T., and Stuvland, A. (2020). Teaching political science research methods across delivery modalities: comparing outcomes between face-to-face and distance-hybrid courses. *J. Political Sci. Educ.*, 1–23. doi: 10.1080/15512169.2020.1760105 [Epub ahead of print]

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q.* 13:319. doi: 10.2307/249008

Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Manag. Sci.* 35, 982–1003. doi: 10.1287/mnsc.35.8.982

Deci, E. L., and Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum.

Deci, E. L., and Ryan, R. M. (2000). The "what" and "why" of goal pursuits. Human needs and the self-determination of behavior. *Psychol. Inq.* 11, 227–268. doi: 10.1207/S15327965PLI1104_01

Demuyakor, J. (2020). Coronavirus (COVID-19) and online learning in higher institutions of education: a survey of the perceptions of Ghanaian international students in China. *Online J. Commun. Media Technol.* 10:e202018. doi: 10.29333/ojcmt/8286

Fredericksen, E., Pickett, A., Shea, P., Pelz, W., and Swan, K. (2000). Student satisfaction and perceived learning with on-line courses: Principles and examples from the SUNY learning network *J. Interact. Online Learn.* 4, 7–41. doi: 10.24059/olj.v4i2.1899

Garrison, G. R. (2011). *E-Learning in the 21st Century: A Framework for Research and Practice. 2nd Edn.*. New York, NY: Routledge.

Goertz, L., and Hense, J. (2021). "Studie zu Veränderungsprozessen in Unterstützungsstrukturen für Lehre an deutschen Hochschulen in der Corona-Krise: [Study on change processes in support structures for teaching at German universities during the corona-crisis]," Hochschulforum Digitalisierung Arbeitspapier 56. https://hochschulforumdigitalisierung.de/sites/default/files/dateien/HFD_AP_56_Support-Strukturen_Lehre_Corona_mmb.pdf. (Accessed April 26, 2021)

Granitz, N., and Koernig, S. K. (2011). Web 2.0 and marketing education: explanations and experiential applications. *J. Mark. Educ.* 33, 57–72. doi: 10.1177/0273475310392539

Händel, M., Stephan, M., Gläser-Zikuda, M., Kopp, B., Bedenlier, S., and Ziegler, A. (2020). Digital readiness and its effects on higher education students' socio-emotional perceptions in the context of the COVID-19 pandemic. *J. Res. Technol. Educ.*, 1–13. doi: 10.1080/15391523.2020.1846147 [Epub ahead of print]

Hartnett, M. (2012). "Facilitating motivation through support for autonomy," *Proceedings ASCILITE–Australian Society for Computers in Learning in Tertiary Education Annual Conference, 2012*.

Hartnett, M. K. (2015). Influences that undermine learners' perceptions of autonomy, competence and relatedness in an online context. *Australas. J. Educ. Technol.* 31, 86–99. doi: 10.14742/ajet.1526

Hartnett, M., St George, A., and Dron, J. (2011). Examining motivation in online distance learning environments: complex, multifaceted, and situation-dependent. *Int. Rev. Res. Open Dist. Learn.* 12, 20–38. doi: 10.19173/irrodl.v12i6.1030

Hattie, J. (2011). "Which strategies best enhance teaching and learning in higher education," in *Empirical research in teaching and learning: Contributions from social psychology*. ed. D. Mashek and E. Y. Hammer (Chicester: Wiley-Blackwell), 130–141.

Henriksen, D., Creely, E., and Henderson, M. (2020). Folk pedagogies for teacher educator transitions: approaches to synchronous online learning in the wake of COVID-19. *J. Technol. Teach. Educ.* 28, 201–209.

Hodges, C., Moore, S., Lockee, B., Trust, T., and Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educ. Rev.* 27, 1–12.

Hrastinski, S. (2008). Asynchronous and synchronous e-learning. *Educ. Q.* 31, 51–55.

Hrastinski, S. (2010). "How do e-learners participate in synchronous online discussions? Evolutionary and social psychological perspectives," in *Evolutionary Psychology and Information Systems Research*. ed. N. Kock (Boston, MA: Springer US), 119–147.

Hsu, H.-C. K., Wang, C. V., and Levesque-Bristol, C. (2019). Reexamining the impact of self-determination theory on learning outcomes in the online learning environment. *Educ. Inf. Technol.* 24, 2159–2174. doi: 10.1007/s10639-019-09863-w

International Association of Universities (2020). "The impact of Covid-19 on higher education around the world,". https://www.iau-aiu.net/IMG/pdf/iau_covid19_and_he_survey_report_final_may_2020.pdf. (Accessed June 18, 2021).

Kain, D. J. (2003). Teacher-centered versus student-centered: balancing constraint and theory in the composition classroom. *Pedagogy* 3, 104–108. doi: 10.1215/15314200-3-1-104

Kim, H. J., Hong, A. J., and Song, H.-D. (2019). The roles of academic engagement and digital readiness in students' achievements in university e-learning environments. *Int. J. Educ. Technol. High. Educ.* 16, 1–18. doi: 10.1186/s41239-019-0152-3

Kuo, Y.-C., Walker, A. E., Schroder, K. E., and Belland, B. R. (2014). Interaction, internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *Internet High. Educ.* 20, 35–50. doi: 10.1016/j.iheduc.2013.10.001

Malik, M., and Fatima, G. (2017). E-learning: students' perspectives about asynchronous and synchronous resources at higher education level. *Bull. Educ. Res.* 39, 183–195.

Malkin, A., Rehfeldt, R. A., and Shayter, A. M. (2018). An investigation of the efficacy of asynchronous discussion on students' performance in an online research method course. *Behav. Anal. Pract.* 11, 274–278. doi: 10.1007/s40617-016-0157-5

Moorhouse, B. L., and Kohnke, L. (2021). Thriving or surviving emergency remote teaching necessitated by COVID-19: university teachers' perspectives. *Asia Pac. Educ. Res.* 30, 279–287. doi: 10.1007/s40299-021-00567-9

Moos, D. C., and Azevedo, R. (2008). Exploring the fluctuation of motivation and use of self-regulatory processes during learning with hypermedia. *Instr. Sci.* 36, 203–231. doi: 10.1007/s11251-007-9028-3

Murphy, E., Rodríguez-Manzanares, M. A., and Barbour, M. (2011). Asynchronous and synchronous online teaching: perspectives of Canadian high school distance education teachers. *Br. J. Educ. Technol.* 42, 583–591. doi: 10.1111/j.1467-8535.2010.01112.x

Nandi, D., Hamilton, M., and Harland, J. (2015). What factors impact student – content interaction in fully online courses. *Inter. J. Modern Educ. Computer Sci.* 7, 28–35. doi: 10.5815/ijmecs.2015.07.04

Nguyen, T., Netto, C. L. M., Wilkins, J. F., Bröker, P., Vargas, E. E., Sealfon, C. D., et al. (2021). Insights into students' experiences and perceptions of remote learning methods: From the COVID-19 pandemic to best practice for the future. *Front. Educ.* 6. doi: 10.3389/feduc.2021.647986

Niemiec, C. P., Lynch, M. F., Vansteenkiste, M., Bernstein, J., Deci, E. L., and Ryan, R. M. (2006). The antecedents and consequences of autonomous self-regulation for college: a self-determination theory perspective on socialization. *J. Adolesc.* 29, 761–775. doi: 10.1016/j.adolescence.2005.11.009

Nieuwoudt, J. E. (2020). Investigating synchronous and asynchronous class attendance as predictors of academic success in online education. *Australasian J. Educ. Technol.* 36, 15–25. doi: 10.14742/ajet.5137

Northey, G., Bucic, T., Chylinski, M., and Govind, R. (2015). Increasing student engagement using asynchronous learning. *J. Mark. Educ.* 37, 171–180. doi: 10.1177/0273475315589814

Nsa, S. O., Akpan, E. O., and Williams, P. S. (2012). Instructional strategies and students' skills acquisition in vegetable crop production. *Pakistan J. Bus. Economic Rev.* 8, 163–167.

OECD (2020). "Education responses to covid-19: Embracing digital learning and online collaboration," https://read.oecd-ilibrary.org/view/?ref=120_120544-8ksud7oaj2&title=Education_responses_to_Covid-19_Embracing_digital_learning_and_online_collaboration. (Accessed April 26, 2021).

Ogbonna, C. G., Ibezim, N. E., and Obi, C. A. (2019). Synchronous versus asynchronous e-learning in teaching word processing: An experimental approach. *South African J. Educ.* 39, 1–15. doi: 10.15700/saje.v39n2a1383

Pekrun, R. (2020). Self-report is indispensable to assess students' learning. *FLR* 8, 185–193. doi: 10.14786/flr.v8i3.637

Peterson, A. T., Beymer, P. N., and Putnam, R. T. (2018). Synchronous and asynchronous discussions: effects on cooperation, belonging, and affect. *Online Learning* 22, 7–25. doi: 10.24059/olj.v22i4.1517

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., and Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: refocusing teacher presence and learning activity. *Postdigital Sci. Educ.* 2, 923–945. doi: 10.1007/s42438-020-00155-y

Reaburn, P., Muldoon, N., and Bookallil, C. (2009). "Blended spaces, work based learning and constructive alignment: Impacts on student engagement," in *Same Places, Different Spaces: Proceedings ASCILITE Auckland 2009*, ed. A. Abraham, K. M. Adams, S. Agostinho, A.-M. Alger, A. Alm, A. Alwi, B. Anderson et al. (University of Auckland, Australasian Society for Computers in Learning in Tertiary Education), 820–831.

Reeve, J., and Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *J. Educ. Psychol.* 98, 209–218. doi: 10.1037/0022-0663.98.1.209

Rösler, L., Zimmermann, F., Bauer, J., Möller, J., and Retelsdorf, J. (2016). Erleben von Selbstbestimmung und bereichsspezifische Interessen im Lehramtsstudium. [Self-determination and domain-specific interests in initial teacher education]. *Psychol. Erzieh. Unterr.* 63:91. doi: 10.2378/peu2016.art11d

Ryan, R. M., and Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am. Psychol.* 55, 68–78. doi: 10.1037/0003-066X.55.1.68

Schellings, G., and van Hout-Wolters, B. (2011). Measuring strategy use with self-report instruments: theoretical and empirical considerations. *Metacogn. Learn.* 6, 83–90. doi: 10.1007/s11409-011-9081-9

Schunk, D. H., Pintrich, P. R., and Meece, J. L. (2014). Motivation in education: Theory, research, and applications. 4. ed. Boston: Pearson.

Shen, D., Cho, M.-H., Tsai, C.-L., and Marra, R. (2013). Unpacking online learning experiences: online learning self-efficacy and learning satisfaction. *Internet High. Educ.* 19, 10–17. doi: 10.1016/j.iheduc.2013.04.001

Shevlin, M., Banyard, P., Davies, M., and Griffiths, M. (2000). The validity of student evaluation of teaching in higher education. Love me, love my lectures? *Assess. Eval. High. Educ.* 25, 397–405. doi: 10.1080/713611436

Skylar, A. A. (2009). A comparison of asynchronous online text-based lectures and synchronous interactive web onferencing lectures. *Issues Teacher Educ.* 18, 69–84.

Smith, D., and Smith, K. (2014). Case for 'passive' learning – the 'silent' community of online learners. *Eurro. J. Open Distance E-Learn.* 17, 86–99. doi: 10.2478/eurodl-2014-0021

Struyven, K., Dochy, F., and Janssens, S. (2008). Students' likes and dislikes regarding student-activating and lecture-based educational settings: consequences for students' perceptions of the learning environment, student learning and performance. *Eur. J. Psychol. Educ.* 23, 295–317. doi: 10.1007/BF03173001

Šumak, B., Heričko, M., and Pušnik, M. (2011). A meta-analysis of e-learning technology acceptance: The role of user types and e-learning technology types. *Comput. Hum. Behav.* 27, 2067–2077. doi: 10.1016/j.chb.2011.08.005

Sweetman, D. S. (2021). Making virtual learning engaging and interactive. *FASEB bioAdvances* 3, 11–19. doi: 10.1096/fba.2020-00084

van der Keylen, P., Lippert, N., Kunisch, R., Kühlein, T., and Roos, M. (2020). Asynchronous, digital teaching in times of COVID-19: a teaching example from general practice. *Journal for Medical Education* 37:Doc98. doi: 10.3205/ZMA001391

Wright, G. B. (2011). Student-centered learning in higher education. *Inter. J. Teach. Learn. Higher Educ.* 23, 92–97.

Xie, K., Debacker, T. K., and Ferguson, C. (2006). Extending the traditional classroom through online discussion: The role of student motivation. *J. Educ. Comput. Res.* 34, 67–89. doi: 10.2190/7BAK-EGAH-3MH1-K7C6

Xie, H., Liu, W., Bhairma, J., and Shim, E. (2018). "Analysis of synchronous and asynchronous E-learning environments," in *Proceedings of the 2018 3rd Joint International Information Technology, Mechanical and Electronic Engineering Conference (JIMEC 2018)*, ed. B. Xu (Paris: Atlantis Press).

Zawacki-Richter, O. (2020). The current state and impact of Covid-19 on digital higher education in Germany. *Human Behav. Emerging Technol.*, 1–9. doi: 10.1002/hbe2.238 [Epub ahead of print]

Zhu, E. (2006). Interaction and cognitive engagement: An analysis of four asynchronous online discussions. *Instr. Sci.* 34, 451–480. doi: 10.1007/s11251-006-0004-0

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 21 October 2021
doi: 10.3389/fpsyg.2021.701347

An Evaluation of Forced Distance Learning and Teaching Under Pandemic Conditions Using the Technology Acceptance Model

Barbara Drueke[1]*, *Verena Mainz*[1], *Martin Lemos*[2], *Markus Antonius Wirtz*[3] and *Maren Boecker*[1]

[1] Institute of Medical Psychology and Medical Sociology, University Hospital of RWTH Aachen University, RWTH Aachen University, Aachen, Germany, [2] Audiovisual Media Center, Faculty of Medicine, RWTH Aachen University, Aachen, Germany, [3] Department of Research Methods, University of Education, Freiburg, Germany

OPEN ACCESS

Edited by:
Timo Gnambs,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Ning Jiang,
University of South Carolina, United States
Olivia López Martínez,
University of Murcia, Spain

***Correspondence:**
Barbara Drueke
bdrueke@ukaachen.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: 27 April 2021
Accepted: 15 September 2021
Published: 21 October 2021

Citation:
Drueke B, Mainz V, Lemos M, Wirtz MA and Boecker M (2021) An Evaluation of Forced Distance Learning and Teaching Under Pandemic Conditions Using the Technology Acceptance Model. Front. Psychol. 12:701347. doi: 10.3389/fpsyg.2021.701347

Research: Due to the sudden outbreak of COVID-19 and the resulting pandemic situation, universities were forced to rapidly change their traditional pedagogical and didactical approach by shifting from mostly face-to-face teaching to entirely virtual and online teaching methods. Through this, a "forced" distance learning and teaching situation emerged. This study aimed at investigating the effect of these innovations on the implementation, acceptance, and use of the virtual teaching offer within the framework of the technology acceptance model (TAM).

Methods: A total of 218 students and 69 lecturers of a German Medical Faculty completed online questionnaires on the acceptance, satisfaction, and usefulness of the forced distance learning (FDL) and teaching (FDT), respectively. An extended version of the TAM was used to assess the acceptance of the students and lecturers of FDL and FDT. In order to estimate the multivariate dependencies, path analysis was employed using structural equation modeling (SEM).

Results: In general, students and lecturers reported being satisfied with the implementation of the FDL and FDT. Regarding the TAM model, the fit indices suggested an acceptable model fit for both groups. The model of the students revealed that the perceived usefulness had a strong predictive power on the attitude toward using and the perceived ease of use also predicted the attitude. The existing technical infrastructure as well as the general media affinity and pandemic-related worries proved to be positively associated with the perceived usefulness while data security worries and organization of online teaching predicted the perceived ease of use in students. The strong positive predictive power of the perceived usefulness for the attitude toward using was also evident in the model for the lecturers and the technical infrastructure predicted the perceived ease of use in the lecturers.

Conclusion: The TAM is a suitable framework to represent the implementation, acceptance, and use of the virtual teaching offer during the special pandemic situation at

the university. However, personal and structural context factors were important predictors for the perceived usefulness and the perceived ease of use in the student group. The forced situation for learning and teaching makes it more difficult to predict the actual use of virtual teaching offers solely based on attitude.

Keywords: technology acceptance model, TAM, COVID, acceptance, attitude, perceived usefulness (PU), perceived ease of use (PEOU)

INTRODUCTION

The emergence of the internet and the development of modern technologies have affected education and learning. Still, traditional teaching and learning both take place in physical classrooms, while online learning is the exception in most universities irrespective of size, place, and time constraints (Liu et al., 2010). Due to the sudden outbreak of the disease COVID-19, German universities had to prepare an online/digital semester for their students as face-to-face teaching was restricted, and physical classrooms were not allowed [Hochschulrektorenkonferenz (HRK), 2020]. This had to be done under time pressure as the events required quick action. The situation challenged the educational systems in German universities and forced all involved persons to shift to an online mode of teaching overnight. The students and lecturers at RWTH Aachen University had to prepare for a digital semester in a very short time. The medical faculties of the university hospitals had a special role during the pandemic situation. In this study, the challenges of introducing digital teaching were particularly high since medical care had to be guaranteed during the time of the pandemic. Moreover, in addition to the theoretical content, studying medicine includes a large number of practical courses, the teaching of practical skills, hands-on exercises, and laboratory work that are difficult to teach or learn virtually. Because of these challenges, we were interested in the acceptance and satisfaction of the virtual teaching offer in the Medical Faculty of RWTH Aachen University during the summer term of 2020. Furthermore, we aimed at investigating both, students' as well as lecturers, potential acceptance or rejection of this offer and factors that might influence the implementation of digital learning and teaching, respectively. Since the students and lecturers had to prepare for a digital semester due to COVID-related restrictions, we referred to this matter as "forced distance teaching and learning" (FDT; FDL) in this study.

In this research, the proposed model is based on the technology acceptance model (TAM) as a framework to understand the role of acceptance and satisfaction with the virtual teaching method in this FDL and FDT situation. The TAM adapts the theory of reasoned action by Ajzen and Fishbein (1980) to explain the causal relationship between the internal beliefs (usefulness and ease of use), attitude, and computer usage behavior of the users (Davis, 1989). More recently, the TAM has been proven to be a robust model for predicting the acceptance of users when it comes to technology (Venkatesh and Davis, 1996, 2000; Venkatesh, 2000; Legris et al., 2003). Moreover, the TAM has attracted significant attention in e-learning research (Ahuja and Thatcher, 2005; Sumak et al., 2011; Shin and Kang, 2015). In its original form, the model assumes that the behavior of a person is determined by his or her voluntary attitude toward using a technology (ATU), which then results in a behavioral intention. In general, it is necessary to measure attitude and beliefs regarding the use of technology rather than attitude and beliefs directed toward the technology itself, since individuals might hold a positive view about the technology without being favorably disposed toward its use. Attitudes are formed from the beliefs a person holds about the use of a particular technology, which are seen as cognitive factors that might influence each other. The first belief "perceived usefulness" (PU) is the notion of the user which refers to their "subjective probability that using a specific application system will increase their job performance within an organizational context" (Davis, 1989, p. 320). The second belief "perceived ease of use" (PEOU) is "the degree to which the user expects the target system to be free of efforts" (Davis, 1989, p. 320). Furthermore, the model describes the influence of external variables, such as design features, that can affect the cognitive factors. These variables received attention in research as they could improve the understanding of how cognitive factors like PU and PEOU are formed or how they can be manipulated (Chin and Gopal, 1995). At a very early stage, Venkatesh and Davis (1996) further illustrated that the effectiveness of the model can be increased by such extensions. In a meta-analysis of Yousafzai et al. (2007), they classified various external variables into four categories of organizational-, system-, and personal characteristics of the users, among other variables. Other studies have rather focused on a few and specific factors, e.g., personal factors as playfulness (Moon and Kim, 2001; Estriegana et al., 2019) or learning styles (Al-Azawei et al., 2017). The study of Rauniar et al. (2014) found trustworthiness to be an important factor for the TAM model. Trustworthiness concerns the security of information posted on social media sites. For our purposes, we defined a similar construct which we called data security worries that assess worries regarding the misuse of data and worries of being spied on while using the video conferencing programs. Another particular interest for our study was the construct of the technical support as investigated by several researchers (Fathema et al., 2015; Servidio and Cronin, 2018). The study of Servidio and Cronin (2018) found that technical support, defined as interventions by technical staff to assist students in their usage, influences the usefulness and the ease of use. We defined our construct of technical infrastructure (TI) regarding aspects of good internet quality or suitable equipment, for example. Other studies (Persico et al., 2014;

Fathema et al., 2015) further highlighted the importance of system components besides the availability of the technical infrastructure. System components deal with different issues concerning organizational aspects which are also of interest for the students in our study, i.e., organization of online teaching (OT). Researchers also focused on personal variables such as perceived self-efficacy (Fathema et al., 2015), indicating the judgment or the confidence of the own capability of the user when it comes to operating/navigating/working with a system. A related construct to this is the experience with technology as investigated by Sun and Zhang (2006). For our purposes, we defined a similar construct called general media affinity that indicates if somebody is an expert computer user. Finally and noteworthy, it has been shown that in mandatory environments, attitude strongly correlates with usage behavior (Leonard-Barton, 1998), and in our case, the pandemic is an extremely mandatory environment which is why we included pandemic-related worries into our model.

The main objective of the study was to define and empirically test a theory-based, extended TAM model. The focus was to see whether pandemic-specific conditions have an impact on the acceptance and perceived usefulness of virtual teaching. We hypothesized that certain personal and structural factors are more important in this forced COVID-19 situation compared with situations without pandemic conditions, for example, some technical equipment was not available for purchase. In our study, we proposed an extended TAM model including external variables that might impact the acceptance and usage of virtual teaching methods of the students and lecturers in this COVID-bound FDL and FDT situation. As proposed in the original model, we assumed that attitude toward using (ATU) should affect the actual system use (AU) in students and lecturers (ATU → AU). We also hypothesized that perceived usefulness (PU), as well as perceived ease of use (PEOU), have a strong effect on attitude toward using (PU → ATU, PEOU → ATU). Additionally, we hypothesized an association between ease of use and perceived usefulness (PEOU → PU). Furthermore, new relationships which were not proposed in the original model were established in this study to assume the person and context factors. The model considered the influence of personal and structural factors separately, supposing that these influence the attitude of a person toward using *via* PU and PEOU. We hypothesized that on the side of a person, general media affinity (GMA) and data security issues (DSW) would play a certain role and, above this, the characteristics of the special pandemic situation and the related subjective pandemic related worries (PW) should impact the model. More specifically, we hypothesized an effect of GMA on PU and PEOU (GMA → PU, GMA → PEOU). Similarly, data security worries (DSW) should affect PU and PEOU (DSW → PU, DSW → PEOU), while pandemic-related worries (PW) should predict PU more than PEOU (PW → PU). As external structural factors that might influence PU and PEOU, we assumed that the existing technical infrastructure (TI) and the organization of online teaching (OT) would play an important role assuming that those factors might have a greater predictive value for PEOU than for PU (TI → PEOU, OT → PEOU).

METHODS

Participants

Among the human medicine (N = 1,300) and dentistry (N = 349) students contacted *via* the university mailing lists, 262 took part in the study, and 218 (13.2% of N = 1,649) completed the questionnaire. Participants did not receive any financial compensation for their participation. Only those participants who completed the online survey and actively send it off were included in the analysis. Exactly 159 (73%) of the students with completely answered questionnaires were women. The majority of students participating in the study was still in the preclinical phase of the medical studies (2nd = 28.4%; 4th = 22.9%, 6th = 22.9%, 8th = 9.2% and 10th = 12.8%). Students reported using the virtual teaching offer on an average of 15 h per week (Monday–Friday) (M = 15, SD = 10) and an average of 5 (M = 5, SD = 5) h on weekends. Among the students, 25% had reported working in health care due to additional demands during the COVID-19 pandemic. From all of the professors and scientists of the Faculty of Medicine, about 300 persons were involved in teaching during the summer term of 2020. There were 260 lecturers who made videos for their teaching to be available, from whom, 106 (40.8%) took part in the study and 69 (26.5%) completed the questionnaire. Among the lecturers, 32 (46.4%) with completely answered questionnaires were women. The majority of lecturers were between 30 and 60 years of age (age groups: 30–40 = 33.3%; 41–50 = 20.3%, 51–60 = 28.9%, 17.4% were younger or older). On average, lecturers have been teaching for an average of 13 years (M = 13, SD = 10). Across the semester, the lecturers taught on average 20 h (M = 20, SD = 17). The reorganization of the teaching including the familiarization with the new technique resulted in an additional workload of on average of 9 h for this semester (M = 9, SD = 13). Respondents at 52% indicated that their primary activity would be research in addition to teaching, while 30% reported mainly work in health care. Only 15 lecturers indicated to have had experience with online teaching in former semesters.

Data Collection

The study was carried out at the Medical Faculty of RWTH Aachen University at the end of the summer term of 2020. We collected data in July 2020 through an online survey using the program Limesurvey GmbH (2020) (Lime Survey, Hamburg, Germany). The study was approved by the Ethics Committee of the Medical Faculty of RWTH Aachen University (EK 227/20). In the introductory section of the online survey, we provided information about the study, i.e., justification, aim, and methods, and the permission of the participants to withdraw at any point. We also explained how we were going to safeguard anonymity and confidentiality. All data were treated according to the European legislation on data protection. Participants accepted voluntary participation before completing the online survey by ticking a box that stated, "I have read and understood the above information and agree voluntarily, to participate in this survey by clicking

on NEXT. I am aware that I can cancel the survey at any time."

Survey Instruments

Two online questionnaires were generated, one for students and one for lecturers (as shown in **Supplementary Table 2**). It was tried to construct both questionnaires as similar as possible. However, since the student version assessed the FDL situation and the lecturer version the FDT situation, they both differed slightly from each other in some subscales regarding content and the number of items. For this reason, data for students and lecturers were analyzed separately.

In both versions, participants were first asked to provide some demographic information, e.g., age, gender, occupation. In the following section, participants had to complete questions as indicators for the original TAM subscales (PU and PEOU), ATU, and AU. Additionally, three-person and two structural context variables were collected. The person context factors included questions on GMA in assessing whether one is a skilled computer user who easily familiarizes with new software, on DSW in assessing worries regarding misuse of data and worries of being spied on while using the video conferencing programs, and on PW in assessing whether one is negatively affected by the COVID-19 pandemic. The structural context factors included questions on the TI, such as whether one has suitable technical equipment and good Internet quality, and the organization of OT (only in student version) in assessing the structural organization of the OT. Regarding the survey, participants were instructed to refer to the live streams and video recordings of lectures and/or seminars in their answers. The TAM items, as well as personal and structural context variables assumed for the extended TAM model, were assessed using a 4-point Likert scale (Likert, 1932) ranging from "1 = do not agree at all" to "4 = fully agree," indicating to what extent participants agreed with the respective statements. Overall, the FDL-version for the students consisted of 29 items, while the FDT-version for the lecturers of 22 items and took about 15 min to complete.

Item Generation

As outlined above, the survey instrument consisted of the four original TAM model factors which are PU, PEOU, ATU, and AU, three subscales assessing the person context factors which are GMA, DSW, and PW, as well as two subscales assessing the structural context factors which are TI and OT, while the latter subscale was only included in the FDL-version for the students. These structural and person variables were considered as potential influencing factors regarding the acceptance of FDL and FDT as judged by a five-headed expert team and five students, respectively. The items for the original TAM model factors (Davis, 1989) were adapted to the FDL- and FDT-situation. The items for all other subscales were newly formulated. Easily understood language was used to prevent ambiguous statements and to help minimize errors due to misleading expressions. The questionnaire was revised by several experts to determine whether the questions were appropriate and confirm that the statements were unambiguous. The items can be seen in the **Supplementary Material**.

Data Analysis

For the descriptive statistics of the scales, SPSS 25 for Windows software (SPSS Inc., Chicago, IL, USA) was used. Means (*M*) and *SD*s for variables incorporated in subsequent analyses and their intercorrelations were calculated. The intercorrelations can be found in the **Supplementary Table 2**. Before using structural equation modeling (SEM) (Bollen, 1989; Little and Kline, 2016), the reliabilities of the subscales were determined using Cronbach's Alpha and the dimensional structure was investigated using confirmatory factor analysis (CFA). For Cronbach's Alpha, values $\geq$0.70 indicate acceptable reliability. The item was deleted, if single subscale items showed low item-total correlations ($<$0.4) and Cronbach's Alpha could be improved when deleting the respective item. The 9-factorial CFA was only calculated for the students because of the small sample size of the lecturers.

The analysis aimed to estimate unbiased latent model parameters for the TAM models specifications. Estimating the structural model and the measurement models simultaneously is generally a valid approach to yield unbiased estimates. In a single analysis step, systematic variance components and error variance components are estimated for each construct (Bollen, 1989; Little and Kline, 2016). Only the systematic variance components are considered when modeling construct associations. This is equivalent to the mitigation-corrected parameter estimation (Steyer and Eid, 2002). However, this approach is not stably applicable for the data set of lecturers due to the too small sample size ($N = 69$) and the high number of parameters to be estimated ($N = 56$) (Schermelleh-Engel and Moosbrugger, 2003).

The modeling approach of Sass and Smith (2006) allows the determination of the reliability-corrected latent correlations and regression coefficients, although the number of parameters to be estimated is considerably reduced. This approach consists of two steps:

First, the reliability of the constructed assessment must be determined. For each construct, the latent trait and the reflective indicators in the measurement model are defined. This corresponds to the CFA of the constructs. Based on the estimated standardized model parameters (γ_i = factor loading; θ_{ii} = measurement error variances), construct-specific composite reliability values (Reuterberg and Gustafsson, 1992) can then be determined:

$$CR = \frac{\left(\sum_{i=1}^{c} \gamma_i\right)^2}{\left(\sum_{i=1}^{c} \gamma_i\right)^2 + \sum_{i=1}^{c} \theta_i}$$

Second, in the final estimation of the comprehensive model, only one indicator is used for each construct, namely the scale value (mean value over the indicator items of the original measurement model). The error variance of each construct is fixed to the value [(1–CR)*variance (scale value)].

This procedure ensures that the reliability correction is based on the same assumptions as in the simultaneous estimation of structural and measurement models (assuming at least congeneric measurements) but addresses a considerably more parsimonious model structure in the final estimation.

Since only one item for the construct PW was answered by the lecturers, reliability was estimated based on the three student items. The Spearman-Brown correction formula was applied to estimate the reliability of a single item for the students. This value was adopted as the reliability estimate for the instructor item.

Model fit was evaluated using measures of absolute model fit, e.g., root mean square error of approximation (RMSEA), and measures of incremental fit, e.g., Tucker-Lewis index (TLI), comparative fit index (CFI). The RMSEA indicates the proportion of variance-covariance information which is not correctly predicted by the model. As a criterion of acceptable fit, values of $\leq$0.08 or $\leq$0.05 are deemed as indicating an acceptable or good fit. The same applies to the standardized root mean square residuals (SRMR). In addition, the TLI and the comparative fit index CFI were calculated as measures of the incremental model fit. For these measures, values $\geq$0.90 (Hu and Bentler, 1998) or $\geq$0.95 (Little and Kline, 2016) are suggested to indicate an acceptable model fit. The maximum likelihood estimation procedure (Little and Kline, 2016) implemented in the software AMOS 26 (IBM, Armond, New York, USA; Arbuckle and Wothke, 1999) was used to estimate the model parameters. As for the CFA, the same procedure (Little and Kline, 2016) implemented in the same software (Arbuckle and Wothke, 1999) was used to test the structural models. The input for SEM was the empirical covariance matrix. To accept a theory-based specified SEM as a plausible explanatory model for the empirical data, measures of absolute model fit, e.g., non-significant X^2, RMSEA, SRMR, and measures of incremental fit, e.g. TLI, CFI, were calculated. In case of insufficient model-fit potential sources of the model, the violation was analyzed by inspecting unexplained residual correlations, i.e., modification indices, as well as insufficient indicator-construct associations, i.e., indicator reliabilities.

Indicators of local fit for the latent variables assess whether constructs can be reliably estimated from their indicators. Recommended thresholds were used to determine a good local model fit: Average Variance Extracted (AVE) $\geq$0.5, factor reliability $\geq$0.6, reliability (Cronbach's Alpha) $\geq$0.7, and Residual-Correlations ($\leq$0.3). Indicator reliabilities should exceed the value of 0.4 to ensure that each item is sufficiently associated with the assumed underlying latent variable (Little and Kline, 2016).

Data is available: https://osf.io/r97ha/.

RESULTS

For some subscales, items were removed due to weak item-construct associations, i.e., low indicator reliabilities. Thus, one item each had to be removed from PU, AU, GMA, PW, and TI in the student version. In the version of the lecturers, one item each was removed for AU, GMA, and TI. All of the remaining items had acceptable indicator reliability. An overview of all items with their corresponding indicator reliabilities as well as an English translation can be found in **Supplementary Table 2**.

The final number of items in each subscale and the descriptive statistics for the students and the lecturers can be found in **Table 1**.

Descriptive Statistics for the Students

The actual system use (AU) proved to be high from the student perspective with the item mean across the subscale items being ($M = 3.63$, $SD = 0.54$). The perceived usefulness (PU, $M = 3.2$, $SD = 0.78$) and the perceived ease of use (PEOU, $M = 3.4$, $SD = 0.70$) were considered high and the attitude of willingness toward using (ATU, M = 3.1, SD = 0.77) was indicated as well. Substantially lower values prevailed for the pandemic related worries (PW, $M = 2.24$, $SD = 0.73$), the worries regarding data security (DSW, M = 1.7, SD = 0.74), and the organization of OT (OT, $M = 2.7$, $SD = 0.58$). The general media affinity (GMA, $M = 3$, $SD = 0.77$) and the availability of technical infrastructure (TI, $M = 3.4$, $SD = 0.62$) were evaluated from the perspective of the students as high, i.e., students reported to quickly find their way around computers and to have good technical equipment. Overall, the students reported a high level of satisfaction and acceptance with relatively low concerns about the pandemic and data security.

Descriptive Statistics for the Lecturers

Overall, for the lecturers, most means across subscale items were slightly lower than the means found in students, but values for PEOU ($M = 3.13$, SD = 0.62) and PU ($M = 2.97$, $SD = 0.6$) proved to be high indicating an overall strong agreement in the lecturers as well. For ATU ($M = 2.61$, SD = 0.75) and AU ($M = 2.78$, $SD = 0.86$), lecturers reported a slightly lower but still positive agreement. Compared with the means of the student group, PW ($M = 2.62$, $SD = 0.82$) and DSW were slightly higher ($M = 2.37$, $SD = 0.86$) indicating a moderate level of worries, i.e., lecturers were more worried about their data security and had more pandemic related worries than the students indicated. The TI was also rated as high ($M = 3.15$, $SD = 0.66$).

Analysis of Latent Structural Path Model for the Students

The confirmatory factor analysis revealed acceptable global model fit ($\chi^2 = 430.99$, df = 219, $p < 0.01$, RMSEA = 0.067, TLI = 0.89, CFI = 0.91, SRMR = 0.06).

Testing the latent structural path model for students (as shown in **Figure 1A**), we found a valid model ($\chi^2 = 28.49$, df = 12, $p = 0.005$, RMSEA = 0.08, TLI = 0.93, CFI = 0.98, SRMR = 0.035). 89% of variance in the PU and 62% of the variance in the PEOU could be explained by the external factors. Furthermore, 96% of variance in the ATU could be explained by the model factors. In contrast to that, only 7% of variance in the AU was explained by the model factors. The GMA showed a negative predictive value for the PU ($\beta = -0.15$, $p = 0.04$). The technical infrastructure (TI, $\beta = 0.3$, $p = 0.09$) also predicted the PU, but the best predictor for the PU were the pandemic related worries (PW, $\beta = -0.63$, $p < 0.001$). The organization of OT ($\beta = 0.52$, $p =. 01$) has a high predictive value for the PEOU and the DSW also predicted the PEOU ($\beta = 0.17$ $p = 0.05$). The ATU was highly predicted by the PU ($\beta = 0.90$, $p < 0.001$), but also by the PEOU ($\beta = 0.16$, $p =$

TABLE 1 | Descriptive statistics for the extended TAM model.

Factors and predictors	Scale	Students									Lecturers								
		N_{Items}	α	CR	AVE	M_I (SD)	M_S (SD)	SKEW	Kurtosis	VAR_{SV}	FeV	N_{Items}	α	CR	M_I (SD)	M_S (SD)	SKEW	Kurtosis	VAR_{SV}	FeV
TAM factors	PU	3	0.89	0.89	0.73	3.20 (0.78)	9.61 (2.33)	−0.79	−0.07	0.60	0.07	3	0.78	0.78	2.97 (0.60)	8.91 (1.80)	0.02	−0.42	0.35	0.08
	PEOU	2	0.70	0.70	0.54	3.43 (0.70)	6.86 (1.40)	−1.11	1.86	0.59	0.08	2	0.51	0.52	3.13 (0.62)	6.26 (1.23)	−0.23	−0.81	0.55	0.07
	ATU	4	0.87	0.87	0.64	3.13 (0.77)	12.52 (3.09)	−0.95	0.38	0.48	0.14	4	0.86	0.87	2.61 (0.75)	10.43 (2.99)	−0.11	−0.76	0.37	0.18
	AU	2	0.64	0.64	0.47	3.63 (0.54)	7.26 (1.08)	−1.11	0.68	0.29	0.10	2	0.69	0.69	2.78 (0.86)	5.57 (1.72)	−0.42	−0.51	0.73	0.23
Person	PW	3	0.66	0.68	0.44	2.24 (0.73)	6.71 (2.19)	0.56	−0.05	0.53	0.17	1	–	(0.42)	2.62 (0.82)	2.62 (0.82)	0.16	−0.63	0.67	0.39
	GMA	2	0.75	0.76	0.61	3.04 (0.77)	6.08 (1.54)	−0.42	−0.54	0.59	0.14	2	0.75	0.74	3.22 (0.59)	6.45 (1.18)	−0.23	−0.57	0.34	0.09
	DSW	2	0.87	0.87	0.78	1.71 (0.74)	3.42 (1.47)	1.44	1.05	0.54	0.07	3	0.85	0.85	2.37 (0.86)	7.10 (2.58)	0.18	−1.02	0.73	0.11
Structure	TI	2	0.58	0.59	0.43	3.41 (0.62)	6.82 (1.24)	−0.69	0.67	0.38	0.16	2	0.64	0.64	3.15 (0.66)	6.30 (1.32)	−0.27	−0.79	0.43	0.15
	OT	4	0.66	0.68	0.35	2.72 (0.58)	10.86 (2.33)	−0.19	−0.32	0.34	0.11	–	–	–	–	–	–	–	–	–

*PU, perceived usefulness; PEOU, perceived ease of use; ATU, attitude toward using; AU, actual system use; PW, pandemic related worries; GMA, general media affinity; DSW, data security worries; TI, technical infrastructure; OT, organization of online teaching; N_{Items}, number of items; α, Cronbach's α; CR, composite reliability; AVE, average variance extracted; M_I, mean of scale items; SD, standard deviation; M_S, scale mean; SKEW, skewness; VAR_{SV}, variance of the scale value; FeV, Fixed error variance: (1-CR)*VAR.*

0.002). The ATU has a small but predictive value for the AU (β = 0.27, $p = 0.002$).

Regarding the indicators of local fit the factor reliabilities were acceptable and are shown in **Table 1**. The indicator reliabilities were ≥0.4 for most of the items, but six out of 24 items showed values below this threshold (as shown in **Supplementary Table 2**). However, these items were kept in order to improve subscale reliability.

Analysis of the Latent Structural Path Model for the Lecturers

For the lecturers, we found an acceptable, non-significant model fit: $\chi^2 = 16.43$ df = 10, $p = 0.08$, RMSEA = 0.1, CFI = 0.92, TLI = 0.79, SRMR = 0.069. 67% of the variance in the PEO) could be explained by the model factors while only 36% of the variance in the PU. Furthermore, 83% of the variance in the ATU could be explained by the model factors, while almost no variance (1%) in the AU could be explained by the ATU. The PU has a really strong predictive value for the ATU (β = 0.92, $p < 0.001$). Different than expected, the PEOU has almost no predictive value for the ATU (β = 0.08, $p > 0.05$). The PEOU was best predicted by the TI (β = 0.67, $p = 0.02$). Different from the student sample, there was no effect of the ATU on the AU (β = 0.11, $p > 0.05$), indicating that the attitude did not provide predictive value for the actual use in the lecturer group. As in the student group, the PEOU has no significant impact on the PU (β = 0.97, $p > 0.05$). Different from the student group, TI did not show a predictive value for PU (β = −0.61, $p > 0.05$). In both cases, we saw high estimates which might indicate that the PEOU could predict the PU, and TI could predict PU, respectively. The lack of significance could be explained by the high standard errors at the same time which might be due to the small sample size of the lecturers. For the lecturers, neither the DSW, PW, nor GM provided any predictive value for the PU or the PEOU (as shown in **Figure 1B**).

DISCUSSION

In this study, an extended TAM model was used to investigate the acceptance and usage of the students and lecturers of the online teaching and learning offered at a Medical Faculty of a German university in 2020. The students and lecturers were in a very special situation as they were forced to learn and teach with the help of online tools as face-to-face-teaching and -participation was not allowed due to the risk of infection with COVID-19. Therefore, we were interested in finding out whether an extended TAM model holds up under these forced conditions and which factors are particularly relevant. The extended TAM model assumed the importance of different external factors influencing the acceptance and usage of the students and lecturers of online learning and teaching, respectively. The TAM model was extended by the personal variables which are PW, GMA, and DSW, as well as the structural context variables TI and OT. Indeed, this is important as Legris et al. (2003) stated that other variables should be included to understand those factors that affect technology adoption. This conclusion was confirmed by Edmunds et al. (2012) to indicate that the two factors, namely

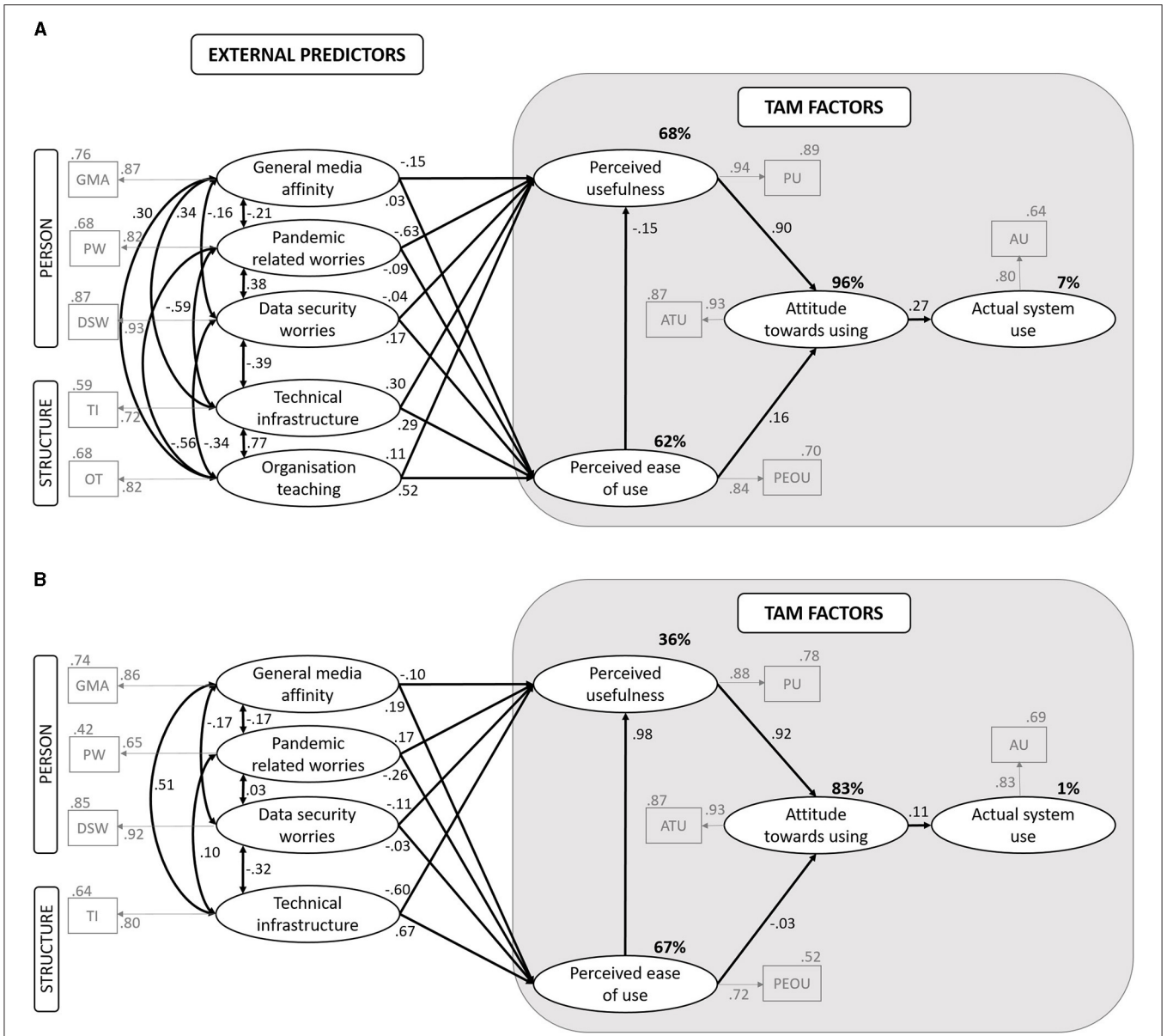

FIGURE 1 | Latent structural path models. **(A)** Students. **(B)** Lecturers. Rectangles indicate observed indicator variables. Ovals indicate latent variables. Numbers on arrows indicate standardized regression weights.

ease of use and usefulness, may not identify all significant components in predicting technology acceptance. The study of Holden and Karsh (2010) also stated in their review that an important future direction for TAM is to adapt the model specifically to the context, which is in our case the COVID-19 pandemic.

Overall, the implementation of digital learning and teaching has received positive resonance from both students and teachers. The high means for PU and ATU indicated that students and teachers conveyed a high level of satisfaction with the digital teaching offer. Furthermore, both groups did not report high levels of worries either for pandemic-related worries or for worries on data security. This meant that on average, the worries and the associated burden seemed manageable in both groups. AU was reported to be very high for the students indicating that the students not only assessed the digital learning offer as useful but also actually used it. The high mean values for TI also showed that both groups had suitable technical equipment for using the learning/teaching offer which is an essential prerequisite for acceptance and usage of digital learning and teaching.

An extended TAM was found to be an appropriate model to investigate the effects of the COVID-19 pandemic on the acceptance and usage of virtual learning and teaching for students. The comparison of models showed some differences

between the models of the lecturers and the students. Furthermore, the models also differed in several aspects as the former is about learning and the latter about teaching. For the students, the aspect of the organization of online teaching, i.e., When does a course start? Where can I find the information about the link to the online course?, was very relevant, while these points were rather obligatory on side of the lecturers and in their responsibility regardless of the pandemic situation. Concerning the aspect of pandemic-related burden, the student model also differed from the model of the lecturers. In comparison with the lecturers, students might, for example, not be able to pursue employment during a lock-down, which might result in financial difficulties.

So far, the original model assumed that the PU and PEOU predict ATU, which was found in several studies (Holden and Karsh, 2010; Fathema et al., 2015). ATU in turn should predict AU. In the group of students, the PU and the PEOU were confirmed as predictors of ATU. This supported our hypothesis and was consistent with the results from the literature (Wong et al., 2013). The TI significantly predicted the PU but not PEOU. This indicated that good technical equipment has a predictive value for the perceived usefulness of students. The empirical evidence of the importance of external variables like TI the TAM has been found in the past (for example, see Yeou, 2016; Servidio and Cronin, 2018). The ATU was confirmed as a predictor of the AU which is in line with our hypotheses. This effect was found but not as high as in other studies which could be due to the forced situation. The PEOU was best predicted by the OT. The best negative predictor for the PU was the PW indicating that students who felt burdened by the Corona-pandemic reported lower perceived usefulness which could be due to the stress of the overall situation. This is also in line with our hypotheses. Interestingly, the PW was negatively correlated with the TI and OT indicating that students with good technical equipment stated that they were less stressed by the pandemic and were able to cope well with organizational aspects (see **Figure 1A**). TI was also negatively correlated with DSW which indicated that students with good technical equipment reported fewer worries on data security. The DSW was also significantly correlated with the PW indicating that the pandemic was a stressful situation with lots of concerns to the students at all. Interestingly and contrary to our hypotheses, the PEOU had no predictive value for the PU. This result could be explained by the fact of a rather forced distance learning situation. There was 68% of the variance in the PU, 62% in the PEOU, and 96% in the ATU that could be clarified. Only 7% of the variance in the AU could be explained by the model factors which might be a result of the forced situation as well in which students had almost no alternative than using the digital learning offer.

The predictive power of PU on ATU was also evident in lecturers which is in line with evidence from the literature (Holden and Karsh, 2010; Fathema et al., 2015). The TI failed to reach significance for the PU which might be due to a high estimation error. Compared with the student group and contrary to our hypothesis, the PEOU was not confirmed as a predictor for the ATU, and the ATU in turn has no predictive power for the AU. This might be due to the pandemic situation in which lecturers had *de facto* no other way to reach their students than *via* the digital offering. This emphasized the forced part of teaching even more. Interestingly, we found an impact of the TI on the PEOU in the lecturers emphasizing the importance of good equipment and indicating that lecturers with good technical equipment perceived the challenges in the implementation as simple or easy to use. For the lecturers, there was also a positive correlation between the TI and GMA (as shown in **Figure 1B**) which shows that lecturers with a high affinity for media were well equipped. For the lecturers, we found no significant effect for the PEOU on the PU. The influence of the PW on the PU was not evident in the lecturers. This may be because PW was seen independently of the usefulness. For the students, we found a relationship between the PW and the TI which was not evident in lecturers as well. There was 36% of the variance in the PU and 67% in the PEOU that could be explained by personal and structural context factors in the model. Furthermore, 83% of the variance in the ATU could be explained by PU and PEOU, but almost no variance could be explained in the AU (1%). In the model of the lecturers, the explanation of variance was lower which could be due to the not optimal model fit and small sample size in lecturers. All in all, for the lecturers many paths did not reach significance and we did not find as much evidence for our hypotheses as for the students.

The following limitations must be considered when interpreting the study results. The data and the resulting SEM originated from a study with a cross-sectional design which did not allow a causal interpretation of the relationships found in the predictive model. The cross-sectional design was mainly because the sudden outbreak of COVID-19 meant that everything had to be rearranged under enormous time pressure. In the future, there should be the conduction of model-based intervention trials to gain enhanced evidence. Although the model postulates causal effects, these cannot be proven using the analytical approach. We only estimated the strength of the effects, assuming the model structure. But whether these assumptions were appropriate cannot be tested empirically. One limitation is the model fit, which was not optimal in all parameters, especially for the lecturers. But with the given preconditions, we presented the best possible result. Another limitation is the relatively small sample size, especially for the lecturers. The small sample size may explain why some results and indices did not become significant due to insufficient test power. Nevertheless, a sample size >47 generally allowed the detection of medium effects sizes with sufficient power ($1–\beta < 0.2$; Faul et al., 2009). Several explanations are conceivable. On the one hand, it is possible that some courses were not offered online as they required face-to-face interaction or the use of special equipment, for example. On the other hand, the study participation was voluntary, and there was no payment for the participants. Furthermore, data collection took place during the exam period which might have reduced the number of participants. Another important point to mention is that the role of surveys in seeking information is problematic as low response rates are common (for example, see Grava-Gubins and Scott, 2008). Researchers need to investigate

alternative strategies for achieving higher rates of response, especially as response rates were found to be lower for digital invitations compared with paper-based invitations (Ebert et al., 2018).

Another limitation is ceiling effects for some measures, e.g., the mean of the AU scale, resulting in likely rather small variances that limit the potential to identify substantial effects. This is not surprising and probably due to the special pandemic situation as all participants were in a forced situation in which there was no alternative to online learning/teaching.

All in all, during the first lockdown in Germany, we assessed the implementation, acceptance, and use of the virtual teaching offer at a German university. The results showed that an extended TAM is a suitable framework to test for this. The PU strongly predicted the ATU of students and of lecturers while the influence of the PEOU seemed to be smaller in a pandemic situation in which all participants were forced to use online learning and teaching, respectively. External variables like PW strongly predicted the PU especially for students, while the TI was an important predictor for the ease of use in both groups. However, the forced situation for learning and teaching made it more difficult to predict the actual use of virtual teaching offers based on attitude.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Medical Faculty of RWTH Aachen University (EK 227/20). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

BD: conceptualization, data curation, formal analysis, investigation, methodology, visualization, and writing—original draft. MW: conceptualization, data curation, formal analysis, methodology, and writing—review and editing. VM: conceptualization, methodology, data curation, formal analysis, validation, and writing—review and editing. ML: conceptualization, project administration, methodology, resources, and writing—review and editing. MB: conceptualization, formal analysis, data curation, methodology, project administration, and writing—review and editing. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.701347/full#supplementary-material

REFERENCES

Ahuja, M. K., and Thatcher, J. B. (2005). Moving beyond intentions and toward the theory of trying: effects of work environment and gender on post-adoption information technology use. *Manage. Inf. Syst. Q.* 29, 427–459. doi: 10.2307/25148691

Ajzen, I., and Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Al-Azawei, A., Parslow, P., and Lundqvist, K. (2017). Investigating the effect of learning styles in a blended e-learning system: an extension of the technology acceptance model (TAM). *Aust. J. Educ. Technol.* 33, 1–23. doi: 10.14742/ajet.2741

Arbuckle, J. L. and Wothke, W. (1999). *AMOS 4.0 User's Guide*. Chicago, IL: Small-Waters Corporation

Bollen, K. A. (1989). *Structural Equations with Latent Variables*. New York, NY: Wiley. doi: 10.1002/9781118619179

Chin, W. W., and Gopal, A. (1995). Adoption intention in GGS: relative importance of beliefs. *Data Base Adv.* 26, 42–63. doi: 10.1145/217278.217285

Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Manage. Inf. Syst. Q.* 13, 319–40. doi: 10.2307/249008

Ebert, J. F., Huibers, L., Christensen, B., and Christensen, M. B. (2018). Paper- or web-based questionnaire invitations as a methods for data collection: cross-sectional comparative study of differences in response rate, completeness of data, and financial cost. *J. Med. Internet Res.* 20:e24. doi: 10.2196/jmir.8353

Edmunds, R., Thorpe, M., and Conole, G. (2012). Student attitudes towards and the use of ICT in course study, work and social activity: a technology acceptance approach. *Br. J. Educ. Technol.* 43, 71–84. doi: 10.1111/j.1467-8535.2010.01142.x

Estriegana, R., Medina-Merodio, J. A., and Barchino, R. (2019). Student acceptance of virtual laboratory and practical work: an extension of the technology acceptance model. *Comput. Educ.* 135, 1–14. doi: 10.1016/j.compedu.2019.02.010

Fathema, N., Shannon, D., and Ross, M. (2015). Expanding the technology acceptance model (TAM) to examine faculty use of learning management systems (LMSs) in higher education institutions. *J. Online Learn. Teach* 11, 210–232. Available online at: https://jolt.merlot.org/Vol11no2/Fathema_0615.pdf

Faul, F., Erdfelder, E., Buchner, A., and Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behav. Res. Methods* 41, 1149–1160. doi: 10.3758/BRM.41.4.1149

Grava-Gubins, I., and Scott, S. (2008). Effects of various methodologic strategies: survey response rates among Canadian physicians and physicians-in-training. *Can. Family Phys.* 54, 1424–1430.

Hochschulrektorenkonferenz (HRK) (2020). *German rectors Conference (2020). Bestimmung im Sommersemester 2020*. Available online at: https://www.hrk.de/themen/hochschulsystem/covid-19-pandemie-und-die-hochschulen/ (accessed November 10, 2020).

Holden, R. J., and Karsh, B. T. (2010). The technology acceptance model: its past and its future in health care. *J. Biomed. Inform.* 43, 159–172. doi: 10.1016/j.jbi.2009.07.002

Hu, L., and Bentler, P. M. (1998). Fit indices in covariance structural equation modeling: sensitivity to underparameterized model misspecification. *Psychol. Methods* 3, 424–453. doi: 10.1037/1082-989X.3.4.424

Legris, P., Ingram, J., and Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Inf. Manage.* 40, 191–204. doi: 10.1016/S0378-7206(01)00143-4

Leonard-Barton, D. (1998). Implementation characteristics of organizational innovations. *Commun. Res.* 15, 603–631. doi: 10.1177/009365088015005006

Likert, R. (1932). A technique for the measurement of attitudes. *Arch. Psychol.* 22, 140–55.

Limesurvey GmbH (2020). *LimeSurvey: An Open Source Survey Tool*. Hamburg: LimeSurvey GmbH. Available online at: http://www.limesurvey.org

Little, T. D. and Kline, R. B. (eds) (2016). *Principles and Practice of Structural Equation Modeling, 4th ed.* New York, NY: The Guilford Press

Liu, I. F., Chen, M. C., Sun, Y. S., Wible, D., and Kuo, C. H. (2010). Extending the TAM model to explore the factors that affect intention to use an online learning community. *Comput. Educ.* 54, 600–610. doi: 10.1016/j.compedu.2009.09.009

Moon, J. W., and Kim, Y. G. (2001). Extending the TAM for a World-Wide-Web context. *Inf. Manage.* 38, 217–230. doi: 10.1016/S0378-7206(00)00061-6

Persico, D., Manca, S., and Pozzi, F. (2014). Adapting the technology acceptance model to evaluate the innovative potential of e-learning systems. *Comput. Human Behav.* 30, 614–622. doi: 10.1016/j.chb.2013.07.045

Rauniar, R., Rawski, G., Yang, J., and Johnson, B. (2014). Technology acceptance model (TAM) and social media usage: an empirical study on Facebook. *J. Enterprise Inf. Manage.* 27, 6–30. doi: 10.1108/JEIM-04-2012-0011

Reuterberg, S. E., and Gustafsson, J. E. (1992). Confirmatory factor analysis and reliability: testing measurement model assumptions. *Educ. Psychol. Meas.* 52, 795–811. doi: 10.1177/0013164492052004001

Sass, D. A., and Smith, P. L. (2006). The effects of parceling unidimensional scales on structural parameter estimates in structural equation modeling. *Struct. Equ. Model.* 13, 566–586. doi: 10.1207/s15328007sem1304_4

Schermelleh-Engel, K., and Moosbrugger, H. (2003). Evaluating the fit of structural equation models: tests of significance and descriptive goodness-of-fit measures. *Methods Psychol. Res.* 8, 23–74. Available online at: https://www.researchgate.net/publication/251060246_Evaluating_the_Fit_of_Structural_Equation_Models_Tests_of_Significance_and_Descriptive_Goodness-of-Fit_Measures

Servidio, R., and Cronin, M. (2018). PerLE: an 'open-source', e-learning moodle-based platform. A study of university undergraduates acceptance. *Behav. Sci.* 8:63. doi: 10.3390/bs8070063

Shin, W. S., and Kang, M. (2015). The use of a mobile learning management system at an online university and its effect on learning satisfaction and achievement. *Int. Rev. Res. Open Distrib. Learn.* 16, 110–130. doi: 10.19173/irrodl.v16i3.1984

Steyer, R., and Eid, M. (2002). *Messen und Testen*. Berlin: Springer. doi: 10.1007/978-3-642-56924-1

Sumak, B., Hericko, M., and Pusnik, M. (2011). A meta-analysis of e-learning technology acceptance: the role of user types and e-learning technology types. *Comput. Human Behav.* 27, 2067–2077. doi: 10.1016/j.chb.2011.08.005

Sun, H., and Zhang, P. (2006). The role of moderating factors in user technology acceptance. *Int. J. Hum. Comput. Stud.* 64, 53–78. doi: 10.1016/j.ijhcs.2005.04.013

Venkatesh, V. (2000). Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Inf. Syst. Res.* 11, 342–365. doi: 10.1287/isre.11.4.342.11872

Venkatesh, V., and Davis, D. F. (1996). A model of the antecendents of perceived ease of use: development and test. *Dec. Sci.* 27, 451–481. doi: 10.1111/j.1540-5915.1996.tb01822.x

Venkatesh, V., and Davis, F. D. (2000). A theoretical extension of the technology acceptance model. Four longitudinal field studies. *Manage. Sci.* 46, 186–204. doi: 10.1287/mnsc.46.2.186.11926

Wong, K. T., Osman, R., Goh, P. S. C., and Rahmat, M. K. (2013). Understanding student teachers' behavioural intention to use technology: technology acceptance model (TAM) validation and testing. *Int. J. Instruct.* 6, 89–104 Available online at: https://www.e-iji.net/dosyalar/iji_2013_1_7.pdf

Yeou, M. (2016). An investigation of students acceptance of moodle in a blended learning setting using technology acceptance model. *J. Educ. Technol. Syst.* 44, 300–318. doi: 10.1177/0047239515618464

Yousafzai, S. Y., Foxall, G. R., and Paliister, J. G. (2007). Technology acceptance: a meta-analysis of the TAM: Part 1. *J. Model. Manag.* 2, 251–280. doi: 10.1108/17465660710834453

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Education

ORIGINAL RESEARCH
published: 26 October 2021
doi: 10.3389/feduc.2021.714526

Attitude Towards and Adoption of the Novel Learning Environment Among Undergraduate Medical Students During COVID-19

Sonja Mohr[1]*, *Birgit Küfe*[1], *Anke Rheingans*[1] and *Jennifer Guse*[2]

[1]Dean's Office for Student Affairs, Faculty of Medicine, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [2]Department of Medical Psychology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

OPEN ACCESS

Edited by:
Karin Gehrer,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Jing Yu,
Tianjin Normal University, China
Rining (Tony) Wei, Xi'an Jiaotong-Liverpool University, China
Alexandre Berney,
Centre Hospitalier Universitaire Vaudois (CHUV), Switzerland

***Correspondence:**
Sonja Mohr
s.mohr@uke.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *25 May 2021*
Accepted: *06 October 2021*
Published: *26 October 2021*

Citation:
Mohr S, Küfe B, Rheingans A and Guse J (2021) Attitude Towards and Adoption of the Novel Learning Environment Among Undergraduate Medical Students During COVID-19. Front. Educ. 6:714526. doi: 10.3389/feduc.2021.714526

Higher education has changed significantly since the beginning of the COVID-19 pandemic. Medical education programs with extensive practical and interactive components faced major challenges to protect students, faculty and patients. In response to COVID-19, many medical schools worldwide shut down undergraduate medical education and converted most of their teaching to digital formats. The aim of this paper is to assess the attitude towards and adoption of the novel learning environment among undergraduate medical students during COVID-19. Two studies were conducted to analyze specific aspects of the adaption of digital teaching during the digital summer semester 2020 (study 1), and to compare student satisfaction and their feeling of preparedness for exams in the digital semester compared to traditional semesters (study 2). Results show that there are numerous pros and cons of digital teaching. Pros were the large flexibility and large-scale availability of digital teaching materials. Cons were the lack of interactions with peers, professionals, and patients in practice. Results also show that female students as well as year 1 students seemingly coped better with the digital learning environment. Students with childcare or job obligations also benefited from the large flexibility. While student satisfaction decreased in the digital semester, they did not feel less prepared for exams. Cross-sectional comparisons revealed that student satisfaction and agreement gradually decreased in the comparison of the different cohorts with fourth year students being the least satisfied and showing the least agreement regarding the feeling of preparedness for exams. Altogether, our results indicate that students were able to cope with digital teaching, but clearly, some groups of students were able to better adapt to the novel learning environment. This might demand the introduction of tailored educational support services for different groups of students during COVID-19 as they progress through medical school.

Keywords: medical education, learning environment, digital teaching, COVID-19, mixed-methods study

INTRODUCTION

The coronavirus disease (COVID-19) pandemic and its consequences have an impact on private, professional and social life of the general population and specific groups (Vindegaard and Benros, 2020). Higher education has changed significantly since the beginning of the pandemic. Particularly, study courses with extensive practical and interactive components such as medical education faced major challenges to protect students, faculty and patients, and flatten the curve by social distancing while ensuring the educational mission at the same time. Undergraduate medical education usually applies many different formats in teaching (i.a., bedside-teaching, laboratory courses, practical training) and in assessment (i.a., Multiple-Choice-Questions, Objective Structured Clinical Examinations, mini-clinical evaluation exercise) (Holzinger et al., 2020; Vanderbilt et al., 2013). In response to COVID-19, many medical schools worldwide shut down undergraduate medical education and converted most of their teaching to digital formats (Rose, 2020). In addition, the exams changed significantly. For example, all Objective Structured Clinical Examinations (OSCE) were converted into Multiple Choice tests. This rapid change of the learning environment may cause several effects among medical students. Both, positive and negative effects of the learning environment on health profession education have been reported (Gruppen et al., 2019; Weiss et al., 2013) and strategies to improve the learning environment in undergraduate medical education to promote students' well-being were recommended before the pandemic began (Wasson et al., 2016; Dyrbye et al., 2020). Learning environments that are perceived as unsupportive are typically associated with high levels of depression, burnout or exhaustion and medical students' level of mental health decreases the further they progress in their undergraduate medical education (Brazeau et al., 2014; Dyrbye et al., 2010; Schwenk et al., 2010).

The definition of the learning environment by Gruppen et al. (2019) serves as an important background for this study: "Learning environment refers to the social interactions, organizational cultures and structure, and physical and virtual spaces that surround and shape the learners' experience, perceptions and learning." The rapid change to digital formats and asynchronous teaching resulted in a dramatic decrease of social interactions. The organizational culture in medical education depends on a direct interaction between physicians and students, especially in clinical teaching. The organizational structure of medical education with its complex and multifaceted class schedules could be relatively easily arranged for digital teaching, because a unique digital tool for the administration of curricula already existed at the University Medical Center of Hamburg-Eppendorf. Using this platform, the Faculty could control the virtual space that shapes the students' experiences. However, the physical environment of students could no longer be controlled and might be an important aspect of how students' handled the situation.

There is limited evidence on how a pandemic and its consequences affect medical education. However, some previous studies provide some insight that has to be considered in the context of the present paper. A study during the SARS pandemic showed that the elimination of routines and the massive reduction in social contact often led to boredom, frustration, and a sense of isolation from the outside world (Hawryluck et al., 2004; Reynolds et al., 2008). A few studies targeting higher health education were published early on in the COVID-19 pandemic: Chen et al. (2021) showed that the rapid introduction of synchronous e-learning initially worsened the learning of dental students. Consequently, asynchronous formats and the recording of lectures were introduced. This was well received by students, because they could use the recorded material for review. In a qualitative study, Khalil et al. (2020) assessed medical students' perspectives on synchronous online learning. Results also show that the utilization of recorded lectures was well perceived. Another important benefit was time efficiency of online learning. Students also reported methodological (e.g., timing and lecture duration), technical (e.g., internet connectivity and sound quality), and behavioral challenges (e.g., lack of interaction and individual learning style).

The aim of this study is to assess the attitude towards and adoption of the novel learning environment among a large sample of undergraduate medical students during COVID-19 (study 1). Therefore, students' perceptions of positive and negative effects of the online teaching formats compared to the diverse face-to-face teaching formats were assessed. Second, the aim was to find out how the novel learning environment affected students' satisfaction, and their view on preparedness for exams (study 2).

MATERIALS AND METHODS

Setting

Both studies are cross-sectional surveys conducted at the University Medical Center Hamburg-Eppendorf (UKE), Germany. Undergraduate medical education in Germany encompasses either traditional study courses or reform study courses as full education programs with a duration of 6 years including a practical year at the end. The Medical Faculty in Hamburg is one of the larger faculties in Germany with cohorts consisting of approximately 370 medical students per year and launched the longitudinal integrated medical degree program iMED in 2012. Altogether, the reformed integrated curriculum iMED consists of 19 modules. In each semester, medical students attend two modules in a given order. Each module lasts for 6 weeks. A week of exams follows each module in the first three semesters. From the fourth semester onward, exams are conducted in the last week of the semester after both modules have been completed. At UKE, students are invited to participate in the end-of-semester evaluation from the very beginning of the program. Participation in the anonymous online-questionnaire is voluntary, but highly recommended. More precisely, the whole population of medical students is eligible to participate in the evaluation each semester. The actual samples are made up of participants who have voluntarily chosen to participate.

TABLE 1 | Descriptive statistics of items regarding positive and negative perceptions of digital teaching (study 1).

Negative perceptions of digital teaching	N	M (SD)	Mdn
The digital classes left more questions unanswered for me than usual teaching	1,349	3.81 (1.70)	4
I was shy of asking questions in video conferences	1,118	3.58 (1.71)	4
I felt overstrained by the lack of a time frame and structure in the digital teaching	1,353	3.43 (1.78)	4
Positive perceptions of digital teaching			
I appreciate the use of digital teaching offers independently of time and location	1,334	4.93 (1.29)	5
I appreciate the possibility to use digital teaching material repeatedly	1,357	5.52 (0.90)	6
The use of digital teaching offers increases my study satisfaction	1,349	4.18 (1.60)	4
The digital teaching format motivated me to continuously pursue autonomous learning	1,356	3.88 (1.66)	4
I managed the autonomous acquisition of the study topics well	1,362	4.55 (1.29)	5

Study 1

In study 1, students participated in an additional voluntary evaluation 6 weeks into the semester (May, 2020) as well as at the end of the semester (July, 2020). The online survey was conducted from May 28, 2020 to June 7, 2020 (t1), and from July 14, 2020 to July 30, 2020 (t2). During this period and before (since mid-March 2020), the German government announced several public health measures to suppress the spread of COVID-19 by increasing social distancing. The following measures were predominantly used: the closure of schools, daycare, playgrounds and non-essential shops, and the prohibition to meet more than one person from another household. Lectures and seminars were held in a digital format–presentations with audio recordings in the majority of cases–to diminish interpersonal contact and protect patients, students and faculty.

This study utilized a mixed-methods design following a sequential explanatory strategy (Creswell, 2014). In this, a set of new self-developed or adapted items was integrated in the questionnaires. In this process, the student council was consulted to ensure that all relevant aspects of digital teaching were captured in the questionnaire. The items in the formative evaluation (May, 2020) targeted the identification of technical issues as well as the technical application of digital teaching methods. Students were also asked to assess whether presentations with audio recordings were inferior, superior or equivalent to face-to-face teaching in lectures, seminars, bedside teaching, and practical training. At the end of the semester, an assessment of the positive and negative perceptions of digital teaching was implemented in the questionnaire (see **Table 1**). Additionally, students were asked to describe positive and negative aspects of the digital teaching compared to usual teaching in an open-ended question. The integration of this qualitative source of data at t2 was needed to better understand how students handled the first digital semester at our Faculty. Also, the sequential analysis of follow-up qualitative data helped explain the quantitative results.

Study 2

In study 2, end-of-semester evaluations of the digital semester as well as two previous summer semesters were compared. Response rates are usually above 90%. The questionnaire to evaluate all study modules is comprised of self-constructed items that cover general perceptions of the module and the study program as well as subject-specific items since the implementation of iMED in 2012. In this paper, three items regarding the module or study program in general were analyzed: Every semester, students are asked to rate their current satisfaction with iMED as well as the completed module. In addition, students were asked to assess whether they knew what they had to learn for the exams. All items are assessed using a 6-point Likert scale ranging from 1 = not at all to 6 = absolutely.

Participants Study 1

Study 1 participants were 959 medical students (62% female) who completed the formative evaluation (population = 1,544 students; response rate = 62%) in May 2020. At the end of the semester in July 2020, 1,425 students (58% female) participated in the evaluation (population = 1,501 students; response rate = 95%). 50% (May 2020) and 56% (July 2020) of students were between 21 and 25 years old respectively. Four different cohorts of students participated in the evaluation (July 2020): 338 (24%) first year students (second semester), 338 (24%) second year students (fourth semester), 430 (30%) third year students (sixth semester), and 319 (22%) fourth year students (eighth semester).

Participants Study 2

Participants were N = 4,215 medical students who participated in the end-of-semester evaluation in the summer semester 2018 (n = 1,382, population = 1,476 students; response rate 94%), summer semester 2019 (n = 1,408, population = 1,477 students; response rate 95%) and summer semester 2020 (n = 1,426, population = 1,501; response rate 95%). 58% were female. The majority of students (55%) was between 21 and 25 years old. In each of the three semesters, four different cohorts of students participated in the evaluation.

Quantitative Analysis

Perceptions of students were compared using either Kruskal-Wallis tests or Mann-Whithney U tests due to skewed distributions. In study 1, a Bonferroni correction was applied due to multiple testing, resulting in a significance level of 0.006 (0.05/8). In study 2, a Bonferroni correction was applied resulting in a significance level of 0.017 (0.05/3). Effect size calculations were conducted to determine the magnitude of the differences.

According to Cohen's guidelines (Cohen, 1988), $r = 0.10$ was considered to be a small effect, $r = 0.30$ as a medium effect, and $r = 0.50$ as a large effect. In terms of the effect size eta-squared, $\eta^2 = 0.01$ was considered as a small effect, $\eta^2 = 0.06$ as a medium effect, and $\eta^2 = 0.14$ as a large effect.

Qualitative Analyses

In study 2, all comments by the students were analyzed using an inductive category formation in MAXQDA 2018 (VERBI GmbH). Two top-level codes, namely positive and negative effects of digital teaching, were set beforehand. Initially, one coder (BK) worked through two modules to build a coding frame containing categories associated with one of these top-level codes. Afterwards, all documents were completely worked through by two coders to share the workload (BK, SM). In a next step, all codes in all categories were screened to identify discrepancies in category attribution and to consolidate ambiguous categories. This coding and counting process of the qualitative data enabled the connection to quantitative data.

Ethical Considerations

The study was realized in accordance with the Declaration of Helsinki (World Medical Association, 2013). Participation in the studies was voluntary. The permission to evaluate teaching and learning is granted in the Hamburg higher education act (section 111 subsection 2, Hamburgisches Hochschulgesetz, HmbHG). At our faculty, data analyses and dissemination processes are regulated in the "Statutes of evaluation of teaching and learning at the Medical Faculty, University of Hamburg." When entering iMED, students officially consent to the procedures of the web-based evaluation. The consent is voluntary, and over 99% of students give it. The anonymity of students is guaranteed.

RESULTS

Study 1

The results of the formative evaluation 6 weeks into the semester showed that students agreed to the statement that they were able to use the digital teaching offers with their technical equipment as well as their internet connection (N = 945, M = 5.17, SD = 1.12, Mdn = 6). Students also strongly agreed that they were able to make use of the different digital teaching methods (presentations with audio recordings: N = 946, M = 4.98, SD = 1.17, Mdn = 5; video conference: N = 796, M = 4.78, SD = 1.35, Mdn = 5; videos: N = 845, M = 4.73, SD = 1.40, Mdn = 5). 52% of students felt that presentations with audio recordings were superior to face-to-face lectures. In contrast, the majority of students felt that presentations with audio recordings were inferior regarding seminars (60%), bedside teaching (79%), and practical training (80%).

Several items regarding the adaption of digital teaching were assessed in study 1 (July, 2020). None of the items were normally distributed. The largest approval was found regarding the appreciation of the possibility to use digital teaching material repeatedly (see **Table 1**). Sixty percent of students stated they very often or often made use of this possibility. All items regarding positive perceptions of digital teaching were negatively skewed. Perceptions of negative aspects were somewhat heterogeneous resulting in rather bimodal distributions with larger groups of students disagreeing or agreeing to the statements, respectively.

Within this study, four different cohorts of students participated in the evaluation (year 1 students/second semester; year 2 students/fourth semester; year 3 students/sixth semester; year 4 students/eighth semester). In a next step, differences between students of different cohorts were analyzed (see **Supplementary Table S1**). **Figure 1** illustrates that first year students were seemingly able to cope with the negative aspects of digital teaching the best, because they agreed the least with these statements. First year students also agreed most to the positive aspects of digital teaching. In contrast, second year students agreed most to negative aspects of digital teaching, and disagreed most to positive aspects of digital teaching, respectively. Kruskal-Wallis tests were statistically significant ($p < 0.006$) in all but two comparisons (see **Supplementary Table S1**). There were no statistically significant differences regarding the items "I appreciate the use of digital teaching offers independently of time and location" as well as "I appreciate the possibility to use digital teaching material repeatedly." Post-hoc tests served to show which groups were different from each other. Effect sizes of post-hoc tests were rather small, but the most substantial differences were found between first and second year students. The effect sizes of these pairwise comparisons in the post-hoc test varied between $r = 0.14$ and $r = 0.23$.

Analysis of gender differences showed that female students' perceptions were different from male students' perceptions in the majority of items (see **Figure 2**; **Supplementary Table S2**). After a Bonferroni correction for multiple comparisons, three statistically significant differences were detected ($p < 0.006$). Male students agreed more to the statement that the lack of a time frame and structure in the digital teaching made them feel overstrained, representing a small effect ($r = 0.13$). In contrast, female students agreed more to the statement that digital teaching increased their study satisfaction ($r = 0.09$) as well as the statement that digital teaching motivated them to continuously pursue autonomous learning ($r = 0.10$).

Lastly, differences between age groups were analyzed. This additional analysis is called for, because the cohort is oftentimes not a strong predictor of the age group due to the complex admission procedures in Germany (e.g., applicants can be put on a waiting list for up to 7 years to get into university). In our study, the age group was not strongly associated with the cohort ($r = 0.252$, $p < 0.000$). Therefore, differences between age groups regarding all eight items on the adaption of digital teaching were analyzed. Results show that two statistically significant differences between age groups were detected ($p < 0.006$; see **Supplementary Table S3**). Older students agreed more to the statement that digital teaching increased their study satisfaction ($M = 4.75$, $SD = 1.52$, $Mdn = 5$; $H = 30.26$, $p < 0.000$, $\eta 2 = 0.02$). In addition, older students agreed the least that digital classes left more questions unanswered for them than face-to-face teaching ($M = 3.38$, $SD = 1.74$, $Mdn = 4$; $H = 21.55$, $p < 0.000$, $\eta 2 = 0.014$).

At the end of the semester, students were asked for positive and negative aspects of digital compared to face-to-face teaching in a free

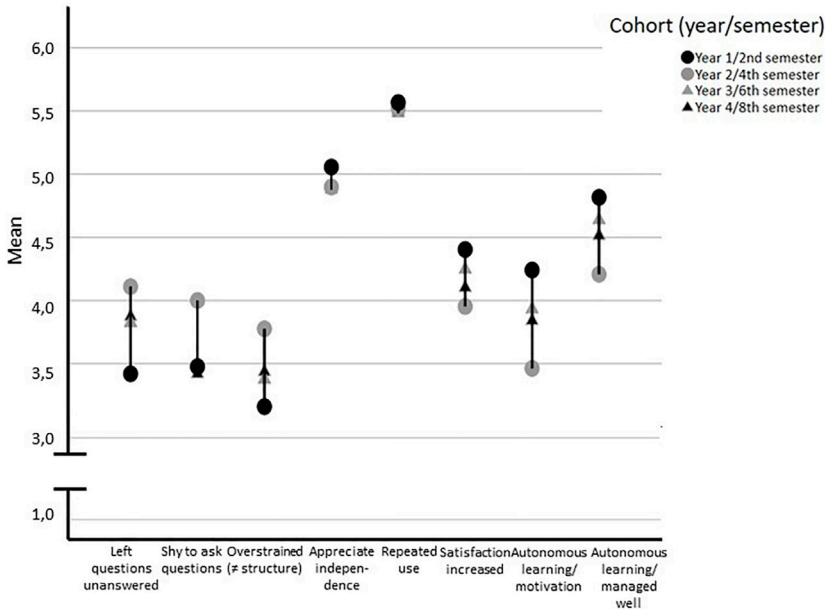

FIGURE 1 | Drop-line chart showing the difference of positive and negative perceptions of digital teaching between four cohorts.

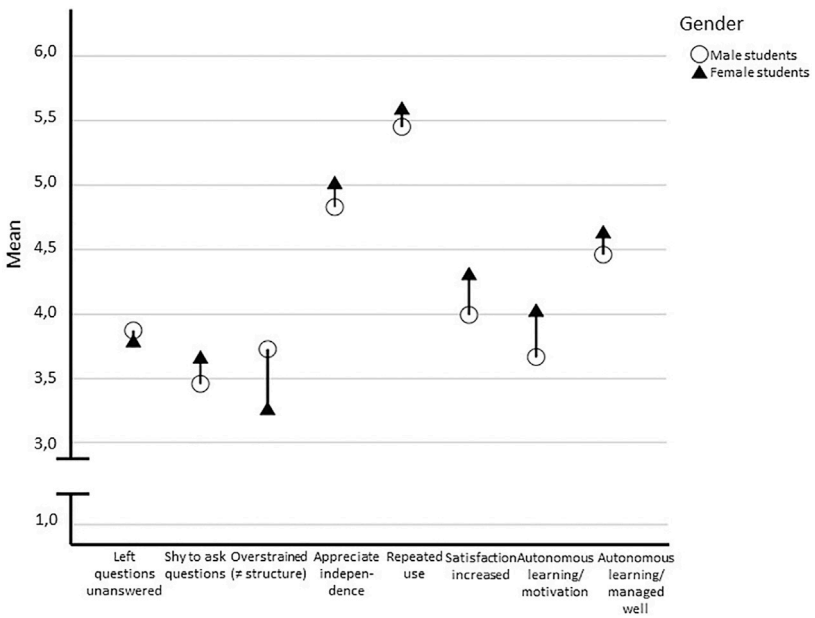

FIGURE 2 | Drop-line chart showing the difference of positive and negative perceptions of digital teaching between male and female students.

text format. Four hundred seventeen (29%) students responded to this free-choice question. These students mentioned 705 aspects of which 50% were positive (n = 357 codings within 13 sub-codes) and roughly 50% were negative (n = 349 codings within 12 sub-codes). All sub-codes including their frequencies are presented in **Table 2**.

One theme stood out within the positive code, namely the possibility to pause presentations with audio recordings and repeatedly work through these (n = 132 codings). Especially, students appreciated the fact that this format allowed them to adjust their studies to their own learning style.

"It's great to have your own schedule. If you need a break, you just pause the presentation. You can listen to the presentation repeatedly while consulting relevant literature."

The second most important positive aspect was the large flexibility in the use of digital course materials (n = 125 codings). Students appreciated the fact that they could access the materials

TABLE 2 | Codes and categories of study 1 qualitative data including frequencies.

Positive effects of digital teaching	**Codings**
Possibility to pause presentations with audio recordings and repeatedly work through these	96
Adjustment to own learning style	29
Parallel consultation of literature	7
Flexibility in the use of digital course materials	86
Positive regarding childcare obligations	13
Positive regarding job obligations	20
Adjustment of the class order	6
More intensely work through course material	19
Digital course material is better structured and more refined	21
All students have access to the same material	6
Digital course material would be an ideal supplement of face-to-face teaching	44
Especially useful for postprocessing	10
Total	357
Negative effects of digital teaching	
Missing of face-to-face interactions with teachers and peers	103
Lack of practical experiences and patient encounters	93
Amount of course material too large	40
Monotony of course material	23
Lack of a daily structure	21
Digital teaching cannot replace face-to-face teaching	16
Digital contents cannot be memorized	13
Missing of social interaction	11
Get lost in details	8
Negative comments on digital teaching in general	8
Lack of tutorials/exercises	5
Total	349

whenever and wherever they wanted. Within this sub-code, 33 students emphasized the advantages of this format for students with other responsibilities like childcare or part-time jobs.

"It's just positive. Self-regulated learning and this freedom enabled me to better structure my obligations as a student, mother and employee."

Within the negative code, many students described how they missed the face-to-face interaction with teachers and peers (n = 103 codings). The students argued that asynchronous interaction (e.g., via e-mail) had negative effects on their learning. Some students mentioned that they were reluctant to ask questions *via* e-mail or in video conferences.

"The lack of interaction and the lack of the possibility to develop questions within a conversation stand in the way of sustainable learning."

The second most important negative effect was the lack of practical experiences and patient encounters (n = 93 codings). Many students were disappointed and emphasized that they were unable to improve their competence because of the missing application of theoretical knowledge in practice.

"I have the feeling that a lot less knowledge got stuck due to the lack of practical teaching."

Study 2

In study 2, end-of-semester evaluations of the digital semester as well as two previous semesters were compared (**Table 3**). Results of a Kruskal-Wallis test showed that the feeling of preparedness for exams was not associated with the semester [H (2) = 5.96, p = 0.051]. Results regarding the difference in satisfaction with iMED showed that satisfaction was associated with the semester [H (2) = 14.47, p = 0.001]. Post-hoc tests revealed that satisfaction was lower in the digital semester compared to both other semesters, representing small effects. The same was found for the satisfaction with the module: students were the least satisfied in the digital semester compared to the two previous semesters [H (2) = 38.93, p > 0.001]. The pairwise comparisons were also small in effect size.

Within each semester, four different cohorts of students participated in the evaluation (year 1 students/second semester; year 2 students/fourth semester; year 3 students/sixth semester; year 4 students/eighth semester; see **Supplementary Table S4**). In this analysis, the digital summer semester 2020 stood out in different ways. In both previous summer semesters (2018 and 2019) first year students were the most satisfied and agreed most in all three items. Student satisfaction and agreement gradually decreased in the comparison of the different cohorts with fourth year students being the least satisfied and showing the least agreement regarding the feeling of preparedness for exams. Kruskal-Wallis tests were statistically significant in all comparisons. Medium sized effects were detected in the comparisons of cohorts in 2018 and 2019 (see **Supplementary Table S4**). Post-hoc tests of these results revealed that the largest effect sizes of pairwise comparisons of the cohorts were found between first and fourth year students (r = 0.28–0.35). In 2020, we identified a different pattern. First year students' satisfaction with the module and the program was lower than in previous semesters, resulting in scores approximately on the

TABLE 3 | Descriptive statistics of study 2.

	Summer 2018			Summer 2019			Summer 2020		
	N	M (SD)	Mdn	N	M (SD)	Mdn	N	M (SD)	Mdn
I knew what I had to learn for the assessment	1,416	4.37 (1.24)	5	1,411	4.42 (1.26)	5	1,426	4.31 (1.3)	4
Overall, I am satisfied with the study program iMED	1,434	5.15 (0.89)	5	1,441	5.17 (0.92)	5	1,443	5.04 (0.98)	5
Overall, I am satisfied with the completed module	1,431	4.81 (0.93)	5	1,432	4.81 (1)	5	1,356	4.57 (1.15)	5

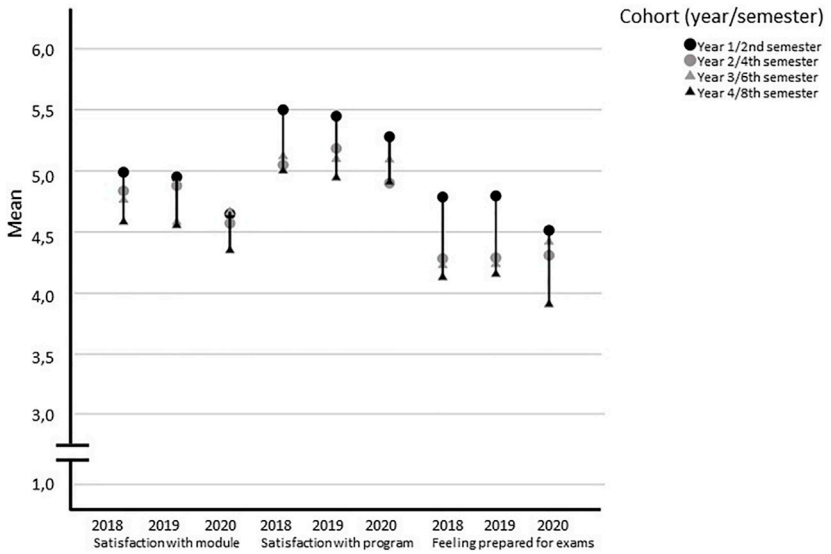

FIGURE 3 | Drop-line chart showing the difference of satisfaction and feeling of preparedness for exams between four cohorts.

level of third year students. First year students also felt less prepared for exams than in previous semesters. Effect sizes were rather small in 2020 compared to the previous semesters (see **Supplementary Table S4**). Pairwise comparisons of post-hoc tests also revealed smaller effects (r = 0.13–0.21). All means of the different cohorts in all three semesters are presented in **Figure 3**.

In a next step, differences regarding gender and age were analyzed. Therefore, data of the three different semesters were split to investigate each semester separately. A statistically significant difference between male and female students was found with female students being more satisfied with the module in the digital semester (female students: n = 808, M = 4.66, SD = 1.05, Mdn = 5; male students: n = 516, M = 4.44, SD = 1.25, Mdn = 5; U = 192,247.5, z = −2.518, p = 0.012, r = 0.06). None of the other comparisons of male and female students were statistically significant (see **Supplementary Table S5**).

Since the age group was not strongly associated with the cohort/semester (r = 0.274, p < 0.000), the differences between students in the four age groups were additionally analyzed. Results showed that age group was associated with the three items. Several statistically significant differences between students of different age groups were detected, however effect sizes were small (see **Supplementary Table S6**). Students in the age group <21 years were the most satisfied with the study program in all three semesters. Students in the age group >31 years were the least satisfied with the study program in all three semesters. The same pattern of satisfaction was found regarding the item "satisfaction with module." However, a statistically significant difference was only detected for the summer semester 2019. The only statistically significant differences between students in different age groups regarding the item "feeling of preparedness for exams" was found in the summer semester 2019. Students in the age group <21 years felt the most prepared while students between 21 and 25 years as well as students >31 years felt less prepared for exams. All pairwise comparisons in follow-up post-hoc analyses of statistically significant effects represented small to medium effect sizes.

DISCUSSION

Overall, the results indicate that students coped well with the usage of the digital teaching offers. Unlike the results of Khalil et al. (2020) suggest, technical challenges were not prevalent in the present study. It depended on the teaching format whether students rated digital teaching offers superior or inferior to non-digital teaching: More than half of the students even appreciated presentations with audio recordings more than non-digital lectures whereas the majority evaluated digital practical training, bedside-teaching, and seminars inferior compared to

non-digital formats. It is no wonder that lectures with audio recordings that can be replayed as much as one needs to comprehend the contents are appreciated most by students (Khalil et al., 2020; Chen et al., 2021). In all probability, the content availability has never been this convenient before.

Meaningful (Online) Learning Experiences

The reported inferiority of certain digital teaching offers could be explained by a lack of meaningful learning experience (Rusticus et al., 2014). Meaningful learning experiences as one scale of the Medical School Learning Environment Survey developed by (Marshall, 1978) and modified by (Feletti and Clarke, 1981) represents the degree to which students perceive that the educational experience is relevant to the practice of medicine. The extreme reduction of social interaction can also be identified as a negative aspect of digital teaching and learning. The qualitative findings of this study corroborate this assumption: The students argued that the lack of interactions had negative effects on their learning.

Online Learning Style

Both quantitative and qualitative results of the present study add to the body of research on (online) learning style of medical students. Students stated that the online format allows them to adjust their studies to their own learning style (Khalil et al., 2020). Seemingly, students with childcare or job obligations did profit the most. A recent study among undergraduate dental students reported that performing digital learning activities in an office or study room was an important factor to maintaining a high quality of life (Silva et al., 2021). In general a suitable environment that allows an adequate level of concentration (McCutcheon et al., 2015) is crucial for improved academic performance (Kirschner et al., 1997). Students with childcare or job obligations as well as older students might be more likely to have such a learning environment than younger students due to financial resources. As mentioned before, another positive factor might be the opportunity to manage their numerous obligations on their own terms. Altogether, the flexibility and control within the novel learning environment in terms of the possibility to use digital teaching material repeatedly and independent of time and location was most appreciated by the students.

The Role of Sample Characteristics

Three sample characteristics were analyzed in this study: medical education level, gender, and age group. Interestingly, first year students disagreed most to the negative aspects of digital teaching, and agreed most to the positive aspects of digital teaching, respectively. The background of these results could be the structure of the undergraduate medical curriculum with predominantly preclinical subjects, which can be more easily studied with the help of presentations with audio recordings, and few practical training in the first year (Chenot, 2009; Hense et al., 2021; Rheingans et al., 2019). Furthermore, prior research among undergraduate medical and dental students found that students adopted a different learning approach (Lee at al., 2020; Wickramasinghe and Samarasekera, 2011) and increased levels of stress (Erschens et al., 2018) with the entry to clinical training. This might account for our findings that second year students (fourth semester) agreed most to negative aspects of digital teaching, and disagreed most to positive aspects of digital teaching, respectively. At the University Medical Center of Hamburg-Eppendorf, the large cohort of approximately 370 students is divided into four groups after the third semester, and students enter the second stage of the program in which the complexity as well as clinical teaching offers are increased (Rheingans et al., 2019). This might be an explanation why second year students perceptions stand out in the analysis.

In addition, gender differences were revealed in the analysis. While male students felt more overstrained, female students seemingly coped better with the digital learning environment. A study in relation to the COVID-19 pandemic by Salfi et al. (2020) also showed that women in the Italian population seemed to cope better with the ongoing lockdown measures. Nevertheless, our findings do not refer to mental health issues, but to the handling of educational challenges. In this regard, our findings are interesting, because it was shown that women "define themselves as higher in relational interdependence than men, and men define themselves as higher in independence/agency than women" (Guimond et al., 2006, p. 221). Findings of other studies in medical education on how motivation affects medical students suggest that male and female student' quantity and quality of motivation differ: female students have higher autonomous motivation than male students, and male students have higher controlled motivation than female students (e.g., Kusurkar et al., 2013). The absence of perceived approval from others as well as the fact that any external reinforcement was missing during the digital, asynchronous teaching might have led male students to feel more overstrained than female students. Nevertheless, future studies will be needed to further analyze how female students coped with the lack of social interaction despite the fact that relational interdependence is evidently more important to women.

Additionally, a few differences between age groups were detected in study 1. On the one hand, older students agreed more to the statement that digital teaching increased their study satisfaction. On the other hand, this group of students agreed more that digital teaching left more questions unanswered for them than face-to-face teaching. Older students might have to face more job and family obligations. The very flexible, asynchronous digital teaching makes it easier for this group to manage their several obligations, which might have resulted in their higher study satisfaction.

In-Person vs. Distance Medical Education

Results of study 2 showed that satisfaction with the integrated study course iMED decreased during distance medical education compared to previous in-person medical education summer semesters. Interestingly, students did not feel less prepared for exams. This might be because exams were organized in a multiple-choice format only. Nonetheless, students' quantitative ratings as well as their written statements indicate that many questions were left unanswered due to missing interaction and practical experiences. It has been reported that students' perceptions of the medical school learning environment is associated with satisfaction (Genn, 2001). In the comparison of four different cohorts, a particular pattern was detected in the digital semester (2020). Differences between cohorts in terms of the satisfaction with the module were smaller than in

previous semesters. Fourth year students felt the least prepared for exams. In this advanced stage of medical education, the practical study components are usually particularly high (Hense et al., 2021; Rheingans et al., 2019) and are probably the most difficult to learn digitally. Altogether, the finding that satisfaction seemingly decreased during the course of medical school could be associated with the fact that the mental health of students also changes throughout the course of the semesters and is increasingly characterized by distress (Dyrbye et al., 2009).

Only one statistically significant difference between male and female students was detected in study 2 with female students being more satisfied with the module in the digital semester. This finding is in accordance with the findings of study 1 in which females were also found to have more positive perceptions of digital teaching and learning. The comparison of age groups revealed a remarkable difference in the satisfaction with the study program: Younger students were the most satisfied and older students were the least satisfied. The fact that older students were the least satisfied might be associated with multiple obligations of older students (e.g., job, family), although this group explicitly pointed out the advantages of digital learning in study 1.

Limitations

Both studies have several limitations. The cross-sectional design does not allow causal statements. The representativeness is limited due to the implementation at a single institution. In study 1, there were differences in terms of response rates. Students are used to complete an extensive evaluation at the end of each semester. Also, at the end of the semester all exams are completed for both modules of the semester. This might be the reason why students were not as committed to evaluate the module 6 weeks into the semester as usual. Consequently, the response rates were different. In addition, despite many statistically significant associations, effect sizes were small, which may be due to the big sample size that increases the likelihood for the p value to become statistically significant.

Nevertheless, we assume that those limitations could be compensated partially. A particular strength of both studies is the high response rate and the consideration of quantitative and qualitative data (Frambach et al., 2013). The approach of conventional content analysis can be used when existing theories or literature are limited. The information comes directly from the participants without predefined categories (Hsieh and Shannon, 2005; Patton, 2014). Quantifying the qualitative data can also facilitate the process of assigning meaning through pattern recognition by identifying consistencies and inconsistencies in the data, especially when analyzing large data sets (Neale et al., 2014; Monrouxe and Rees, 2020). Another limitation is the lack of results on mental health of students that could amplify the reasoning of the present study.

CONCLUSION

Altogether, our results indicate that the attitude towards the novel learning environment in medical education is comprised of negative as well as positive aspects. Despite several advantages in terms of the flexibility and large-scale availability of digital teaching materials, medical students were seriously affected by the lack of interactions with peers, professionals, and patients in practice. This corroborates the results of previous studies that were conducted during the SARS pandemic (Hawryluck et al., 2004; Reynolds et al., 2008). Participation in activities *via* telephone or video meeting could not compensate for the negative emotional states (Jeong et al., 2016). Since the undergraduate medical education is very structured (Chenot, 2009) this effect might account in parts for the negative perception of the students. At the same time, the structured curriculum enables the Faculty to more easily make digital learning materials accessible. Furthermore, social support in terms of peers and faculty as well as physical space for gathering is considered one important domain of system-level factors that influence learner well-being (Dyrbye et al., 2020).

In particular, the differences regarding gender, age group, and semester might demand the introduction of tailored educational support services for students during COVID-19 as they progress through medical school. This has to be acknowledged by Universities, since there is not a single strategy that will match all students' needs. In addition, longitudinal studies are needed as the pandemic continues to monitor the perceived impact of the novel learning environment.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because evaluation data cannot be shared publicly because of internal data protection reasons. The Medical Faculty, in this case represented by the Vice Dean for student affairs, does not allow the non-aggregated publication of student evaluation data. This regulation is specified in §5 of the "Statutes of evaluation of teaching and learning at the Medical Faculty, University of Hamburg." Requests to access the datasets should be directed to SM, s.mohr@uke.de.

AUTHOR CONTRIBUTIONS

All authors contributed to the conception and design of the studies. SM and BK analysed the quantitative and qualitative data. SM and JG wrote the manuscript in consultation with BK and AR. AR supervised the studies.

ACKNOWLEDGMENTS

The authors would like to thank all undergraduate medical students for their participation in the voluntary evaluation.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2021.714526/full#supplementary-material

REFERENCES

Brazeau, C. M., Shanafelt, T., Durning, S. J., Massie, F. S., Eacker, A., Moutier, C., et al. (2014). Distress Among Matriculating Medical Students Relative to the General Population. *Acad. Med.* 89, 1520–1525. doi:10.1097/acm.0000000000000482

Chen, E., Kaczmarek, K., and Ohyama, H. (2021). Student Perceptions of Distance Learning Strategies during COVID-19. *J. Dent. Educ.* 85 (Suppl. 1), 1190–1191. doi:10.1002/jdd.12339

Chenot, J. F. (2009). Undergraduate Medical Education in Germany. *Ger. Med. Sci.* 7, Doc02. doi:10.3205/000061

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. New York, NY: Academic Press.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks, CA: SAGE Publications.

Dyrbye, L. N., Lipscomb, W., and Thibault, G. (2020). Redesigning the Learning Environment to Promote Learner Well-Being and Professional Development. *Acad. Med.* 95, 674–678. doi:10.1097/ACM.0000000000003094

Dyrbye, L. N., Massie, F. S., Eacker, A., Harper, W., Power, D., Durning, S. J., et al. (2010). Relationship between Burnout and Professional Conduct and Attitudes Among US Medical Students. *JAMA* 304, 1173–1180. doi:10.1001/jama.2010.1318

Dyrbye, L. N., Thomas, M. R., Harper, W., Massie, F. S., Power, D. V., Eacker, A., et al. (2009). The Learning Environment and Medical Student Burnout: A Multicentre Study. *Med. Educ.* 43, 274–282. doi:10.1111/j.1365-2923.2008.03282.x

Erschens, R., Herrmann-Werner, A., Keifenheim, K. E., Loda, T., Bugaj, T. J., Nikendei, C., et al. (2018). Differential Determination of Perceived Stress in Medical Students and High-School Graduates Due to Private and Training-Related Stressors. *PLoS One* 13, e0191831. doi:10.1371/journal.pone.0191831

Feletti, G. I., and Clarke, R. M. (1981). Review of Psychometric Features of the Medical School Learning Environment Survey. *Med. Educ.* 15, 92–96. doi:10.1111/j.1365-2923.1981.tb02403.x

Frambach, J. M., van der Vleuten, C. P., and Durning, S. J. (2013). AM Last Page. Quality Criteria in Qualitative and Quantitative Research. *Acad. Med.* 88, 552. doi:10.1097/ACM.0b013e31828abf7f

Genn, J. M. (2001). AMEE Medical Education Guide No. 23 (Part 1): Curriculum, Environment, Climate, Quality and Change in Medical Education-A Unifying Perspective. *Med. Teach.* 23, 337–344. doi:10.1080/01421590120063330

Gruppen, L. D., Irby, D. M., Durning, S. J., and Maggio, L. A. (2019). Conceptualizing Learning Environments in the Health Professions. *Acad. Med.* 94, 969–974. doi:10.1097/acm.0000000000002702

Guimond, S., Chatard, A., Martinot, D., Crisp, R. J., and Redersdorff, S. (2006). Social Comparison, Self-Stereotyping, and Gender Differences in Self-Construals. *J. Pers Soc. Psychol.* 90, 221–242. doi:10.1037/0022-3514.90.2.221

Hawryluck, L., Gold, W. L., Robinson, S., Pogorski, S., Galea, S., and Styra, R. (2004). SARS Control and Psychological Effects of Quarantine, Toronto, Canada. *Emerg. Infect. Dis.* 10, 1206–1212. doi:10.3201/eid1007.030703

Hense, H., Harst, L., Küster, D., Walther, F., and Schmitt, J. (2021). Implementing Longitudinal Integrated Curricula: Systematic Review of Barriers and Facilitators. *Med. Educ.* 55, 558–573. doi:10.1111/medu.14401

Holzinger, A., Lettner, S., Steiner-Hofbauer, V., and Capan Melser, M. (2020). How to Assess? Perceptions and Preferences of Undergraduate Medical Students Concerning Traditional Assessment Methods. *BMC Med. Educ.* 20, 312. doi:10.1186/s12909-020-02239-6

Hsieh, H. F., and Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qual. Health Res.* 15, 1277–1288. doi:10.1177/1049732305276687

Jeong, H., Yim, H. W., Song, Y. J., Ki, M., Min, J. A., Cho, J., et al. (2016). Mental Health Status of People Isolated Due to Middle East Respiratory Syndrome. *Epidemiol. Health* 38, e2016048. doi:10.4178/epih.e2016048

Khalil, R., Mansour, A. E., Fadda, W. A., Almisnid, K., Aldamegh, M., Al-Nafeesah, A., et al. (2020). The Sudden Transition to Synchronized Online Learning during the COVID-19 Pandemic in Saudi Arabia: A Qualitative Study Exploring Medical Students' Perspectives. *BMC Med. Educ.* 20, 285. doi:10.1186/s12909-020-02208-z

Kirschner, P., Van Vilsteren, P., Hummel, H., and Wigman, M. (1997). The Design of a Study Environment for Acquiring Academic and Professional Competence. *Stud. Higher Educ.* 22, 151–171. doi:10.1080/03075079712331381014

Kusurkar, R. A., Ten Cate, T. J., Vos, C. M., Westers, P., and Croiset, G. (2013). How Motivation Affects Academic Performance: A Structural Equation Modelling Analysis. *Adv. Health Sci. Educ. Theor. Pract* 18, 57–69. doi:10.1007/s10459-012-9354-3

Lee, J., Kim, R. J. Y., and Choi, H. (2020). Most Surface Learning in the Third Year: Dental Student Learning Approaches and Implications for Curriculum and Assessment. *J. Dent Educ.* 84, 464–472. doi:10.1002/jdd.12043

Marshall, R. E. (1978). Measuring the Medical School Learning Environment. *J. Med. Educ.* 53, 98–104. doi:10.1097/00001888-197802000-00003

McCutcheon, K., Lohan, M., Traynor, M., and Martin, D. (2015). A Systematic Review Evaluating the Impact of Online or Blended Learning vs. Face-To-Face Learning of Clinical Skills in Undergraduate Nurse Education. *J. Adv. Nurs.* 71, 255–270. doi:10.1111/jan.12509

Monrouxe, L. V., and Rees, C. E. (2020). When I Say ... Quantification in Qualitative Research Quantification in Qualitative Research. *Med. Educ.* 54, 186–187. doi:10.1111/medu.14010

Neale, J., Miller, P., and West, R. (2014). Reporting Quantitative Information in Qualitative Research: Guidance for Authors and Reviewers. *Addiction* 109, 175–176. doi:10.1111/add.12408

Patton, M. Q. (2014). *Qualitative Research & Evaluation Methods: Integrating Theory and Practice*. Thousand Oaks, CA: SAGE Publications.

Reynolds, D. L., Garay, J. R., Deamond, S. L., Moran, M. K., Gold, W., and Styra, R. (2008). Understanding, Compliance and Psychological Impact of the SARS Quarantine Experience. *Epidemiol. Infect.* 136, 997–1007. doi:10.1017/s0950268807009156

Rheingans, A., Soulos, A., Mohr, S., Meyer, J., and Guse, A. H. (2019). The Hamburg Integrated Medical Degree Program iMED. *GMS J. Med. Educ.* 36, Doc52. doi:10.3205/zma001260

Rose, S. (2020). Medical Student Education in the Time of COVID-19. *JAMA* 323, 2131. doi:10.1001/jama.2020.5227

Rusticus, S., Worthington, A., Wilson, D., and Joughin, K. (2014). The Medical School Learning Environment Survey: An Examination of its Factor Structure and Relationship to Student Performance and Satisfaction. *Learn. Environ Res* 17, 423–435. doi:10.1007/s10984-014-9167-9

Salfi, F., Lauriola, M., Amicucci, G., Corigliano, D., Viselli, L., Tempesta, D., et al. (2020). Gender-Related Time Course of Sleep Disturbances and Psychological Symptoms during the COVID-19 Lockdown: A Longitudinal Study on the Italian Population. *Neurobiol. Stress* 13, 100259. doi:10.1016/j.ynstr.2020.100259

Schwenk, T. L., Davis, L., and Wimsatt, L. A. (2010). Depression, Stigma, and Suicidal Ideation in Medical Students. *JAMA* 304 (11), 1181–1190. doi:10.1001/jama.2010.1300

Silva, P. G. D. B., Oliveira, C. A. L., Borges, M. M. F., Moreira, D. M., Alencar, P. N. B., Avelar, R. L., et al. (2021). Distance Learning during Social Seclusion by COVID-19: Improving the Quality of Life of Undergraduate Dentistry Students. *Eur. J. Dent Educ.* 25, 124–134. doi:10.1111/eje.12583

Vanderbilt, A. A., Feldman, M., and Wood, I. K. (2013). Assessment in Undergraduate Medical Education: A Review of Course Exams. *Med. Educ. Online* 18, 1–5. doi:10.3402/meo.v18i0.20438

Vindegaard, N., and Benros, M. E. (2020). COVID-19 Pandemic and Mental Health Consequences: Systematic Review of the Current Evidence. *Brain Behav. Immun.* 89, 531–542. doi:10.1016/j.bbi.2020.05.048

Wasson, L. T., Cusmano, A., Meli, L., Louh, I., Falzon, L., Hampsey, M., et al. (2016). Association between Learning Environment Interventions and Medical Student Well-Being: A Systematic Review. *JAMA* 316, 2237–2252. doi:10.1001/jama.2016.17573

Weiss, K. B., Bagian, J. P., and Nasca, T. J. (2013). The Clinical Learning Environment: the Foundation of Graduate Medical Education. *JAMA* 309, 1687–1688. doi:10.1001/jama.2013.1931

Wickramasinghe, D. P., and Samarasekera, D. N. (2011). Factors Influencing the Approaches to Studying of Preclinical and Clinical Students and Postgraduate Trainees. *BMC Med. Educ.* 11, 22. doi:10.1186/1472-6920-11-22

World Medical Association (2013). World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. *JAMA* 310, 2191–2194. doi:10.1001/jama.2013.281053

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

BRIEF RESEARCH REPORT
published: 27 October 2021
doi: 10.3389/fpsyg.2021.670722

A Two-Sided Lockdown? Social Class Variations in the Implementation of Homeschooling During the COVID-19 Lockdown

Camille Sanrey[1,2], Sébastien Goudeau[1], Arnaud Stanczak[3] and Céline Darnon[3]*

[1] CeRCA – CNRS UMR 7295, Université de Poitiers, Poitiers, France, [2] LPC, Université de Strasbourg, Strasbourg, France, [3] LAPSCO – CNRS UMR 6024, Université Clermont Auvergne, Clermont-Ferrand, France

The COVID-19 pandemic deeply affected how schools and families functioned through most of 2020. In particular, school closures meant parents took on a more central role in their children's learning. This study analyzed social class variations in the quantity and quality of homeschooling during the lockdown. Through an online questionnaire, 360 parents reported (1) their digital equipment and use, (2) the perceptions of their ability to homeschool their children, (3) how they handled homeschooling and (4) the extent to which they supported other activities considered more or less "profitable" from an educational point of view (e.g., reading, watching television). A social position index was used as a proxy of social class. The results indicated that all parents were highly involved in setting up homeschooling and that the lower the parents' social position, the more they spent time homeschooling their children. However, in line with the digital divide literature, the lower the parents' social position, the lower the digital equipment and the less the parents felt capable of homeschooling. Finally, the higher the social position of the families, the more children spent time doing activities considered to be "educationally profitable," and the less they spent time doing "unprofitable activities." Thus, even if all parents were highly involved in homeschooling, higher social position parents were better equipped both materially and psychologically to face the challenge of homeschooling. The long-term impact of these processes on the perpetuation of social class inequalities are discussed.

Keywords: COVID-19, lockdown, homeschool, parental practices, social inequalities in education

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Paolo Roma, Sapienza University of Rome, Italy
Pablo Gracia, Trinity College Dublin, Ireland

****Correspondence:***
Camille Sanrey
camille.sanrey@unistra.fr

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *22 February 2021*
Accepted: *05 October 2021*
Published: *27 October 2021*

Citation:
Sanrey C, Goudeau S, Stanczak A and Darnon C (2021) A Two-Sided Lockdown? Social Class Variations in the Implementation of Homeschooling During the COVID-19 Lockdown. Front. Psychol. 12:670722. doi: 10.3389/fpsyg.2021.670722

A TWO-SIDED LOCKDOWN? SOCIAL CLASS VARIATIONS IN THE IMPLEMENTATION OF HOMESCHOOLING DURING THE COVID-19 LOCKDOWN

In the beginning of 2020, the COVID-19 pandemic deeply affected the functioning of societies around the world. In particular, the first wave of the pandemic led many countries to close schools, impacting hundreds of millions of learners (UNESCO, 2020). More recently, highly contagious variants of the virus have emerged, forcing a new period of school closures in many countries

worldwide. This situation places a heavy responsibility on parents (Lee et al., 2021) and recent studies have documented that the lockdown has increased the risk of parental stress (Griffith, 2020; Spinelli et al., 2020) and parenting-related exhaustion (Marchetti et al., 2020). In addition, higher levels of depression and anxiety have been observed among parents and children than in normal times (Zhao et al., 2020). All these difficulties, due in large part to the fact parents had to homeschool their children (Thorell et al., 2021), are particularly true for working-class parents (Goudeau et al., 2021; Parolin and Lee, 2021). The goal of the present paper is to document social class variations in the implementation of homeschooling in France during spring 2020.

Social class is a powerful context of life and socialization associated with diverse material, cultural, and psychological resources that constitute (dis)advantages for many aspects of schooling (Stephens et al., 2012; Goudeau et al., 2017). More precisely, research has highlighted the existence of "divides," which can be particularly problematic when schools are closed. These divides concern both digital equipment and use (i.e., "digital divide," Zhang, 2015; Harris et al., 2017), and cultural practices that appear to be more or less "profitable" in terms of educational outcomes (e.g., Bourdieu and Passeron, 1990; Lareau, 2003; Gaddis, 2013), as well as parental perceptions of their ability to homeschool their children (Tazouti and Jarlégan, 2016).

The digital divide refers to the fact that social class is a strong and recurrent predictor of digital access, skills, and use of digital tools (e.g., Harris et al., 2017; Anderson and Kumar, 2019). Indeed, upper-middle-class families[1] not only live in larger houses and have more available space in which to study, they also have better digital equipment. Although the digital divide in access to digital tools has decreased over time, working-class families are still less equipped than upper-middle-class families and, thus, are more likely to be partially or totally excluded from the digital world (e.g., Cruz-Jesus et al., 2016). For example, in the United States in 2019, 41% of working-class families did not own a computer, compared to 8% of upper-middle-class families (Vogels, 2021). In addition to access to digital equipment, disparities in digital use also exist (Yates et al., 2015: Harris et al., 2017). For example, working-class families are more likely to use digital tools for entertainment than upper-middle-class families (e.g., video games; Bonfadelli, 2002; Harris et al., 2017), who are more likely to use digital tools for work or educational purposes (Robinson and Schulz, 2013; Harris et al., 2017).

In addition, as mentioned above, the school system plays an important role in reproducing social inequalities (Bourdieu and Passeron, 1990), notably by promoting practices, languages and way of being that are more in line with those developed in upper-class families than in working-class families. Thus, beyond the digital divide, working-class families usually have less familiarity with the academic knowledge and skills expected and valued in school compared to upper-middle-class families (Lamont and Lareau, 1988; Goudeau and Croizet, 2017). Consequently, working-class families are less likely to engage in cultural practices that match school curriculum (e.g., reading stories to children, visiting museums, Bernstein, 1974; Lareau, 2003; Gaddis, 2013). This lower familiarity toward academic knowledge and skills constitutes a disadvantage for working-class parents, who are likely to feel particularly challenged when they have to homeschool their children. Combined with other factors, such as negative stereotypes regarding one's intelligence (e.g., Jury et al., 2017; Grigoryan et al., 2019), this lower familiarity with (academic) cultural capital may lead working-class parents into developing a poor sense of academic self-efficacy (Wiederkehr et al., 2015; Tazouti and Jarlégan, 2016). This poor self-efficacy may also be associated with a greater fear of academic failure for their children (see Wagner and Brahm, 2017).

Furthermore, because of these differences in cultural capital, upper-middle-class and working-class families may also differ in the nature of activities they supported among their children during the lockdown. Indeed, some activities (e.g., reading stories to their children) have the potential to increase students' cultural capital (Lareau, 2003; Gaddis, 2013; Lahire, 2019). In contrast, other activities (e.g., watching television) are less "profitable" because beyond being less aligned with schools' expectations and less valued by teachers, they are less likely to develop academic skills. Supporting this idea, working-class families have been shown to regulate their children's television use to a lesser degree (Mentec and Plantard, 2014; Nikken and Jansz, 2014) and tend to watch less educative TV programs than upper-middle-class ones, further affecting their achievement (Sullivan, 2001). By supporting these activities, upper-middle-class parents provide their children with a cultural advantage that appears to be profitable for future academic success. Indeed, reading, practicing creative activities, and exercising are all activities that have been shown to be linked to cognitive development (e.g., Alvarez-Bueno et al., 2017) or academic achievement (e.g., Bus et al., 1995; Swanson et al., 2011; Gajda et al., 2017), whereas watching TV is negatively associated with achievement (e.g., Williams et al., 1982; Razel, 2001). Interestingly, the differential implementation of profitable and unprofitable activities at home is one of the reasons underlying the summer learning loss (i.e., the increase in the social class achievement gap during school breaks; Cooper et al., 1996; Alexander et al., 2007; Stewart et al., 2018).

OVERVIEW AND HYPOTHESES

In this paper, we seek to analyze how social class predicts the quantity and quality of homeschooling during the 2020 lockdown. More precisely, we examined social class variations on four main categories of outcomes: (1) digital equipment, (2) parents' perceptions of their ability to homeschool their children and fear of their children's academic failure, (3) implementation of homeschooling during school closure (e.g., duration of homeschooling, completion of exercises sent by

[1]Social class is mainly assessed using income, educational level and/or occupation. Thus, "Upper-middle-class families" refers to the families in the advantaged range of these indicators (i.e., high-income level, university education level and/or prestigious occupations such as lawyers or researchers). On the contrary, "working-class families" refers to the disadvantaged families on these indicators (i.e., low-income level, no university degree, less prestigious occupations such as blue-collar workers).

the teachers), and (4) engagement in other profitable and unprofitable activities during school closure.

First, we hypothesize that the lower the parents' social position, the lower their access to digital tools and the more they should use these tools for entertainment rather than for education. Second, although all families are expected to support homeschooling (e.g., do the exercises sent by the teachers), lower social position should be associated to lower levels of self-efficacy for homeschooling as well as a greater fear of academic failure. Finally, the likelihood to support profitable (vs. unprofitable) activities should increase (vs. decrease) with the parents' social position.

METHOD

Participants

French parents of preschool- to elementary-school-aged children were invited to respond to an online questionnaire shared through personal, professional, and social networks in April 2020. The questionnaire was fully answered by a total of 360 parents (290 women, 68 men and 2 non-binary people; $M_{age} = 37.70$, SD = 5.10, min = 19, max = 53). Parents in this sample had on average two children ($M = 2.07$, SD = 0.84, min = 1, max = 6). Children were 164 girls (45.56%) and 196 boys, $M_{age} = 6.32$ years (SD = 2.13, *min* = 3, *max* = 11); 162 were enrolled in preschool (45.25%) and 196 were enrolled in elementary school (54.75%). Responses to all the questions were mandatory (except for the socio-demographic questions concerning the partner). Thus, there was no missing data. We used the *Social Position Index* (SPI) as a proxy of social class. This indicator is a standardized continuous variable, with mean = 100 and standard deviation = 30. It has been developed on large French databases in order to capture multiple dimensions linked to social class (e.g., educational attainment, parental education, material conditions, cultural capital, Rocher (2016), for a description of each possible social position values, see **Supplementary Table 2**). We assigned a social position index value to the respondent, as well as their partner, and kept the highest as a proxy of social class (Rocher, 2016).

Measures

All measures and associated modalities are reported in **Supplementary Table 1** in **Supplementary Material**.

Digital Equipment and Uses

Participants were asked to report whether they had (1) Internet access, (2) high-speed Internet access, (3) at least one computer at home, and (4) a printer (0 = *no*, 1 = *yes*). Participants who owned at least one computer were asked to indicate the number of owned computers and the number of users. Digital uses were assessed by asking participants about their frequency (from 1 = *never* to 4 = *several times a day*) and duration (average number of hours per week) of computer use for (1) leisure activities (e.g., watching movies), (2) work (e.g., professional email), and (3) schoolwork (e.g., information search). For each type of use, they were asked to answer for (a) normal times (i.e., before the lockdown) and (b) during the lockdown.

Perception of Homeschooling Ability

Perceived self-efficacy was measured using three items ($\alpha = 0.72$) inspired from Tazouti and Jarlégan (2016) and adapted to the homeschooling context (e.g., "I am able to replace my child's teacher during the lockdown" on scales ranging from 1 (*totally disagree*) to 7 (*totally agree*). Furthermore, fear of academic failure was measured using three items ($\alpha = 0.58$) created to assess parental fear of failure concerning their child(ren)'s schooling (e.g., "I feel that my child will fall behind academically"; see SM for the entire scale), ranging from 1 (*totally disagree*) to 7 (*totally agree*).

Homeschooling Activities[2]

Participants were asked to indicate if they provided homework help in normal times (0 = *no*, 1 = *yes*) and, if so, its frequency per week (from 1 day to 7 days per week) as well as the average duration per day (from 1 = *less than 30 minutes a day* to 5 = *more than 3 hours a day*). They were then asked to indicate if they participated in homeschooling during the lockdown (0 = *no*, 1 = *yes*) and, if so, the frequency (i.e., number of days per week) and the average time per day (the same scale as for homework help, from 1 to 5). They then reported whether they received resources from their child's teacher (0 = *no*; 1 = *yes*) and if they made their child do every exercise received (from 1 = *none* to 3 = *every one*). Participants were then asked whether they had made their child(ren) work on new concepts on their own initiative at least once (0 = *no*, 1 = *yes*) and if they knew of any additional resources (e.g., educational websites, educative television programs; 0 = *no*; 1 = *yes*). If so, they reported the frequency at which they used them (from 1 = *every day* to 5 = *never*).

Other (Profitable and Unprofitable) Activities During Lockdown

Participants indicated whether, during the lockdown, they had their child(ren) do some (1) creative activities (e.g., painting) and (2) sport activities (e.g., stretching; 0 = *no*, 1 = *yes*) and, if so, the frequency of these activities (from 1 = *every day* to 4 = *less than once a week*). Participants were also asked to specify the approximate time per week they[3] spent reading books to their children and, if their children could already read, how long they spend reading by themselves (1) in normal times and (2) during the lockdown (from 1 = *less than 30 minutes a day* to 5 = *more than 3 hours a day*). Educationally unprofitable activities were assessed by asking participants to indicate the duration of television watching time (1) in normal times and (2) during the lockdown (from 1 = *less than 30 minutes a day* to 5 = *more than 3 hours a day*).

[2]When they had several children, participants were asked to answer all the questions concerning their practices for the youngest child attending preschool or elementary school.

[3]Participants were asked to answer for themselves and for their partner. A composite score was created by averaging the response for the participant and the response for their partner. The reading time score thus corresponds the average time spent reading to the child by one parent.

RESULTS

Data Analyses

We analyzed the extent to which the social position index predicted the four categories of outcomes. Due to some normality and heteroscedasticity issues, we used robust regressions on continuous variables and logistical robust regressions on categorical variables (using the "robustbase" R package). It is worth noting that in further analyses, we computed covariates analyses. These covariates analyses are reported in **Supplementary Tables 3, 4** (see **Supplementary Material**).

Digital Equipment and Uses

The higher the social position, the higher the probability to own a computer, $Z = 3.14$, $p = 0.002$, OR = 1.03, 97.5% CI = [1.01; 1.05], the higher the probability to own a printer (marginal), $Z = 1.70$, $p = 0.089$, OR = 1.01, 97.5% CI = [0.99; 1.02], the higher the probability to have access to high-speed Internet, $Z = 2.25$, $p = 0.025$, OR = 1.01, 97.5% CI = [1.00; 1.02] and the higher the number of owned computers, $t(358) = 5.30$, $p < 0.001$, IRR = 1.01, 97.5% CI = [1.01; 1.02].

In normal times, the higher the social position, the higher the frequency of leisure use (marginal), $t(341) = 1.85$, $p = 0.066$, IRR = 1.01, 97.5% CI = [0.99; 1.02], and the higher the duration of leisure use, $t(336) = 2.21$, $p = 0.028$, IRR = 1.02, 97.5% CI = [1.00; 1.03]. Furthermore, the higher the social position, the higher the frequency and duration of work uses, respectively $t(341) = 4.26$, $p < 0.001$, IRR = 1.02, 97.5% CI = [1.01; 1.03] and $t(333) = 2.87$, $p = 0.004$, IRR = 1.06, 97.5% CI = [1.02; 1.09]. However, contrary to the hypothesis, the higher the social position, the less participants tent to use it for school work, $t(341) = -1.88$, $p = 0.060$, IRR = 0.99, 97.5% CI = [0.99; 1.00], and the lower the duration of this school work oriented use, $t(333) = -3.60$, $p < 0.001$, IRR = 0.99, 97.5% CI = [0.98; 0.99].

Similar trends emerged concerning the frequency and duration of use during the lockdown for leisure activities: The higher the social position, the higher the frequency and duration of leisure use, respectively, $t(341) = 2.48$, $p = 0.013$, IRR = 1.01, 97.5% CI = [1.00; 1.02] and, $t(335) = 1.88$, $p = 0.061$, IRR = 1.02, 97.5% CI = [0.99; 1.04]. Similarly, the higher the social position, the more participants used their computer for work, $t(333) = 7.72$, $p < 0.001$, IRR = 1.24, 97.5% CI = [1.18; 1.32]. Contrariwise, during the lockdown, duration of use for schoolwork did not depend on social position, $p = 0.769$.

Perception of Homeschooling Ability

Results indicated that the higher the social position, the higher the homeschooling self-efficacy, $t(358) = 3.51$, $p < 0.001$, IRR = 1.01, 97.5% CI = [1.00; 1.01] and the lower the fear of academic failure, $t(358) = -4.42$, $p < 0.001$, IRR = 0.99, 97.5% CI = [0.98; 0.99].

Homeschooling Activities

The higher the social position, the lower parents reported helping their children with their homework in normal times, $Z = -3.12$, $p = 0.002$, OR = 0.98, 97.5% CI = *[0.97*; 0.99]. Furthermore, for those who did help with homework, the higher the social position, the lower the frequency of such help (marginal), $t(272) = -1.91$, $p = 0.057$, IRR = 0.99, 97.5% CI = [0.99; 1.00]. Social position did not impact the probability to engage in homeschooling during the lockdown, $p = 0.507$ nor the frequency of homeschooling, $p = 0.471$. Nevertheless, the higher the social position, the lower the time spent doing homeschooling, $t(347) = -3.14$, $p = 0.002$, IRR = 0.99, 97.5% CI = [0.99; 1.00].

The probability to receive resources from teachers did not depend on social position, $p = 0.971$, nor did the probability to complete the exercises received, $p = 0.909$ or the probability of working on new concepts, $p = 0.294$. However, the higher the social position, the higher the probability of knowing complementary resources (e.g., educative websites or programs), $Z = 2.91$, $p = 0.004$, OR = 1.01, 97.55% CI = [1.00; 1.02], although the frequency of use did not depend on social position, $p = 0.267$.

Other (Profitable and Unprofitable) Activities During Lockdown

Concerning profitable activities, the higher the social position, the more parents tend to support their children creative activities (marginal), $Z = 1.94$, $p = 0.052$, OR = 1.01, 97.5% CI = [0.99; 1.02], and sport activities and the higher the frequency of such activities, respectively $Z = 3.55$, $p < 0.001$, OR = 1.02, 97.5% CI = [1.01; 1.03] for probability and $t(298) = 3.41$, $p = 0.001$, IRR = 1.01, 97.5% CI = [1.00; 1.01] for frequency.

Finally, although autonomous reading time did not depend on social position during normal time, $p = 0.347$; during lockdown, the higher the social position of the parents, the more children spent time reading in autonomy (marginal), $t(277) = 1.72$, $p = 0.087$, IRR = 1.00, *97.5% CI = [0.99*; 1.01]. Furthermore, the higher their social position, the more parents spent time reading to their children, $t(309) = 3.63$, $p < 0.001$, IRR = 1.01, 97.5% CI = [1.00; 1.01].

Concerning educationally unprofitable activities, the higher the parents' social position, the less children spent time watching television, both in normal times and during lockdown, respectively $t(358) = -4.37$, $p < 0.001$, IRR = 0.99, 97.5% CI = [0.99; 1.00] for normal time and $t(358) = -3.91$, $p < 0.001$, IRR = 0.99, 95% CI = [0.98; 0.99] for lockdown.

DISCUSSION

School closures represent a huge challenge for parents, whose role in their children's learning becomes even more essential than during normal times (Goudeau et al., 2021). In the present research, we argued that, even if all parents were involved in homeschooling during school closures, important variations may emerge depending on the social-class position of the family. Indeed, because of the economic, digital and cultural disparities associated with social class, the lower the parents' social position, the more they are likely to suffer from both a material and a psychological disadvantage in supporting their children's learning during lockdown.

First, the results document that, although nearly all respondents had Internet access, the lower the families' social position, the lower the probability to have a computer, and lower number of owned computers. These results are in line with recent research (Robinson et al., 2020) showing that working-class families experience greater difficulties accessing digital tools (see Legleye and Rolland, 2019; Green, 2020). Hence, accessing the digital tools needed to complete schoolwork during the lockdown may have been particularly challenging in working-class families. Concerning digital uses, contrary to our hypothesis, the higher the social position of the family, the less parents spent time using their computers for schoolwork in normal times. More research is needed to understand this variation, but one possible explanation could be that families with the lower social position, being less comfortable with the academic culture, have a greater need to rely on Internet resources to help their children with their schoolwork than families with higher social position.

Second, in line with our hypothesis, the lower the parents' social position, the less they felt able to support homeschooling and the more they fear of their children's academic failure. These findings are consistent with other findings observed in normal times (e.g., Holloway et al., 2016; Tazouti and Jarlégan, 2016). We assume that these differences in perception of schooling ability are due to the fact that working-class families have both fewer digital resources and less familiarity with academic skills and knowledge (Lamont and Lareau, 1988; Gaddis, 2013; Goudeau and Croizet, 2017). In the COVID-19 pandemic context, this unequal familiarity may have enhanced the difficulties encountered by working-class parents to support their children's work, with further impacts on stress, level of perseverance (Jones and Prinz, 2005), and their real ability to help their children acquire skills and knowledge (Bandura et al., 1996). Interestingly, recent surveys conducted during the lockdown confirm that upper-middle-class parents felt more capable of implementing homeschooling than working-class parents (see Andrew et al., 2020; Bol, 2020; Cullinane and Montacute, 2020).

In line with some past surveys (see Hartas, 2011), our data highlight that in all social classes families were highly involved in the implementation of homeschooling. Interestingly, parents with lower social position reported spending even more time per day homeschooling their children than higher social position ones. Such an observation seems consistent with the fact that they also reported spending more time providing homework help in normal times. As discussed above, this higher level of involvement could be explained by their need for more time to ensure pedagogical continuity as they feel less comfortable with the academic culture and less able to support homeschooling. This interpretation is consistent with the fact that the higher the parents' position, they more they are likely to know additional educational resources.

Thus, families do not significantly differ regarding their likelihood to engage in homeschooling and monitor their children's schoolwork. Nevertheless, important disparities emerged concerning the other activities in which they engaged during lockdown, supporting the model of cultural capital disparities among those groups (Bourdieu and Passeron, 1990; Lareau, 2003). Indeed, the higher the parents' social position, the more they encouraged educationally profitable activities and the less they encouraged educationally unprofitable activities. Indeed, even if these effects would need further investigations, as some of them seem to be driven by child's age or cohabitation status (which are correlated with social position), higher social position parents more often implemented reading, creative activities, and sports than lower social position ones, who were more likely to have their children watch television.

Based on these results, it seems reasonable to predict that one consequence of school closures could be the widening of the social class achievement gap. This prediction needs further investigation, but is already indirectly supported by research documenting the existence of a summer learning loss (e.g., Cooper et al., 1996; Stewart et al., 2018). This research demonstrated that the social class achievement gap that exists during the school year tends to grow during school breaks, particularly during summer holidays. More importantly, recent research shows that school closure has, indeed, enhanced the social class achievement gap during the first wave of the pandemic (Andreu et al., 2020; Engzell et al., 2020, for a synthesis, see Goudeau et al., 2021). Since academic success is usually claimed to be "meritocratic" (Mijs, 2016; Darnon et al., 2018; Kuppens et al., 2018) and since it subsequently determines future occupations in society, the school system not only contributes to the reproduction of social inequalities but also to their legitimization (Darnon et al., 2018). Thus, the specific situation of lockdown may even accentuate *in fine* this process and the role of education in sustaining future social inequalities (Bourdieu and Passeron, 1990; Goudeau et al., 2017).

Some limitations of the present study must be noted. First, our sample is unbalanced, probably in part due to the recruitment method (i.e., the Internet), with more parents possessing a high social position than lower social position ones. Thus, replications using others methods of recruitment (e.g., questionnaire transferred through teachers), with larger, more class-balanced samples are necessary. Moreover, the present study documented different practices during the lockdown known to impact academic achievement. However, we did not measure academic achievement. In addition, this research was conducted during lockdown, but it is difficult to define the specificity of this period compared to other normal (pre-COVID) periods. For these reasons, we believe a longitudinal study, comparing practices and academic achievement during normal time to those during lockdown, would complement the present findings. Similarly, the present research is cross-sectional and thus, causality cannot be established. Manipulating the salience of lockdown could represent an interesting follow-up of the present study. The effect of social class should be particularly pronounced in contexts in which lockdown is salient, as compared to more neutral contexts.

The COVID pandemic has fundamentally changed the way we live, travel, and interact as well as learn and teach. One consequence of this pandemic has been school closures. From a purely medical perspective, such closures appear both necessary and inevitable, yet we point out the important consequences they may have in terms of children's learning and achievement and, more largely, academic inequalities. In particular, our results document for the first time the gap that exists in family practices according to social class when schools are closed, thereby highlighting an important impact of lockdowns—namely, the risk of drastically increasing social class educational disparities. By making learning rely more heavily on parents, school closures not only increase the risk of parental stress and burnout (Griffith, 2020; Marchetti et al., 2020; Spinelli et al., 2020), they create very uneven learning situations among children. This represent a very risky situation, particularly if school closures last for several months. In such a situation, national policies providing both economic (e.g., providing the necessary digital equipment) and academic support (e.g., setting up remedial courses) when dealing with such unprecedented situations are necessary to ensure that no child is left behind. Technology-assisted interventions, for example, are particularly efficient to increase the effects of parenting programs during the pandemic amongst socially disadvantaged families (Harris et al., 2020). Similarly, the adaptation of home-based interventions (e.g., EDI model, Bann et al., 2016) could limit the observed disparities by providing parents interactive learning activities that are beneficial to their child's cognitive development and which could be implemented at home during school closures. It is imperative to anticipate and prevent these phenomena as the whole world is currently experiencing the third wave of the COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://osf.io/nqdy9/?view_only=a929f02b25d2406d9abad64fa2edefb2.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CS contributed to the conception and design of the study, collected the data and performed the statistical analyses, and wrote the first draft of the manuscript. SG contributed to the conception and design of the study. AS organized the database and performed the statistical analyses. CD contributed to the conception and design of the study. All authors contributed to the manuscript revision, read and approved the submitted version.

FUNDING

This research was supported by the grant ANR-19-CE28-0007-PRESCHOOL from the Agence Nationale de la Recherche (France).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.670722/full#supplementary-material

REFERENCES

Alexander, K. L., Entwisle, D. R., and Olson, L. S. (2007). Lasting consequences of the summer learning gap. *Am. Sociol. Rev.* 72, 167–180. doi: 10.1177/000312240707200202

Alvarez-Bueno, C., Pesce, C., Cavero-Redondo, I., Sanchez-Lopez, M., Martínez-Hortelano, J. A., and Martinez-Vizcaino, V. (2017). The effect of physical activity interventions on children's cognition and metacognition: A systematic review and meta-analysis. *J. Am. Acad. Child Adoles. Psychiat.* 56, 729–738. doi: 10.1016/j.jaac.2017.06.012

Anderson, M., and Kumar, M. (2019). *Digital divide persists even as lower-income Americans make gains in tech adoption. Pew Research*. Available online at: https://www.pewresearch.org/fact-tank/2019/05/07/digital-divide-persists-even-as-lower-income-americans-make-gains-in-tech-adoption/ (accessed November 20, 2020).

Andreu, S., Cioldi, I., Conceicao, P., Eteve, Y., Fabre, M., Le Breton, S., et al. (2020). *Évaluations 2020, Repères CP, CE1: Premiers Résultats [2020 Assessments, First and Second Grades Benchmarks: First Results]*, Vol. 20. Note D'information de la DEPP. Available online at: https://www.education.gouv.fr/evaluations-2020-reperes-cp-ce1-premiers-resultats-307122

Andrew, A., Cattan, S., Costa Dias, M., Farquharson, C., Kraftman, L., Krutikova, S., et al. (2020). Inequalities in children's experiences of home learning during the COVID-19 lockdown in England. *Fiscal Stud.* 41, 653–683. doi: 10.1111/1475-5890.12240

Bandura, A., Barbaranelli, C., Caprara, G. V., and Pastorelli, C. (1996). Multifaceted impact of self-efficacy beliefs on academic functioning. *Child Dev.* 67, 1206–1222. doi: 10.2307/1131888

Bann, C. M., Wallander, J. L., Do, B., Thorsten, V., Pasha, O., Biasini, F. J., et al. (2016). Home-based early intervention and the influence of family resources on cognitive development. *Pediatrics* 137:e20153766. doi: 10.1542/peds.2015-3766

Bernstein, B. (1974). *Class, Codes and Control: Towards a Theory of Educational Transmissions*, Vol. 3. New York: Routledge.

Bol, T. (2020). Inequality in homeschooling during the Corona crisis in the Netherlands. First results from the LISS panel. *SocArXiv [Preprint]*. doi: 10.31235/osf.io/hf32q

Bonfadelli, H. (2002). The Internet and knowledge gaps: A theoretical and empirical investigation. *Eur. J. Commun.* 17, 65–84. doi: 10.1177/0267323102017001607

Bourdieu, P., and Passeron, J. C. (1990). *Reproduction in education, society and culture*. London: Sage.

Bus, A. G., Van Ijzendoorn, M. H., and Pellegrini, A. D. (1995). Joint book reading makes for success in learning to read: A meta-analysis on intergenerational transmission of literacy. *Rev. Educ. Res.* 65, 1–21. doi: 10.3102/00346543065001001

Cooper, H., Nye, B., Charlton, K., Lindsay, J., and Greathouse, S. (1996). The effects of summer vacation on achievement test scores: A narrative and meta-analytic review. *Rev. Educ. Res.* 66, 227–268. doi: 10.3102/00346543066003227

Cruz-Jesus, F., Vicente, M. R., Bacao, F., and Oliveira, T. (2016). The education-related digital divide: An analysis for the EU-28. *Comp. Hum. Behav.* 56, 72–82. doi: 10.1016/j.chb.2015.11.027

Cullinane, C., and Montacute, R. (2020). *COVID-19 and Social Mobility. Impact Brief #1: School Shutdown*. Available online at: https://www.suttontrust.com/wp-content/uploads/2020/04/COVID-19-Impact-Brief-School-Shutdown.pdf (accessed October 23, 2020).

Darnon, C., Smeding, A., and Redersdorff, S. (2018). Belief in school meritocracy as an ideological barrier to the promotion of equality. *Eur. J. Soc. Psychol.* 48, 523–534. doi: 10.1002/ejsp.2347

Engzell, P., Frey, A., and Verhagen, M. D. (2020). *Learning inequality during the COVID-19 pandemic*. Available online at: https://osf.io/mzc4w/

Gaddis, S. M. (2013). The influence of habitus in the relationship between cultural capital and academic achievement. *Soc. Sci. Res.* 42, 1–13. doi: 10.1016/j.ssresearch.2012.08.002

Gajda, A., Karwowski, M., and Beghetto, R. A. (2017). Creativity and academic achievement: A meta-analysis. *J. Educ. Psychol.* 109, 269–299. doi: 10.1037/edu0000133

Goudeau, S., Autin, F., and Croizet, J. C. (2017). Étudier, mesurer et manipuler la classe sociale en psychologie sociale: approches économiques, symboliques et culturelles [Studying, measuring and manipulating social class in social psychology: economic, symbolic and cultural approaches]. *Int. Rev. Soc. Psychol.* 30, 1–19. doi: 10.5334/irsp.52

Goudeau, S., and Croizet, J. C. (2017). Hidden advantages and disadvantages of social class: how classroom settings reproduce social inequality by staging unfair comparison. *Psychol. Sci.* 28, 162–170. doi: 10.1177/0956797616676600

Goudeau, S., Sanrey, C., Stanczak, A., Manstead, A., and Darnon, C. (2021). Why lockdown and distance learning during the COVID-19 pandemic are likely to increase the social class achievement gap. *Nat. Hum. Behav.* 1–9. doi: 10.1038/s41562-021-01212-7

Green, F. (2020). *Schoolwork in lockdown: new evidence on the epidemic of educational poverty*. Available online at: https://www.llakes.ac.uk/wp-content/uploads/2021/03/RP-67-Francis-Green-Research-Paper-combined-file.pdf (accessed October 15, 2020).

Griffith, A. K. (2020). Parental burnout and child maltreatment during the COVID-19 pandemic. *J. Fam. Violence* 2020, 1–7. doi: 10.1007/s10896-020-00172-2

Grigoryan, L., Bai, X., Durante, F., Fiske, S. T., Fabrykant, M., Hakobjanyan, A., et al. (2019). Stereotypes as historical accidents: Images of social class in postcommunist versus capitalist societies. *Personal. Soc. Psychol. Bull.* 46, 927–943. doi: 10.1177/0146167219881434

Harris, C., Straker, L., and Pollock, C. (2017). A socioeconomic related 'digital divide' exists in how, not if, young people use computers. *PloS One* 12:e0175011. doi: 10.1371/journal.pone.0175011

Harris, M., Andrews, K., Gonzalez, A., Prime, H., and Atkinson, L. (2020). Technology-assisted parenting interventions for families experiencing social disadvantage: a meta-analysis. *Prevent. Sci.* 21, 714–727. doi: 10.1007/s11121-020-01128-0

Hartas, D. (2011). Families' social backgrounds matter: Socio-economic factors, home learning and young children's language, literacy and social outcomes. *Br. Educ. Res. J.* 37, 893–914. doi: 10.1080/01411926.2010.506945

Holloway, S. D., Campbell, E. J., Nagase, A., Kim, S., Suzuki, S., Wang, Q., et al. (2016). Parenting self-efficacy and parental involvement: Mediators or moderators between socioeconomic status and children's academic competence in Japan and Korea? *Res. Hum. Dev.* 13, 258–272. doi: 10.1080/15427609.2016.1194710

Jones, T. L., and Prinz, R. J. (2005). Potential roles of parental self-efficacy in parent and child adjustment: A review. *Clin. Psychol. Rev.* 25, 341–363. doi: 10.1016/j.cpr.2004.12.004

Jury, M., Smeding, A., Stephens, N. M., Nelson, J. E., Aelenei, C., and Darnon, C. (2017). The experience of low-SES students in higher education: psychological barriers to success and interventions to reduce social-class inequality. *J. Soc. Issues* 73, 23–41. doi: 10.1111/josi.12202

Kuppens, T., Spears, R., Manstead, A. S. R., Spruyt, B., and Easterbrook, M. J. (2018). Educationism and the irony of meritocracy: Negative attitudes of higher educated people towards the less educated. *J. Exper. Soc. Psychol.* 76, 429–447. doi: 10.1016/j.jesp.2017.11.001

Lahire, B. (2019). *Culture écrite et inégalités scolaires: Sociologie de « l'échec scolaire » [Written Culture and School Inequalities: Sociology of "School Failure"]*. France: Presses Universitaires de Lyon.

Lamont, M., and Lareau, A. (1988). Cultural capital: Allusions, gaps and glissandos in recent theoretical developments. *Sociol. Theor.* 6, 153–168. doi: 10.2307/202113

Lareau, A. (2003). *Unequal childhoods: Class, race, and family life*. Berkeley: University of California Press.

Lee, S. J., Ward, K. P., Chang, O. D., and Downing, K. M. (2021). Parenting activities and the transition to home-based education during the COVID-19 pandemic. *Child. Youth Serv. Rev.* 122:105585. doi: 10.1016/j.childyouth.2020.105585

Legleye, S., and Rolland, A. (2019). *Une personne sur six n'utilise pas Internet, plus d'un usager sur trois manques de compétences numériques de base [One in six people do not use the Internet, more than one in three users lack basic digital skills]. INSEE Première, 1780*. Available online at: https://www.insee.fr/fr/statistiques/4241397 (accessed September 5, 2020).

Marchetti, D., Fontanesi, L., Mazza, C., Di Giandomenico, S., Roma, P., and Verrocchio, M. C. (2020). Parenting-related exhaustion during the Italian COVID-19 lockdown. *J. Pediat. Psychol.* 45, 1114–1123. doi: 10.1093/jpepsy/jsaa093

Mentec, M. L., and Plantard, P. (2014). INEDUC: pratiques numériques des adolescents et territoires [INEDUC: adolescents' numerical practices and territories]. *Netcom* 28, 217–238. doi: 10.4000/netcom.1799

Mijs, J. J. B. (2016). The unfulfillable promise of meritocracy: Three lessons and their implications for justice in education. *Soc. Justice Res.* 29, 14–34. doi: 10.1007/s11211-014-0228-0

Nikken, P., and Jansz, J. (2014). Developing scales to measure parental mediation of young children's internet use. *Learn. Media Technol.* 39, 250–266. doi: 10.1080/17439884.2013.782038

Parolin, Z., and Lee, E. K. (2021). Large socio-economic, geographic and demographic disparities exist in exposure to school closures. *Nat. Hum. Behav.* 5, 522–528. doi: 10.1038/s41562-021-01087-8

Razel, M. (2001). The complex model of television viewing and educational achievement. *J. Educ. Res.* 94, 371–379. doi: 10.1080/00220670109598774

Robinson, L., and Schulz, J. (2013). Net time negotiations within the family. *Inform. Commun. Soc.* 16, 542–560. doi: 10.1080/1369118x.2013.777761

Robinson, L., Schulz, J., Blank, G., Ragnedda, M., Ono, H., Hogan, B., et al. (2020). *Digital inequalities 2.0: Legacy inequalities in the information age. First Monday*. Chicago: University of Illinois.

Rocher, T. (2016). Construction d'un indice de position sociale des élèves [Construction of a students' social position index]. *Éduc. Format.* 90, 5–27.

Spinelli, M., Lionetti, F., Pastore, M., and Fasolo, M. (2020). Parents' stress and children's psychological problems in families facing the COVID-19 outbreak in Italy. *Front. Psychol.* 11:1713. doi: 10.3389/fpsyg.2020.01713

Stephens, N. M., Markus, H. R., and Fryberg, S. A. (2012). Social class disparities in health and education: Reducing inequality by applying a sociocultural self model of behavior. *Psychol. Rev.* 119:723. doi: 10.1037/a0029028

Stewart, H., Watson, N., and Campbell, M. (2018). The cost of school holidays for children from low-income families. *Childhood* 25, 516–529. doi: 10.1177/0907568218779130

Sullivan, A. (2001). Cultural capital and educational attainment. *Sociology* 35, 893–912. doi: 10.1017/s0038038501008938

Swanson, E., Vaughn, S., Wanzek, J., Petscher, Y., Heckert, J., Cavanaugh, C., et al. (2011). A synthesis of read-aloud interventions on early reading outcomes among preschool through third graders at risk for reading difficulties. *J. Learn. Disabil.* 44, 258–275. doi: 10.1177/0022219410378444

Tazouti, Y., and Jarlégan, A. (2016). The mediating effects of parental self-efficacy and parental involvement on the link between family socioeconomic status and children's academic achievement. *J. Family Stud.* 25, 250–266. doi: 10.1080/13229400.2016.1241185

Thorell, L. B., Skoglund, C., de la Peña, A. G., Baeyens, D., Fuermaier, A. B., Groom, M. J., et al. (2021). Parental experiences of homeschooling during the COVID-19 pandemic: Differences between seven European countries and between children with and without mental health conditions. *Eur. Child Adolesc. Psychiatry* 2021, 1–13. doi: 10.1007/s00787-020-01706-1

UNESCO (2020). *Education: From Disruption to Recovery*. Available online at: https://en.unesco.org/covid19/educationresponse

Vogels, E. (2021). *Digital divide persists even as Americans with lower incomes make gains in tech adoption. Pew Research Center*. Available online at: https://www.pewresearch.org/fact-tank/2021/06/22/digital-divide-persists-even-as-americans-with-lower-incomes-make-gains-in-tech-adoption/

Wagner, D., and Brahm, T. (2017). "Fear of academic failure as a self-fulfilling prophecy," in *Higher education transitions: theory and research*, eds E. Kyndt, V. Donche, K. Trigwell, and S. Lindblom-Ylänne (London/New York: Routledge).

Wiederkehr, V., Darnon, C., Chazal, S., Guimond, S., and Martinot, D. (2015). From social class to self-efficacy: internalization of low social status pupils' school performance. *Soc. Psychol. Educ.* 18, 769–784. doi: 10.1007/s11218-015-9308-8

Williams, P. A., Haertel, E. H., Haertel, G. D., and Walberg, H. J. (1982). The impact of leisure-time television on school learning: A research synthesis. *Am. Educ. Res. J.* 19, 19–50. doi: 10.3102/00028312019001019

Yates, S., Kirby, J., and Lockley, E. (2015). Digital media use: Differences and inequalities in relation to class and age. *Sociol. Res. Online* 20, 71–91. doi: 10.5153/sro.3751

Zhang, M. (2015). Internet use that reproduces educational inequalities: Evidence from big data. *Comp. Educ.* 86, 212–223. doi: 10.1016/j.compedu.2015.08.007

Zhao, Y., Guo, Y., Xiao, Y., Zhu, R., Sun, W., Huang, W., et al. (2020). The effects of online homeschooling on children, parents, and teachers of grades 1–9 during the COVID-19 Pandemic. *Med. Sci. Monit.* 26:e925591. doi: 10.12659/MSM.925591

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 02 November 2021
doi: 10.3389/fpsyg.2021.733830

Factors Influencing Pre-service Teachers' Intention to Use Digital Learning Materials: A Study Conducted During the COVID-19 Pandemic in Germany

Jennifer Paetsch[1]* *and Barbara Drechsel*[2]

[1] *Institute for Educational Science, University of Bamberg, Bamberg, Germany,* [2] *Institute of Psychology, University of Bamberg, Bamberg, Germany*

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Alberto Crescentini, University of Applied Sciences and Arts of Southern Switzerland (SUPSI), Switzerland
Alexander Nussbaumer, Graz University of Technology, Austria

***Correspondence:**
Jennifer Paetsch
Jennifer.paetsch@uni-bamberg.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *05 October 2021*
Published: *02 November 2021*

Citation:
Paetsch J and Drechsel B (2021) Factors Influencing Pre-service Teachers' Intention to Use Digital Learning Materials: A Study Conducted During the COVID-19 Pandemic in Germany. Front. Psychol. 12:733830. doi: 10.3389/fpsyg.2021.733830

The COVID-19 pandemic necessitated an abrupt change in university teacher education, in that most face-to-face courses were replaced by online education, which had a profound impact on students. Pandemic distance learning required students to possess a high degree of self-regulation concerning their learning environment and to find new ways of communicating with their peers and instructors. At the same time, the novel situation offered opportunities to experience new educational applications. To learn more about the possible benefits of distance learning, this study examines how the first online semester during the pandemic contributed to pre-service teachers' intentions to use digital learning materials in the future. Pre-service teachers enrolled in a German university ($n = 348$) answered an online questionnaire at the end of the summer term of 2020. Findings from structural equation modeling showed that the perceived quality of teacher training during the online semester and self-reported improvements in digital skills predicted significantly students' intentions to use digital learning materials for future teaching. Moreover, results revealed that attentional regulation predicted perceived quality of teacher training and self-reported improvements in digital skills during distance learning. Thus, attentional regulation had a significant indirect effect on pre-service teachers' behavioral intentions. The indirect effects of other resource management strategies (effort and time management) and intrinsic motivation were not significant. Our results show that the quality of online instruction was an important factor in student teachers' learning processes during the pandemic. Based on our results, we discuss implications for the promotion of pre-service teachers' intentions to use digital learning materials for teaching in schools.

Keywords: COVID-19, self-regulated learning, resource-management strategies, teacher education, pre-service teacher, ICT in education, emergency remote teaching, higher education

INTRODUCTION

The COVID-19 pandemic has necessitated a range of measures to restrict social contact. One of these has been the widespread introduction of distance learning in schools, colleges, and universities (UNICEF, 2020). In higher education (HE), this move has had a profound impact, with most face-to-face courses replaced by online education and only laboratory work in subjects such as medicine and chemistry remaining unaffected (Crawford et al., 2020). The extent to which HE has been digitalized was revealed by the first IAU—COVID-19 Global Impact Survey, which found that 85% of European institutions had replaced classroom teaching with remote instruction, while 15% had suspended or canceled teaching activities altogether (Marinoni et al., 2020). Overall, an extensive increase in digitalization in HE has occurred as a result of the pandemic.

The rapid transformation of teaching and learning settings (Crawford et al., 2020) has posed tremendous challenges across the education sector. Besides the administrative difficulty of procuring and installing appropriate technology, this "emergency remote teaching" (Hodges et al., 2020) has required university educators to manage the switch from traditional, in-class settings to various forms of distance education to ensure the continuation of lessons. At the same time, reduced access to the support systems and fixed structures that typify campus instruction has demanded higher levels of autonomy, self-regulation, and intrinsic motivation from students (Naujoks et al., 2021; Pelikan et al., 2021).

Although the switch to online teaching due to COVID-19 seemed sudden, a broader, technology-driven transformation of the educational landscape had long been underway. Innovations in information and communication technology (ICT) have led to the development of various applications to support learning processes (Koong and Wu, 2011; Hwang et al., 2015) by offering an active learning environment to students (de Koning-Veenstra et al., 2014). The potential benefits of ICT in learning and teaching at schools have received significant research attention and the results suggest that technology integration in the classroom is an important factor in enhancing learning processes (Chauhan, 2017; Zhu and Urhahne, 2018). Thus, ICT and digital instruction skills are viewed as crucial competencies for students starting into a professional career as teachers (Koehler and Mishra, 2009; Tondeur et al., 2012; Martin, 2015). Eventually, in-service teachers must be prepared and willing to support students' learning through the use of technology (Hatlevik and Hatlevik, 2018).

German teacher education[1], like those of other countries, places great emphasis on developing special teacher training programs in the field of ICT. Specifically, pre-service teachers should develop their ability to apply technologies to pedagogical concepts and teaching practice (Mishra and Koehler, 2006). In turn, teacher educators are expected to equip pre-service teachers with the skills and motivation to use ICT for teaching and learning (Joo et al., 2018). From this perspective, the recent ubiquity of emergency remote teaching has provided both teacher educators and their students with the opportunity to expand their range of digital skills.

To explore the possible benefits of the pandemic-driven growth of distance learning in HE, this study examines how pre-service teachers' experiences during the initial distance learning semester (summer term, 2020) affected their intentions to use digital learning materials in future teaching. More specifically, the study investigated the relationships between pre-service teachers' intentions to use digital learning materials in their teaching, the quality of teacher training during the online semester, and self-reported changes in digital skills. Additionally, the role of personal resources such as internal learning strategies (namely attention, effort, and time management) and intrinsic motivation was explored.

Digital Learning Environments in Initial Teacher Education

In recent years, emerging educational technology, such as web-based applications and collaborative tools, has expanded the available options for online learning in HE (e.g., Wong et al., 2019). Previous studies have demonstrated that instruction that is delivered entirely online is as effective as face-to-face instruction (Means et al., 2013). Although universities in many countries have developed teacher training programs for online instruction, digital learning environments are yet to be fully integrated into curricula. For example, a recent survey of higher education in Germany found that just 1.7% of universities rated the digitalization of teaching and learning in their institution as "well-advanced" (Gilch et al., 2019). Moreover, before COVID-19, the amount of teaching which could be conducted online was restricted by law at most German universities (Faller, 2015). Thus, when lockdown began, many initial teacher education programs were not fully prepared for online instruction by the start of the summer 2020 term (Zawacki-Richter, 2020). In contrast to planned and well-designed online learning environments, emergency remote teaching during COVID-19 has been characterized by a fast, temporary shift of instruction to an alternate delivery mode (Hodges et al., 2020). This mode was viewed as a specific form of online instruction in which neither teacher educators nor student teachers participated voluntarily (Hodges et al., 2020; Naujoks et al., 2021).

Initially, the pandemic meant that the homes of pre-service teachers were transformed into learning spaces consisting of asynchronous or synchronous online courses. The nature of this new digital learning environment has obstructed the learning process in various ways and thus has affected students' learning experiences. For students, the lack of in-class settings and fewer direct interactions may have required greater self-regulation and self-motivation, with reduced levels of support (Littlejohn et al., 2016; Naujoks et al., 2021). Pre-service teachers were required to plan, monitor, and control their learning processes more autonomously in order to follow self-study materials, organize participation in asynchronous and synchronous events, and

[1]In Germany, all teachers are educated and trained in a process consisting of two phases. During the first phase, pre-service teachers attend university and study two or three school subjects and their subject-didactics. In addition, they study educational topics and have several internships in schools.

communicate with peers and lecturers (Naujoks et al., 2021). Thus, the use of adequate self-regulated learning (SRL) strategies can be considered essential to the academic success of such students (Zimmerman, 2002; Naujoks et al., 2021).

Self-regulated learning has three key categories of learning strategies: cognitive, metacognitive, and resource management (Dresel et al., 2015; Panadero, 2017). Cognitive and metacognitive strategies are important for information processing and monitoring and verifying one's learning outcomes. Resource management is divided into external strategies (e.g., seeking help) or internal strategies, such as regulation of effort and attention, time management, and motivation (Dresel et al., 2015). SRL is crucial in learning environments that provide low levels of support and guidance (Wong et al., 2019) and in distance learning in particular (Zawacki-Richter, 2020; Naujoks et al., 2021). Prior studies have demonstrated that SRL strategies are positively correlated with academic success in online learning environments that afford high levels of learner autonomy (Broadbent and Poon, 2015; Broadbent, 2017). Specifically, internal resource-management strategies have proven to play an important role to achieve learning objectives in online learning (Broadbent and Poon, 2015; Broadbent, 2017; Kizilcec et al., 2017). *Thus, in situations where remote* learning, obligatory physical distancing, and a range of online platforms are widespread, internal resource-management strategies may be key to successful autonomous learning characterized by marked reductions in social support (Biwer et al., 2021).

Current empirical studies support this assumption. Pelikan et al. (2021) examined how students coped with the challenges of distance learning during the pandemic and found that students with high self-perceived competence reported higher levels of intrinsic motivation and elaborate learning strategies. However, the students in this study also noted significant obstacles to organizing their learning, keeping track of tasks, managing their time, and adhering to deadlines (Pelikan et al., 2021). Similarly, Biwer et al. (2021) investigated university students' adaption to emergency remote learning during the pandemic, with particular attention to resource-management strategies. Their findings indicate that students experienced greater difficulties in time management and regulating their attention and efforts. In addition, participants reported being less motivated by online than face-to-face education and also rated their general educational experience lower (Biwer et al., 2021). Finally, Naujoks et al. (2021) investigated students' use of external resource management strategies (e.g., environment structuring, time management, and help-seeking) during emergency remote teaching and differences between students' intended and actual use of them. They found that HE students were digitally prepared for online learning (e.g., they had access to necessary hardware and applications), but had not applied as many resource regulation strategies as intended before entering the remote learning environment.

The findings summarized above indicate that students are likely to encounter significant obstacles to their learning as a result of the switch to online instruction. At the same time, the lockdown provided a novel opportunity for pre-service teachers to improve their use of educational technology. However, two questions remain unanswered. First, has the digital competence of pre-service teachers increased as a result of the lockdown, and second, how has the digital learning experience contributed to pre-service teachers' intentions to use ICT materials in their professional lives?

The Intention to Use ICT for Teaching and Learning

The policy impetus to foster teachers' use of ICT in teaching in school is grounded in (a) enhancing teaching and learning processes via digital media and (b) enabling students to participate fully in 21st-century societies by improving their digital literacy (OECD, 2015). The use of technology for educational purposes affords multiple opportunities to improve both teaching quality and learning outcomes (Koong and Wu, 2011; Hwang et al., 2015). Existing empirical studies indicate that the comprehensive embedding of technology into lessons can foster learning processes (Chauhan, 2017; Zhu and Urhahne, 2018). Integrating technology in this way works well with a variety of subjects, application types, and learning environments (Chauhan, 2017).

Although today's pre-service teachers commonly use ICT applications in their daily lives, the use of such apps for teaching and learning purposes is more problematic (Lei, 2009; Valtonen et al., 2011; Sailer et al., 2021). One possible reason is that pre-service teachers themselves have limited personal experience of digital learning environments (Lei, 2009; Valtonen et al., 2015). Despite their familiarity with various ICT applications, pre-service teachers show limited skills in utilizing these in teaching and learning (Lei, 2009; Valtonen et al., 2011), highlighting the need for initial teacher education programs to address the current deficit (Koehler and Mishra, 2009; Tondeur et al., 2012; Martin, 2015). Of particular importance is pre-service teachers' motivation to integrate technology into classroom practice (Backfisch et al., 2021a,b).

Thus, initial teacher education has the dual role of (a) providing pre-service teachers with opportunities to use digital learning materials and (b) motivating them to use ICT for teaching and learning in their professional lives. Indeed, teacher educators can serve as motivating models of good practice by using digital learning environments effectively themselves (Valtonen et al., 2015). The intention to use technology is defined "as the degree to which the user would like to use technology in the future" (Joo et al., 2018; p. 51) and it is assumed that the intention to use ICT in teaching is closely related to the user's acceptance of technology. In recent years, researchers have presented and tested several models to explain and predict the acceptance and use of IT among users (e.g., Wong, 2016). For instance, the technology-acceptance model (TAM) describes factors influencing teachers' acceptance and use of technologies (Teo, 2011; Wong, 2016; Scherer and Teo, 2019).

A recent meta-analysis of 45 studies deploying the TAM as a theoretical framework demonstrated that the intention to use ICT for teaching increases when teachers find educational technology both easy to use and useful (Scherer and Teo, 2019).

Moreover, the analysis found that higher behavioral intentions were associated with higher degrees of technology integration (Scherer and Teo, 2019). Research also indicates that pre-service teachers' perceived self-efficacy, as well as the perceived ease of application and usefulness of technology, had a positive influence on their intention to use ICT in their future careers (Teo and Tan, 2012; Joo et al., 2018).

Thus, meaningful learning experiences with educational technology appear to be key to developing strong intentions to apply educational technology to teaching (Joo et al., 2018). Valtonen et al. (2015) showed that authentic learning experiences with ICT affected pre-service teachers' self-efficacy and subjective norms regarding technology, thus tilting them toward its use in teaching and learning. In the context of COVID-19, these findings prompt questions of whether and how the acceptance and use of technologies by pre-and in-service teachers depends on their experiences. In line with theoretical models, König et al. (2020) found that teachers' current ICT skills and opportunities to improve them were significant factors in their adoption of online teaching during school closures in Germany. Moreover, one recent qualitative study reported that online teaching during the pandemic led to a transition in teachers' identity and positively impacted their beliefs about ICT (Nazari and Seyri, 2021).

Research Questions

The primary aim of this study, conducted during the pandemic, was to investigate the factors involved in pre-service teachers' intentions to use digital learning materials in their professional lives. The study first investigated the relationships between pre-service teachers' experiences of distance education during the first online semester and pre-service teachers' intentions to use digital learning materials for teaching. It was hypothesized that the perceived quality of university teacher training (*hypothesis 1*) and self-reported improvements in digital skills during emergency remote teaching (*hypothesis 2*) will predict the intention to use digital learning materials for teaching in the future.

The second area of investigation was the role of internal resource management strategies and intrinsic motivation in this context. We hypothesized that intrinsic motivation, effort regulation, time management, and attentional regulation are associated with perceived quality of teacher training (*hypothesis 3*) and self-reported enhancement of digital skills during distance learning (*hypothesis 4*). Thus, intrinsic motivation and resource management strategies will have an indirect effect on pre-service teachers' intention to use digital learning materials for teaching (*hypothesis 5*). The hypothetical model is displayed in **Figure 1**.

MATERIALS AND METHODS

Sample

A total of 348 pre-service teachers (84.4% female, 17.7% male, and 0.9% non-binary) studying different combinations of subjects participated in the research study. All students were enrolled at the University of Bamberg and aimed to teach at a range of school types. Among the participants, 46.6% intended to work in elementary school, 13.5% at secondary school/middle school, 23.9% at high school/gymnasium, and 16.1% at vocational schools. The mean age of the participants was 22.5 years (SD = 3.1) with a mean study duration of 5.1 semesters (SD = 2.8).

Participants were asked about their online activities during the first distance learning semester using the following question: *How often have you participated in synchronous lectures (real-time teaching, i.e., Zoom) and asynchronous lectures (not limited to a specific point of time, i.e., video or audio recording) during the semester?* The findings showed that 82.5% of the students had attended at least eight synchronous lectures and 68.9% of the students had been present at least eight asynchronous lectures. In addition, students were asked about their workloads: most students (79.9%) reported their online classroom hours as over 10 hours per week and 81.3% of students claimed that their general workload (including self-study) was higher than in the previous (regular) semester.

Procedures

Data were collected through an online survey administered at the end of the first online semester, in July 2020. The university had undertaken to provide online education throughout the semester, with educators designing and organizing their courses autonomously. Our research study was announced and the survey was distributed via websites, e-mail, and social media. Pre-service teachers completed an online questionnaire. The participation of all student teachers was voluntary, and they were informed at a preliminary stage about the objectives of the investigation and how the data would be used in keeping with the ethical guidelines of human subject research. The confidentiality of the data and anonymity of participants were also assured.

Measures

The novel scales developed for this research reflected the circumstances of the pandemic. To ensure the construct validity of the measures, confirmatory factor analyses (CFA) were conducted.

Intention to Use Digital Learning Materials

To assess the subjects' intention to use digital learning materials we newly designed a scale consisting of two items, as follows: 1. *I will use some of the computer programs that I worked with in the context of digital teaching for my future teaching profession.* 2. *The experience I have gained in the context of digital teaching proves useful for my future teaching profession.* Respondents were asked to indicate the extent to which they agree to the items on a 7-point Likert-type scale (1 = very strongly disagree to 7 = very strongly agree). The reliability coefficient of the scale is $\alpha = 0.81$.

Quality of Teacher Training During the Online Semester

The second scale consisted of six items to measure students' perspectives on the quality of teacher training during the online semester. The time before distance learning was used as a benchmark in questions such as the following: *Compared to the time before the COVID-19 outbreak, how do you rate your experience of the average quality of instruction?* Respondents were

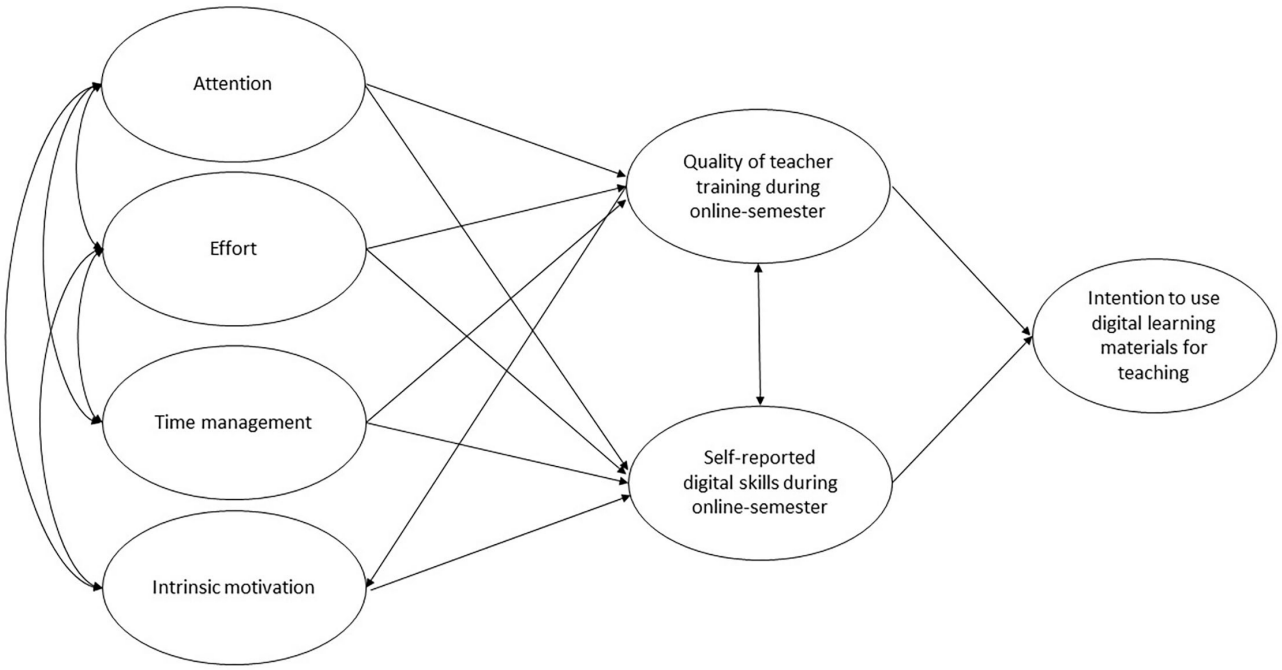

FIGURE 1 | Hypothetical model.

asked to indicate the extent of their agreement with each item on a 5-point Likert-type scale (1 = much worse to 5 = much better). The reliability coefficient of the scale is $\alpha = 0.85$.

Self-reported Changes in Digital Skills

This scale comprised four items assessing students' self-reported digital skills during the online semester with the time before the semester as the benchmark from which changes in self-assessed digital skills were measured. A sample item on the scale is as follows: *Compared to the time before the COVID-19 outbreak, how do you rate your digital expertise?* Respondents indicated the extent of their agreement on a 5-point Likert-type scale (1 = much worse to 5 = much better). The reliability coefficient of the scale is $\alpha = 0.89$.

Intrinsic Motivation

The 3-item measurement of motivational regulation for learning in university students scale (SMR-LS) was developed by Thomas et al. (2018). It was based on Deci and Ryan's Self-Determination Theory (Deci and Ryan, 2002). We used the scale in the current study to measure pre-service teachers' intrinsic motivation. A sample item on the scale is as follows: *Currently, I enjoy studying.* Respondents were asked to indicate the extent to which they agreed to the items on a 7-point Likert-type scale (1 = very strongly disagree to 7 = very strongly agree). The reliability coefficient of the scale is $\alpha = 0.90$.

Strategies for Managing Internal Resources

The use of internal regulation strategies (attention, effort, and time management) was assessed with three scales from Klingsieck (2018) learning strategies of university students (LIST-K). All items were based on a five-point scale ranging from 1 (rarely) to 5 (very often). Attention ($\alpha = 0.89$) was assessed by three items. A sample item on the scale is as follows: *While studying I'm easily distracted.* Effort ($\alpha = 0.62$) was assessed by two items. A sample item on the scale is as follows: *I don't give up, even if the content is difficult and complex.* Time management ($\alpha = 0.81$) was assessed by two items. A sample item on the scale is as follows: *While studying I stick to a specific timetable.*

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics 26.0 (IBM Corp, 2017) and Mplus 7.4 (Muthén and Muthén, 2012). The percentage of missing values at the item level was low (max 5.46%). To deal with the small number of missing values, the full information maximum likelihood approach (FIML) implemented in Mplus was employed. Robust maximum likelihood (MLR) estimation was most appropriate to the Likert scales employed in the items. Significance testing was performed at the 0.05 level.

Confirmatory factor analyses were conducted to analyze construct validity, with two CFA models constructed for the seven constructs. The indicators of the latent variables were the items of the different scales. Structural equation modeling (SEM) was used to analyze the relationships of the hypothetical model. SEM is a multivariate quantitative technique used to estimate the relationships among observed variables to validate a theoretical model (Thakkar, 2020). The effects of the study duration and the school type (elementary school vs. other school types) were

TABLE 1 | Descriptive results, correlations, and reliabilities.

	1	2	3	4	5	6	7
1. Intention to use digital learning materials							
2. Quality of teacher training	0.38**						
3. Self-reported digital skills	0.23**	0.40**					
4. Intrinsic motivation	0.22**	0.25**	0.22**				
5. Internal regulation strategies: attention	0.25**	0.41**	0.33**	0.24**			
6. Internal regulation strategies: effort	0.14**	0.15**	0.18**	0.15*	0.35**		
7. Internal regulation strategies: time management	0.02	0.09	0.13*	0.09	0.34**	0.32**	
Means	4.53	2.85	3.73	4.61	2.58	3.92	2.77
SD	1.57	0.70	0.63	1.31	1.02	0.76	1.09
Min	1	1.17	1	1	1	1	1
Max	7	5	5	7	5	5	5
Cronbach's alpha	0.81	0.85	0.89	0.90	0.89	0.62	0.81
N	344	316	329	340	341	341	339
Missing values	4	32	19	4	7	7	9

***Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed).*

TABLE 2 | Standardized factor loadings for the items in the CFA models.

CFA models	Latent variable	Item	Factor loadings
Model 1 Intentions to use digital learning materials, quality of teacher training, and self-reported digital skills.	Intentions to use digital learning materials	1	0.74
		2	0.92
	Quality of teacher training	1	0.79
		2	0.65
		3	0.79
		4	0.65
		5	0.60
		6	0.77
	Self-reported digital skills	1	0.81
		2	0.85
		3	0.77
		4	0.81
Model 2 Intrinsic motivation and internal regulation strategies	Intrinsic motivation	1	0.86
		2	0.90
		3	0.82
	Attention	1	0.84
		2	0.93
		3	0.81
	Effort	1	0.73
		2	0.62
	Time management	1	0.76
		2	0.84
		3	0.70

controlled for. Additionally, indirect effects on the intention to use digital learning materials were investigated by decomposing the total effect into a set of direct and indirect effects.

Several indices were used to evaluate the model. We deployed the χ^2/df test (<5), the root mean square error of approximation (RMSEA), the comparative fit index (CFI), the Tucker–Lewis index (TLI), and the standardized root mean square residual (SRMR). We utilized widely-used cutoff scores reflecting excellent and adequate fit to the data: TLI and CFI values above 0.95 or 0.90; RMSEA values below 0.06 or 0.08; and SRMR values below 0.08 (Hu and Bentler, 1999).

RESULTS

Descriptive Results and Construct Validity of Scales

The descriptive results, correlations, and reliability scores of the constructs are presented in **Table 1**. There were significant correlations among all variables, except for time management, which only correlated significantly with the two other internal regulation strategies and self-reported skills. Small to medium effect sizes were found for all other correlations. The mean scores for intention to use digital learning materials ($M = 4.53$, $SD = 1.57$), self-reported digital skills ($M = 3.73$, $SD = 0.63$), intrinsic motivation ($M = 4.61$, $SD = 1.31$) and effort ($M = 3.92$, $SD = 0.76$) exceeded the midpoint of a 5-point (3) or 7-point scale (4), indicating that students had assessed themselves as strong in these areas. The mean scores for quality of teacher training ($M = 2.85$, $SD = 0.70$), attention ($M = 2.58$, $SD = 1.02$), and time management ($M = 2.77$, $SD = 1.09$), however, were just below the midpoint, indicating less confidence in these areas.

In addition, two separate CFAs were conducted to confirm the factor structures of the latent variables. The first 3-factor CFA model included a total of 12 items measuring pre-service teachers' intentions to use digital learning materials, the quality of teacher training during distance learning, and self-reported digital skills. The indices indicated good data fit ($\chi^2 = 107.39$, $df = 51$, $p < 0.001$, RMSEA = 0.06, SRMR = 0.04, TLI = 0.96, and CFI = 0.97) with factor loadings ranging from 0.60 to 0.92. The second 4-factor CFA model included 11 items measuring intrinsic motivation and the internal regulation strategies of attention, effort, and time management. The indices for this model again indicated a good fit to the data ($\chi^2 = 78.73$, $df = 38$, $p < 0.001$, RMSEA = 0.06, SRMR = 0.04, TLI = 0.96, and CFI = 0.97) with factor loadings ranging from 0.62 to 0.93. The factor

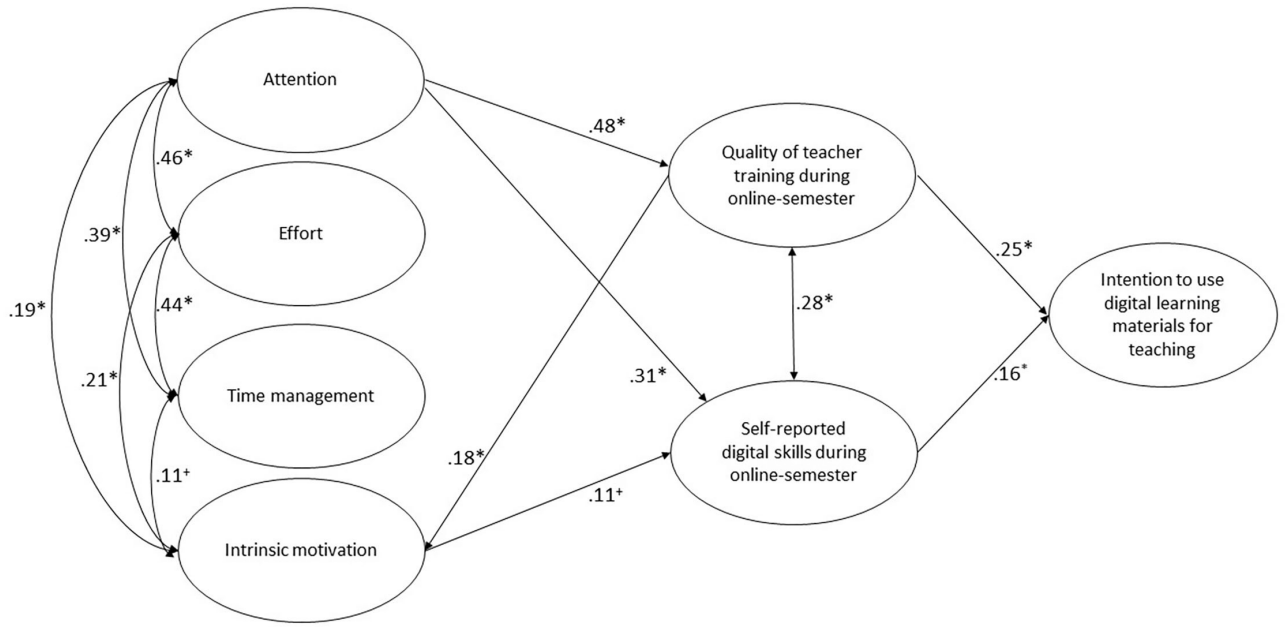

FIGURE 2 | Structural equation model. Only paths $p < 0.10$ are displayed. $^{*}p < 0.05$; $^{+}p < 0.10$. The included control variables *study duration* and *school type* are not illustrated. See **Table 3** for the effects. See **Table 4** for direct and indirect effects among variables.

loadings for both CFA models are reported in **Table 2**. These results indicated that the construct validity of all of the scales was acceptable, and all of the latent variables were well-represented by the indicators.

Results of the Structural Equation Modeling

The structural model was tested to examine the direct and indirect relationships between the intention to use digital learning materials for teaching, the quality of teacher training during distance learning, self-reported digital skills during distance learning, intrinsic motivation, and internal regulation strategies (attention, effort, and time management). The indices indicated an excellent fit for the model ($\chi^2 = 348.92$, $df = 241$, $\chi^2/df = 1.45$, RMSEA = 0.04 [0.027, 0.044], SRMR = 0.04, TLI = 0.96, and CFI = 0.97).

These findings reveal that the perceived quality of teacher training during the online semester ($\beta = 0.25$, $p < 0.05$) and self-reported digital skills ($\beta = 0.16$, $p < 0.05$) were significant predictors of students' intention to use digital learning materials for teaching (see **Figure 2**). These results thus supported hypothesis 1 and hypothesis 2.

The internal regulation strategies of attention, effort, and time management had no direct effects on students' intention to use digital learning materials for teaching. However, attention was a significant predictor of the perceived quality of teacher training during the online semester (*hypothesis 3*, $\beta = 0.48$, $p < 0.05$) and self-reported digital skills (*hypothesis 4*, $\beta = 0.31$, $p < 0.05$). The internal strategies of effort and time management did not predict student perceptions of training quality. Thus, hypotheses 3 and 4 can only be confirmed for the internal regulation strategy of attention.

There was a positive correlation between the perceived quality of teacher training and self-reported digital skills ($\beta = 0.28$, $p < 0.05$). Intrinsic motivation was predicted by the perceived quality of teacher training during the online semester ($\beta = 0.18$, $p < 0.05$) and positively correlated with attention ($\beta = 0.19$, $p < 0.05$), and effort ($\beta = 0.21$, $p < 0.05$). For the control variable of study duration, only significant effects on time management ($\beta = 0.12$, $p < 0.05$) and attention ($\beta = 0.12$, $p < 0.05$) were detectable (see **Table 3**). For the control variable of school type (elementary school vs. other school types) significant negative effects on students' intention to use digital learning materials for teaching ($\beta = -0.24$, $p < 0.05$), intrinsic motivation ($\beta = -0.11$, $p < 0.05$), and attention ($\beta = -0.12$, $p < 0.05$) were observable (see **Table 3**). This means that students, who intended to work in elementary school showed, on average, significantly less values on this scales than students, who intended to work in other school types.

Indirect Effects on Students' Intention to Use Digital Learning Materials for Teaching

Direct and indirect effects on students' intention to use digital learning materials for teaching were estimated in Mplus using model indirect. As shown in **Table 4**, among all predictors, only attention ($z = 0.18$, $p < 0.01$) had a significant indirect effect on the intention to use digital learning materials for teaching (*hypothesis 5*). The direct relationship between attention, effort, time management, intrinsic motivation, and intention to use digital learning materials for teaching was not statistically

TABLE 3 | Standardized effects for the included control variables *study duration* and *school type* (elementary school vs. other).

Variables	Study duration		Elementary school	
	β	*p*	*β*	*p*
Intention to use digital learning materials for teaching	−0.06	0.36	−0.24*	< 0.01
Self-reported digital skills	0.03	0.53	0.02	0.78
Quality of teacher training	−0.09	0.10	−0.03	0.58
Attention	0.12*	0.04	−0.12*	0.04
Effort	0.12	0.07	−0.01	0.85
Time management	0.12*	0.04	0.09	0.14
Intrinsic motivation	−0.01	0.87	−0.11*	0.05

**Significant at the 0.05 level (2-tailed).*

TABLE 4 | Standardized indirect effects on intention to use digital learning materials for teaching.

Predictors	Standardized estimates of direct effect	Standardized estimates of indirect effect	Standardized estimates of total effect
Attention	0.04	0.18*	0.22*
Effort	0.11	0.02	0.12
Time management	−0.07	−0.02	−0.10
Intrinsic motivation	0.08	0.02	0.10

**Significant at the 0.05 level (2-tailed).*

significant (see **Table 4**). Thus, hypothesis 5 is supported only for attention.

DISCUSSION

Against the backdrop of the switch to distance education necessitated by the COVID-19 pandemic, the present study aimed to shed light on pre-service teachers' experiences during the challenging situation and to identify key factors in students' intentions to use digital learning materials in their future teaching profession. We argue that under the conditions of emergency remote teaching, with traditional learning formats transformed into online provision, pre-service teachers' experience with technology has increased the likelihood that they will use it in their future careers. In Germany, digital learning had not been fully integrated into HE before the pandemic struck (Gilch et al., 2019). Therefore, the rapid shift to online education has enabled students to gain a deeper understanding of how technology might be integrated into teaching and the benefits this may confer (Lei, 2009; Valtonen et al., 2015).

First, the study investigated the relationship between pre-service teachers' intentions to use digital learning materials in their teaching and (a) the perceived quality of teacher training and (b) self-reported improvements in digital skills at a large public university. Our descriptive findings indicate that, despite the sudden shift from the traditional, classroom-based education format to a remote format, pre-service teachers evaluated the quality of initial teacher training during the first online semester as equivalent, on average, to the quality of traditional, pre-pandemic initial teacher training. Furthermore, on average, students reported improvements in their digital skills. As expected, our results demonstrate that the perceived quality of teacher training during COVID-19 had a notable and significant impact on students' intentions to use digital learning material in their future work as teachers. Pre-service teachers who perceived the quality of emergency remote teaching to be equivalent to or better than their pre-COVID experiences reported stronger intentions to use ICT in their work. The analyses results support those of previous studies that identified meaningful learning experiences with educational technology as a key factor in the development of such intentions (Valtonen et al., 2015).

Additionally, self-reported digital skills proved to have a statistically significant influence on students' intentions. This finding is in line with other studies whose results suggested that pre-service teachers' self-efficacy and skills predict behavioral intentions (Valtonen et al., 2015; Joo et al., 2018). However, the effect is very small what may be due to our focus on the improvement of students' digital skills and thus on the effect of online learning in the pandemic. Specifically, pre-service teachers' self-reported digital skills were compared with a pre-pandemic baseline, meaning that some students may have felt they had already acquired skills which the online semester had not necessarily improved. The assessment of teacher training quality, however, was positively correlated with changes in self-reported digital skills. Thus, pre-service teachers who perceived that the quality of emergency remote teaching exceeded or equaled the traditional instruction they had experienced before the outbreak of COVID-19 reported larger gains in digital skills. From a theoretical perspective, it seems reasonable to suggest that the relationship would be bidirectional: on the one hand, improved online instruction might help to develop students' ICT skills, while on the other hand, improved digital skills might allow for more participation and investment in online courses, thus influencing students' perceptions of quality.

Effects of different school types of pre-service teachers were also analyzed. As elementary school teachers will teach students in a different age group than secondary school teachers, the use of digital applications in the classroom might be different for different school types. Furthermore, there are differences between students' entry characteristics concerning school type (Retelsdorf and Möller, 2012). The results reveal that students who intended to work in elementary school showed, on average, significantly fewer intentions to use digital learning materials in their future work as teachers. This finding might be explained by the particularities of ICT integration into classroom environment for young children. This result highlights the need to differentiate between pre-service teachers with different study objectives.

Another area of investigation focused on the relationship between internal resource management strategies (attention, effort, and time management), intrinsic motivation, and

instructional quality, as well as skill improvement. Previous studies have shown that all these are important factors in online learning environments characterized by high levels of learner autonomy (Broadbent and Poon, 2015; Broadbent, 2017; Kizilcec et al., 2017). However, the regulative resource of attention was found to be the only significant factor in participants' perception of instructional quality and skills. As anticipated, pre-service teacher who reported higher levels of attention regulation also perceived the quality of teacher training to be higher and reported greater gains in self-reported digital skills. This corroborates the findings of Biwer et al. (2021) who detected a positive correlation between attention and the educational experience of HE students during the pandemic.

Contrary to expectations, neither pre-service teachers' regulation of effort nor time management strategies predicted their perceived quality of teacher training or self-reported digital skills. This is surprising as an increased need for self and time management was reported by Reinhold et al. (2021) following the recent switch to distance learning. Biwer et al. (2021) also found positive associations between effort, time management, and educational experience during the crisis. However, the authors only reported bivariate relationships between these factors, whereas our use of structural equation modeling enabled complex relationships to be detected. The findings of the current study may be explained by the fact that demands on students' time management were not particularly severe during this phase of the pandemic since social distancing rules severely restricted leisure opportunities of any sort, thus freeing up additional time for study. This assumption aligns with the finding of Naujoks et al. (2021) that time management strategies were less often used during the online semester than students had previously intended. Similarly, Zhang et al. (2021) indicated that students succeeded in completing their assignments in the first online semester.

As expected, students' perception of instructional quality had a significant impact on intrinsic learning motivation. Pre-service teachers who perceived the quality of emergency remote teaching to be equivalent to or better than their pre-COVID experiences reported greater intrinsic motivation for learning. This result aligns with the finding of Biwer et al. (2021) that students' motivation correlated with educational experience during the pandemic. Although intrinsic learning motivation in our study did not make a significant contribution to digital skill improvement, results from Pelikan et al. (2021) indicate that students with high perceived competence have higher intrinsic motivation than students with low perceived competence during distance learning. As mentioned above, we measured only perceived digital skill improvement, thus pre-service teachers' general perceived competence was not taken into account.

The last area of investigation focused on indirect effects on intention to use digital learning materials for teaching. Among the intrinsic motivation and resource management strategies investigated in this study, only the regulation of attention was found to indirectly affect pre-service teachers' intention to use digital learning materials for teaching. There were no significant contributions of effort and time management to participants' intention to use digital learning materials for teaching. However, there are substantial relationships between the three internal resource management strategies. Hence, the findings further confirm both the importance of internal resource management to successful online learning during the pandemic and to pre-service teachers' willingness to integrate technology into their future teaching profession. The results indicate that students who positively evaluate their experience of distance learning, which is linked to their capacity to regulate their attention, might be more willing to integrate technology in their classroom in their future careers. Overall, the current study contributes to the literature by underlining the importance of well-designed digital learning environments in initial teacher education. It also highlights the positive effects of digitalization in teacher education conferred by the switch to remote distance learning during the pandemic.

Limitations and Future Directions

The first limitation of this study is that the sample consisted of volunteer subjects and therefore was not representative of the population of pre-service teachers. Given that self-regulatory resources were a key area of investigation, the voluntary basis of participation may have skewed the sample toward students with a higher capacity for self-regulation: participants with less of a capacity for self-regulation during the pandemic may have felt unable to take or complete the survey, or may have missed the lectures in which the study was announced. This students may have been unintentionally excluded from our sample, thus potentially biasing the results. However, the composition of the sample was manifold, with pre-service teachers of all school types and with different study durations (i.e., number of semesters student teachers completed in summer term 2020).

The second limitation of this study is that the validity of the newly designed instruments was not verified. Due to the novelty of the pandemic situation, it was necessary to develop items to suit the current circumstances. We measured the subjects' intention to use digital learning materials with a scale consisting of only two items, which may have affected its validity. However, the results of the CFA confirmed the factor structures of the latent variables. Further research is needed to verify the psychometric parameters of the reliability and validity of the instruments developed in our study.

A third limitation stems from the study's reliance on self-report measures, which can elicit socially desirable responses from participants and therefore lead to results that differ markedly from those obtained by other methods such as behavioral observation. Pre-Service teachers' self-reports were compared with a pre-pandemic baseline, meaning that the general level of current digital skills and instructional quality was not taken into account. Various constraints meant that some factors were excluded from the model. For example, data on participants' achievements, individual use of distance learning, such as time spent on courses or number of interactions, general motivational profile, or their personal situation were not analyzed. Multiple additional factors influencing the intention to use digital learning materials remain uninvestigated (e.g., self-efficacy of using educational technologies), but these factors lay beyond the scope of the current study. Future research on the intentions to use digital learning materials

for teaching could include more aspects of students' personal resources (e.g., self-efficacy), prior experiences with digital learning environments, and professional knowledge to generate deeper insights. Additionally, a longitudinal design would allow for insights into changes in intentions and provide further information on the underlying mechanisms that influence behavioral intentions concerning technology integration in education. Moreover, further research is needed to examine characteristics of digitalization in initial teacher education under non-pandemic circumstances and its impact on pre-service teachers' behavioral intentions concerning educational technology integration.

Nonetheless, these limitations of the study are in part counterbalanced by the provision of valuable information on the experiences of a group of students at a unique and highly challenging time and evidence supported recommendations for improving practice in teacher education.

Implications for Initial Teacher Education and Conclusion

This study offers insights into how pre-service teachers experienced emergency remote teaching and how the sudden transformation of teacher training from a traditional classroom-based format into a digital format may have affected their intentions for future teaching. While universities will eventually switch back to face-to-face teacher training, online learning and technology integration are likely to remain part of initial teacher training. Online learning settings differ meaningfully from traditional higher education settings, in that the online learning settings require a greater degree of autonomous learning situations. Hence, fostering resource management strategies seems to be a promising approach.

In conclusion, this study provides robust evidence that university teaching matters to future teachers in terms of building intentions and shaping professional beliefs. It demonstrates the value of providing pre-service teachers with meaningful and adaptive opportunities to learn at university. In addition this study shows that effective teaching fosters the readiness and intention of students to deploy a range of ICT resources in their professional lives. As mentioned above, teacher training must confront a particular challenge within the process of digital transformation. Specifically, universities must attend carefully to their role as learning organizations since they are better placed to integrate ICT than institutions of primary and secondary education. Universities must provide pre-service teachers with state-of-the-art models of teaching so they can apply these models to their own professional lives. However, teacher educators are not a homogeneous group (Daumiller et al., 2021; Scherer et al., 2021) and the comprehensive changes to practice imposed by the pandemic have been implemented in a range of different ways. Nonetheless, the challenge of developing the knowledge, competence, and motivation of teacher educators concerning digital teaching must remain a key goal of teacher training education.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because informed consent signed by participants stated that data were only accessible to the authors of this study. Requests to access the datasets should be directed to Jennifer Paetsch, Jennifer.paetsch@uni-bamberg.de.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JP performed the statistical analyses and drafted the manuscript. BD contributed to the conception of this study, discussed the results of the analyses, contributed to the manuscript, and the revisions. All listed authors read and approved the submitted manuscript.

FUNDING

This project is part of the Qualitätsoffensive Lehrerbildung, a joint initiative of the Federal Government and the *Länder* which aims to improve the quality of teacher training. The program is funded by the Federal Ministry of Education and Research (01JA1915). The authors are responsible for the content of this publication.

REFERENCES

Backfisch, I., Lachner, A., Stürmer, K., and Scheiter, K. (2021a). Variability of teachers' technology integration in the classroom: a matter of utility! *Comput. Educ.* 166:104159. doi: 10.1016/j.compedu.2021.104159

Backfisch, I., Scherer, R., Siddiq, F., Lachner, A., and Scheiter, K. (2021b). Teachers' technology use for teaching: comparing two explanatory mechanisms. *Teach. Teach. Educ.* 104:2. doi: 10.1016/j.tate.2021.103390

Biwer, F., Wiradhany, W., oude Egbrink, M., Hospers, H., Wasenitz, S., Jansen, W., et al. (2021). Changes and adaptations: how university students self-regulate their online learning during the COVID-19 pandemic. *Front. Psychol.* 12:642593. doi: 10.3389/fpsyg.2021.642593

Broadbent, J. (2017). Comparing online and blended learner's self-regulated learning strategies and academic performance. *Internet High. Educ.* 33, 24–32. doi: 10.1016/j.iheduc.2017.01.004

Broadbent, J., and Poon, W. (2015). Self-regulated learning strategies and academic achievement in online higher education learning environments: a systematic review. *Internet High. Educ.* 27, 1–13. doi: 10.1016/j.iheduc.2015.04.007

Chauhan, S. (2017). A meta-analysis of the impact of technology on learning effectiveness of elementary students. *Comput. Educ.* 105, 14–30. doi: 10.1016/j.compedu.2016.11.005

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., et al. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *J. Appl. Learn. Teach.* 3, 1–20. doi: 10.37074/jalt.2020.3.1.7

Daumiller, M., Rinas, R., Hein, J., Janke, S., Dickhäuser, O., and Dresel, M. (2021). Shifting from face-to-face to online teaching during COVID-19: the role of university faculty achievement goals for attitudes toward this sudden change, and their relevance for burnout/engagement and student evaluations of teaching quality. *Comput. Hum. Behav.* 118:106677. doi: 10.1016/j.chb.2020.106677

de Koning-Veenstra, B., Steenbeek, H. W., van Dijk, M. W., and van Geert, P. L. (2014). Learning through movement: a comparison of learning fraction skills on a digital playful learning environment with a sedentary computer-task. *Learn. Individ. Differ.* 36, 101–109. doi: 10.1016/j.lindif.2014.10.002

Deci, E. L., and Ryan, R. M. (2002). "Overview of self-determination theory: an organismic dialectical perspective," in *Handbook of Self-Determination Research*, eds E. L. Deci, and R. M. Ryan (Rochester, NY: University of Rochester Press), 3–33.

Dresel, M., Schmitz, B., Schober, B., Spiel, C., Ziegler, A., Engelschalk, T., et al. (2015). Competencies for successful self-regulated learning in higher education: structural model and indications drawn from expert interviews. *Stud. High. Educ.* 40, 454–470. doi: 10.1080/03075079.2015.1004236

Faller, M. (2015). *Rechtsfragen zu digitalen Lehrformaten*. Berlin: Hochschulforum Digitalisierung.

Gilch, H., Beise, A. S., Krempkow, R., Müller, M., Stratmann, F., and Wannemacher, K. (2019). *Digitalisierung der Hochschulen. Ergebnisse einer Schwerpunktstudie für die Expertenkommission Forschung und Innovation*. Hannover: HIS-Institut für Hochschulentwicklung (HIS-HE).

Hatlevik, I. K., and Hatlevik, O. E. (2018). Examining the relationship between teachers' ICT self-efficacy for educational purposes, collegial collaboration, lack of facilitation and the use of ICT in teaching practice. *Front. Psychol.* 13:935. doi: 10.3389/fpsyg.2018.00935

Hodges, C., Moore, S., Lockee, B., Trust, T., and Bond, A. (2020). *The Difference Between Emergency Remote Teaching and Online Learning*. Available online at: https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning (accessed April 20, 2021).

Hu, L. T., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equat. Model.* 6, 1–55. doi: 10.1080/10705519909540118

Hwang, G.-J., Chiu, L.-Y., and Chen, C.-H. (2015). A contextual game-based learning approach to improving students' inquiry-based learning performance in social studies courses. *Comput. Educ.* 81, 13–25. doi: 10.1016/j.compedu.2014.09.006

IBM Corp. (2017). *IBM SPSS Statistics for Windows, Version 25.0*. Armonk, NY: IBM Corp.

Joo, Y. J., Park, S., and Lim, E. (2018). Factors influencing preservice teachers' intention to use technology: TPACK, teacher self-efficacy, and technology acceptance model. *Educ. Tech. Soc.* 21, 48–59.

Kizilcec, R. F., Perez-Sanagustin, M., and Maldonado, J. J. (2017). Self-regulated learning strategies predict learner behavior and goal attainment in massive open online courses. *Comput. Educ.* 104, 18–33. doi: 10.1016/j.compedu.2016.10.001

Klingsieck, K. B. (2018). Kurz und knapp–die Kurzskala des Fragebogens "Lernstrategien im Studium" (LIST). *Zeitschrift für Pädagogische Psychologie* 32, 249–259. doi: 10.1024/1010-0652/a000230

Koehler, M., and Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemp. Issues Tech. Teach. Educ.* 9, 60–70. doi: 10.1177/002205741319300303

König, J., Jäger-Biela, D. J., and Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany. *Eur. J. Teach. Educ.* 43, 608–622. doi: 10.1080/02619768.2020.1809650

Koong, C.-S., and Wu, C.-Y. (2011). The applicability of interactive item templates in varied knowledge types. *Comput. Educ.* 56, 781–801. doi: 10.1016/j.compedu.2010.10.021

Lei, J. (2009). Digital natives as preservice teachers: what technology preparation is needed? *J. Comput. Teach. Educ.* 25, 87–97.

Littlejohn, A., Hood, N., Milligan, C., and Mustain, P. (2016). Learning in MOOCs: motivations and self-regulated learning. *Internet High. Educ.* 29, 40–48. doi: 10.1016/j.iheduc.2015.12.003

Marinoni, G., van't Land, H., and Jensen, T. (2020). *The Impact of Covid-19 on Higher Education Around the World*. Paris: International Association of Universities (IAU).

Martin, B. (2015). Successful implementation of tpack in teacher preparation programs. *Int. J. Integr. Tech. Educ.* 4, 17–26. doi: 10.5121/ijite.2015.4102

Means, B., Toyama, Y., Murphy, R., and Baki, M. (2013). The effectiveness of online and blended learning: a meta-analysis of the empirical literature. *Teach. Coll. Rec.* 115, 1-47. doi: 10.1177/016146811311500307

Mishra, P., and Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teach. Coll. Rec.* 108, 1017–1054. doi: 10.1111/j.1467-9620.2006.00684.x

Muthén, B., and Muthén, L. (2012). *Mplus*. Chapman and Hall/CRC.

Naujoks, N., Bedenlier, S., Gläser-Zikuda, M., Kammerl, R., Kopp, B., Ziegler, A., et al. (2021). Self-regulated resource management in emergency remote higher education: status quo and predictors. *Front. Psychol.* 12:672741. doi: 10.3389/fpsyg.2021.672741

Nazari, M., and Seyri, H. (2021). Covidentity: examining transitions in teacher identity construction from personal to online classes. *Eur. J. Teach. Educ.* doi: 10.1080/02619768.2021.1920921

OECD (2015). *Students, Computers and Learning: Making the Connection*. Paris: OECD Publishing.

Panadero, E. A. (2017). Review of self-regulated learning: six models and four directions for research. *Front. Psychol.* 8:422. doi: 10.3389/fpsyg.2017.00422

Pelikan, E. R., Lüftenegger, M., Holzer, J., Korlat, S., Spiel, C., and Schober, B. (2021). Learning during COVID-19: the role of self-regulated learning, motivation, and procrastination for perceived competence. *Zeitschrift für Erziehungswissenschaften* 24, 393–418. doi: 10.1007/s11618-021-01002-x

Reinhold, F., Schons, C., Scheuerer, S., Gritzmann, P., Richter-Gebert, J., and Reiss, K. (2021). Students' coping with the self-regulatory demand of crisis-driven digitalization in university mathematics instruction: do motivational and emotional orientations make a difference? *Comput. Hum. Behav.* 120:106732. doi: 10.1016/j.chb.2021.106732

Retelsdorf, J., and Möller, J. (2012). Grundschule oder gymnasium? Zur Motivation ein Lehramt zu studieren [Primary or secondary school? On the motivation for choosing teacher education]. *Zeitschrift für Pädagog. Psychol.* 26, 5–17. doi: 10.1024/1010-0652/a000056

Sailer, M., Murböck, J., and Fischer, F. (2021). Digital learning in schools: what does it take beyond digital technology? *Teach. Teach. Educ.* 103:1. doi: 10.1016/j.tate.2021.103346

Scherer, R., Howard, S. K., Tondeur, J., and Siddiq, F. (2021). Profiling teachers' readiness for online teaching and learning in higher education: who's ready? *Comput. Hum. Behav.* 118:106675. doi: 10.1016/j.chb.2020.106675

Scherer, R., and Teo, T. (2019). Unpacking teachers' intentions to integrate technology: a meta-analysis. *Educ. Res. Rev.* 27, 90–109. doi: 10.1016/j.edurev.2019.03.001

Teo, T. (2011). Factors influencing teachers' intention to use technology: model development and test. *Comput. Educ.* 57, 2432–2440. doi: 10.1016/j.compedu.2011.06.008

Teo, T., and Tan, L. (2012). The theory of planned behavior (TPB) and pre-service teachers' technology acceptance: a validation study using structural equation modeling. *J. Tech. Teach. Educ.* 20, 89–104.

Thakkar, J. J. (2020). *Structural Equation Modelling. Application for Research and Practice (with AMOS and R)*. Singapore: Springer. doi: 10.1007/978-981-15-3793-6

Thomas, A. E., Müller, F. H., and Bieg, S. (2018). Entwicklung und Validierung der Skalen zur motivationalen Regulation beim Lernen im studium (SMR-LS). *Diagnostica* 64, 145–155. doi: 10.1026/0012-1924/a000201

Tondeur, J., van Braak, J., Sang, G., Voogt, G., Fisser, P., and Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: a synthesis of qualitative evidence. *Comput. Educ.* 59, 134–144. doi: 10.1016/j.compedu.2011.10.009

UNICEF (2020). *UNICEF Scales Up Support in 145 Countries to Keep Children Learning, as COVID-19 Forces Majority of Schools Worldwide to Close*. New York, NY: UNICEF.

Valtonen, T., Kukkonene, J., Kontkanen, S., Sormunen, K., Dillon, P., and Sointu, E. (2015). The impact of authentic learning experiences with ICT on pre-service teachers' intentions to use ICT for teaching and learning. *Comput. Educ.* 81, 49–58. doi: 10.1016/j.compedu.2014.09.008

Valtonen, T., Pontinen, S., Kukkonen, J., Dillon, P., Väisänene, P., and Hacklin, S. (2011). Confronting the technological pedagogical knowledge of finnish net generation student teachers. *Tech. Pedagog. Educ.* 20, 3–18. doi: 10.1080/1475939X.2010.534867

Wong, G. K. (2016). The behavioral intentions of Hong Kong primary teachers in adopting educational technology. *Educ. Tech. Res. Dev.* 64, 313–338. doi: 10.1007/s11423-016-9426-9

Wong, J., Baars, M., Davis, D., Van Der Zee, T., Houben, G.-J., and Paas, F. (2019). Supporting self-regulated learning in online learning environments and MOOCs: a systematic review. *Int. J. Hum. Comput. Interact*. 35, 356–373. doi: 10.1080/10447318.2018.1543084

Zawacki-Richter, O. (2020). The current state and impact of Covid-19 on digital higher education in Germany. *Hum. Behav. Emerg. Tech.* 3, 218–226. doi: 10.1002/hbe2.238

Zhang, T., Taub, M., and Chen, Z. (2021). Measuring the impact of COVID-19 induced campus closure on student self-regulated learning in physics online learning modules. *Learn. Anal. Knowl. LAK* 21, 110–120. doi: 10.1145/3448139.3448150

Zhu, C., and Urhahne, D. (2018). The use of learner response systems in the classroom enhances teachers' judgment accuracy. *Learn. Instr.* 58, 255–262. doi: 10.1016/j.learninstruc.2018.07.011

Zimmerman, B. J. (2002). Becoming a self-regulated learner: an overview. *Theory Pract.* 41, 64–70. doi: 10.1207/s15430421tip4102_2

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 08 November 2021
doi: 10.3389/fpsyg.2021.701888

Reasons Given by ECEC Professionals for (Not) Being in Contact With Parents During the COVID-19 Pandemic

Fabian Hemmerich[1]†, Hande Erdem-Möbius[1,2]†, Lars Burghardt[1] and Yvonne Anders[1]*

[1] Chair of Early Childhood Education, University of Bamberg, Bamberg, Germany, [2] Department of Early Childhood Education, Freie Universität Berlin, Berlin, Germany

In response to the COVID-19 pandemic, the German government took drastic measures and ordered the temporary closure of early childhood education and care services (apart from emergency care). Most pedagogical professionals in early childhood education and care (ECEC) settings were unable to provide institutional care for children during this period, and thus experienced difficulties fulfilling their legally mandated professional obligation to educate children. Building on the importance of professional–parent collaboration, this study investigates the reasons ECEC professionals gave for (not) being in contact with parents during the pandemic. The database comprises a nationwide survey conducted between April and May 2020 (n = 2,560 ECEC professionals). The results show that the vast majority of respondents were in contact with parents; their stated motives include providing informational or emotional support for parents and children, maintaining a relationship, or inquiring about family wellbeing. The explanations for not being in contact with parents include already existing contact with parents by another member of the ECEC staff, an employer-mandated contact ban, problems on the parents' side, or personal reasons. We find some differences between managers in center-based childcare, pedagogical employes in center-based childcare, and professionals in family based childcare. Practical implications concerning professional–parent collaboration and the temporary closure of ECEC services are discussed.

Keywords: COVID-19, early childhood education and care, ECEC professionals, ECEC managers, professional role understanding, cooperation with parents, social support, pandemic

OPEN ACCESS

Edited by:
Karin Sørlie Street, Western Norway University of Applied Sciences, Norway

Reviewed by:
Claudia Vrijhof, Leiden University, Netherlands
Aihua Hu, Western Norway University of Applied Sciences, Norway
Chris Heemskerk, University of Bern, Switzerland

***Correspondence:**
Fabian Hemmerich
fabian.hemmerich@uni-bamberg.de

†These authors share first authorship

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *28 April 2021*
Accepted: *19 October 2021*
Published: *08 November 2021*

Citation:
Hemmerich F, Erdem-Möbius H, Burghardt L and Anders Y (2021) Reasons Given by ECEC Professionals for (Not) Being in Contact With Parents During the COVID-19 Pandemic. Front. Psychol. 12:701888. doi: 10.3389/fpsyg.2021.701888

INTRODUCTION

By March 2020 at the latest, it was clear that the rapid, worldwide spread of the virus SARS-CoV-2 could no longer be prevented. On March 11, the World Health Organization referred to a pandemic for the first time. The German government, and those of the 16 federal states, continue to take varied and drastic measures to stem the spread of the virus. Among these measures was the temporary closure of center- and family based early childhood education and care (ECEC) services. For at least 2 months from the middle of March 2020 onward, all German ECEC institutions could only offer so-called *emergency care* (*Notbetreuung*), mostly for children whose parents work in systemically

relevant professions (e.g., doctors and employes in the food supply sector). The exact duration varied depending on the federal state (Steinmetz et al., 2020).

During this time, most ECEC professionals[1] were unable to provide institutional care for children and thus experienced difficulties fulfilling their legal mandate to educate the children in their care. Furthermore, they faced challenges in finding new ways to cooperate with parents without face-to-face contact. Existing research emphasizes that strong and supportive relationships with parents positively impact children's socio-emotional development, educational achievement, and long-term success in school (Jeynes, 2012; Hachfeld et al., 2016; Cohen and Anders, 2020). Accordingly, an examination of the relationship between parents and ECEC professionals during the pandemic[2] closures is critical to establish insights into its potential effects on families and ECEC professionals.

The present paper aims to understand how and why professionals in center- and family based ECEC services did or did not cooperate with parents during the pandemic. Although some studies have explored the impact of previous pandemics on parents and children (e.g., Bruce-Barrett et al., 2007) and childcare centers (e.g., Shope et al., 2017), little is currently known about the impact of the unprecedented COVID-19 pandemic on ECEC, particularly on the relationships between professionals and parents. Accordingly, this study provides more in-depth insight into why pedagogical professionals were or were not in contact with parents during their services' temporary closure. In addition to contributing to research on the perspectives and experiences of ECEC professionals when collaborating with parents, the findings can also inform pedagogical practice and policy with the aim of improving the conditions of ECEC settings.

OVERVIEW OF THE GERMAN EARLY CHILDHOOD EDUCATION AND CARE SYSTEM

The German ECEC system comprises center-based and family based services. Center-based ECEC services are formal institutions where, usually, more than one group of children are cared for and at least two pedagogical employes are responsible for one group. Staff-child ratios vary between 1:3 to 1:5 for groups with 0–3-year-old children and 1:7 to 1:12 for groups with 3–6-year-olds (Autorengruppe Bildungsberichterstattung, 2020). The most important center-based ECEC institutions are preschools (*Kindergärten*) for 3–6-year-old children, crèches (*Krippen*) for 0–3-year-olds, and day care centers (*Kindertagesstätten*) for 0–6-year-olds (Linberg et al., 2013). Family based ECEC services (*Kindertagespflege)*, meanwhile, are official daytime services in the professionals' or parents' homes or other suitable premises (Schoyerer et al., 2016). Mostly, a single self-employed professional is responsible for a small group of up to five children. Sometimes, two or more professionals provide joint care for five or more children (Heitkötter and Teske, 2014). In 2019, approximately 92.2% of 3–6-year-old children attended a center-based and 0.7% attended a family based ECEC service. Among children younger than 3 years old, 28.8% attended a center-based and 5.5% attended a family based ECEC service (Autorengruppe Bildungsberichterstattung, 2020).

Approximately 70% of the professionals in center-based ECEC institutions have the official occupation of "educators" (*Erzieherinnen*) and have completed 3–5 years of non-academic vocational training, whereas about 6% of the staff have a bachelor's degree (Autorengruppe Bildungsberichterstattung, 2020). The managers of center-based ECEC services are also predominantly trained educators (Geiger, 2019). Although the managers have their own autonomy, they are also bound by instructions and financial support from the providers (mostly municipalities or welfare associations). Unlike the staff in center-based ECEC services, the majority of professionals in family based ECEC services have completed only a mandatory basic pedagogical qualification course (Schoyerer et al., 2016). However, legal regulations regarding the level and scope of qualifications vary among the 16 federal states in Germany.

According to §22 SGB VIII (Sozialgesetzbuch – Social Code of Law), both center- and family based ECEC services are legally mandated to support and supplement the education and care of children. Regarding center-based ECEC services, legal educational plans on a state level contain guidelines on how to cooperate with parents; however, these are normally not binding. Some providers have additional guidelines for cooperation with parents. According to §8a of the Social Code of Law, ECEC professionals are also legally obligated to protect children.

THE COVID-19 PANDEMIC AND PROFESSIONAL–PARENT COLLABORATION

The COVID-19 containment measures that limit face-to-face contact have created specific difficulties regarding cooperation between parents and ECEC professionals. Many families have experienced stress due to worries regarding their health, safety, financial situation, and their attempts to balance childcare and work (Andresen et al., 2020; Brown et al., 2020; Cohen et al., 2020; Huebener et al., 2021). Parents of preschool-aged children are even less satisfied with the childcare situation and have encountered additional challenges as their children strongly depend on them (Andresen et al., 2020), resulting in relatively high declines in overall life satisfaction during the pandemic (Huebener et al., 2021). Accordingly, in this period, parents have expressed a desire for support from ECEC institutions for their children's education (Cohen et al., 2020). The home learning environment has become significantly more challenging because of homeschooling, especially for children

[1] Unless explicitly stated otherwise, the term "ECEC professionals" always refers to members of the three professional groups: "managers in center-based ECEC services," "employes in center-based ECEC services," and "professionals in family based ECEC services." The term "early childhood teacher" is avoided as professionals in the field of ECEC in Germany are generally not trained as teachers.

[2] Unless explicitly stated otherwise, terms such as "pandemic closures" and similar in this article always refer specifically to the period of temporary closures in ECEC services in spring 2020.

from socioeconomically disadvantaged families and families with a migration background (Geis-Thöne, 2020; Ravens-Sieberer et al., 2021). Furthermore, higher parental stress levels during this period can cause a deteriorating family climate, which can negatively affect children's wellbeing (Geis-Thöne, 2020) and increase the likelihood of child abuse (Brown et al., 2020; Ravens-Sieberer et al., 2021). Oppermann et al. (2021) found that perceived parental stress was the strongest predictor of changes in home learning activities. The more parents felt stressed, the fewer learning activities they undertook with the child. Research has shown that educators are particularly concerned about the increasing stress children have experienced during the pandemic (Jones, 2020). As educators play an essential role in the early detection and reporting of child maltreatment (Fitzpatrick et al., 2020), their ability to assess children's wellbeing might be limited during the temporary closure of ECEC services. Accordingly, contact with parents is the primary prerequisite for assessing children's current situations. Scholars have also investigated ECEC professionals' mental health and emotional stress during the pandemic, finding that pay-cuts, job losses, or preschool closures are the leading economic stressors. In their personal lives, professionals have expressed worries regarding their physical and emotional wellbeing, feelings of loneliness and isolation, and their families (Jones, 2020; Pramling Samuelsson et al., 2020; Tarrant and Nagasawa, 2020). ECEC professionals' wellbeing can affect their relationships with the children (Whitaker et al., 2015) as well as their cooperation with parents (Kuusimäki et al., 2019).

In general, preschools are ill-prepared for pandemics (Shope et al., 2017; Pramling Samuelsson et al., 2020). Many ECEC professionals lack knowledge and competencies in dealing with pandemics in professional practice, including adopting information and communication technologies (ICT) for educational purposes (Jones, 2020; Pramling Samuelsson et al., 2020; Tarrant and Nagasawa, 2020; Cohen et al., 2021). Langmeyer et al. (2020) found that, even if family households are equipped with ICT, most children in Germany had little contact with their educators. However, Cohen et al. (2021) found that 75% of professionals used ICT for contacting parents, though most of these contacts were sporadic. Institutional rules at the ECEC services, particularly in ECEC centers, have also affected professionals' relationships with parents, such as data protection or prohibition of usage of personal devices for contacting parents (Studienleitungen "Elementarpädagogik/Elementarbildung" an Österreichs Pädagogischen Hochschulen and Projektteam, 2020). Professionals may also avoid discussing sensitive topics with parents via ICT (e.g., conflicts, health issues) (Kuusimäki et al., 2019) or have privacy and security concerns (Pramling Samuelsson et al., 2020). Parents' anticipated reactions can also affect their contact. Furthermore, scholars have found that professionals have developed more positive attitudes toward using ICT in pedagogical practice during the pandemic (Cohen et al., 2021). They have adopted creative approaches to contacting parents and children such as providing self-made videos, offering live morning meetings online, or sending emails to parents with ideas for joint activities with their children (Dayal and Tiko, 2020; Tarrant and Nagasawa, 2020). However, COVID-19 has also brought additional challenges in reaching disadvantaged families, such as families with a migration background, due to a lack of personal contact, difficulties in reaching via digital channels, and existing linguistic barriers (Lüken-Klaßen et al., 2020; Studienleitungen "Elementarpädagogik/Elementarbildung" an Österreichs Pädagogischen Hochschulen and Projektteam, 2020). In Germany, intercultural parent–preschool partnership practices considering the support needs of families with a migration background are not widespread (Hachfeld et al., 2016). For instance, exchanging information (in print or digital form) in languages other than German is not common practice (Viernickel et al., 2013). Outreach problems concerning specific groups have been particularly visible in ECEC services during the pandemic (Studienleitungen "Elementarpädagogik/Elementarbildung" an Österreichs Pädagogischen Hochschulen and Projektteam, 2020).

Previous studies have identified a positive impact on the quality of education in preschools resulting from a professional exchange between team members and collaborative team culture (Wertfein et al., 2013; Resa et al., 2018). Although the pandemic has also resulted in confusion and management problems at some ECEC institutions, some managers have applied good practices, such as developing strategic plans to contact families (Fogarty, 2020; Mitchell et al., 2020). The challenges specific to the pandemic might motivate employes of an ECEC institution to collaborate more closely and develop creative and effective forms of cooperation with parents (Studienleitungen "Elementarpädagogik/Elementarbildung" an Österreichs Pädagogischen Hochschulen and Projektteam, 2020). ECEC professionals' understanding of their professional role may also affect their collaboration with parents (Anders, 2012). Puriola (2002) found that ECEC professionals perceive their work within five frames: educational (e.g., promoting children's learning), caring (e.g., ensuring children's wellbeing), managing (e.g., decision-making), practical (e.g., organizing), and personal (e.g., emotions, skills). Conceptions of their own pedagogical role and attitudes toward the responsibility of preschools can affect professionals' interactions, including collaboration with parents (Anders, 2012). Especially in a difficult period such as the pandemic, ECEC professionals' understanding of their professional role might significantly affect whether or how they contact parents.

THEORETICAL FRAMEWORK

The Importance of Cooperation Between Early Childhood Education and Care Professionals and Parents

Collaboration with parents has a long tradition in the German ECEC system; the practice was first propounded by early pedagogues such as Friedrich Fröbel, who created the kindergarten as an institution to supplement the family (Tschöpe-Scheffler, 2018). In Germany, common established forms of cooperation between ECEC professionals and parents include regular talks when parents drop off and pick up their

children, individual conversations about the child's development, or the organization of information evenings on pedagogical topics. Home visits or involving parents in curriculum-related management decisions are less likely (Fröhlich-Gildhoff, 2013; Viernickel et al., 2013; Hachfeld et al., 2016; Cohen and Anders, 2020). Cooperation between professionals and parents has long been considered an indispensable part of pedagogical work with children (Dusolt, 2018), and it represents an important field of action in ECEC (Betz, 2015) and in the conceptualization of ECEC quality (Anders and Roßbach, 2019). Referring to the structural–processual model of pedagogical quality, which is widely used in research on institutional childcare settings, four main dimensions can be identified: structural characteristics (e.g., educator–child ratio), educational beliefs, educational processes (e.g., interactions between children and educators), and networking with families (Kluczniok and Roßbach, 2014). In this model, it is assumed that ECEC services will have a particularly positive effect on children's development if the institutions do not focus exclusively on the children but also include their families, forming a partnership between professionals and parents (Anders, 2018). Both sides take responsibility for the development of the child and complement or strengthen each other mutually (Textor and Blank, 2014). Dialog and exchange between parents and ECEC professionals thus build a bridge between the family on the one hand and childcare on the other, creating a basis for mutual acceptance and trust (Dusolt, 2018). This has a positive effect on the child. Parents and ECEC professionals can be seen as equal experts for the respective child, considering that they sometimes have different perspectives as they experience the child in different environments (Anders, 2018). Opening up to each other is about making everyday life in center- and family based childcare transparent for families. In addition, parents attribute a high degree of professionalism to pedagogical professionals and seek their advice and guidance. Cooperation between ECEC professionals and parents does not only mean exchanging information about the child's behavior, development, and upbringing, but also attempting to coordinate educational goals, shape the educational process together, and complement and support each other in the best possible interests of the child. Thus, continuity between practices in childcare and family can be ensured which focuses on the child's upbringing and development (Cloos, 2018), although there is also a group of parents whose engagement in partnerships with ECEC professionals is considered difficult.

Professional Competencies of Early Childhood Education and Care Professionals

For qualified pedagogical work, there must be sufficient time for regular cooperation with parents, as well as the ability and willingness of professionals to approach this task. Models of professional competence (e.g., Fröhlich-Gildhoff et al., 2011) emphasize the interplay between disposition and performance. The term disposition refers to the basic principles of action available to a person, whereas performance describes the implementation of individual abilities and skills – i.e., dispositions – in a specific situation and thus refers to actual action (Fröhlich-Gildhoff et al., 2014). Subject-specific and theoretical knowledge play a central role in determining dispositions. To act professionally in a certain situation, professionals must have knowledge relevant to the specific subject at hand, as well as general pedagogical knowledge (Anders, 2012). These theoretical bodies of knowledge are complemented by implicit experiential knowledge; if reflected upon in a professional context, this knowledge can be made explicit. As such, professionals can actively draw on their own experiences, for example when collaborating with parents. This knowledge influences the manner in which professionals perceive and analyze a concrete situation. The willingness to act is significantly influenced by the perception and analysis of the situation, as well as motivation levels. In addition, action-guiding attitudes and values (e.g., individuals' understanding of their roles as professionals in ECEC) are crucial to determining whether – and in what manner – professionals act in a concrete situation (Fröhlich-Gildhoff et al., 2011).

Transferring these theoretical assumptions to the present study and to the collaboration between ECEC professionals and parents, we characterize the pandemic closures as a specific challenging situation for professionals. The perception of this situation, as well as different circumstances and the own role understanding, can be assigned to the area of disposition on the one hand and – referring to the structural–processual model of quality – to the dimension of educational beliefs on the other hand. Both areas influence the concrete action (processual quality) and manifest in professional–parent collaboration; in this case, the reasons given for (not) being in contact with parents.

Types of Social Support

Social support can be defined as the process through which social interactions promote health and wellbeing (Cohen et al., 2000). In the context of our study, social support for families can be considered a key component of ECEC professional–parent cooperation. Examining the importance that ECEC professionals placed on providing social support for families during the pandemic-related closure of ECEC services is, therefore, a key concern of this study. The term "social support" is complex and can refer to a variety of actions. There are various approaches for systematizing different types of social support (Cobb, 1976, 1979; House, 1981): The distinction made by House (1981) between *emotional support*, *informational support*, *instrumental support*, and *appraisal support* is one of the most widely used approaches in social support studies (e.g., Hamilton and Sandelowski, 2004; Ostberg and Lennartsson, 2007). Emotional support includes expressions of appreciation, trust, or concern for someone else and empathic behavior in general. Informational support includes making suggestions, giving advice, and sharing knowledge with others. Instrumental support includes actions that directly benefit someone else, such as the provision of goods and services. Appraisal support is characterized by the communication of information that serves another's self-assessment, e.g., giving constructive feedback. We apply House's (1981) conceptualization of social support to our data on reasons given for (not) being in contact with parents to

examine the importance ECEC professionals place on different forms of social support.

RESEARCH QUESTIONS

We pose the following research questions:

> RQ1: What reasons do ECEC professionals give for (not) being in contact with parents during the temporary closure of ECEC settings?
> RQ2: In what ways do the following three groups – (1) managers in center-based ECEC settings, (2) pedagogical employes in center-based ECEC settings, and (3) professionals in family based ECEC settings – differ in their reasons for (not) being in contact with parents during the temporary closure of ECEC settings?
> RQ3: Are there differences in the professionals' own understanding of their pedagogical role within the stated reasons for (not) being in contact with parents during the temporary closure of ECEC settings?

METHOD

Research Design and Sampling Procedure

This study is based on a nationwide (but not nationally representative) online survey conducted from April 10 to May 24, 2020, with pedagogical professionals in German center- and family based ECEC settings (Cohen et al., 2020). We carried out a convergent parallel mixed method design by collecting both qualitative (open-ended questions) and quantitative (close-ended questions) data within one survey study, and integrating statistical and text analysis (Creswell, 2014). The mixed-method design allowed us to provide comprehensive as well as detailed perspectives of professionals.

Participant recruitment took place via various channels. We emailed the survey to ECEC institutions and providers, requesting that they forward it to their employes, and distributed the link to various online portals and social media groups for ECEC professionals. Applying the snowball principle, we encouraged participants to forward the link to other professionals. Overall, 4,968 professionals participated in the online survey, which included a dichotomous question addressing if they were currently in contact with parents. Depending on their answer, we then asked participants an open-ended question to describe their reasons for being or not being in contact with parents. For our study, we only included professionals who answered one of these two questions. A closer examination of the data revealed that some people who were not actually professionals (e.g., trainees) had filled out the questionnaire. We excluded all such cases. As we focused merely on professionals officially working at the ECEC services when they participated in the survey, we also excluded those on vacation or who stated they were unable to work at that time. This resulted in a final sample size of 2,560 participants (see **Supplementary Figure 1** for further details of how the sample size was derived).

Sociodemographic data of the participants are shown in **Table 1**. The majority of respondents were female (95.2%). On average, the participants were 41.34 years old. Most participants had non-academic vocational training (74.1%), with training as an educator being the most common. Regarding their profession, more than half of the participants were pedagogical employes in center-based ECEC and approximately a quarter were managers of center-based ECEC institutions or professionals in family based ECEC services respectively.

Written informed consent was given by the participants. Participants were informed that they could stop the survey at any time at no disadvantage. The study abided by APA ethical guidelines on conducting studies with human participants. No formal approval from a governing or institutional review board was required for the study (see guidelines provided by the German Research Foundation for the social sciences[3]).

Data Analysis

Qualitative Analysis

We used qualitative text analysis to answer RQ1 by describing professionals' reasons (not) to be in contact with parents. All participants' responses to one of the two open questions on reasons for existing or non-existing contact with parents were first saved in a SPSS Statistics 26 dataset. Subsequently, we transferred them into a MAXQDA 2020 dataset to create thematic categories applying qualitative text analysis (Kuckartz, 2014). First, part of the data was independently coded by two researchers (n = 100 responses, approximately 3% of the total data) to build main categories. After each researcher had finished the first coding round, they compared and discussed their results and created a new coding scheme. Due to the complexity of responses (many participants named several aspects) and to avoid loss of information, the creation of subcategories (and in some cases sub-subcategories) was afforded special attention in a second round of independent coding. Multiple coding was applied to each response unit, making it possible to assign each response to several categories and subcategories. To cope with this complexity, both coders agreed that when coding each new response, they would first carefully check whether it fit at least one of the categories or subcategories already created. If this was not the case, they created a new (sub-)category for this response. This coding rule can thus be summarized as "as many categories as necessary and as few categories as possible." In each category, memos were created by providing a brief description of the code and at least one excerpt from the data (see **Supplementary Tables 1**, **2** for further information on descriptions of main categories and (sub-)subcategories and examples of responses). We ensured that every response was assigned to both the subcategory and its superordinate main category. Conversely, each answer assigned to a main category had to be assigned to at least one of its subordinate subcategories. After finalizing the coding of 100 responses, the assigned codes were compared again; units of coding with no agreement

[3]www.dfg.de/en/research_funding/faq/faq_humanities_social_science/index.html

TABLE 1 | Sociodemographic data of participants.

		Respondents with reasons for having contact with the parents (*n* = 2,238)	Respondents with reasons for *not* having contact with the parents (*n* = 322)	Total (*n* = 2,560)
Gender	Female	95.5%	93.5%	95.2%
	Male	4.4%	6.5%	4.7%
	Non-binary	0.1%	0%	0.1%
Age	Mean	41.61	39.40	41.34
	SD	11.20	11.29	11.23
	Range	19–67	21–65	19–67
Qualification	*Only* non-academic vocational training	73.6%	77.3%	74.1%
	Only academic degree	17.02%	16.1%	16.9%
	Non-academic vocational training *and* academic degree	8.0%	6.2%	7.7%
	No formal qualification	1.4%	0.3%	1.3%
Profession	Managers in center-based ECEC services	25.8%	7.1%	23.5%
	Employes in center-based ECEC services	46.6%	89.1%	52.0%
	Professionals in family based ECEC services	27.5%	3.7%	24.5%

were discussed to reach a consensus between the two coders. Subsequently, we adjusted the coding scheme. To code all further responses we consulted four more coders, explaining our coding scheme to them. Due to the existence of multiple coders, we ensured the documentation of regular updates in the coding scheme. In addition, the entire coding team met regularly to discuss questions, difficulties, or discrepancies, which helped create consensus between coders. During this coding process, we not only created new categories but also removed or combined existing ones. All categories were formed inductively, except six of the main categories ("emotional support of parents/children," "informational support of parents/children," and "instrumental support of parents/children"). These categories were formed deductively based on House's (1981) systematization approach of different social support types as the importance that ECEC professionals attribute to these types was a focal point of our analysis. Subcategories to these deductive main categories were formed inductively. The fourth type of social support mentioned by House (1981), "appraisal support," could not be identified in our data.

To check the degree of objectivity of our finalized code system, we applied an intercoder agreement measure using MAXQDA. Approximately 10% of the coded responses to each open-ended question—reasons for being in contact with parents (n = 211) and reasons for not being in contact with parents (n = 29)—were randomly selected using SPSS. These cases were coded by another person who had not been involved in the previous coding procedure. This person was informed about the coding rules that contained definitions and examples for each category. A percentage value for the total agreement between the research team and the second coder regarding the presence or absence of categories was calculated. For each category, matching non-assignments to a response were also counted as matches in this calculation. This resulted in an agreement value of 93.77% for cases where professionals gave reasons for being in contact with parents and an agreement value of 98.33% for cases where professionals gave reasons for *not* being in contact with parents. These values were considered satisfactory and no revision of the category system or re-testing of the intercoder agreement was undertaken.

Quantitative Analysis

Variables

Reasons for (not) being in contact with parents. To answer RQ2 and RQ3, we converted all main categories for reasons for (not) being in contact with parents from our previous qualitative text analysis to dummy variables in SPSS (0 = not present; 1 = present) for statistical examination.

Understanding of one's own professional role. To evaluate how the ECEC professionals understand their own professional role regarding cooperation with parents and social support of families (RQ3), we computed a new scale which shows if the professionals view cooperation with parents and the support of families as part of their role understanding (1 = do not agree at all; 4 = fully agree, Cronbach's α = 0.69). For 86 cases of the participants who gave reasons for being in contact and for 20 cases of the participants who gave reasons for not being in contact, we could not compute the scale due to missing data; these cases were excluded. This scale comprises the mean of five items which provide information regarding the extent to which professionals consider certain aspects part of their professional role, here related to supporting families and cooperating with parents. The participants were asked to agree or disagree on a 4-point Likert

TABLE 2 | Descriptive data of items used to compute a scale on professionals' own understanding of their roles regarding cooperation with parents and support of families.

	N	Mean	SD	Min	Max	Skewness	Kurtosis
Items (1 = do not agree at all; 4 = fully agree)							
(1) I can't influence what happens in families[1]	2988	2.77	0.77	1	4	0.24	−0.26
(2) Child development (e.g., language development) is currently the sole responsibility of parents[1]	2994	2.87	0.85	1	4	0.34	−0.52
(3) What happens in the families is none of my business[1]	2987	1.74	0.79	1	4	−0.84	0.11
(4) There are more important issues for me right now than collaborating with parents[1]	2911	1.87	0.84	1	4	−0.68	−0.26
(5) Especially during the temporary closure of center-/family based early childhood education and care, I feel obligated to help parents support their children, for example by providing materials	2995	2.98	0.85	1	4	−0.47	−0.45
Scale: professionals' own understanding of their roles regarding cooperation with parents and support of families (1 = do not agree at all; 4 = fully agree)	2823	2.75	0.55	1	4	−0.32	0.12

[1]As these four items have a negative wording, they have later been reverse coded to compute the scale on professionals' own role understanding. All five items are included in the scale "professionals' own understanding of their roles regarding cooperation with parents and support of families."

scale for all five items. The items and the descriptions of the scale are presented in **Table 2**. We later reverse coded the first four variables with negative wording; high scores on the newly computed scale thus correspond to participants who consider cooperation with parents and support of families an integral part of their professional role. We computed a principal component analysis to confirm that the five items load on one factor. The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.75, representing a relatively good factor analysis, and Bartlett's test of sphericity was significant ($p < 0.001$). An examination of Kaiser's criteria and the scree-plot yielded the empirical justification for retaining one factor.

Procedure

To answer RQ2, we conducted descriptive analyses of the frequencies with which the three different groups of professionals responded to each main category. In addition, we performed chi-square analyses to identify significant differences in the frequency with which these three groups referred to the different categories for reasons to be in contact with parents. However, for the categories of reasons *not* to be in contact with parents, the sample sizes of managers in center-based ECEC services and professionals in family based ECEC services were extremely small. In addition, most chi-square tests for significant differences between the three groups violated the requirement that the expected frequency is less than 5 for no more than 20% of the cells. For this reason, we used Fisher's exact test instead to test for significant differences between the three groups of professionals among participants who gave reasons *not* to be in contact with parents. In case of a significant group difference, additional *post hoc* tests using the Bonferroni correction were calculated, both for reasons to be in contact and reasons *not* to be in contact with parents.

To answer RQ3, we split the sample into two groups: ones who gave reasons to be in contact with parents and ones who gave reasons *not* to be in contact with parents. The scale "understanding of one's own professional role" is an ordinal variable and not normally distributed (Shapiro–Wilk test: $p < 0.001$); the reasons they gave are nominal variables. Therefore, we used the Mann–Whitney U (MWU) test to establish whether those who gave a specific reason to be in contact differ from those who did not give the reason regarding the scale "understanding of one's own professional role." For better interpretation, we computed the effect size *r* as proposed by Cohen (1988) if the MWU test revealed a significant group difference by dividing the z-value by the square root of the sample size (Fritz et al., 2012). Following Cohen's guidelines, effect sizes of 0.1 can be interpreted as a small effect, effect sizes of 0.3 as a medium effect, and effect sizes of 0.5 as a large effect (Coolican, 2009). For each stated reason, we computed a separate MWU test.

As the sample sizes for reasons *not* to be in contact with parents are partly in the single-digit range and the smaller sample is partly more scattered than the larger sample, we decided not to compute MWU tests for this sample as the test would lose validity under these conditions. Therefore, regarding the reasons given for *not* being in contact with parents, we kept descriptive comparisons of differences in the "understanding of one's own professional role" scale between professionals who gave a specific reason and those who did not.

FINDINGS

The vast majority of participants in our final sample—87.42%—named reasons for being in contact with parents (n = 2,238), whereas only 12.58% of participants gave reasons for *not* being in contact with them (n = 322). **Table 1** reports the descriptive data on sociodemographic characteristics of both subsamples. There were no meaningful differences between participants who gave reasons for being in contact and participants who gave reasons for *not* being in contact with parents regarding gender, age, and qualification. However, regarding their profession, the subsample of professionals who gave reasons *not* to be in contact with parents differed greatly from the other subsample

as well as from the total sample, with the vast majority being pedagogical employes in center-based ECEC (89.1%). The mean of 2.75 (SD = 0.55) of the scale on professionals' own understanding of their role shows that they tend to agree that cooperating with families and supporting families are a part of their own professional role (see **Table 2**). In the following, we report the results separately for professionals who gave reasons for contact with parents and for professionals who gave reasons for *no* contact with parents. In each section, we first present the main categories that emerged from our qualitative text analysis. We rooted them in comprehensive thematic dimensions, followed by a figure illustrating the main categories and their most relevant associated subcategories (RQ1). Secondly, as these categories were converted into dichotomous variables, we demonstrate statistical analyses by providing the frequencies of the main categories, together with significant differences between (1) managers in center-based ECEC settings; (2) pedagogical employes in center-based ECEC settings; and (3) professionals in family based ECEC (RQ2). Thirdly, we report the differences in professional role understanding regarding cooperation with parents and support of families within the stated reasons for (not) being in contact with parents (RQ3).

Reasons for Being in Contact With Parents

Our final coding system provided 15 main categories (with additional (sub-)subcategories) of the professionals' reasons for being in contact with parents. These categories were assigned to six thematic dimensions: action-oriented (social support), action-oriented (other), target group-oriented, personal, work-related, and outcome-oriented reasons (see **Figure 1**). In the following, we present our main categories below each thematic dimension to provide a detailed insight into the professionals' perspectives.

Thematic Dimensions for Being in Contact With Parents and Associated Categories (RQ1)

Action-Oriented Reasons: Social Support of Families

The ECEC professionals referred to different types of social support (*informational, emotional, or instrumental*) as their motives for being in contact with parents; nevertheless, many respondents simply mentioned that they wanted to help parents but gave no further details about the nature of this *unspecific social support*. They primarily stated their desire to support parents, but in some cases they also explicitly referred to the children.

Informational support of parents was the most mentioned type of social support. Professionals discussed sharing information with parents yet rarely mentioned its content. When they did, it was usually to discuss expectations of when normal care would resume. They also wanted to give advice and tips (e.g., about activities for the children), to answer parents' questions and be available to them as contact persons. *Emotional support of parents* shows their desire to achieve or maintain a sense of trust among parents. Professionals stressed the importance of making parents aware that they can always rely on them and expressed their appreciation and sympathy to parents. They also wanted to reassure parents when they shared their worries and problems. Furthermore, some underlined the *emotional support of children* by stressing their desire to achieve or maintain a sense of trust among them and express their appreciation to them. In addition, bringing joy to the children (e.g., by sending them Easter gifts) was linked to the intention to distract them from the current difficult situation. *Instrumental support of parents* almost exclusively refers to cases in which professionals mentioned their involvement in providing emergency care. Other aspects, such as directing parents to professional counseling centers were rarely mentioned. *Instrumental support of children* reported by respondents indicates that they provided educational and playing materials for children (e.g., craft templates, coloring books, or literacy or numeracy tasks). A number of professionals also emphasized the importance of being in direct contact with the children, both via "analog" activities (e.g., writing letters) and digital activities (e.g., recording and sending videos or live meetings via video conferencing tools).

Other Action-Oriented Reasons

In addition to action-oriented social support motives, we identified two further categories for reasons in which actions on the part of the professionals were in the foreground: *maintaining relationship/exchange with families and inquiring about family wellbeing.* A large proportion of the professionals stated their desire to maintain their relationships and regular exchange with the families. They named specific topics for which a regular exchange was important to them (e.g., the children's development). In addition, some explicitly reported the necessity of not just a direct relationship with parents but also with children. Moreover, they wanted to detect whether families were doing well during the pandemic by expressing their concerns regarding some parents' psychological and/or physical stress and the potential adverse effects it has on their children.

Target Group-Oriented Reasons

Some professionals gave statements where parents' or children's social–emotional circumstances were mentioned, but the professionals' intention to actively support them or inquire about their wellbeing was not necessarily stated. In these cases, their responses addressed the *social-emotional circumstances of parents,* mentioning parents' current worries (e.g., regarding their children's development), extreme parental stress, or strain. Some professionals also mentioned *social-emotional circumstances* of children and underlined how much the children were likely to miss daily life in the ECEC setting or noted that the current situation was fundamentally difficult and stressful for children.

Personal Reasons

Some professionals referred to their *own emotional state* to justify their contact with parents. Mostly, their personal motivation or need for contact were mentioned. Some also emphasized how they missed the children.

Work-Related Reasons

In two categories, professionals mentioned work-related aspects as reasons for being in contact with parents. Some referred to their *legal pedagogical mandates* and especially stressed cooperation with parents as a central task of their profession. In

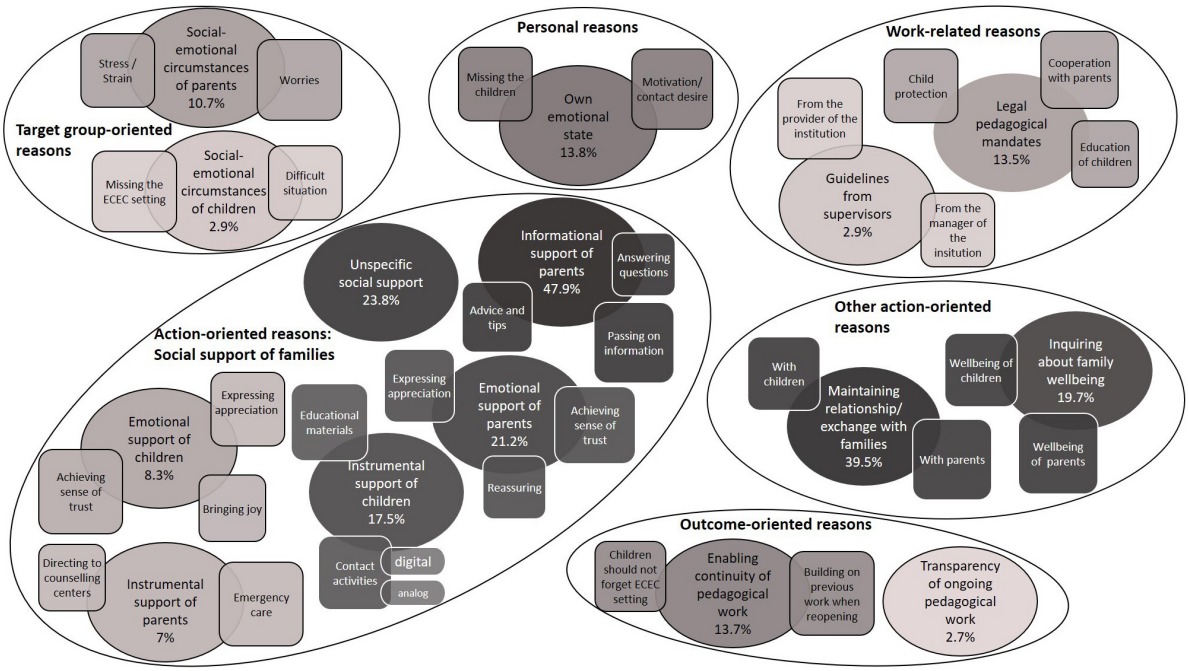

FIGURE 1 | ECEC professionals' reasons for being in contact with parents. The categories are divided, based on comprehensive thematic dimensions, with large circles. Inside each large circle, the main categories are shown as circles, while subcategories are illustrated as squares. The categories change from dark to light according to the frequency of the assigned responses.

addition, they noted both their legal mandate of child protection and their legal mandate of educating children. A few professionals referred to *guidelines from their supervisors* (e.g., the provider or the manager of a center-based ECEC service), implying that contact with the parents was more obligatory than voluntary.

Outcome-Oriented Reasons

Enabling continuity of pedagogical work and *transparency of ongoing pedagogical work* were important outcome-oriented reasons for professionals to be in contact with parents. Professionals emphasized that they wanted to ensure the continuity of their pedagogical work despite the temporary closure of ECEC services. They also hoped that, as soon as all children were able to attend the ECEC facility again, they would be able to build on the extensive collaborations with families that occurred during the temporary closure. Furthermore, many professionals highlighted that children should not forget daily life in the ECEC facility and the professionals who work there. A few professionals stated that through their contact with parents, they wanted to show them that they were still pursuing their professional pedagogical activities instead of just "relaxing."

Frequencies of the Main Categories and Differences Between the Three Groups of Early Childhood Education and Care Professionals (RQ2)

Table 3 depicts the frequencies of the main categories in descending order and the differences between the three groups of ECEC professionals who gave reasons for having contact with parents. *Informational support of parents* was by far the most frequently named reason for existing contact with parents (47.9%), followed by *maintaining the relationship* and *exchange with families* (39.5%). Relatively few professionals (13.5%) justified their contact by the *legal pedagogical mandates*. With less than 3% each, professionals most rarely referred to the *children's social-emotional circumstances*, *guidelines from supervisors*, and the *transparency of their ongoing pedagogical work* as reasons for their contact. We identified significant differences between the three groups of professionals for 12 of the 15 categories. In six of these cases, the category occurred most frequently, and at the same time significantly more frequently than in both comparison groups, among the managers of center-based ECEC services (e.g., *informational support of parents*, *emotional support of parents, legal pedagogical mandates*). In three cases, the proportion of professionals referring to the category was highest among pedagogical employes in center-based ECEC (*instrumental support of children*, *emotional support of children*, *guidelines from supervisors*). For all three categories, however, *post hoc* tests showed that this proportion differed significantly from professionals in family based ECEC but not from managers in center-based ECEC. In another three cases, the category occurred most frequently among professionals in family based ECEC services. For two of these categories, this proportion was significantly higher than for both comparison groups (*inquiring about family wellbeing*, *enabling continuity of pedagogical work*), and for one category it was only significantly higher than for pedagogical employes in center-based ECEC (*own emotional state*). It is also noteworthy that *legal pedagogical mandates,*

TABLE 3 | Main categories and their respective frequencies of reasons for being in contact with parents (n = 2,238).

Main category	Frequency				Chi^2 Test	*Post hoc* Tests (Bonferroni-Correction)
	Managers center-based ECEC (n = 578)	Pedagogical employes center-based ECEC (n = 1,044)	Professionals family based ECEC (n = 616)	Total (n = 2,238)		
Informational support of parents	60.0%	41.3%	47.9%	47.9%	χ^2 (2) = 52.412, $p < 0.001$	mc > pc, mc > pf, pf > pc
Maintaining relationship/exchange with families	43.8%	38.0%	38.1%	39.5%	χ^2 (2) = 5.828, n.s.	/
Unspecific social support	32.5%	24.9%	13.8%	23.8%	χ^2 (2) = 58.917, $p < 0.001$	mc > pc, mc > pf, pc > pf
Emotional support of parents	27.3%	21.4%	15.3%	21.2%	χ^2 (2) = 26.030, $p < 0.001$	mc > pc, mc > pf, pc > pf
Inquiring about family well-being	13.3%	20.2%	24.8%	19.7%	χ^2 (2) = 25.310, $p < 0.001$	pf > mc, pf > pc
Instrumental support of children	17.5%	20.9%	11.7%	17.5%	χ^2 (2) = 22.707, $p < 0.001$	mc > pf, pc > pf
Own emotional state	13.3%	12.3%	16.9%	13.8%	χ^2 (2) = 7.110, $p < 0.05$	pf > pc
Enabling continuity of pedagogical work	12.3%	12.1%	17.7%	13.7%	χ^2 (2) = 11.662, $p < 0.01$	pf > mc, pf > pc
Legal pedagogical mandates	21.1%	13.0%	7.3%	13.5%	χ^2 (2) = 48.966, $p < 0.001$	mc > pf, mc > pc, pc > pf
Social-emotional circumstances of parents	15.7%	9.8%	7.5%	10.7%	χ^2 (2) = 23.109, $p < 0.001$	mc > pf, mc > pc
Emotional support of children	8.5%	10.2%	5.0%	8.3%	χ^2 (2) = 13.360, $p < 0.01$	pc > pf
Instrumental support of parents	11.1%	5.6%	5.5%	7.0%	χ^2 (2) = 20.223, $p < 0.001$	mc > pf, mc > pc
Social-emotional circumstances of children	2.9%	2.4%	3.7%	2.9%	χ^2 (2) = 2.467, n.s.	/
Guidelines from supervisors	2.4%	4.5%	0.8%	2.9%	χ^2 (2) = 19.189, $p < 0.001$	pc > pf
Transparency of ongoing pedagogical work	3.5%	2.7%	1.9%	2.7%	χ^2 (2) = 2.613, n.s.	/

n.s., not significant; mc, managers center-based ECEC; pc, pedagogical employes center-based ECEC; pf, professionals family based ECEC.

emotional support of parents and *unspecific social support* were mentioned significantly less frequently by professionals in family based ECEC services than by both comparison groups.

Differences in Professionals' Own Understanding of Their Roles Regarding Cooperation With Parents and Support of Families Within Reasons for Being in Contact With Parents (RQ3)

In the following section, we examine if there are differences in the professionals' own understanding of their roles regarding cooperation with parents and support of families within their reasons for being in contact with parents. As there were no significant differences between the three groups of ECEC professionals in the variable on professionals' role understanding, we do not differentiate between these three groups and instead address the total sample of ECEC professionals who gave reasons for having contact with families (n = 2,152). Furthermore, we only report differences in their understanding of their professional roles within the main categories which emerged as statistically significant. The scaling of the variable enables the interpretation

of mean values larger than 2.5 as (partial) agreement and those smaller than 2.5 as (partial) disagreement. With a mean value of $M = 2.82$ (SD = 0.52), the results show that professionals tend to agree that cooperating with families and supporting families are parts of their understanding of their own role. For the analysis, we computed a MWU Test for each stated reason and compared the role understanding of those who stated that reason with those who did not. The descriptives of those both groups, as well as the results of the MWU test and the calculated effect sizes, are reported in **Table 4**. Again, we present the reasons in descending order based on their frequency.

We find statistically significant differences within eleven of the fifteen main categories of reasons for contact with families regarding the professionals' understanding of their roles. For ten of the reason given by the professionals, the results of the MWU reveal that those who gave the reason find it comparatively more important to cooperate with parents and support families than those who did not give the reason. The reasons are as follows: maintaining relationship/exchange with families ($U = 450917.00$, $Z = -7.231$, $p < 0.001$, $r = 0.16$), unspecific social support ($U = 297175.00$, $Z = -10.299$, $p < 0.001$, $r = 0.22$), emotional support of parents ($U = 310787.00$, $Z = -6.773$, $p < 0.001$, $r = 0.15$), emotional support of children ($U = 159107.00$, $Z = -2.211$, $p < 0.05$, $r = 0.05$), inquiring about families' wellbeing ($U = 339515.50$, $Z = -2.189$, $p < 0.05$, $r = 0.05$), instrumental support of children ($U = 312986.00$, $Z = -2.109$, $p < 0.05$, $r = 0.05$), professional's own emotional state ($U = 246920.00$, $Z = -3.188$, $p < 0.01$, $r = 0.07$), fulfilling the legal pedagogical mandates ($U = 188323.00$, $Z = -8.693$, $p < 0.001$, $r = 0.18$), social-emotional circumstances of parents ($U = 167095.50$, $Z = -6.266$, $p < 0.001$, $r = 0.14$), and the social-emotional circumstances of children ($U = 54735.50$, $Z = -2.100$, $p < 0.05$, $r = 0.05$).

We find only one group difference where professionals who gave instrumental support as a reason to be in contact with families find it comparatively less important to cooperate with parents and support families than those who did not give this reason ($U = 135618.00$, $Z = -2.114$, $p < 0.05$, $r = 0.05$).

Reasons for Not Being in Contact With Parents

Our final coding system provided 13 main categories (with additional (sub-)subcategories) for the professionals' reasons for *not* being in contact with parents. These categories are assigned to three thematic dimensions: work-related, parent-related, and personal reasons (see **Figure 2**). To delineate professionals' perspectives and experiences, in the following we present each dimension again with its associated main categories.

Thematic Dimensions for *Not* Being in Contact With Parents and Associated Categories (RQ1)

Work-Related Reasons

Many professionals noted *contact by others* as a motive for not being in contact with parents themselves. They mentioned that other persons, especially managers, took responsibility for staying in contact with parents. Other pedagogical employes, particularly those who still worked at facilities for emergency care, were also frequently named as responsible contact persons for parents. Fewer respondents reported considering the provider as the responsible actor for being in contact with parents.

Another significant reason was *the prohibition from the employer*. In the context of official prohibitions, the issue of data protection was the most important aspect here. Professionals in center-based ECEC services stressed that they were not allowed to access parents' contact information outside of their institution. Many professionals named the managers, and some named the providers, as having prohibited contact with parents. Furthermore, the *HomeOffice* situation brought additional challenges to pedagogical practice. Whereas some professionals merely stated working from home in their response, others explained this aspect in further detail. For a number of respondents, having contact with parents was associated merely with face-to-face contact. Some underlined the issue of data protection alongside working from home, mentioning their prohibition from accessing and using parents' private contact information outside of the ECEC setting.

The unprepared COVID-19 situation in ECEC centers also negatively affected *communication within the team*. The lack of explicit indication from the provider or manager, general management problems within their institutions, and disagreements or lack of exchange within their team were highlighted among respondents. However, some professionals noted being in the preparation phase as a team, working on finding new or better ways to keep in contact with parents.

Some professionals stressed their heavy *workload* during this period. Delivering emergency care was frequently specified to justify not being in contact with parents. In addition, in center-based ECEC services, the *precautions against COVID-19* were seen as a reason not to be in contact with parents, such as not allowing them to enter the facility to avoid face-to-face contact. In addition, *technical equipment* or *digital media availability* were further topics addressed by professionals. They complained that their ECEC institution had failed to provide an official communication app, software, or messenger group that would enable them to contact parents. Furthermore, the poor quality or lack of work-based devices (e.g., laptops, computers, smartphones) or an insufficient internet connection in the ECEC facility were reported.

Parent-Related Reasons

Some professionals reported that they wanted contact with parents but were faced with *problems from the parents' side*. They highlighted difficulties in reaching families, especially ones with a migrant or low socioeconomic background, and mentioned their language barrier, the lack of families' competencies in using digital media, and the absence of technical equipment in their households. They also mentioned that some parents exhibited no interest in maintaining contact with professionals.

Personal Reasons

Professionals also had various personal reasons for not having contact with parents. In addition to their professional life, they also faced challenges in coping with the pandemic in their private life. Among these, *family responsibilities* were remarked

TABLE 4 | Differences in professionals role understanding within reasons for being in contact with parents (n = 2,152).

Main category	Professionals' own understanding of their roles regarding cooperation with parents and support of families (1 = do not agree at all; 4 = fully agree)						Mann-Whitney-*U*-Test	Effect size
	Reason *not* stated			Reason stated				
	N	M (SD)	Median	*N*	M (SD)	Median		
Informational support of parents	1117	2.81 (0.53)	2.80	1035	2.84 (0.50)	2.80	U = 565376.00 Z = −0.886 n.s.	/
Maintaining relationship/exchange with families	1308	2.76 (0.53)	2.80	844	2.93 (0.48)	3.00	U = 450917.00 Z = −7.231 $p < 0.001$	r = 0.16
Unspecific social support	1634	2.76 (0.53)	2.80	518	3.02 (0.44)	3.00	U = 297175.00 Z = −10.299 $p < 0.001$	r = 0.22
Emotional support of parents	1690	2.79 (0.52)	2.80	462	2.97 (0.47)	3.00	U = 310787.00 Z = −6.773 $p < 0.001$	r = 0.15
Inquiring about family well-being	1731	2.81 (0.52)	2.80	421	2.87 (0.50)	2.80	U = 339515.50 Z = −2.189 $p < 0.05$	r = 0.05
Instrumental support of children	1773	2.81 (0.52)	2.80	379	2.88 (0.51)	3.00	U = 312986.00 Z = −2.109 $p < 0.05$	r = 0.05
Own emotional state	1851	2.81 (0.52)	2.80	301	2.92 (0.51)	3.00	U = 246920.00 Z = −3.188 $p < 0.01$	r = 0.07
Enabling continuity of pedagogical work	1858	2.82 (0.52)	2.80	294	2.87 (0.50)	2.80	U = 260248.00 Z = −1.310 n. s.	/
Legal pedagogical mandates	1857	2.78 (0.50)	2.80	295	3.07 (0.51)	3.20	U = 188323.00 Z = −8.693 $p < 0.001$	r = 0.18
Social-emotional circumstances of parents	1920	2.80 (0.52)	2.80	232	3.02 (0.49)	3.00	U = 167095.50 Z = −6.266 $p < 0.001$	r = 0.14
Emotional support of children	1973	2.82 (0.52)	2.80	179	2.90 (0.50)	3.00	U = 159107.00 Z = −2.211 $p < 0.05$	r = 0.05
Instrumental support of parents	2001	2.83 (0.52)	2.80	151	2.73 (0.53)	2.80	U = 135618.00 Z = −2.114 $p < 0.05$	r = 0.05
Social-emotional circumstances of children	2090	2.82 (0.52)	2.80	62	2.93 (0.55)	3.00	U = 54735.50 Z = −2.100 $p < 0.05$	r = 0.05
Guidelines from supervisors	2086	2.82 (0.52)	2.80	66	2.78 (0.58)	2.80	U = 67478.50 Z = −0.275 n. s.	/
Transparency of ongoing pedagogical work	2095	2.82 (0.52)	2.80	57	2.94 (0.46)	3.00	U = 52788.00 Z = −1.505 n. s.	/

n.s., not significant.

upon, such as taking care of their own children or household-related issues. A few professionals reported not being in contact with parents due to *private reasons or worries* such as health concerns for themselves and their families. A small number of professionals found *contacting is not necessary*. Although some opined that families are responsible for the education and care of their children at home, some noted that parents do not require additional support.

We found that a few professionals were also critical about having contact with parents outside of ECEC centers due to *privacy concerns*. They described their hesitance to contact parents via their private telephone numbers or email

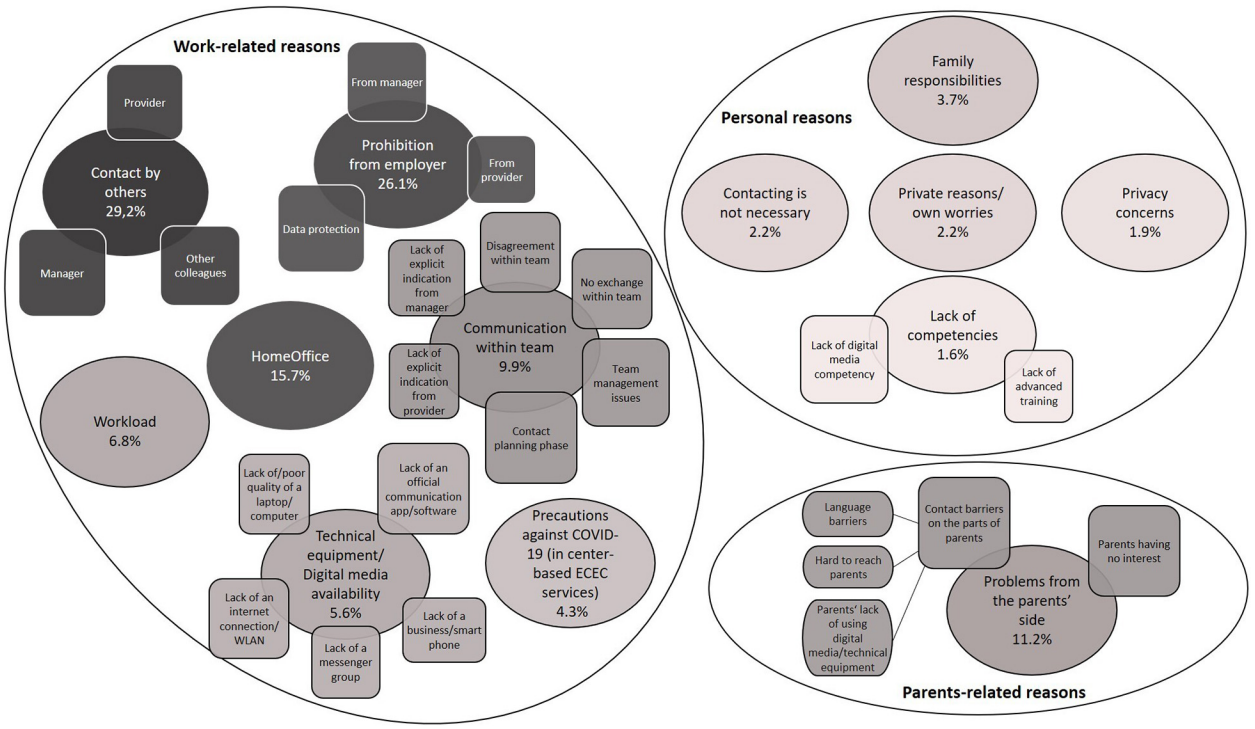

FIGURE 2 | ECEC professionals' reasons for not being in contact with parents. The categories are divided, based on comprehensive thematic dimensions, with large circles. Inside each large circle, the main categories are shown as circles, while subcategories are illustrated as squares. The categories change from dark to light according to the frequency of the assigned responses.

addresses and underlined the importance of a separation of the professional and private spheres. Furthermore, a *lack of competencies* in contacting parents was reported. Whereas some highlighted their lack of digital media competencies, others mentioned their lack of training in consulting parents in a pandemic situation.

Frequencies of the Main Categories and Differences Between the Three Groups of Early Childhood Education and Care Professionals (RQ2)

Table 5 presents the frequencies of the main categories and the differences between the three groups of ECEC professionals who had given reasons for *not* having contact with parents in descending order. Professionals most frequently mentioned that other people were responsible for this. The second most frequent reason given was a prohibition of contacting parents on the part of the employer. Other reasons were given comparatively less frequently. Using the Fisher exact test only showed significant differences in three categories between the three compared groups of professionals. However, additional *post hoc* tests for these three categories only revealed a significant group difference for one category: *Problems from the parents' side*. Managers in center-based ECEC mentioned this category significantly more frequently than pedagogical employes in center-based ECEC. The inconsistent findings between the Fisher exact tests and the *post hoc* tests using Bonferroni correction may be due to the extremely small case numbers in the two groups of professionals in family based ECEC and managers in center-based ECEC. Overall, the findings on group differences should, therefore, be interpreted with caution.

Differences in Professionals' Own Understanding of Their Roles Regarding Cooperation With Parents and Support of Families Within Reasons for *Not* Being in Contact With Parents (RQ3)

Compared to the professionals who gave reasons for having contact with the families, the professionals who gave reasons not to be in contact identified less with parent cooperation and family support as part of their professional role (n = 302, M = 2.4, SD = 0.58).

Table 6 presents the descriptives for the ones who gave a specific reason and those who did not give this reason in descending order based on their frequency. Examining the mean values or the medians reveals differences in the professionals' own understanding of their pedagogical role within some of the stated reasons not to be in contact with parents on a descriptive level. The biggest difference can be found for the reason *contacting is not necessary*; professionals who stated this reason had comparatively lower scores on the scale on cooperation with parents and support of families than professionals who did not state this reason (Mean = 1.83; Median = 1.80 vs. Mean = 2.42; Median = 2.60). In addition, the mean values and medians indicate that professionals who stated that a *prohibition from*

TABLE 5 | Main categories and their respective frequencies of reasons for *not* being in contact with parents (*n* = 322).

Main category	Frequency				Fisher Exact Test	*Post hoc* Tests (Bonferroni-Correction)
	Managers center-based ECEC (*n* = 23)	Pedagogical employes center-based ECEC (*n* = 287)	Professionals in family based ECEC (*n* = 12)	Total (*n* = 322)		
Contact by others	13.0%	31.0%	16.7%	29.2%	n.s.	/
Prohibition from employer	8.7%	28.6%	0%	26.1%	$p < 0.01$	/
HomeOffice	8.7%	15.7%	16.7%	15.2%	n.s.	/
Problems from the parents' side	30.4%	8.7%	33.3%	11.2%	$p < 0.01$	mc > pc
Communication within team	8.7%	10.5%	0%	9.9%	n.s.	/
Workload	8.7%	7.0%	0%	6.8%	n.s.	/
Technical equipment/Digital media availability	17.4%	4.5%	8.3%	5.6%	$p < 0.05$	/
Precautions against COVID-19 (center-based ECEC services)	0%	4.9%	0%	4.3%	n.s.	/
Family responsibilities	0%	4.2%	0%	3.7%	n.s.	/
Private reasons/Own worries	4.3%	2.1%	0%	2.2%	n.s.	/
Contacting is not necessary	4.3%	1.7%	8.3%	2.2%	n.s.	/
Private sphere	4.3%	1.4%	8.3%	1.9%	n.s.	/
Lack of competencies	0%	1.7%	0%	1.6%	n.s.	/

n.s., not significant; mc, managers center-based ECEC; ec, pedagogical employes center-based ECEC; pf, professionals family based ECEC.

TABLE 6 | Differences in professionals role understanding within reasons for *not* being in contact with parents (*n* = 302).

Main category	Professionals' own understanding of their roles regarding cooperation with parents and support of families (1 = do not agree at all; 4 = fully agree)					
	Reason *not* stated			Reason stated		
	N	M (SD)	Median	*N*	M (SD)	Median
Contact by others	215	2.34 (0.60)	2.40	87	2.42 (0.54)	2.60
Prohibition from employer	225	2.36 (0.60)	2.40	77	2.52 (0.52)	2.60
HomeOffice	257	2.40 (0.57)	2.40	45	2.43 (0.65)	2.60
Problems from the parents' side	266	2.40 (0.58)	2.40	36	2.39 (0.63)	2.60
Communication within team	272	2.40 (0.59)	2.40	30	2.48 (0.54)	2.60
Workload	281	2.42 (0.58)	2.60	21	2.20 (0.58)	2.20
Technical equipment/Digital media availability	284	2.41 (0.59)	2.50	18	2.30 (0.49)	2.40
Precautions against COVID-19 (center-based ECEC services)	288	2.40 (0.58)	2.60	14	2.36 (0.54)	2.30
Family responsibilities	291	2.41 (0.58)	2.40	11	2.22 (0.74)	2.40
Private reasons/Own worries	297	2.40 (0.58)	2.40	5	2.28 (0.84)	2.60
Contacting is not necessary	295	2.42 (0.57)	2.60	7	1.83 (0.82)	1.80
Private sphere	296	2.40 (0.58)	2.40	6	2.30 (0.77)	2.60
Lack of competencies	298	2.40 (0.58)	2.50	4	2.25 (0.52)	2.10

their employer was a reason for not being in contact with parents identified more with cooperating with parents and supporting families as part of their professional role than those who did not give this reason (Mean = 2.52; Median = 2.60 vs. Mean = 2.36; Median = 2.40). We found other small differences with respect to the descriptives but these are quite small. Furthermore, the descriptive differences cannot be supported by additional quantitative analyses as the requirements for performing a valid MWU test are not met.

DISCUSSION

This study, based on data collected through an online survey, aimed to understand how and why professionals in center- and family based ECEC services do or do not cooperate with parents during the pandemic. We applied a mixed-method research design (Creswell, 2014) by analyzing the professionals' responses to open-ended questions following qualitative text analysis (Kuckartz, 2014) and converting the emergent categories

to variables for further quantitative analysis. This allowed us to examine the differences between different groups of ECEC professionals as well as differences in their professional role understanding within the stated reasons.

The findings show that professionals associate reasons for being in contact with parents with various overarching, substantive dimensions. Most of the professionals mentioned action-oriented reasons, particularly providing social support to families. Many aspects mentioned in their responses align with the different types of social support noted by House (1981). To justify contact with parents, professionals referred less frequently to personal feelings, the circumstances of families, and work-related or outcome-oriented aspects.

Informational support of parents and maintaining the relationship and exchange with families emerged as important motives for being in contact. Aspects of informational support were mentioned particularly by managers of center-based ECEC services, indicating that they felt a special responsibility to keep parents informed. Forms of emotional support for parents and instrumental support for parents were also reported comparatively frequently by managers. However, regarding instrumental support, children were addressed more frequently than parents. The instrumental support of parents was mainly referred to in the context of the professionals' involvement in emergency care provision, which can be mandatory work depending on their employment status. However, instrumental support for children was mainly realized by pedagogical employes in center-based ECEC, and frequently by managers, including different pedagogical activities such as providing craft and learning materials for children or writing letters. In addition, digital media appeared to play a central role as the professionals sent videos and had meetings with the children using video conferencing tools. Mirroring findings from other countries (Dayal and Tiko, 2020; Tarrant and Nagasawa, 2020), our findings illustrate that many professionals are motivated to use ICT for creative and educational contact activities with children. Similarly, Cohen et al. (2021) showed that attitudes toward using ICT have changed positively since the beginning of the pandemic.

Regarding comparisons of the three groups of ECEC professionals, our results indicate that all social support categories are more important motives for existing contact with parents for managers and pedagogical employes in center-based ECEC services than for professionals in family based ECEC services. One possible explanation for this could be that the importance of social support for parents is already emphasized much more strongly in the mandatory staff training in center-based ECEC settings, which is generally more demanding and longer than the usual mandatory qualification course of most professionals in family based ECEC (Schoyerer et al., 2016). Accordingly, in our study we draw attention to the training of professionals, which affects the quality of ECEC services, including cooperation with parents (Anders, 2012).

Another motive for being in contact was inquiring about family wellbeing, which was more frequently stated by professionals in family based ECEC than by managers and pedagogical employes in center-based ECEC. This may be because professionals in family based ECEC are responsible for the care of fewer children and thus probably develop a closer relationship with them and their parents (Viernickel, 2015). Therefore, it is possible that this particular close relationship could make professionals in family based ECEC even more concerned about the families' wellbeing. Many professionals expressed their concerns that high parental stress levels could endanger the children's wellbeing. This finding is in line with results from a study in the United States showing similar concerns among early childhood professionals (Jones, 2020). Existing research suggests an increase in domestic violence during the pandemic (Brown et al., 2020; Steinert and Ebert, 2020), so professionals might feel responsible for detecting child maltreatment.

Compared to other aspects, the ECEC professionals in our study referred relatively rarely to official, occupational legal mandates of their pedagogical work to justify contact with parents: cooperation with parents, child protection, or children's education. Although these legal mandates affect all three groups of ECEC professionals equally, professionals in family based ECEC services referred to them significantly less frequently. As the mandatory qualification course for professionals in family based ECEC is significantly shorter than the usual mandatory training of professionals in center-based ECEC (Schoyerer et al., 2016), the legal foundation of their pedagogical work may play a subordinate role in their training. However, this requires further investigation. Furthermore, as evidenced in cross-country research, professionals' perspectives may differ based on whether ECEC is a legal right for children and families in the country (Pramling Samuelsson et al., 2020). Therefore, professionals' perspectives concerning the legal mandate of their pedagogical work deserve more attention by considering different country contexts with different ECEC systems. It must also be emphasized that the comparatively low frequency of this category does not necessarily mean that professionals do not attach a value to the legal mandate of their work. The high rates of the categories *instrumental support of children* and *inquiring about family wellbeing* indicate that many professionals adhere to their legal mandates to educate and protect children even if they do not explicitly mention them.

Furthermore, ECEC professionals' own understanding of their professional role regarding cooperation with parents and support for families is connected with certain reasons for contact with parents, such as the motive to emotionally support parents and children or to inquire about their wellbeing. Here, the professionals who stated these reasons found it comparatively more important to cooperate with parents and support families than professionals who did not state these reasons. The professional competence model by Fröhlich-Gildhoff et al. (2011) emphasizes that action-guiding attitudes and values—such as professionals' understanding of their role—influence ECEC professionals' actions in a concrete situation. Our findings support this assumption as they indicate that a high level of identification with the aspects *cooperation with parents* and *support of families* as components of one's own professional image is positively correlated to the actual willingness to support parents and children even in times of crisis. We found that among ten of the fifteen reasons for being in contact with parents, those

professionals who gave one of the reasons had comparatively higher scores on the scale on role understanding than those who did not state such a reason. It has to be noted, that the means of the scale show that both groups (partially) agree that cooperation with parents and supporting families is part of their role understanding yet the means of the groups who gave reasons are comparatively higher. The effect sizes indicate small effects (Coolican, 2009), indicating that the differences in the role understanding should not be overinterpreted. *Instrumental support of parents* was the only reason where the group comparison revealed lower scores on role understanding for professionals who gave this reason. One possible explanation for this could be that professional role understanding in the context of cooperation with parents and supporting families is negatively connected to organizing and providing emergency care (which is the main aspect of instrumental support of parents). The organization and implementation of emergency care is perceived as obligatory. Accordingly, it can be assumed that those professionals who stated this reason provide (at least partly) emergency care and are therefore in contact with parents, even if they do not find it important to be in contact. This can also be interpreted in the way that professionals who agreed that cooperating with parents and supporting families is an integral part of their role are less likely to give this reason because cooperation beyond emergency care focuses more on voluntary aspects. The positive connections with the professionals' own understanding of their role and reasons such as maintaining a relationship or inquiring about families' wellbeing support this interpretation. Among the reasons for not having contact, there are some answers such as *lack of competencies* or *contacting is not necessary* which are in the single-digit percentage range and were mentioned only by a very few professionals. Even though the descriptive group comparison revealed that professionals who said contacting was not necessary (partially) disagreed with seeing cooperation with parents and supporting families as part of their role understanding, this group only consisted of seven participants. This result, as well as other results with small sample sizes, should not be generalized and transferred to the entirety of professionals.

Even though significantly fewer ECEC professionals in our study gave reasons for *not* being in contact with parents during the pandemic, their mentioned aspects provide a vivid picture of their personal and institutional challenges. The most relevant aspects were references to work-related conditions, followed by references to the parents' circumstances. In contrast, personal reasons were rarely mentioned. The most frequently mentioned reason for refraining from contact with parents was an existing contact by other persons (e.g., the manager of an ECEC facility or other colleagues). This shows that, in some ECEC services, the responsibility for staying in contact with parents lies in the hands of individuals rather than the whole institution. This suggests that some professionals may not have felt responsible for contacting and supporting families during the pandemic closure. This might have been the result of a responsibility diffusion effect among the professionals on an institutional level, meaning that people feel less responsible for their actions when they are part of a group than when alone (Forsyth et al., 2002). Furthermore, the absence of clarity regarding which areas of pedagogical work they feel responsible for (educational, caring, managing, practical, or personal) can affect their responses (Puriola, 2002). Some professionals in center-based ECEC also cited communication problems within their team as a reason for the lack of contact with parents and highlighted insufficient guidelines from their managers, disagreements with their colleagues, and inadequate (or even non-existent) communication within their team. These aspects correspond to other studies which mention challenges related to management and teamwork in ECEC institutions in this period (Fogarty, 2020; Mitchell et al., 2020). Overall, these findings indicate that, at least in some ECEC institutions, there is a need to improve the team culture and management. Corresponding effort and investment would also be worthwhile because professional exchange and a collaborative team culture can positively influence the quality of education in ECEC institutions (Wertfein et al., 2013; Resa et al., 2018).

Another reason given by some professionals to justify the lack of contact with parents was an official prohibition from the employer, which was mentioned mostly by pedagogical employes in center-based ECEC by addressing a prohibition on the part of the manager. Professionals in family based ECEC did not report this aspect, which is not surprising as they are mostly self-employed (Heitkötter and Teske, 2014). As the responses showed, this prohibition in ECEC centers was mostly justified by data protection requirements or guidelines regarding access to parents' contact information. Data protection and data security are traditionally given high priority in German institutions and, therefore, strongly influence the cooperation between ECEC professionals and families (Cohen et al., 2021). Research has shown that this issue is not specific to Germany; professionals in Austria have described similar challenges (Studienleitungen "Elementarpädagogik/Elementarbildung" an Österreichs Pädagogischen Hochschulen and Projektteam, 2020).

Some respondents cited the poor conditions or the absence of technical equipment such as work computers or smartphones. In addition, they denounced the institutions' lack of official digital communication tools (e.g., messengers such as WhatsApp). Although professionals would have been willing to contact parents, some hesitated to use their private devices for this purpose. Inadequate technical equipment was frequently mentioned by managers of center-based services, suggesting that the need for action in this regard is often seen primarily by providers. Despite improvements in recent years, many German ECEC centers still lack proper technical equipment (Autorengruppe Bildungsberichterstattung, 2020), which is also reflected in our study. Accordingly, significant steps must be taken to improve the technical conditions of ECEC services.

Approximately one-tenth of the professionals referred to parental aspects to justify non-existing contact. In this context, professionals emphasized that some socially disadvantaged parents were particularly hard to reach, which aligns with other findings (Studienleitungen "Elementarpädagogik/Elementarbildung" an Österreichs Pädagogischen Hochschulen and Projektteam, 2020). Reference was made to the language barriers experienced with parents

with non-German mother tongues. Existing pre-COVID-19 findings have already revealed deficits in the manner in which ECEC institutions collaborate with parents with migrant backgrounds (Viernickel et al., 2013; Hachfeld et al., 2016). This problem has been further exacerbated by the loss of face-to-face communication due to the temporary closure of ECEC services. Respondents also highlighted insufficient technical equipment or lack of competencies in using digital media, especially among disadvantaged families. Therefore, it is conceivable that important information (e.g., regarding emergency care) did not reach some parents in time. It is also worth highlighting that, according to numerous respondents, some parents were uninterested in contact. If professionals fail to convince parents that both they and their children would benefit from continued contact in such challenging times, a vicious cycle of mutual disinterest may result. Problems from the parents' side were mentioned particularly frequently by managers in center-based ECEC.

The personal reasons of professionals are also worth acknowledging, even if they were reported far less than other aspects. Respondents stressed, for example, difficult periods in their private lives resulting from health-related, financial, and socioemotional stress, similar to other studies (Jones, 2020; Tarrant and Nagasawa, 2020). Homeschooling their own children, the difficulties of balancing family and work life, and pay-cuts were some of the reasons given to explain why they were not in contact with parents. Some professionals described feeling incompetent in the use of digital media to collaborate with parents. These findings highlight the importance of recognizing the professionals' own socioemotional, financial, and professional support needs. A small number of professionals argued that contacting parents is not necessary and that parents are the only actors responsible for their children's education and care at home, or that the parents are doing well without support from professionals. This finding highlights that it is not just professionals' own understanding of their pedagogical work (Puriola, 2002) but also in which physical context they feel responsible for pedagogical work that is in question.

Professionals who regarded cooperation and family support aspects as important elements of their professional self-image were less likely to justify a lack of contact with parents by considering it unnecessary and more likely to justify a lack of contact by referring to a prohibition from their employer (but only on a descriptive level). These findings indicate that ECEC professionals' reluctance to contact parents may not be related to viewing this task as unimportant. The lack of contact was more likely due to work-related circumstances or parental characteristics than to an insufficient sense of responsibility on the part of the professionals.

LIMITATIONS

The following limitations must be addressed. First, it should be emphasized that our study is based on data provided by ECEC professionals and is therefore limited to only one relevant group in the context of cooperation between ECEC professionals and parents. To obtain a more comprehensive picture, reference can be made to a parent survey conducted during nearly the same time period as this study (Cohen et al., 2020; Oppermann et al., 2021). Another limitation regarding our study sample is that there might be a difference between ECEC professionals who worked in emergency care and those who did not, which could not be sufficiently considered here; professionals working in emergency care might have considered their contact with parents more obligatory than voluntary. We decided not to exclude them nevertheless because we assumed that every ECEC professional will have multiple reasons for (not) being in contact with parents and can simultaneously maintain contact obligatorily *and* voluntarily.

Although in our study data were collected to examine the reasons professionals gave for (not) being in contact with parents, no data were collected on the frequency or quality of their contact. This would have been valuable information, especially as professional–parent cooperation should lead to a strong and supportive relationship which indicates high frequency and high-quality interactions. This should be addressed in future studies. Combining reasons for (not) being in contact with parents with their frequency and quality could show what reasons drive the potent cooperation between professionals and parents and therefore also have practical implications as beneficial and hindering reasons could be identified. It should also be noted that no data were collected on cooperation with parents in the period *prior* to the pandemic closure. Furthermore, no data on the importance of cooperation between professionals and parents in an ECEC facility's mission statement were collected. In addition, the possibility of social desirability in answering the survey questions cannot be excluded. However, as answering these two open questions was voluntary, we do not consider this a serious problem.

Another limitation of this study concerns the coding process. As the researchers' own interpretations always color qualitative data analysis, we cannot rule out the risk of insufficient objectivity. We attempted to keep this risk as low as possible by creating transparent coding rules for all categories and by regularly discussing and clarifying possible ambiguities. In addition, we calculated a measure of intercoder agreement and obtained very satisfactory values. Consequently, we believe that the objectivity of our code system can be assumed to be sufficiently high.

Regarding the findings on the differences between the three different groups of ECEC professionals in terms of reasons for *not* being in contact with parents, the small sample sizes of managers in center-based ECEC services and professionals in family based ECEC services pose another limitation. Even though the Fisher exact test, which also works for small sample sizes, was calculated in this case, the corresponding findings should be interpreted with caution. This also applies to the differences within the professionals' reasons for (not) being in contact with parents and their own professional role regarding cooperation with parents and the social support of families. As we described in the method section, the requirements to perform a valid MWU

test were not met for the sample of professionals who stated reasons *not* to be in contact with parents. Even though the non-parametric MWU test is suitable for non-normally distributed data, the sample sizes of both groups (professionals who stated a reason and those who did not) differ, especially for reasons not to be in contact. The MWU test loses power if the samples are of different size and loses validity if the smaller sample is more scattered than the larger sample. Because of this, we decided not to carry out this test regarding the professionals' reasons *not* to be in contact with parent as it may have led to inaccurate results. We therefore decided to stay on a descriptive level with regard to the professionals reasons for *not* being in contact with parents, but even the descriptive results must be interpreted with caution. This especially applies to the small subsamples in the single-digit range as they may represent a very specific (sub-)group of ECEC professionals and should not be generalized.

The small effect sizes of the MWU tests for reasons to be in contact with parents could partly be a result of low variance, with the different "reasons for (not) being in contact with parents" variables being ascribed the binary values of 1 = present or 0 = not present. For future research, it might be interesting to create standardized items based on the categories found in this study. This would avoid the peculiarity of open questions resulting only in those reasons that occur to the professionals at that moment. Thereby, the individual value professionals attach to each of the reasons for (not) being in contact with parents could be assessed more precisely.

Finally, it must be noted that the data collection period of the study was during the first wave of the pandemic in which ECEC services were unprepared for such a challenging situation. Although in summer 2020, relatively normal institutional early childhood education and care was possible due to low infection rates, this situation changed again in fall, as an exponential increase in infection was recorded. As part of renewed measures to contain the spread of the virus, it was decided to temporarily close ECEC facilities again. This closure period lasted from December 2020 to March 2021. As we do not know to what extent professionals' reasons for (not) being in contact with parents had already changed during this time as a result of the new experiences during the first closure, this would be a starting point for further research.

PRACTICAL IMPLICATIONS

At present, the pandemic is ongoing. Even though it is politically desirable for ECEC services to remain open as long as possible, a further temporary closure of ECEC facilities in Germany cannot be completely ruled out. Consequently, experiences from the first closure period should be used to better prepare for any additional future closures. The findings of our study may be helpful in shaping future effective cooperation between ECEC professionals and parents in such a crisis. Valuable recommendations for action, both on the level of pedagogical professionals and the level of politics, can be derived from our findings.

First, the importance of the joint responsibility of all professionals in an ECEC institution must be emphasized. Especially in large, center-based ECEC services, it is important that each professional is aware of his or her pedagogical responsibility in this regard and does not rely solely on someone else. Managers have a special responsibility in this context. A collaborative team culture characterized by regular exchange based on mutual trust is a key component. If this is not guaranteed from the outset, external team-building measures could be considered. In addition, video conferencing tools can play an important role in ensuring that regular team meetings do not have to be canceled. However, for managers of center-based ECEC services, these circumstances also pose the challenge of ensuring that professionals who only work from home can continue to do pedagogical work (e.g., by creating learning materials or videos for children).

Another practical implication concerns the topic of data protection and data security. To reduce potential insecurities that could hinder action on the part of ECEC professionals, it is important to train them on the legal situation regarding data protection in the context of cooperation with parents. A particular focus should be on informing professionals about what they need to be aware of when using digital media to stay connected with parents. On the policy side, it could be useful to address the extent to which certain data protection laws and policies relevant to the practice of cooperation between professionals and parents can be temporarily relaxed or suspended in times of crisis. In the case of actual changes in data protection laws or policies, the immediate, transparent, and understandable communication of the resulting changes and new opportunities for collaborations to relevant actors in the field of ECEC is important. Because ICT can serve a crucial function in communicating with parents and children during closures, the providers of ECEC services should invest in good technical equipment. Nevertheless, in this context, compliance with data protection requirements must be ensured. Using an ECEC facility's own software or app as a tool for communicating with parents is generally preferable to using a messenger service such as WhatsApp. In addition, equipping all ECEC professionals with work smartphones can be useful so they do not have to use their private devices. Therefore, the pandemic has confronted us with the necessity of creating new pedagogical concepts, both for collaborating with parents and for providing remote education and care for children.

Finally, the need for innovative and effective approaches for reaching and cooperating with socially disadvantaged parents should be recognized. Professionals should have access to targeted outreach strategies for parents with a migration background and language barriers. Especially at times when face-to-face contact is not possible, it must be ensured that these parents are kept up to date on current events. Distributing information leaflets in the parents' origin language, employing professional translators, and strengthening inter-agency collaboration between ECEC services and other family support services (e.g., counseling centers and pediatric practices) is important here. It must be underlined, however, that financial support from the providers of ECEC services is necessary

to realize such efforts. As the pandemic has made existing social inequalities between families more visible, and can even contribute to their aggravation, efforts to prevent social deprivation should be a high priority for policymakers at the local and national levels.

In conclusion, this paper can broaden the current knowledge of professional–parent cooperation during the COVID-19 pandemic. Furthermore, several constructive suggestions, ranging from the training of ECEC professionals to current pedagogical practice, have been addressed based on professionals' perspectives. Therefore, collaboration with parents, which is recognized as a component of quality of education in ECEC services (Kluczniok and Roßbach, 2014), should be taken seriously by institutions and policymakers to tackle the negative consequences of the pandemic for educators, families, and children.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data are currently reserved for scientific qualifications (Ph.D. and masters' theses). Requests to access the datasets should be directed to FH, fabian.hemmerich@uni-bamberg.de.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FH and HE-M provided the initial idea for the study, analyzed the qualitative data, coordinated the coding procedure of the qualitative data, and wrote the first draft of the manuscript. FH and LB performed the statistical analyses. LB contributed to the manuscript's theory section. YA supervised and provided resources. All authors contributed to the conception and design of the study, manuscript revision, and read and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.701888/full#supplementary-material

REFERENCES

Anders, Y. (2012). *Modelle professioneller Kompetenzen für frühpädagogische Fachkräfte. Aktueller Stand und ihr Bezug zur Professionalisierung. Expertise zum Gutachten, Professionalisierung in der Frühpädagogik" im Auftrag des Aktionsrats Bildung. München: vbw - Vereinigung der Bayerischen Wirtschaft*. Available online at: https://www.aktionsrat-bildung.de/fileadmin/Dokumente/Expertise_Modelle_professioneller_Kompetenzen.pdf (accessed April 05, 2021).

Anders, Y. (2018). "Bildung in der Familie," in *Psychologische Grundlagen für Fachkräfte in Kindergarten, Krippe und Hort*, ed. J. Strohmer (Bern: Hogrefe), 295–302.

Anders, Y., and Roßbach, H.-G. (2019). "Qualität in der Kindertagesbetreuung," in *Das Bildungswesen in Deutschland: Bestand und Potenziale*, eds O. Köller, M. Hasselhorn, F. W. Hesse, K. Maaz, J. Schrader, H. Solga, et al. (Bad Heilbrunn: Verlag Julius Klinkhardt), 441–471.

Andresen, S., Lips, A., Möller, R., Rusack, T., Schröer, W., Thomas, S., et al. (2020). *Kinder, Eltern und ihre Erfahrungen während der Corona-Pandemie: Erste Ergebnisse der bundesweiten Studie KiCo*. Hildesheim: Universitätsverlag Hildesheim.

Autorengruppe Bildungsberichterstattung (2020). *Bildung in Deutschland 2020: Ein indikatorengestützter Bericht mit einer Analyse zu Bildung in einer digitalisierten Welt*. Bielefeld: wbv Publikation.

Betz, T. (2015). *Das Ideal der Bildungs- und Erziehungspartnerschaft. Kritische Fragen an eine verstärkte Zusammenarbeit zwischen Kindertageseinrichtungen, Grundschulen und Familien*. Gütersloh: Bertelsmann Stiftung.

Brown, S. M., Doom, J. R., Lechuga-Peña, S., Watamura, S. E., and Koppels, T. (2020). Stress and parenting during the global COVID-19 pandemic. *Child Abuse Neglect* 110, 1–14. doi: 10.1016/j.chiabu.2020.104699

Bruce-Barrett, C., Matlow, A., Rafman, S., and Samson, L. (2007). Pandemic influenza planning for children and youth: Who's looking out for our kids? *Health Manag. Forum* 20, 20–24. doi: 10.1016/S0840-4704(10)60254-2

Cloos, P. (2018). "Zusammenarbeit mit Eltern," in *Handbuch Empirische Forschung in der Pädagogik der frühen Kindheit*, eds T. Schmidt and W. Smidt (New York, NY: Waxmann), 211–227.

Cobb, S. (1976). Social support as a moderator of life stress. *Psychosom. Med.* 38, 300–314. doi: 10.1097/00006842-197609000-00003

Cobb, S. (1979). "Social Support and Health through the Life Course," in *Aging From Birth to Death*, ed. M. W. Riley (Boulder, CO: Westview Press), 93–106.

Cohen, F., and Anders, Y. (2020). Family involvement in early childhood education and care and its effects on the social-emotional and language skills of 3-year-old children. *School Effect School Improv.* 31, 125–142. doi: 10.1080/09243453.2019.1646293

Cohen, F., Oppermann, E., and Anders, Y. (2021). Elternzusammenarbeit in Kindertageseinrichtungen während der Corona-Pandemie. Digitalisierungsschub oder verpasste Chance? *Zeitschrift für Erziehungswissenschaft* 2021:7. doi: 10.1007/s11618-021-01014-7

Cohen, F., Oppermann, E., Anders, Y., Erdem-Möbius, H., and Hemmerich, F. (2020). *Familien & Kitas in der Corona-Zeit: Zusammenfassung der Ergebnisse. Bamberg*. Available online at: https://www.uni-bamberg.de/fileadmin/efp/forschung/Corona/Ergebnisbericht_finale_Version_Onlineversion.pdf (accessed December 10, 2020).

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Hillsdade, NJ: Erlbaum.

Cohen, S., Gottlieb, B. H., and Underwood, L. G. (2000). "Social Relationships and Health," in *Social Support Measurement and Intervention: A Guide for Health and Social Scientists*, ed. S. Cohen, L. G. Underwood, and B. H. Gottlieb (New York, NY: Oxford University Press), 3–25. doi: 10.1093/med:psych/9780195126709.003.0001

Coolican, H. (2009). *Research Methods and Statistics in Psychology*. London: Hodder.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 4th Edn. London: Sage.

Dayal, H. C., and Tiko, L. (2020). When are we going to have the real school? A case study of early childhood education and care teachers' experiences surrounding education during the COVID-19 pandemic. *Austr. J. Early Childhood* 45, 336–347. doi: 10.1177/1836939120966085

Dusolt, H. (2018). *Elternarbeit als Erziehungspartnerschaft: Ein Leitfaden für den Vor- und Grundschulbereich*, 4th Edn. Weinheim: Beltz Verlagsgruppe.

Fitzpatrick, M. D., Benson, C., and Bondurant, S. R. (2020). *Beyond Reading, Writing, and Arithmetic: The Role of Teachers and Schools in Reporting Child Maltreatment. NBER Working Papers No. 27033*. Cambridge, MA: National Bureau of Economic Research. Available online at: https://www.nber.org/system/files/working_papers/w27033/w27033.pdf (accessed March 26, 2021).

Fogarty, L. (2020). Leading in the early childhood education and care sector in England during a pandemic: Reality, relationships and ruminations. *Internat. Stud. Educ. Administr.* 48, 45–50.

Forsyth, D. R., Zyzniewski, L. E., and Giammanco, C. A. (2002). Responsibility diffusion in cooperative collectives. *Personal. Soc. Psychol. Bull.* 28, 54–65. doi: 10.1177/0146167202281005

Fritz, C. O., Morris, P. E., and Richler, J. J. (2012). Effect Size Estimates: Current Use, Calculations, and Interpretations. *J. Exp. Psychol.* 141, 2–18. doi: 10.1037/a0024338

Fröhlich-Gildhoff, K. (2013). Die Zusammenarbeit von pädagogischen Fachkräften und Eltern im Feld der frühkindlichen Bildung, Betreuung und Erziehung. *Bildungsforschung* 10, 11–25.

Fröhlich-Gildhoff, K., Nentwig-Gesemann, I., and Pietsch, S. (2011). *Kompetenzorientierung in der Qualifizierung frühpädagogischer Fachkräfte. WiFF Expertise No. 19*. München: Deutsches Jugendinstitut.

Fröhlich-Gildhoff, K., Nentwig-Gesemann, I., Pietsch, S., Köhler, L., and Koch, M. (2014). *Kompetenzentwicklung und Kompetenzerfassung in der Frühpädagogik: Konzepte und Methoden. Materialien zur Frühpädagogik No 13*. Freiburg: FEL-Verlag.

Geiger, K. (2019). *Personalgewinnung. Personalentwicklung. Personal- bindung. Eine bundesweite Befragung von Kindertageseinrichtungen. WiFF Expertise No. 32*. München: Deutsches Jugendinstitut.

Geis-Thöne, W. (2020). *Häusliches Umfeld in der Krise: Ein Teil der Kinder braucht mehr Unterstützung: Ergebnisse einer Auswertung des Sozio-oekonomischen Panels (SOEP). IW-Report 15*. Köln: Institut der Deutschen Wirtschaft.

Hachfeld, A., Anders, Y., Kuger, S., and Smidt, W. (2016). Triggering parental involvement for parents of different language backgrounds: The role of types of partnership activities and preschool characteristics. *Early Child Dev. Care* 186, 190–211. doi: 10.1080/03004430.2015.1007370

Hamilton, J. B., and Sandelowski, M. (2004). Types of social support in African Americans with cancer. *Oncol. Nurs. Forum* 31, 792–800. doi: 10.1188/04.ONF.792-800

Heitkötter, M., and Teske, J. (eds) (2014). *Formenvielfalt der Kindertagespflege. Standortbestimmung, Qualitätsanforderungen und Gestaltungsbedarfe. DJI Forum Bildung und Erziehung No. 11*. München: DJI Verlag Deutsches Jugendinstitut.

House, J. S. (1981). *Work Stress and Social Support*. Reading, MA: Addison-Wesley.

Huebener, M., Waights, S., Spiess, C. K., Siegel, N. A., and Wagner, G. G. (2021). Parental well-being in times of Covid-19 in Germany. *Rev. Econ. Household* 19, 91–122. doi: 10.1007/s11150-020-09529-4

Jeynes, W. (2012). A meta-analysis of the efficacy of different types of parental involvement programs for urban students. *Urb. Educ.* 47, 706–742. doi: 10.1177/0042085912445643

Jones, D. (2020). *The Impact of COVID-19 on Young Children, Families, and Teachers: A Defending the Early Years Report*. Available online at: https://eric.ed.gov/?id=ED609168 (accessed February 2, 2021).

Kluczniok, K., and Roßbach, H.-G. (2014). Conceptions of educational quality for kindergartens. *Zeitschrift für Erziehungswissenschaft* 17, 145–158. doi: 10.1007/s11618-014-0578-2

Kuckartz, U. (2014). *Qualitative Text Analysis: A Guide to Methods, Practice & Using Software*. Los Angeles: Sage. doi: 10.4135/9781446288719

Kuusimäki, A.-M., Uusitalo-Malmivaara, L., and Tirri, K. (2019). The role of digital school-home communication in teacher well-being. *Front. Psychol.* 10, 1–8. doi: 10.3389/fpsyg.2019.02257

Langmeyer, A., Guglhör-Rudan, A., Naab, T., Urlen, M., and Winklhofer, U. (2020). *Kindsein in Zeiten von Corona: Erste Ergebnisse zum veränderten Alltag und zum Wohlbefinden von Kindern*. München: Deutsches Jugendinstitut.

Linberg, T., Baeumer, T., and Roßbach, H.-G. (2013). Data on early child education and care learning environments in Germany. *Internat. J. Child Care Educ. Policy* 7, 24–42. doi: 10.1007/2288-6729-7-1-24

Lüken-Klaßen, D., Neumann, R., and Elsas, S. (2020). *Kontakt.los! Bildung und Beratung für Familien während der Corona-Pandemie. ifb-Materialien No. 2*. Available online at: https://www.ifb.bayern.de/imperia/md/content/stmas/ifb/materialien/mat_2020_2.pdf (accessed February 8, 2021).

Mitchell, L., Hodgen, E., Meagher-Lundberg, P., and Wells, C. (2020). *Impact of Covid-19 on the Early Childhood Education Sector in Aotearoa New Zealand: Challenges and Opportunities. Initial Findings from a Survey of Managers. Wilf Malcolm Institute of Educational Research*. Available online at: https://www.waikato.ac.nz/__data/assets/pdf_file/0008/547568/Impact-of-Covid-19-on-ECE-Sector-report_FINAL.pdf (accessed March 14, 2021).

Oppermann, E., Cohen, F., Wolf, K., Burghardt, L., and Anders, Y. (2021). Changes in parents' home learning activities with their children during the COVID-19 lockdown – The role of parental stress, parents' self-efficacy and social support. *Front. Psychol.* 12, 1–13. doi: 10.3389/fpsyg.2021.682540

Ostberg, V., and Lennartsson, C. (2007). Getting by with a little help: the importance of various types of social support for health problems. *Scand. J. Public Health* 35, 197–204. doi: 10.1080/14034940600813032

Pramling Samuelsson, I., Wagner, J. T., and Eriksen Ødegaard, E. (2020). The Coronavirus pandemic and lessons learned in preschools in Norway, Sweden and the United States: OMEP policy forum. *Internat. J. Early Childhood* 52, 129–144. doi: 10.1007/s13158-020-00267-3

Puriola, A.-M. (2002). The multiple faces of everyday life: Frame analysis of early childhood practices. *Eur. Early Childhood Educ. Res. J.* 10, 31–47. doi: 10.1080/13502930285208941

Ravens-Sieberer, U., Kaman, A., Erhart, M., Devine, J., Schlack, R., and Otto, C. (2021). Impact of the COVID-19 pandemic on quality of life and mental health in children and adolescents in Germany. *Eur. Child Adolesc. Psychiatry* 2021:5. doi: 10.1007/s00787-021-01726-5

Resa, E., Groeneveld, I., Turani, D., and Anders, Y. (2018). The role of professional exchange in improving language-related process quality in daycare centres. *Res. Papers Educ.* 33, 472–491. doi: 10.1080/02671522.2017.1353671

Schoyerer, G., Weimann-Sandig, N., and Klinkhammer, N. (2016). *Ein internationaler Blick auf die Kindertagespflege: Deutschland, Dänemark, England und Frankreich im Vergleich*. München: Verlag Deutsches Jugendinstitut.

Shope, T. R., Walker, B. H., Aird, L. D., Southward, L., McCown, J. S., and Martin, J. M. (2017). Pandemic influenza preparedness among child care center directors in 2008 and 2016. *Pediatrics* 139, 1–8. doi: 10.1542/peds.2016-3690

Steinert, J., and Ebert, C. (2020). *Gewalt an Frauen und Kindern in Deutschland während COVID-19-bedingten Ausgangsbeschränkungen: Zusammenfassung der Ergebnisse*. Available online at: https://drive.google.com/file/d/19Wqpby9nwMNjdgO4_FCqqlfYyLJmBn7y/view (accessed March 24, 2021).

Steinmetz, H., Batzdorfer, V., and Bosnjak, M. (2020). The ZPID lockdown measures dataset for Germany. *ZPID Sci. Inform.* 20:1.

Studienleitungen "Elementarpädagogik/Elementarbildung" an Österreichs Pädagogischen Hochschulen and Projektteam (2020). *Elementarpädagogik in "Corona-Zeiten". Beispielsammlung. Wie das elementarpädagogische Personal bei Kindergartenschließung Beziehungs- und Bildungsarbeit leistet und Kontakte mit Familien und Kindern aufrechterhält*. Graz: Pädagogische Hochschule Steiermark.

Tarrant, K., and Nagasawa, M. (2020). *New York Early Care and Education Survey: Understanding the Impact of COVID-19 on New York Early Childhood System. New York: New York Early Childhood Professional Development Institute; The City University of New York; Bank Street College of Education*. Available online at: https://educate.bankstreet.edu/cgi/viewcontent.cgi?article=1001&context=sc (accessed March 3, 2021).

Textor, M. R., and Blank, B. (2014). *Elternmitarbeit: Auf dem Wege zur Bildungs- und Erziehungspartnerschaft*, 2nd Edn. München: Bayerisches Staatsministerium für Arbeit und Sozialordnung, Familie und Frauen.

Tschöpe-Scheffler, S. (2018). Zusammenarbeit mit Eltern in Kita und Schule. *Jugendhilfe* 56, 382–386.

Viernickel, S. (2015). "Identifikation struktureller Qualitätsmerkmale in der Kindertagespflege. Theoretische und empirische Analysen, steuerungsrelevante Konsequenzen," in *Qualität für alle: Wissenschaftlich begründete Standards für die Kindertagesbetreuung*, eds S. Viernickel, K. Fuchs-Rechlin, P. Strehmel, C. Preissing, J. Bensel, and G. Haug-Schnabel (Freiburg im Breisgau: Herder), 403–484.

Viernickel, S., Nentwig-Gesemann, I., Nicolai, K., Schwarz, S., and Zenker, L. (2013). *Schlüssel zu guter Bildung, Erziehung und Betreuung: Bildungsaufgaben, Zeitkontingente und strukturelle Rahmenbedingungen in Kindertageseinrichtungen*. Berlin: Der Paritätische Gesamtverband, Diakonie and GEW.

Wertfein, M., Müller, K., and Danay, E. (2013). Die Bedeutung des Teams für die Interaktionsqualität in Kinderkrippen. *Frühe Bildung* 2, 20–27. doi: 10.1026/2191-9186/a000073

Whitaker, R. C., Dearth-Wesley, T., and Gooze, R. A. (2015). Workplace stress and the quality of teacher–children relationships in Head Start. *Early Childhood Res. Q.* 30, 57–69. doi: 10.1016/j.ecresq.2014.08.008

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 15 November 2021
doi: 10.3389/fpsyg.2021.702606

Development of Teachers' Emotional Adjustment Performance Regarding Their Perception of Emotional Experience and Job Satisfaction During Regular School Operations, the First and the Second School Lockdown in Austria

Katharina-Theresa Lindner[1], Hannu Savolainen[2]* and Susanne Schwab[1,3,4]*

[1] Department of Education, University of Vienna, Vienna, Austria, [2] Department of Education, University of Jyväskylä, Jyväskylä, Finland, [3] Center for Teacher Education, University of Vienna, Vienna, Austria, [4] North-West University, Vanderbijlpark, South Africa

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Mei-Lin Chang, Kennesaw State University, United States
Mercedes Inda-Caro, University of Oviedo, Spain

***Correspondence:**
Katharina-Theresa Lindner
Katharina-theresa.lindner@univie.ac.at
Hannu Savolainen
hannu.k.savolainen@jyu.fi

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *29 April 2021*
Accepted: *05 October 2021*
Published: *15 November 2021*

Citation:
Lindner K-T, Savolainen H and Schwab S (2021) Development of Teachers' Emotional Adjustment Performance Regarding Their Perception of Emotional Experience and Job Satisfaction During Regular School Operations, the First and the Second School Lockdown in Austria. Front. Psychol. 12:702606. doi: 10.3389/fpsyg.2021.702606

Starting with the COVID-19 pandemic, research intensively investigated the effects of school lockdowns on involved stakeholders, such as teachers, students and parents. However, as research projects had to be hurriedly conducted, in-depth and longitudinal studies are lacking. Therefore, the current study uses data from a longitudinal study to investigate the well-being of Austrian in-service teachers during the COVID-19 pandemic. In total 256 teachers took part at both measurement waves and participated in an online survey. Standardized questionnaires were used to assess teachers' perception of emotional experiences and job satisfaction before COVID-19 (retrospective, t1), during the first (*in situ*, t2) and during the second school lockdown (*in situ*, t3). The results indicated that the vast majority of teachers generally felt a high level of job satisfaction. However, teachers' satisfaction decreased between regular teaching and school lockdowns. Similarly, positive emotional activation was reduced and negative activation increased. Further, results from a positive activation cross-lagged path model indicated that the lack of positive activation led to lower job satisfaction. For negative emotional activation, job satisfaction during the first school lockdown predicted negative activation at the second lockdown.

Keywords: COVID-19, teachers' emotional experience, job satisfaction, longitudinal study, school lockdown

INTRODUCTION

Due to the spread of the COVID-19 virus, educational processes and regular school operations have been turned upside down. Because of the worldwide increase in infections and the unpredictability of the ongoing pandemic, new basic conditions for teaching and learning processes needed to be established and implemented in a short amount of time (Helm et al., 2021; Lindner et al., 2021). In

the context of a constant transition between classroom and remote schooling, not only aspects of teaching and learning underwent change, but also factors on the individual level were influenced by countless upheavals due to new circumstances and associated challenges (Dabrowski, 2020).

In this context, intrapersonal characteristics on the teacher level, which are considered to influence schooling and education during regular school operation, need to be investigated under the novel conditions of COVID-19. For this reason, job satisfaction and teachers' emotional experiences were examined before and throughout the development of the pandemic to investigate their emotional adjustment under these extraordinary conditions. Teacher attrition and rising dropout rates of those who leave the profession can often be traced back to low job satisfaction (e.g., Heikonen et al., 2017) and the lack of emotional well-being of teachers (e.g., Van Horn et al., 2004; Hong, 2012).

According to Heller et al. (2002), job satisfaction is defined as the fulfilment an individual perceives through performing work that is associated with their job. It also includes the emotional state of satisfaction associated with the job regarding not only in the performance of the job itself but also at an abstract psychological level by considering how employees think or feel about the job. Therefore, fulfilled job satisfaction is realized by the positive attraction an individual has toward their job. This is influenced by intrapersonal factors, such as values, expectations, and beliefs (Heller et al., 2002; Alonso, 2006; Drafke, 2009). As can be seen from the working definition of job satisfaction, the emotional experience of teachers plays a significant role in this context. For this purpose, the current study also focuses explicitly on teachers' emotional experience before and during the COVID-19 pandemic by taking into account the positive and negative affective activation of teachers.

The concept of positive activation (PA) and negative activation (NA) encompasses the idea of affective activation systems that constitute the personality of individuals (Watson and Tellegen, 1985; Schreiber and Jenny, 2020). The core concept of PA/NA builds on the idea of comprising high PA by positively valued affective states with a high degree of activation (e.g., wide awake), whereas negatively valued affective states are at the low level of PA (e.g., tired). The same concept applies in reverse for NA; high NA encompasses negatively associated affective states with a high level of activation (e.g., worry), with its counterpart, "free of worries" at the low end of the positively associated affective state regarding a low NA (Schreiber and Jenny, 2020). Therefore, whether an affective dimension is considered to conceptualize PA or NA depends on the high level of activation of its affective status. In other words, PA indicates a high activation state considered to be a positive affect, whereas NA indicates a high activation state considered to be a negative affect.

Teachers' Job Satisfaction and Emotional Experience Before COVID-19

Job Satisfaction

Teachers' job satisfaction and emotional experience are often considered to be significant factors regarding the quality of teaching processes and pedagogical professionalism. Regarding predictors of teachers' job satisfaction, existing research demonstrates diffused insights into the relation between gender and teachers' job satisfaction. Some studies indicate higher levels of job satisfaction for female teachers (Liu and Ramsey, 2008; Toropova et al., 2021), while other studies highlight the same outcome for male teachers (Klassen and Chiu, 2010; Aydin et al., 2012). Still other studies do not report gender as a predictor for teachers' perception of job satisfaction (e.g., Eliophotou Menon and Athanasoula-Reppa, 2011).

Research on the relation between teaching experience and job satisfaction has also shown diverse outcomes. Some studies report a positive correlation of years of teaching experience and job satisfaction (e.g., Eliophotou Menon and Athanasoula-Reppa, 2011), whereas others show a U-shape curve, highlighting novice and expert teachers as having higher levels of job satisfaction than mid-experienced teachers (Crossman and Harris, 2006). In contrast, a meta-analysis considering data from a United States context (Guarino et al., 2006) and a study on Canadian teachers (Klassen and Chiu, 2010) indicate that especially low- and high-experienced teachers tend to quit their teaching jobs due to low job satisfaction levels.

Regarding the occupation level of teachers, i.e., whether they are teaching at a primary or secondary school level, research indicates that secondary teachers report significantly higher scores on job satisfaction than primary school teachers (e.g., Sharma and Jyoti, 2006). In contrast with this assumption, results of Allen (2005) show higher dissatisfaction levels for secondary school teachers.

Emotional Experience

Teacher well-being is considered a key factor for successful schooling and predicts teachers' choices about leaving the profession (Naghieh et al., 2015). According to teachers' emotional experiences during work, several studies show that, in general, the teaching profession is associated with high levels of stress (Stoeber and Rennert, 2008; Liu and Onwuegbuzie, 2012; Skaalvik and Skaalvik, 2015; Fitchett et al., 2018). In regard to job-related stress in terms of workload, results of previous studies show that women perceive significantly higher stress levels than their male colleagues (Klassen and Chiu, 2010; Nasser-Abu Alhija, 2015). The degree of stress caused by workload and significant differences were found between primary and secondary school teachers. Results of the study of Nasser-Abu Alhija (2015) reported higher stress levels for primary teachers compared to their counterparts in secondary schools. Years of work experience showed a non-linear relation to stress caused by workload and classroom stress increasing from novice teachers to mid-experienced teachers, but decreasing among those with long-term teaching experience (Klassen and Chiu, 2010).

Regarding teachers' perception of energy and exhaustion, studies show that female teachers report significantly higher levels of emotional exhaustion (Skaalvik and Skaalvik, 2011, 2017; Rumschlag, 2017). Rumschlag (2017) indicated a significant difference between novice (less than 5 years) and expert (5 years and longer) teachers regarding the emotional experience of exhaustion. Tsigilis et al. (2011) examined potential burnout factors and emotional exhaustion among physical education

teachers in primary and secondary schools. Due to work circumstances and conditions (e.g., higher intrinsic need for mobility among primary school students) and associated professional demands for teachers, results show higher levels of emotional exhaustion in the sample of secondary school teachers (Tsigilis et al., 2011).

By investigating indicators of teachers' professional identity (including job satisfaction and job motivation of teachers), no significant differences between novice teachers and expert teachers were found by Canrinus et al. (2012). Additional research on gender differences indicated a higher level of motivation among males than their female colleagues (Bishay, 1996). Other studies showed no significant differences between gender and job motivation (Dieleman et al., 2003; Lim, 2014; Nagrath, 2019). In a study conducted by Kunter et al. (2008), no correlation between teachers' enthusiasm and individual characteristics, such as gender and teaching experience, were found.

Relation Between Teachers' Job Satisfaction and Emotional Experience

Previous research on teachers' job satisfaction and its impact on individual factors indicated that it contributed to teachers' emotional well-being, or, in other words, job satisfaction correlates negatively with somatic symptoms such as stress and burnout (Cheryl and Cooper, 1993; Chaplain, 1995; Ho and Au, 2006; Klassen et al., 2010; Skaalvik and Skaalvik, 2011; Toropova et al., 2021). In a study by Kunter et al. (2008) a moderate relation of teachers' job satisfaction and general self-reported job enthusiasm was found.

Education Conditions During the COVID-19 Pandemic in Austria

The COVID-19 global pandemic caused all-encompassing challenges and changes to daily life in Austria. First school closures were initiated during the first lockdown of public life on March 16, 2020. As a consequence, regular school operations shifted from face-to-face lessons to remote learning, which mostly resulted in synchronous and asynchronous digital teaching and learning for teachers and students at all educational stages. Higher secondary schools were closed on March 16, and primary and secondary schools closed 2 days later. For parents who had to work and/or were not able to take care of their children during homeschooling, day care at school was provided (BMBWF, 2020b).

After 2 months of remote schooling, Austrian schools reopened for in-class teaching. First the graduating classes of higher secondary school opened, followed by the primary and lower secondary schools (BMBWF, 2020a). Due to the increase in the number of COVID-19 cases, regular school operations were again changed to home schooling throughout Austria. The second nation-wide lockdown started with the closure of higher secondary schools (starting at Grade 9) on November 3, 2020, followed by all other school types on December 4 (BMBWF, 2020c). In-between these two phases of nationwide school lockdowns, schools were attended in shifts by students. One group attended on Monday and Tuesday, and the other group on Wednesday and Thursday, while remote learning was conducted on other days of the week (BMBWF, 2020d).

COVID-19 and Its Implications for Teachers' Perception of Job Satisfaction and Emotional Experience

Huber et al. (2020) highlighted that approximately 40% of teachers (N = 1,676) felt (rather) burdened at the beginning of the pandemic (end of March 2020).

The results of Schwab et al. (submitted[1]) indicated that 60.8% of Austrian teachers (N = 3,467) felt a high potential for professional burden during the first lockdown of the schools. The percentage of teachers who reported being (rather) concerned during the first school closures in Austria was 46.6%.

In the study of Mikušková and Verešová (2020), 379 Slovakian teachers were asked among other things about their emotional state and job satisfaction during the pandemic. Results showed that primary school teachers' positive emotions correlated positively with their job satisfaction operationalized by their satisfaction with institutional support. In addition to this finding, decreasing positive emotions were related to lower satisfaction with institutional support and the increased teaching of topics with which students were already familiar. For the sample of higher secondary teachers, similar results were found. Negative emotions correlated negatively with teachers' job satisfaction regarding institutional support (Mikušková and Verešová, 2020).

A study of Vietnamese teachers' experience (N = 294) during the COVID-19 pandemic provides interesting insights into teachers' job satisfaction. Descriptive results showed that female teachers reported higher satisfaction than male teachers. Regarding the level of teaching experience of teachers as a predictor of job satisfaction, the outcomes showed that novice teachers (less than 3 years of experience) and expert teachers (more than 10 years of experience) reported similar levels of job satisfaction reaching higher levels than those teachers who had an in-between work experience of 3–10 years. The highest levels of job satisfaction were reported by higher secondary teachers, followed by primary teachers and lower secondary teachers (Vu et al., 2020).

Additionally, the two related factors were associated with a lower perception of somatic burden, stress, and emotional exhaustion (N = 325 Australian teachers; Collie, 2021).

Highlighting the importance of longitudinal studies and results regarding the impact of dramatic and fundamental changes due to the spread of COVID-19, Sokal et al. (2020) provided insights into important findings regarding teachers' development throughout the first 3 months of the pandemic. By asking 1,626 Canadian teachers about their attitudes toward change, efficacy, and burnout during the pandemic, the participants reported increased exhaustion and lack of energy, but simultaneously perceived increased efficacy in handling

[1]Schwab, S., Gutschik, A., Lindner, K.-T., and Kast, J. (submitted). Inklusive Bildung in Zeiten der Corona Krise – Empirische Einblicke in das emotionale Erleben von Lehrkräften, Schülerinnen und Eltern [Inclusive Education in Times of Corona Crisis - Empirical Insights into the Emotional Experiences of Teachers, Students, and Parents].

classroom processes. However, the participating teachers demonstrated increased negative cognitive and emotional attitudes toward change throughout the 3 months of study (Sokal et al., 2020).

Letzel et al. (2020)'s longitudinal study (N = 124 German teachers) (2021) indicated a significant increase of German teachers' NA regarding the transition from regular school operation to remote education, whereas for the same period, a decrease of teachers' PA was observed. More precisely, teachers' emotional experience during homeschooling regarding the feelings of being angry, nervous, worried, and bored increased compared to regular school operation before the pandemic.

Alves et al. (2021) conducted a study among 1,479 Portuguese teachers asking them about their well-being before and during the pandemic and its associated remote teaching. Regarding their job satisfaction, interesting findings were presented comparing their perceptions before and during the pandemic. Prior to the pandemic, teachers with less than 10 years' experience were more satisfied than teachers with more years of experience. In addition, before the pandemic, teachers at lower school levels were more satisfied with their job and the education system than those in secondary schools (Alves et al., 2021). Comparing these findings with teachers' answers regarding their job satisfaction during the pandemic, the results draw the following picture: Being female, having a service time of less than 20 years, increasing well-being, decreasing perceptions about teaching difficulties and increasing positive future perspectives, contribute to the increase in positive perceptions of professional well-being." By taking local regions of Portugal into account, the results differed in some ways (Alves et al., 2021).

This Study

Against the background of newly arisen professional challenges due to COVID-19 and associated school lockdowns, this study investigates Austrian teachers' development of job satisfaction and emotional experience regarding their PA and NA from regular school operations to recurring school closures. By examining teachers' perceptions referring to different measurement points (regular school operation before COVID-19, first Austrian school lockdown from March to May 2020, second Austrian school lockdown from November to December 2020) the manuscript allows for insights into teachers' emotional adjustments. School operations during COVID-19 are explored from a longitudinal perspective. What is not yet clear is the influence of the changed basic conditions on teachers' perceptions of job satisfaction and emotional experience, two decisive factors for professional action. Due to the novelty and continuing topicality of education under global circumstances of COVID-19, longitudinal data about educational processes and the individual development of involved stakeholders are limited. Therefore, this manuscript critically discusses the following research questions:

(1) Are there changes in Austrian teachers' job satisfaction and emotional experience between regular school operations (t1), first school lockdown (t2) and second lockdown (3) due to COVID-19?
(2) Are teachers' gender, expertise (novice or expert), or maintaining their position in elementary or secondary education related to changes in job satisfaction and emotional experience?
(3) Does job satisfaction later predict PA of teachers or vice versa?
(4) Does job satisfaction later predict NA of teachers or vice versa?

In light of the research objectives and research questions, this study makes a major contribution to research on teachers' emotional adjustment in the context of schooling during the COVID-19 pandemic in Austria by presenting results of a longitudinal study.

MATERIALS AND METHODS

Participants

The sample of the current study was derived from two measurement points of the INCL LEA study. The first measurement point (t1) took place during the first lockdown of schools from March to May 2020, in the course of which 3,467 Austrian teachers (2,839 female, 14 diverse; 36.3% from primary schools and 40% from secondary schools). Participants represented all nine federal states of Austria in an online survey on homeschooling to gain insight into teachers' stress level before and during the homeschooling situation. The second survey phase (t2) was carried out from November to December 2020. At t2, 2,651 Austrian teachers completed the online questionnaires (2,159 female, 7 diverse; 35.6% from primary schools and 31% from secondary schools) to provide insight into their emotional experience during the second school closure in Austria.

The current study focuses only on teachers that participated in the first and second surveys, as the methodological center of attention lies on the longitudinal development of teachers' perceptions. Regarding only the longitudinal sample, 256 participating teachers were considered for this purpose, and the sample consists of 220 female teachers. The average age of teachers was 44.63 years (std = 11.60) and the average amount of teaching experience in years is 19.45 (std = 12.66). Following the suggestions of previous studies, the novice cutoff of teaching experience was 5 years (0–5 years novice; 6 years and over, expert). The participants included 49 novice teachers (19.1%) and 204 expert teachers (79.7%). Of this number, 42.2% taught in primary schools and 40.6% in secondary schools.

Instruments

Job Satisfaction

The Enzmann and Kleiber (1989) scale was assessed to determine teachers' job satisfaction. Six items were rated on a four-point Likert scale (1 = totally true to 4 = not true at all). The items were positively and negatively formulated to assess teachers' satisfaction (e.g., "I enjoy my job.") as well as dissatisfaction (e.g., "I have previously seriously considered quitting my job"). Results of previous studies show internal consistency of Cronbach's alpha = 0.79 (Delgrande et al., 2005) and 0.72–0.79 in the Swiss

context (Sandmeier et al., 2017). In the context of the current study, Cronbach's alpha for job satisfaction regarding t1 = 0.72, at t2 = 0.78, and at t3 = 0.81.

Emotional Experience

The PANAVA Scale (Schallberger, 2005) was used to assess teachers' emotional experience. This scale consists of eight items regarding affective experience states by asking participants about their emotional state in the context of opposite adjectives. These adjective pairs can be distinguished into dimensions of PA and NA. The pairs, for example, "full of energy" and "no energy," were ranked on a rating scale with seven increments. In this context, positive and negative activating dimensions do not represent actual positive or negative affective states. For example, "full of energy" is an item that possesses high PA; however, its opposite, "no energy" is understood as an expression of low PA. One example item for NA is relaxed (low NA) and stressed (high NA; Schreiber and Jenny, 2020). Previous studies using the scale have shown acceptable internal consistency with Cronbach's alpha = 0.89 (PA) and 0.86 (NA) (Zurbriggen and Venetz, 2018) and Cronbach's alpha = 0.85 (PA) and 0.80 (NA) (Schreiber and Jenny, 2020). Considering the current sample, Cronbach's alpha for PA was 0.81 (t1), 0.76 (t2), and 0.82 (t3); and for NA = 0.79 (t1), 0.80 (t2), and 0.77 (t3).

Procedure

The current study was conducted within the COVID-19 related research project INCL LEA (Inclusive Home Learning during COVID-19) based at the University of Vienna. The research project was developed and implemented in cooperation with the local school boards in Austria, which also gave ethical approval for the study. Teachers from all federal states in Austria participated in an online survey during the first and second lockdowns of Austrian schools due to the COVID-19 pandemic (Kast et al., 2021; Lindner et al., submitted[2]; Schwab and Lindner, 2021; Schwab et al., submitted) (see text footnote 1). The collected data regarding teachers' job satisfaction and emotional experience refers to three measurement points: t1 = regular school operation (teachers referred to t1 retrospectively during the first lockdown), t2 = first school lockdown in Austria (first simultaneous survey), and t3 = second school lockdown in Austria (second simultaneous survey).

Analysis Strategy

Changes in the mean levels of the outcomes (Job satisfaction, Positive emotional experiences, and negative emotional experiences) were analyzed with repeated ANOVA measures with each outcome viewed separately. First a within time model with a single outcome in turn was estimated to test if changes between measurements in these outcomes were statistically significant. Within time contrast were used to test whether the possible change in outcome levels in time took place between t1 and t2 or between t2 and t3. Then models with each outcome as the within the time factor and the three background variables in turn as between level factors were estimated. Full models with within time main effect, within time interaction with each background group factor and the between groups main effects were calculated separately for each outcome with each background factor (RQ 1 and RQ 2).

Analyses of the direction of within time relationships between job satisfaction and the two other outcomes were analyzed using path modeling (Mplus 8, Muthén and Muthén, 2017). In each model a full model that contained all cross-lagged relationships, all stability paths, and correlations of simultaneous measures was estimated first (see theoretical model in **Figure 1**), and the model was then modified if the fit to the data was not adequate. Modification indices were utilized in making improvements to the model.

RESULTS

Are There Changes in Austrian Teachers' Job Satisfaction and Emotional Experience Between Regular School Operations (t1), First School Lockdown (t2) and Second Lockdown (t3) Due to COVID-19?

The descriptive results, intercorrelations, and reliabilities of the three outcome scales are shown in **Table 1**.

Generally, Austrian teachers' job satisfaction seems to be rather high, as all empirical mean scores are above three (on a four-point rating scale where 2.5 would be the theoretical mean of the scale). For job satisfaction, moderate correlations were found between the three time points (before lockdown, during the first and second lockdowns). For PA, however, no significant correlation was found between the time point before lockdown and during the first lockdown, but a low one was determined in the second lockdown. The correlation between the first and second lockdowns in PA was, however, moderate. For NA, the correlations of the time before lockdowns were small while those between the first and second lockdowns were moderate.

Results from ANOVA indicated that job satisfaction was reduced remarkably between the time of regular school operations and during the two lockdown measurements (see **Table 2**). While the overall within time effect was significant ($p < 0.001$) the within time contrasts indicated, however, that the difference was significant only between t1 and t2 ($p < 0.001$). Effect sizes were large (partial eta^2 = 0.27 and 0.39). Positive emotional experiences also reduced during the studied period ($p < 0.001$; partial eta^2 = 0.20), and contrasts indicated that that the change toward less positive emotional experiences was significant both between t1 and t2 and t2 and t3. The effect size of the initial drop was large (partial eta^2 = 0.20), while the latter change had a small effect size (partial eta^2 = 0.03). Negative emotional experiences increased significantly ($p < 0.001$; partial eta^2 = 0.09), but the change took place only between t1 and t2 ($p < 0.001$; partial eta^2 = 0.09). Effect sizes were moderate.

[2]Lindner, K.-T., Gitschthaler, M., Gutschik, A., Corazza, R., and Schwab, S. (submitted). Increased Educational Disadvantage of Refugee Students in German Language Support Classes during COVID-19 School Closures in Austria – Perceptions and Pedagogical Reactions of Austrian Teachers.

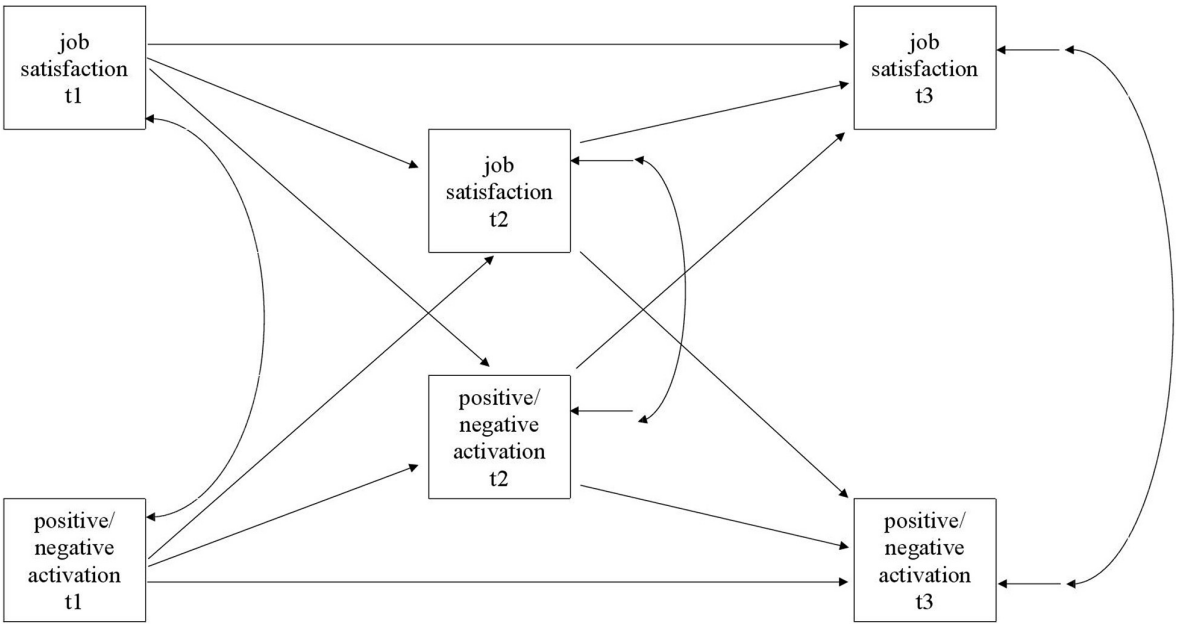

FIGURE 1 | Theoretical path model.

TABLE 1 | Outcome scale correlations, reliabilities, means, and standard deviations.

N = 240–242	JS1	JS2	JS3	PA1	PA2	PA3	NA1	NA2	NA3	Cronbach alpha
JS1										0.72
JS2	0.39**									0.78
JS3	0.49**	0.48**								0.81
PA1	0.44**	0.05	0.24**							0.81
PA2	0.15*	0.49**	0.31**	0.09						0.76
PA3	0.18*	0.33**	0.56**	0.24**	0.52**					0.82
NA1	−0.36**	0.10	−0.19**	−0.60**	−0.06	−0.11				0.79
NA2	−0.13*	−0.46**	−0.23**	0.10	−0.52**	−0.19**	0.20**			0.80
NA3	−0.19**	−0.36**	−0.44**	−0.14*	−0.48**	−65**	0.27**	0.45**		0.77
Mean (std)	3.56 (0.40)	3.12 (0.56)	3.19 (0.59)	5.22 (1.03)	4.49 (1.06)	4.33 (1.21)	3.49 (1.13)	4.01 (1.28)	4.11 (1.22)	

*JS1, job satisfaction at t1; JS2, job satisfaction at t2; JS3, job satisfaction at t3; PA1, positive activation at t1; PA2, positive activation at t2; PA3, positive activation at t3; NA1, negative activation at t1; NA2, negative activation at t2; NA3, negative activation at t. *p < 0.05, **p < 0.01.*

Are Teachers' Gender, Expertise (Novice or Expert), or Maintaining a Position in Elementary or Secondary Education Related to Changes in Job Satisfaction and Emotional Experience?

Gender had a within time interaction effect ($p < 0.05$; partial eta^2 = 0.02) indicating that the reduction in job satisfaction took place differently for males and females. Contrasts indicated that the gender effect was significant both between regular school operations (t1) and first lockdown (t2) ($p < 0.01$; partial eta^2 = 0.03) and between t2 and t3 ($p < 0.05$; partial eta^2 = 0.02). These interactions are depicted in **Figure 2** and show that while male participants experienced a constant reduction in job satisfaction throughout the period, female participants experienced a significant reduction in job satisfaction between regular school operations and the initial lockdown but bounced back toward increased job satisfaction as they neared t3. There were no average between gender differences. Gender was not related to changes in positive or negative emotional experiences, nor were there any between gender differences in the average levels of these outcomes.

Expertise, i.e., comparison of novice and expert participants had a within time interaction effect to job satisfaction ($p < 0.05$; partial eta^2 = 0.02), indicating that there were differences in how job satisfaction changed over the studied period in these groups (see **Figure 3**). The contrasts showed that the change in job satisfaction between t1 and t2 was different for novice and expert teachers ($p < 0.01$; partial eta^2 = 0.03). Expert teachers seemed to react with a larger reduction in job satisfaction when the first lockdown took place, but their job satisfaction did not worsen as they approached t3. Novice

TABLE 2 | Repeated measures analysis of variance results for all three outcomes.

	Within time	Time X group	Between groups	Within time effect contrasts		Time X group contrasts	
	F values and partial eta squared values			t1–t2	t2–t3	t1–t2	t2–t3
Job satisfaction (JS)	82.9*** (0.27)			145.6*** (0.39)	2.7 (0.01)		
JS and gender	26.5*** (0.11)	3.8* (0.02)	0.74 (0.00)	38.3*** (0.15)	0.15 (0.00)	6.7** (0.03)	4.2* (0.02)
JS and expertise	42.0*** (0.16)	3.4* (0.02)	0.54 (0.00)	70.4*** (0.24)	0.24 (0.00)	7.0** (0.03)	2.1 (0.01)
JS and position	70.9*** (0.27)	1.2 (0.01)	1.4 (0.01)	117.9*** (0.38)	0.93 (0.00)	2.2 (0.01)	1.2 (0.00)
Positive activation (PA)	56.2*** (0.20)			55.6** (0.20)	5.8* (0.03)		
PA and gender	19.9*** (0.08)	1.7 (0.01)	0.66 (0.00)	14.2*** (0.06)	6.5* (0.03)	3.0 (0.01)	1.5 (0.01)
PA and expertise	35.1*** (0.14)	1.1 (0.00)	0.23 (0.00)	28.7*** (0.11)	7.9** (0.03)	1.4 (0.01)	2.3 (–01)
PA and position	47.9*** (0.20)	0.72 (0.00)	1.4 (0.01)	52.3*** (0.21)	3.3 (0.02)	1.2 (0.01)	0.06 (0.00)
Negative activation (NA)	21.6*** (0.09)			21.0*** (0.09)	2.0 (0.01)		
NA and gender	7.0** (0.03)	0.52 (0.00)	0.60 (0.00)	6.0* (0.03)	1.1 (0.01)	0.76 (0.00)	0.02 (0.00)
NA and expertise	13.4*** (0.06)	0.08 (0.00)	0.61 (0.00)	12.8*** (0.05)	1.4 (0.01)	0.11 (0.00)	0.00 (0.00)
NA and position	17.6*** (0.08)	1.0 (0.01)	1.9 (0.01)	20.1*** (0.09)	0.44 (0.00)	0.88 (0.01)	0.19 (0.00)

eta^2 *values are partial eta squared values. *p < 0.05, **p < 0.01, ***p < 0.001.*

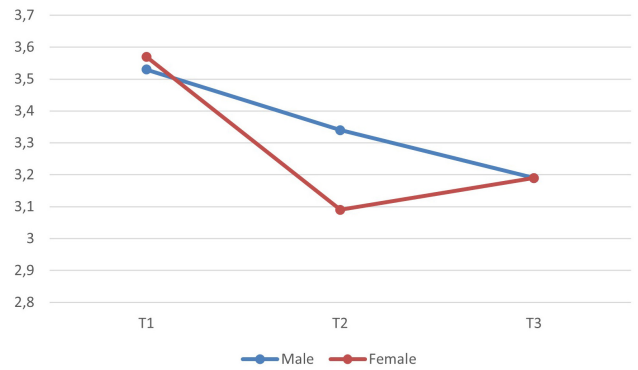

FIGURE 2 | The relation of gender to development in job satisfaction.

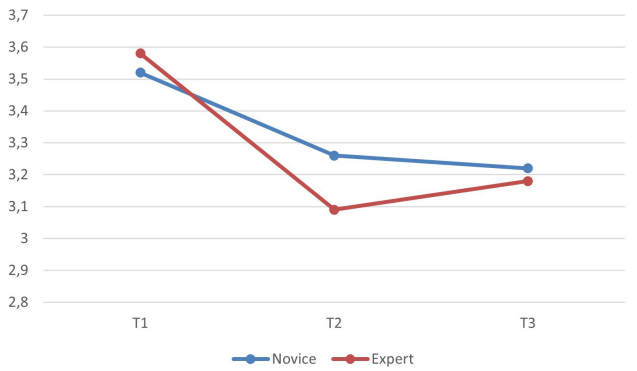

FIGURE 3 | The relation of expertise to development in job satisfaction.

teachers showed a milder drop in job satisfaction. There were no differences on the average in job satisfaction between these groups. Expertise was not related to changes in positive or negative emotional experiences, nor were there any differences on the average level of positive or negative emotional experiences between these groups.

The teachers' position, i.e., whether they worked in primary schools or in secondary schools, had no effect on developments in any of the three outcomes. Neither were there any average differences on the level of job satisfaction, PA, or NA between primary school and secondary school teachers.

Does Teachers' Job Satisfaction Predict Later Positive Activation of Teachers or Vice Versa?

The model of job satisfaction and PA included all stability paths, correlations between same time outcomes, and all four cross-lagged paths. This initial model showed limited fit to data; therefore, an additional direct path between t1 job satisfaction and t3 job satisfaction and t1 and t3 PA were added to the model. The final model had a good fit to the data (chi-square = 1.21; df = 2; p = 0.54; CFI = 1.0; TLI = 1.0; RMSEA = 0.00; SRMR = 0.01). The final model is depicted in **Figure 4**, which shows only statistically significant paths; the non-significant paths were omitted, while they remained in the model.

The job satisfaction stability between t1 and t2 was moderate (Std.Beta = 0.46) and interestingly, t1 job satisfaction prediction of t3 job satisfaction seemed higher (Std.Beta = 0.36) than that between t2 and t3 (Std.Beta = 0.27). In contrast, PA showed no statistically significant stability between t1 and t2, but t1 activation was related to t3 activation (Std.Beta = 0.17). The cross lagged relationships were evident from PA to job satisfaction but not vice versa. Initial level PA predicted lower job satisfaction later during t2 (Std.Beta = –0.15).[3] Positive activation in t2 predicted positive job satisfaction in t3 (Std.Beta = –13).

[3]This negative effect might be real or indicate a suppressor effect, as the initial correlation between these variables was non-significant (r = 0.05) and the prediction between t1 and t2 job satisfaction was Std.Beta = 0.46, while their correlation was r = 0.39.

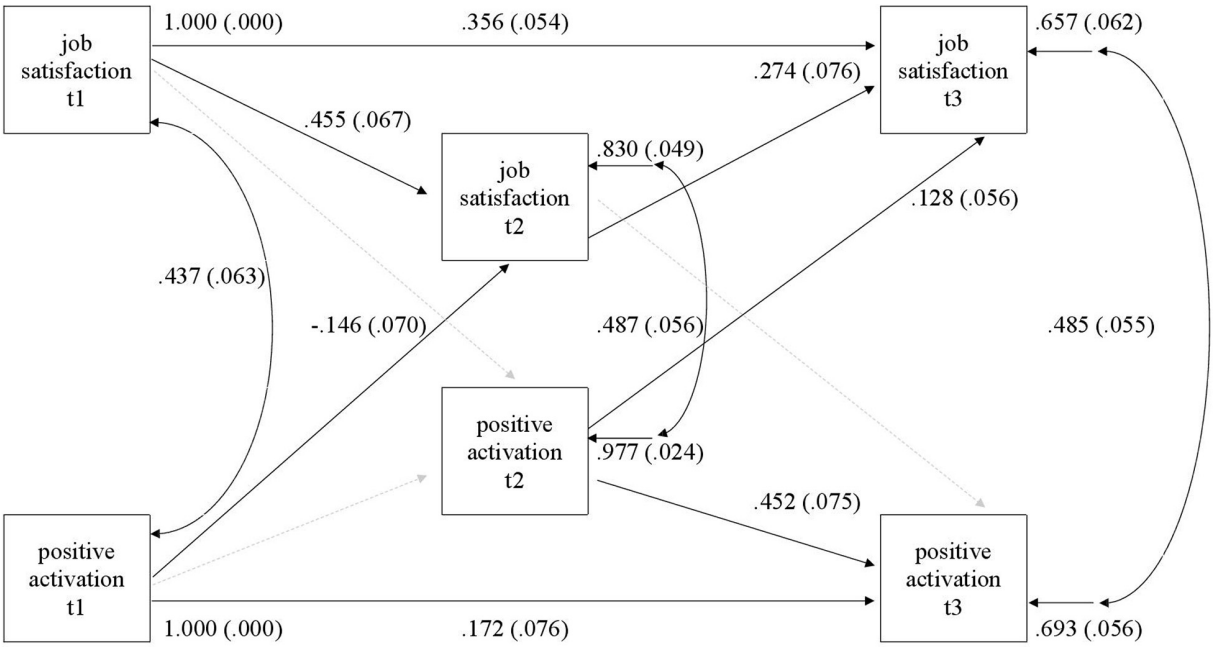

FIGURE 4 | Structural equation model (SEM) of job satisfaction and positive activation. A dashed line indicates that the path is not statistically significant.

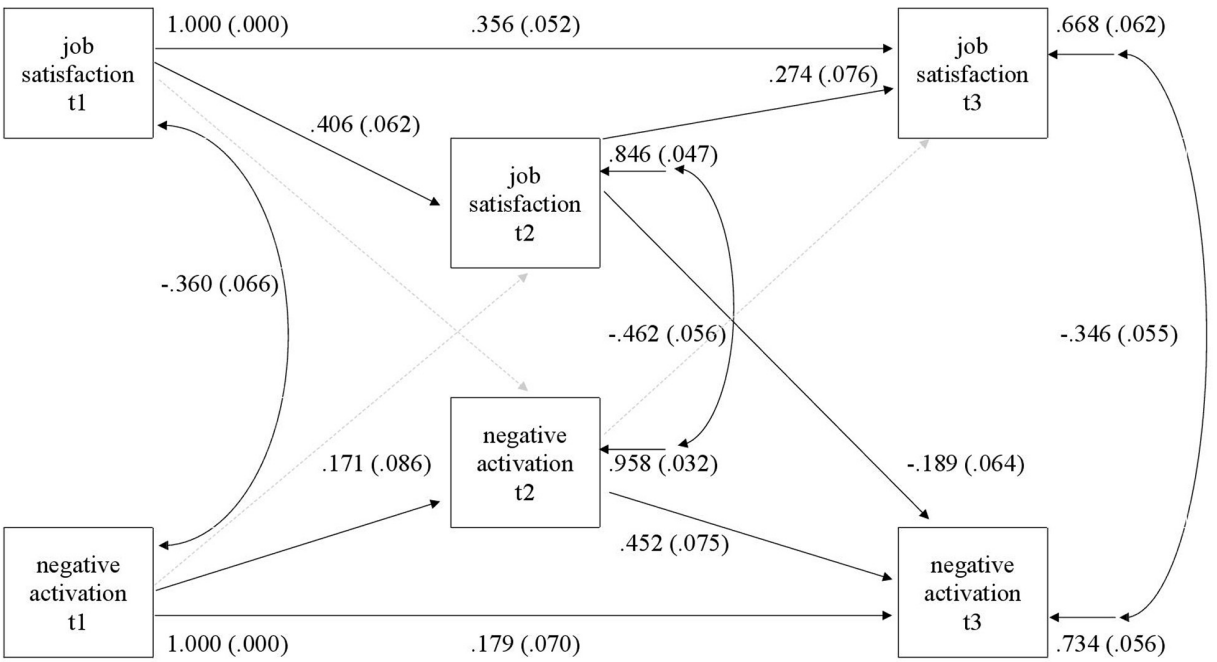

FIGURE 5 | Structural equation model (SEM) model of job satisfaction and negative activation. A dashed line indicates that the path is not statistically significant.

Does Teachers' Job Satisfaction Predict Later Negative Activation of Teachers or Vice Versa?

The model with job satisfaction and NA included all stability paths, correlations between same time outcomes, and all four cross-lagged paths. After the initial test of fit, a direct path between t1 and t3 job satisfaction and between t1 and t3 NA were added to the model, which then fit the data very well (chi-square = 0.89; df = 2; $p = 0.95$; CFI = 1.0; TLI = 1.0; RMSEA = 0.00; SRMR = 0.00). The final model is depicted in **Figure 5** which shows only statistically significant paths.

The stability of job satisfaction is similar to the earlier model. Negative activation had no significant stability between t1 and t2, but the direct path from t1 to t3 was significant (Std.Beta = 0.18), while stability between t2 and t3 was moderate (Std.Beta = 0.33). Simultaneous correlations between outcomes were all significant and negative, indicating that higher job satisfaction was related to less NA. Of all four cross-lagged paths, only a path from t2 job satisfaction to t3 NA was significant (Std.Beta =–0.19), indicating that the level of job satisfaction during t2 predicted lower NA in t3.

DISCUSSION

The current study presents a longitudinal approach that examines Austrian teachers' job satisfaction and emotional experience before and during COVID-19 regarding three time-reference points. In the context of the discussion of the results, the phrase *time-reference points* instead of *measurement points* seems necessary for teachers' perception at t1. The regular school operation data before COVID-19 was collected retrospectively at t2, a time where the spread of COVID-19 had already been declared a global pandemic and schools were closed for the first time in Austria.

This circumstance might explain the significant decrease of job satisfaction from regular school operations to the first closure of schools. As teachers were asked about their perception retrospectively, the uncertainty of the situation during the beginning of the pandemic and its associated new demands and challenges in the context of education and schooling might have had an impact on their view of times before COVID-19, in the sense of a glorification of the past. In this context, the results highlight a remarkably reduction of job satisfaction and PA when comparing regular school operation and the time during the two school lockdowns. Teachers' NA increased significantly between t1 and t2. The results confirm the outcomes of other studies, such as Letzel et al. (2020); Sokal et al. (2020), and Alves et al. (2021).

Interesting results occur when comparing teacher differences in the perception of job satisfaction in regard to gender. While female teachers perceived a tremendous downfall in job satisfaction toward the initial lockdown, more than that of men, this negative trend was leveled and even turned slightly positive as they approached the second lockdown. At the same time male teachers perceived a more or less linear decrease in their job satisfaction, which ended at the same level as female teachers at t3.

One possible explanation might be the differences between private life and home circumstances of female and male teachers as to gender stereotypes and traditional gender role distributions. Females are still more likely to be associated with domestic work and taking care of children or elderly persons who need support. Following an Austrian study regarding home office and domestic work, results show that unpaid work at home (e.g., domestic work, taking care of underaged children) is primarily performed by females, "albeit a second parent is at home due to home office, unemployment or short-time work" (Mader et al., 2020). Against this background, the first tremendous drop of job satisfaction perceived by female teachers may be traced back to cumulating challenges and responsibilities that no one was prepared for, followed by adaptive performance and adjustment of understanding of job-related circumstances.

The results indicate that although the job satisfaction of female teachers significantly decreased initially compared to their male colleagues, they might be better able to adapt and adjust to the current circumstances as indicated by the end of decrease in job satisfaction. These results contradict the results of Vu et al. (2020) as well as Alves et al. (2021), who reported higher job satisfaction for female teachers. However, the adjustment performance of female teachers needs to be highlighted as a successful coping strategy that supports teachers' improvement of job satisfaction during phases of crisis, such as the pandemic.

Regarding teachers' years of experience in teaching, results showed a stronger decrease of job satisfaction for expert teachers from regular school operation to the first school lockdown than for novice teachers. However, in comparison to novice teachers, the development of expert teachers' job satisfaction showed no additional drop, and the level of job satisfaction increased toward the second school lockdown. Novice teachers showed a milder drop in job satisfaction throughout the entire collection process. One explanation might be that expert teachers had developed successful teaching strategies that worked for them over the years, and they might have faced a stronger backlash throughout the pandemic, as they could no longer benefit from their regular teaching style and proven and successful didactic and pedagogical actions. Novice teachers are in an initial professional finding process, which includes testing different methods and approaches to fit students' needs, and adaption to new circumstances might be easier for them.

Teachers' emotional experience, gender, and years of experience were not related to PA or NA throughout the development of the pandemic. Neither was the teachers' school level (primary or secondary school) a significant predictor of job satisfaction (in contrast with the results of Vu et al., 2020) or emotional experience. Therefore, it can be assumed, that the sudden change of institutional conditions and professional demands were perceived similarly, regardless of the educational level of teachers and the fact that affected pedagogues felt confronted with similar challenges. The outcome that none of the investigated variables predicted teachers' emotional experience contradicts with previous studies on teachers' well-being and PA and NA during COVID-19 (Mikušková and Verešová, 2020; Alves et al., 2021). As the PA decreased and the NA increased for all participating teachers similarly, regardless of the examined predictors (gender, teaching experience, school level), it can be assumed that the development of the spread of COVID-19 and the associated changes of the school system triggered similar emotional reaction among all participating teachers.

This can be explained, in part, by the lack of professional communication between the government, the local school

authorities, school principals, and school staff. For instance, school principals and teachers received the information about modifications (e.g., school lockdowns, hygienic measures, etc.) via public press conferences. Therefore, teachers were not informed beforehand, and changes were often announced last minute (e.g., on Friday it was announced by the press that schools would be closed on Monday). Therefore, teachers were not prepared in time, e.g., they often lacked the technical equipment and prepared homework for students) (Helm et al., 2021; Kast et al., 2021; Schwab and Lindner, 2021). This might also be an explanation for the trend in increasing NA and decreasing PA. Whereas teachers might have understood a chaotic transition from regular school operations to school lockdown and accompanying homeschooling periods during the first closure of school at t2, resignations increased, as little had changed during the second lockdown at t3.

Regarding the relation between job satisfaction and emotional experience, studies show that initial level PA predicted lower job satisfaction later at the first lockdown of schools at t2 which means that teachers who reported high PA during regular school operations reported lower job satisfaction during t2 than those who felt less PA before COVID-19. A possible explanation might be that teachers who felt more positive were more overwhelmed by the unpredicted situation than those who felt more negatively activated regarding their job.

Additionally, higher PA during the first lockdown predicted positive job satisfaction levels during the second lockdown. This finding might refer to teachers' adjustment performance, as participants who felt more positively activated might have also been more convinced of their professional actions during the ongoing situation of the pandemic. The same applies to the investigation of NA. Teachers who felt higher levels of job satisfaction were less likely to be negatively activated during the first and second lockdowns. It is encouraging to compare these findings with the results of previous studies on the relation between job satisfaction and teachers' emotional experience, which highlighted the significant negative correlation between high job satisfaction and negative emotional experience, as well as the significant positive correlation between high job satisfaction and PA (before COVID-19: Cheryl and Cooper, 1993; Chaplain, 1995; Ho and Au, 2006; Klassen et al., 2010; Skaalvik and Skaalvik, 2011; Toropova et al., 2021; during COVID-19: Mikušková and Verešová, 2020; Collie, 2021).

The results of the current study show that teachers successfully adjusted their professional understanding by examining their job satisfaction, but considering their emotional experience, a negative reversal could be observed. This might have occurred due to the ongoing situation of exception and the lasting psychological stress due to the enduring state of crisis.

LIMITATIONS

Against the background of this continuing state of emergency, the current study was planned and conducted under tremendous pressure of time and urgency with the purpose of providing rapid insight into educational conditions during COVID-19. Some research limitations are the direct consequence of the urgency of the investigation.

One major limitation of the study deals with the topic of representativeness of the research. Regarding the sample and its acquisition, it must be acknowledged that forwarding an online link to an online survey does not reach the whole desired research population. In some federal states, the research team was only allowed to select data from previously chosen school types, which were selected by the local school authorities. Considering other federal states, permission was given to send the link to every school within the area of responsibility of the local school authorities. This resulted in different acquisition conditions, which led to an unequal distribution of school types.

In addition, no representativity could be achieved regarding teachers' gender. Furthermore, as many teachers felt confronted with new challenges and demands regarding digital competencies, it can be assumed that teachers with good technical equipment and higher perceptions of self-efficacy regarding digital competences were more likely to follow the online link and fill out the questionnaire. Therefore, teachers feeling overtaxed with digital demands during homeschooling may be underrepresented within the sample.

Another aspect regarding the sample was the high dropout rate between t1/t2 and t3. When looking at the basic samples of the two points, the sample sizes are satisfyingly large, but regarding the longitudinal sample, there was a high dropout rate. Reasons may be random or due to the failure of school principals to forward the online link to their teaching staff.

It must be emphasized that in regard to the measurement points, the data considering t1 (regular school operation before COVID-19) was collected retrospectively in the process of measurement point t2 (the first lockdown). Therefore, data concerning teachers' perceptions of job satisfaction and emotional experience might lack internal validity and causality, as they run the risk of being influenced by the actual conditions and circumstances during t2 considering the COVID-19 pandemic (see also Helm et al., 2020).

Another point that must be stressed is the diffuse understanding of the concept of job satisfaction within scientific discussions. Considering previous research and literature, different understandings and conceptualizations of job satisfaction can be observed, e.g., institutional support, perception of efficacy, satisfaction with behavior of students, etc. Therefore, it seems difficult to compare diverse studies examining teachers' job satisfaction when relying on different definitions and concepts.

What now remains open against the background of the investigated predictors for job satisfaction and emotional experience is the question of further predicting variables of the two constructs of teachers' characteristics. Possible variables that might be worthy of investigation are private life and home environment factors of teachers' during homeschooling (e.g., digital resources and competences, family members such as children or the elderly who that need to be taken care of simultaneously).

CONCLUSION

Approximately 1 year after the first school lockdown in Austria, the COVID-19 crisis is still ongoing. Currently, the government is intensively putting their focus on health impacts (e.g., vaccination of the population) and on economic effects (e.g., reopening restaurants, shops etc.). Socio-emotional effects of this crisis have not been addressed to the same extent. Of course, crises can also be associated with positive transformative effects. With regards to schools, some developments (e.g., increasing the use of digital tools) that are positive side effects might not just be temporary during the duration of the pandemic, but rather influence educational processes permanently. Nevertheless, some negative effects might prevail long time after the crisis. The results of the study emphasize that teachers' well-being needs to be addressed more intensively regarding future research, practice, and measurements on institutional levels. The impact of teachers' well-being on outcomes (e.g., burnout) as well as on students' outcomes (e.g., academic achievement) is significant. Therefore, against the background of this study's results, it seems important to address the remarkable negative change in teachers' job satisfaction and emotional experiences to avoid long-term consequential damage on individuals (teachers, students) and institutions (schools, educational system).

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by local school boards in Austria. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

K-TL: conception and design of study, organized the database, first draft of the manuscript, wrote sections of the manuscript, and incorporation of all comments of authors. HS: conception and design of study, performed the statistical analysis, and wrote sections of the manuscript. SS: conception and design of study and wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

REFERENCES

Allen, M. B. (2005). *Eight Questions on Teacher Recruitment and Retention: What does the Research Say?*. Denver, CO: Education Commission of the States (NJ3).

Alonso, P. (2006). Differences in the perception of job satisfaction in a sample of administrative staff. *Bol. Psicol.* 88, 49–63.

Alves, R., Lopes, T., and Precioso, J. (2021). Teachers' well-being in times of Covid-19 pandemic: factors that explain professional well-being. *IJERI Int. J. Educ. Res. Innov.* 15, 203–217.

Aydin, A., Uysal, S., and Sarier, Y. (2012). The effect of gender on job satisfaction of teachers: a meta-analysis study. *Procedia-Soc. Behav. Sci.* 46, 356–362. doi: 10.1016/j.sbspro.2012.05.122

Bishay, A. (1996). Teacher motivation and job satisfaction: a study employing the experience sampling method. *J. Undergraduate Sci.* 3, 147–155.

BMBWF (2020b). *Maßnahmen in Schule und Unterricht [Measures in school and classrooms]*. Vienna: BMBWF.

BMBWF (2020a). *Etappenplan [Step-by-step plan]*. Vienna: BMBWF.

BMBWF (2020c). *Schulbetrieb ab Dem 17*. Vienna: BMBWF.

BMBWF (2020d). *Umsetzung des Etappenplans für Schulen. Richtlinien für die Unterrichtsorganisation und die pädagogische Gestaltung [Setting the step-by-step plan for schools. Guidelines for the organization of lessons and pedagogical design]*. Vienna: BMBWF.

Canrinus, E. T., Helms-Lorenz, M., Beijaard, D., Buitink, J., and Hofman, A. (2012). Self-efficacy, job satisfaction, motivation and commitment: exploring the relationships between indicators of teachers' professional identity. *Eur. J. Psychol. Educ.* 27, 115–132. doi: 10.1007/s10212-011-0069-2

Chaplain, R. P. (1995). Stress and job satisfaction: a study of English primary school teachers. *Educ. Psychol.* 15, 473–489. doi: 10.1080/0144341950150409

Cheryl, J. T., and Cooper, C. L. (1993). Mental health, job satisfaction and occupational stress among UK teachers. *Work Stress* 7, 203–219. doi: 10.1080/02678379308257062

Collie, R. J. (2021). COVID-19 and teachers' somatic burden, stress, and emotional exhaustion: examining the role of principal leadership and workplace buoyancy. *AERA Open* 7:2332858420986187.

Crossman, A., and Harris, P. (2006). Job satisfaction of secondary school teachers. *Educ. Manag. Administration Leadership* 34, 29–46.

Dabrowski, A. (2020). Teacher wellbeing during a pandemic: surviving or thriving? *Soc. Educ. Res.* 2, 35–40. doi: 10.37256/ser.212021588

Delgrande, J. M., Kuntsche, E. N., and Sidler, J. (2005). Arbeitsüberforderung und-unzufriedenheit von Lehrpersonen in der Schweiz-Zusammenhänge mit depressivität und somatischen Beschwerden [Work Overload and Dissatisfaction of Teachers in Switzerland - Associations with Depressiveness and Somatic Complaints]. *Schweizerische Zeitschrift für Bildungswissenschaften* 27, 123–139. doi: 10.24452/sjer.27.1.4700

Dieleman, M., Cuong, P. V., Anh, L. V., and Martineau, T. (2003). *Identifying Factors for Job Motivation of Rural Health Workers in North Viet Nam*. Geneva: Human Resources for Health.

Drafke, M. (2009). *The Human Side of Organizations*. London: Pearson Education, Inc.

Eliophotou Menon, M., and Athanasoula-Reppa, A. (2011). Job satisfaction among secondary school teachers: the role of gender and experience. *School Leadership Manag.* 31, 435–450. doi: 10.1080/13632434.2011.614942

Enzmann, D., and Kleiber, D. (1989). *Helfer-Leiden: Streß und Burnout in psychosozialen Berufen. (korr. Fassung, 2004)*. Heidelberg: Asanger.

Fitchett, P. G., McCarthy, C. J., Lambert, R. G., and Boyle, L. (2018). An examination of US first-year teachers' risk for occupational stress: associations with professional preparation and occupational health. *Teachers Teach.* 24, 99–118. doi: 10.1080/13540602.2017.1386648

Guarino, C. M., Santibanez, L., and Daley, G. A. (2006). Teacher recruitment and retention: a review of the recent empirical literature. *Rev. Educ. Res.* 76, 173–208. doi: 10.3102/00346543076002173

Heikonen, L., Pietarinen, J., Pyhalt, K., Toom, A., and Soini, T. (2017). Early career teachers' sense of professional agency in the classroom: associations with turnover intentions and perceived inadequacy in teacher-student interaction. *Asia-Pacific J. Teacher Educ.* 45, 250–266. doi: 10.1080/1359866x.2016.1169505

Heller, D., Judge, T. A., and Watson, D. (2002). The confounding role of personality and trait affectivity in the relationship between job and life satisfaction. *J. Organ. Behav.* 23, 815–835. doi: 10.1002/job.168

Helm, C., Huber, S., and Loisinger, T. (2021). Meta-Review on findings about teaching and learning in distance education during the Corona pandemic-evidence from Germany, Austria and Switzerland. *Zeitschrift Erziehungswissenschaft: ZfE*. Online ahead of print.

Helm, C., Weber, C., Krammer, G., and Wetzelhütter, D. (2020). *Bildung, Schule, Lehren und Lernen während der Schulschließungen aufgrund der Corona-Pandemie - Ein Überblick zu bestehenden Online-Umfragen [Education, school, teaching and learning during school closures due to the Corona pandemic - An overview of existing online surveys] oefeb*. Available online at: https://www.oefeb.at/webroot/uploads/files/Aktuelles/Rahmung%20der%20Studien%20zum%20Fernunterricht%20w%C3%A4hrend%20der%20Schulschlie%C3%9Fungen%20aufgrund%20von%20COVID-19_230920.pdf

Ho, C. L., and Au, W. T. (2006). Teaching satisfaction scale: measuring job satisfaction of teachers. *Educ. Psychol. Measurement* 66, 172–185. doi: 10.1177/0013164405278573

Hong, J. Y. (2012). Why do some beginning teachers leave the school, and others stay? Understanding teacher resilience through psychological lenses. *Teach. Teach. Theory Pract.* 18, 417–440. doi: 10.1080/13540602.2012.696044

Huber, S. G., Günther, P. S., Schneider, N., Helm, C., Schwander, M., Schneider, J. A., et al. (2020). *COVID-19 und Aktuelle Herausforderungen in Schule und Bildung. Erste Befunde des Schul-Barometers in Deutschland, Österreich und der Schweiz [COVID-19 and Current Challenges in Schools and Education. First Findings of the School Barometer in Germany, Austria and Switzerland]*. Münster: Waxmann.

Kast, J., Lindner, K.-T., Gutschik, A., and Schwab, S. (2021). Austrian teachers' attitudes and self-efficacy beliefs regarding at-risk students during home learning due to COVID-19. *Eur. J. Special Needs Educ.* 36, 114–126. doi: 10.1080/08856257.2021.1872849

Klassen, R. M., and Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction: teacher gender, years of experience, and job stress. *J. Educ. Psychol.* 102:741. doi: 10.1037/a0019237

Klassen, R. M., Usher, E. L., and Bong, M. (2010). Teachers' collective efficacy, job satisfaction, and job stress in cross-cultural context. *J. Exp. Educ.* 78, 464–486.

Kunter, M., Tsai, Y. M., Klusmann, U., Brunner, M., Krauss, S., and Baumert, J. (2008). Students' and mathematics teachers' perceptions of teacher enthusiasm and instruction. *Learn. Instr.* 18, 468–482.

Letzel, V., Pozas, M., and Schneider, C. (2020). Energetic students, stressed parents, and nervous teachers: a comprehensive exploration of inclusive homeschooling during the COVID-19 crisis. *Open Educ. Stud.* 2, 159–170. doi: 10.1515/edu-2020-0122

Lim, H. L. (2014). Managing young professional talent in the UAE: work motivators and gender differences. *Int. J. Economy Manag. Soc. Sci.* 3, 874–882.

Lindner, K.-T., Letzel, V., Tarini, G., and Schwab, S. (2021). When home turns into quarantine school – new demands on students with special educational needs, their parents and teachers during COVID-19 quarantine. *Eur. J. Special Needs Educ.* 36, 1–4. doi: 10.1080/08856257.2021.1874153

Liu, S., and Onwuegbuzie, A. J. (2012). Chinese teachers' work stress and their turnover intention. *Int. J. Educ. Res.* 53, 160–170. doi: 10.1016/j.ijer.2012.03.006

Liu, X. S., and Ramsey, J. (2008). Teachers' job satisfaction: analyses of the teacher follow-up survey in the United States for 2000–2001. *Teach. Teacher Educ.* 24, 1173–1184. doi: 10.1016/j.tate.2006.11.010

Mader, K., Derndorfer, J., Disslbacher, F., Lechinger, V., and Six, E. (2020). *Genderspezifische Effekte von COVID-19 [Gender specific effects of covid-19]*. Available online at: https://www.wu.ac.at/vw3/forschung/laufende-projekte/genderspezifscheeffektevoncovid-19 (accessed 13 April, 2021)

Mikušková, E. B., and Verešová, M. (2020). Distance education during COVID-19: the perspective of Slovak teachers. *Probl. Educ. 21 Century* 78, 884–906.

Muthén, L. K., and Muthén, B. O. (2017). *Mplus User's Guide*, 8th Edn. Los Angeles, CA: Muthén & Muthén.

Naghieh, A., Montgomery, P., Bonell, C. P., Thompson, M., and Aber, J. L. (2015). Organisational interventions for improving wellbeing and reducing work-related stress in teachers. *Cochrane Database Syst. Rev.* 4, 1–65. doi: 10.4324/9780429279379-1

Nagrath, G. (2019). Work motivation of school teachers: an application of job characteristics model. *J. Strategic Hum. Resource Manag.* 8:26.

Nasser-Abu Alhija, F. (2015). Teacher stress and coping: the role of personal and job characteristics. *Procedia Soc. Behav. Sci.* 185, 374–380.

Rumschlag, K. E. (2017). Teacher burnout: a quantitative analysis of emotional exhaustion, personal accomplishment, and depersonalization. *Int. Manag. Rev.* 13, 22–36.

Sandmeier, A., Kunz Heim, D., Windlin, B., and Krause, A. (2017). Negative beanspruchung von schweizer lehrpersonen. trends von 2006 bis 2014 [Negative stress among Swiss teachers. Trends from 2006 to 2014]. *Schweizerische Zeitschrift für Bildungswissenschaften* 39, 75–94. doi: 10.24452/sjer.39.1.5000

Schallberger, U. (2005). *Kurzskalen zur Erfassung der Positiven Aktivierung, Negativen Aktivierung und Valenz in Experience Sampling Studien (PANAVA-KS) [Short scales for the assessment of Positive Activation, Negative Activation and Valence in Experience Sampling Studies (PANAVA-KS)]*. Zürich: Psychologisches Institut der Universität Zürich.

Schreiber, M., and Jenny, G. J. (2020). Development and validation of the 'lebender emoticon PANAVA' Scale (LE-PANAVA) for digitally measuring positive and negative activation, and valence via emoticons. *Personality Individual Diff.* 160:109923. doi: 10.1016/j.paid.2020.109923

Schwab, S., and Lindner, K.-T. (2021). Auswirkungen von Schulschließungen und Homeschooling während des ersten österreichweiten Lockdowns auf Bildungsungleichheit [Effects of school closures and homeschooling during the first Austria-wide lockdown on educational inequality]. *WISO* 43, 49–63.

Sharma, R. D., and Jyoti, J. (2006). Job satisfaction among school teachers. *IIMB Management Rev.* 18, 349–363.

Skaalvik, E. M., and Skaalvik, S. (2011). Teacher job satisfaction and motivation to leave the teaching profession: relations with school context, feeling of belonging, and emotional exhaustion. *Teach. Teacher Educ.* 27, 1029–1038. doi: 10.1016/j.tate.2011.04.001

Skaalvik, E. M., and Skaalvik, S. (2015). Job satisfaction, stress and coping strategies in the teaching profession-what do teachers say? *Int. Educ. Stud.* 8, 181–192.

Skaalvik, E. M., and Skaalvik, S. (2017). Dimensions of teacher burnout: relations with potential stressors at school. *Soc. Psychol. Educ.* 20, 775–790.

Sokal, L., Trudel, L. E., and Babb, J. (2020). Canadian teachers' attitudes toward change, efficacy, and burnout during the COVID-19 pandemic. *Int. J. Educ. Res. Open* 1:100016. doi: 10.1016/j.ijedro.2020.100016

Stoeber, J., and Rennert, D. (2008). Perfectionism in school teachers: relations with stress appraisals, coping styles, and burnout. *Anxiety Stress Coping* 21, 37–53. doi: 10.1080/10615800701742461

Toropova, A., Myrberg, E., and Johansson, S. (2021). Teacher job satisfaction: the importance of school working conditions and teacher characteristics. *Educ. Rev.* 73, 71–97. doi: 10.1080/00131911.2019.1705247

Tsigilis, N., Zournatzi, E., and Koustelios, A. (2011). Burnout among physical education teachers in primary and secondary schools. *Int. J. Hum. Soc. Sci.* 1, 53–58.

Van Horn, J. E., Taris, T. W., Schaufeli, W. B., and Schreurs, P. J. (2004). The structure of occupational well-being: a study among Dutch teachers. *J. Occup. Organ. Psychol.* 77, 365–375. doi: 10.1348/0963179041752718

Vu, C. T., Hoang, A. D., Than, V. Q., Nguyen, M. T., Dinh, V. H., Le, Q. A. T., et al. (2020). Dataset of Vietnamese teachers' perspectives and perceived support during the COVID-19 pandemic. *Data Brief* 31:105788. doi: 10.1016/j.dib.2020.105788

Watson, D., and Tellegen, A. (1985). Toward a consensual structure of mood. *Psychol. Bull.* 98, 219–235. doi: 10.1037/0033-2909.98.2.219

Zurbriggen, C., and Venetz, M. (2018). "Diversität und aktuelles emotionales erleben von schülerinnen und schülern im inklusiven Unterricht [Diversity and current emotional experience of students in inclusive classrooms]," in *Emotionen und Emotionsregulation in der Schule und Hochschule*, eds G. Hagenauer and T. Hascher (Münster, NY: Waxmann), 87–102.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

CONCEPTUAL ANALYSIS
published: 24 November 2021
doi: 10.3389/fpsyg.2021.694386

Constructing a Teaching Presence Measurement Framework Based on the Community of Inquiry Theory

Yang Wang[1], Li Zhao[1], Shusheng Shen[1] and Wenli Chen[2]*

[1] School of Education Science, Nanjing Normal University, Nanjing, China, [2] National Institute of Education, Nanyang Technological University, Singapore, Singapore

Given that there is no consensus on a framework for measuring presence in online teaching, this paper focuses on the construction of a reliable measurement framework of teaching presence based on the Community of Inquiry theory. In this study, 408 questionnaires were collected from college students who had online learning experience. Item analysis, exploratory factor analysis, and confirmatory factor analysis were used to analyze the results, which showed that the five-factor framework is in good agreement with the data. The confirmatory factor analysis also demonstrated a good model fit of the correlated five-factor teaching presence framework. Therefore, the teaching presence measurement framework consisting of design and organization, discourse facilitation, direct instruction, assessment, and technological support, can serve as an effective tool to support teaching presence measurement and to provide guidance for instructors' online teaching.

Keywords: teaching presence, measurement framework, community of inquiry, reliability and validity, online learning

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Virginia Lien Cairns, University of Tennessee at Chattanooga, United States
Zhonghua Zhang, The University of Melbourne, Australia

****Correspondence:***
Li Zhao
li.zhao@njnu.edu.cn

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *13 April 2021*
Accepted: *01 November 2021*
Published: *24 November 2021*

Citation:
Wang Y, Zhao L, Shen S and Chen W (2021) Constructing a Teaching Presence Measurement Framework Based on the Community of Inquiry Theory. Front. Psychol. 12:694386. doi: 10.3389/fpsyg.2021.694386

INTRODUCTION

Online learning has dramatically increased in recent years. As such, online education has been applied in all education stages including formal and informal education (Martine et al., 2020). Online learning has brought convenience to teaching and learning without the restraint of time and space. However, the quality of online learning needs to be improved (Chen et al., 2021; Wang et al., 2021). Lee and Recker (2021) proposed that online learning quality depended not only on online learning resources but also on instructors' teaching presence. Teaching presence determines students' learning efficiency (Caskurlu et al., 2020). It is a link between curriculum content and learners. Due to physical separation, face-to-face communication and instant feedback are reduced in online learning. It seems that the demand for teaching presence has weakened. However, in the online learning environment, the requirements for teaching presence are higher (Wang and Liu, 2020).

Teaching presence can be interpreted as the visibility of the instructor, which influences students' participation and engagement (Caskurlu et al., 2020). It gives instructors guidance on course design and organization to facilitate students' learning. Teaching presence is taken as a useful tactic in the process of online learning (Akyol et al., 2009). Specifically, the establishment and maintenance

of a community of inquiry require a comprehensive teaching presence (Shea et al., 2006; Akyol et al., 2009). It is teaching presence that enhances students' cognitive and social presence (Zhang et al., 2016; Law et al., 2019). However, in the online environment, it is not necessary that the instructor should respond to every student's post, but the instructor acting as a mediator and guide is helpful for students' discussion. That is, instructors are expected to design effective online activities to support students' high-level cognitive interactions. For example, Wang and Liu (2020) compared three courses and found that the design and facilitation improved students' interaction and knowledge construction. Caskurlu et al. (2020) tested the relationship between learning outcomes and teaching presence and found that there was a strong correlation between teaching presence and students' perceived learning as well as their satisfaction. Preisman (2014) also supported that the instructor plays an essential role in facilitating students' online learning. Designing a well-structured online course is of great significance for the instructor. Similarly, Szeto (2015) found that the expected learning outcomes are less dependent on the social and cognitive presences than on the teaching presence. That is, studies support that teaching presence is essential to an online community of inquiry. The components of teaching presence have therefore become a focus of online teaching research.

Currently, four methods can be adopted to measure teaching presence. Anderson et al. (2001) hold that teaching presence is mainly composed of two elements: instructional design and organization, and facilitating instruction. Akyol et al. (2009) support that teaching presence consists of three elements: design and organization, discourse facilitation, and direct instruction. This interpretation is also supported by Caskurlu (2018). Shea and Bidjerano (2010) took a step further and added "assessment" as an important element, while also redefining the confusing elements of "discourse facilitation" and "direct instruction". Shea et al. (2010) supported that teaching presence in online learning environments consists of design and organization, discourse facilitation, direct instruction, and assessment. There are also many researchers who support that teaching presence is a general concept (Coppola et al., 2002; LaPointe and Gunawardena, 2004; Arbaugh and Hwang, 2006). Despite there are many studies on the teaching presence, its measurement framework is still to be explored. Herein, the purpose of this study is to explore the framework of teaching presence.

LITERATURE REVIEW

Community of Inquiry

The Community of Inquiry (CoI) theory was proposed by Garrison et al. (2001) to illuminate the multifaceted components of teaching and learning (Garrison et al., 2000). The CoI theory supports that learners' social, cognitive, and teaching presence are three basic factors associated with their perceived learning. Social presence is the level of learners' recognition of the learning environment and the learning group. Cognitive presence is the degree of learners' meaning construction through continuous reflection and discourse (Shea et al., 2014). Teaching presence can be defined as a means of designing, facilitating, and directing cognitive and social processes to achieve personal and educational value (Anderson et al., 2001). Teaching presence, as one of the key element in CoI, is highly related to social and cognitive presence (Garrison et al., 2010). It is aimed at designing, facilitating, and directing social and cognitive presence to achieve expected learning outcomes (Anderson et al., 2001). While learning online, teaching presence determines students' learning satisfaction (Khalid and Quick, 2016; Kyei-Blankson et al., 2019), performance (Arbaugh, 2008), and engagement behaviors (Zhang et al., 2016). Thus, teaching presence is an important factor determining online learning efficiency (Gurley, 2018).

Teaching Presence

There have been many studies on online teaching presence, most of which have focused on the relationship between online teaching presence and learning engagement (Zhang et al., 2016), students' interactions and collaborative knowledge construction (Wang and Liu, 2020), and students' learning satisfaction (Caskurlu et al., 2020). For example, teaching presence is not the same as traditional teaching presence in a face-to-face classroom (Gurley, 2018). Instructors must communicate effectively with students despite being separated from them by time and place. It is supported that students and teachers play essential roles in teaching presence, with teachers playing the main role in constructing teaching presence (Wang and Liu, 2020). Hence the teacher's teaching presence in online environments was explored further in this study to give instructors practical suggestions to improve their online teaching.

Although teaching presence is important, there is not a consensus on its measurement. Garrison et al. (2000) proposed the Community of Inquiry theory and scaled teaching presence with three dimensions: teaching management, constructing understanding, and direct instruction, based on existing studies conducted in western countries. Shea et al. (2005) explored the structure of teaching presence through factor analysis in the United States and found that two factors (i.e., design and organization, and directed facilitation) fit the data well. They proposed that direct instruction is a factor of facilitation and may not be an indicator of teaching presence. To further explore the structure of teaching presence, Shea et al. (2006) examined the two-factor model consisting of discourse facilitation and direct instruction through a Principal Component Analysis (PCA) in the United States. Arbaugh and Hwang (2006) investigated Master of Business Administration (MBA) students in a Mid-Western United States university and found that the three-factor model (i.e., instructional design and organization, facilitation, and direct instruction) fit the data well through confirmatory factor analysis. Caskurlu (2018) performed a confirmatory factor analysis at a university in the United States and also supported that teaching presence can be scaled with three dimensions: design and organization, facilitation, and direct instruction. However, they found that there may be some overlaps between direct instruction and facilitation. Given there is no consensus on teaching presence measurement, this study explored a measurement framework to improve online teaching.

Research Purpose

In the context of online learning, the online teaching platform is the foundation. Technological support is of great significance to the development and success of online teaching. Therefore, it is believed that technological support is also an important role of instructors in the online teaching presence. It is supported that three aspects can be improved in the online teaching presence measurement research.

First, the attention to the technological support is insufficient. The instructor not only acts as the designer, facilitator, instructor, and evaluator, but also as the technological supporter in the online community of inquiry. The widely accepted teaching models, Pedagogy-Society-Technology (PST) and the Technological Pedagogical and Content Knowledge (TPACK), both emphasize the important role of technology in teaching. PST supports that education is always a unique combination of technological, social, and educational contexts and affordances (Kirschner et al., 2004). Among them, pedagogy is the teaching practice to achieve specific teaching objectives, and mainly includes teaching content, activities, and assessment. Social interaction refers to activities that promote learners' interaction, including the interactive environment, tools, and interactive rules. Technological support represents the extent to which technology supports learning, including the usefulness, usability, and ease of use of technology. The model proposes that online teaching will become a castle in the air without technological support. The CoI and PST both emphasize that technological support is necessary for a meaningful online learning experience. TPACK was built based on Shulman (1986) model to describe how teachers perceive educational technologies. With the support of technology, the elements of Pedagogical Content Knowledge (PCK) interact with each other to produce effective teaching (Koehler and Mishra, 2009). The TPACK model defines teaching competencies from three aspects: technological, pedagogical, and content knowledge. Technological knowledge refers to the knowledge that enables a person to accomplish occupational tasks using information technology. TPACK emphasizes the role of technology in teaching, and holds that technology and teaching are mutually integrated. However, technological support is not sufficiently considered in the Community of Inquiry model.

Second, the definition of "design and organization" needs to be expanded. Design and organization were initially described as pre-class activities including curriculum structure, collaborative and individual activities, timetables, and expectations (Anderson et al., 2001). Although most design takes place before classes, the second component, "organization," represents the arrangement of scattered people or things in a systematic way to achieve the same teaching objective. It consists of the rules and procedures of inquiry activities in online communities, including not only the design and organization before discussion activities, but also the design, organization, and management during and after activities.

Third, the scope of research needs to be expanded (Caskurlu, 2018). The application environment of teaching presence was online discussion when it was first proposed. However, a great deal of teaching support is also necessary and observed in areas besides online discussions. To understand the role of teaching presence, all observable teaching support should be analyzed. The support mainly includes participating in discussions, answering students' questions, providing related materials, arranging activities, and other teaching practices related to the course.

Hence, this study constructed a model to explain the online teaching presence measurement framework based on the CoI theory, which consists of five factors: design and organization, discourse facilitation, direct instruction, assessment, and technological support. The purpose of the study was to (1) test whether the five-dimensional model is a reliable tool for the measurement of teaching presence; and (2) explore the internal relationships among the five factors.

METHODS

Research Design

Preliminary Development of the Teaching Presence Measurement Framework

Given the three problems of existing teaching presence measurement frameworks mentioned above, a teaching presence measurement framework including the following five dimensions: design and organization, discourse facilitation, direct instruction, assessment, and technological support, was developed. The design and organization, and discourse facilitation are measured with five and eight indicators (Anderson et al., 2001; Akyol et al., 2009). The direct instruction and assessment are scaled with five and six indicators (Shea et al., 2010). The technological support is scaled with six indicators (Shea et al., 2010; Wang and Liu, 2020). Finally, there are 30 items in the questionnaire to measure instructors' teaching presence. Each item was measured using a 5-point Likert scale (ranging from *strongly agree to strongly disagree*, as shown in **Table 1**). To further explore the importance ranking of the five dimensions of teaching presence, a question on the perceived importance of the five dimensions was added at the end of the questionnaire.

Pretest and Formal Test

To ensure the validity of the measurement framework, five educational technology experts examined the items before the questionnaire was further tested. To ensure the popularity, accuracy, and objectivity of the items, the questionnaire was pretested by 24 online learners, and the presentation of the items was improved according to their feedback. Finally, a questionnaire consisting of 35 items was constructed, including four items on personal background information, five on design and organization, eight on discourse facilitation, five on direct instruction, six on assessment, six on technological support, and one on the perceived importance of the five dimensions of teaching presence.

Data Collection

In November 2018, the questionnaire was distributed to learners majoring in educational technology from four universities in central, western, and eastern regions of China through an online social communication platform. They enrolled in the

TABLE 1 | Items of the five-dimensional teaching presence scale.

Dimension	No.	Indicator	Code	Source
Design and organization (DO)	1	The teacher communicated essential course outcomes, e.g., goals, strategies, schedule, expectations, and rubrics	DO1	Akyol et al. (2009)
	2	The teacher provided instructions on participating in course activities, e.g., illuminating strategies to fulfill assignments successfully	DO2	Anderson et al. (2001)
	3	The teacher communicated accurate schedule of learning activities to guide students keep pace with each other	DO3	
	4	The teacher helped students understand the rules of online learning behaviors	DO5	
	5	The teacher provided explanation for the significance of assignment	DO6	
Discourse facilitation (DF)	6	The teacher helped to examine areas of agreement and disagreement to facilitate students' learning	FD1	Akyol et al. (2009)
	7	The teacher helped to reach agreement	FD2	Anderson et al. (2001)
	8	The teacher encouraged and enhanced contributions	FD3	
	9	The teacher set an inquiry environment	FD4	
	10	The teacher facilitated students' discussion	FD5	
	11	The teacher evaluated the effectiveness of the learning process	FD6	
	12	The teacher refocused on specific topics to be discussed	FD7	Shea et al. (2010)
	13	The teacher summarized discussions	FD8	
Direct instruction (DI)	14	The teacher offered useful examples of analogies	DI1	Shea et al. (2010)
	15	The teacher provided helpful explanations	DI2	
	16	The teacher delivered informative presentations	DI3	
	17	The teacher clarified information provided	DI4	
	18	The teacher mentioned external materials explicitly	DI5	
Assessment (AS)	19	The teacher provided formative feedback for discussion	AS1	Shea et al. (2010)
	20	The teacher offered formative feedback for coursework	AS2	
	21	The teacher provided summary feedback for discussion	AS3	
	22	The teacher offered summary feedback for assignments	AS4	
	23	The teacher asked students for formative feedback of curriculum design and activities	AS5	
	24	The teacher asked students for a summary feedback of curriculum design and activities	AS6	
Technological support (TS)	25	The teacher made full use of technology in teaching	TS1	Shea et al. (2010)
	26	The teacher diagnosed technical problems that students may face before class	TS2	Stein and Wanstreet (2017)
	27	The teacher chose the appropriate media according to the expected learning results	TS3	
	28	The teacher used different medias to promote different learning styles	TS4	
	29	The teacher edited and updated distributed learning resources	TS5	
	30	The teacher respected for intellectual property rights	TS6	

same online training consisting of several courses at one platform conducted by one instructor from a university in central China. At the end of the training, students were administered a questionnaire on their perceived teaching presence in the same training courses. Participants were told to answer questions according to their online learning experience. After completing the questionnaire, participants were entered in a lottery to win a random amount of money ranging from 10 to 50 RMB as an incentive. Participants should answer all 35 questions before submitting the questionnaire. In the introduction of the questionnaire, the purpose, duration, and anonymity of the survey were explained. A total of 416 questionnaires were collected. Three experimenters who were familiar with the items answered the questionnaire. They felt that it should take at least 30 s to complete. The average answer time of the collected samples was 219.88 s. Thus, eight questionnaires submitted in less than 30 s were deleted, leaving 408 valid questionnaires.

Measurements

To construct a teaching presence measurement framework and to verify its effectiveness, the following measurements were conducted. The samples were randomly divided into two groups, with 204 in each (Yurdakul et al., 2012). The first sample was subjected to exploratory factor analysis (Vogel et al., 2009). Confirmatory factor analysis was applied to the second sample. First, exploratory factor analysis (EFA) was conducted on the data of 204 questionnaires, and the results of principal component analysis were used to further improve the questionnaire. Second, confirmatory factor analysis (CFA) was conducted on the remaining 204 questionnaires to verify the results. Finally, item analysis was performed on all samples to test the suitability and

differentiation of the questions. Data were analyzed using SPSS 25.0 and AMOS 24.0.

RESULTS

Exploratory Factor Analysis

The EFA was conducted using SPSS 24.0, and factors were rotated with the maximum variance method. The KMO value was 0.950 (higher than 0.9), and the Bartlett sphericity test showed that there was a correlation between variables (x2 = 3873.077; $p = 0.000 < 0.001$), demonstrating that these data were applicable for exploratory factor analysis.

To test the validity of the measurement dimensions, the principal component extraction (PCA) method was used to extract factors, and five factors were finally obtained. Although the factors were found to be correlated after the preliminary analysis, the oblique rotation method was better. However, since the purpose of this study was to replicate the analysis, Kieffer (1998) suggests that researchers should use two strategies for exploratory factor analysis. When there is no difference between the results of the orthogonal and oblique rotations, the analysis results of the orthogonal rotations can be used. Therefore, the maximum variance orthogonal rotation method and the optimal skew are used for exploratory factor analysis. The results of the two analyses were similar. Therefore, this paper presents the results of the maximum variance orthogonal rotation method. FD3, DI1, TS1, and TS2 were removed as their maximum factor loadings were not in their measurement dimension (Conway and Huffcutt, 2016). The maximum variance rotation method was used to determine the factors' interpretability. The result is shown in the component transformation matrix (see **Table 2**). The standardized factor loading of each factor was greater than 0.5, indicating that the factors demonstrated good interpretability (Fabrigar et al., 1999).

The principal component analysis was applied to extract factors, and maximum variance rotation was used for the EFA. The factors with an eigenvalue higher than 1 were picked. Items with less than 0.4 on factor loading and inconsistent content were removed through the multiple orthogonal rotations (Zhao et al., 2021a). There were 26 items with eigenvalues greater than 1 and independent factor loadings greater than 0.5 which were retained (Fabrigar et al., 1999). Finally, five factors were selected, with a cumulative variance contribution of 65.744% (Conway and Huffcutt, 2016). The eigenvalues and cumulative variance contributions of the five factors are shown in **Table 3**.

TABLE 2 | Teaching presence measurement factor analysis (N Sample 1 = 204).

Items	1	2	3	4	5
DO1				0.726	
DO2				0.754	
DO3				0.597	
DO4				0.601	
DO5				0.580	
FD1	0.616				
FD2	0.621				
FD4	0.647				
FD5	0.563				
FD6	0.659				
FD7	0.610				
FD8	0.616				
DI2					0.766
DI3					0.768
DI4					0.683
DI5					0.504
AS1		0.541			
AS2		0.662			
AS3		0.685			
AS4		0.747			
AS5		0.609			
AS6		0.581			
TS3			0.678		
TS4			0.691		
TS5			0.653		
TS6			0.659		

TABLE 3 | The eigenvalues and contribution rates of the five factors in the model.

Component	Eigenvalue	Percentage of variance	Cumulative variance contribution rate
1	12.293	47.281%	47.281%
2	1.535	5.904%	53.185%
3	1.172	4.508%	57.693%
4	1.061	4.080%	61.773%
5	1.032	3.971%	65.744%

Confirmative Factor Analysis

The first-order CFA is applied to determine the reliability, convergence, and identifiability of the framework in this study. The CFA is used to explore the relationships among factors, and then to build the online teaching presence measurement framework.

Fitting Validity Analysis for Framework

In the first-order confirmatory factor analysis (see **Figure 1**), the item with a standardized loading less than 0.5 has to be removed (Hair et al., 2014). To examine the model fit, the absolute and relative fitting indexes were calculated. In this study, the chi-square/df was 1.183. The RMSEA was 0.030 (<0.08) (Liu et al., 2021). The values of GFI and AGFI were 0.933 and 0.906 (>0.9) (Foster et al., 1993). The values of NFI, CFI, and RFI were 0.932, 0.989, and 0.915 (>0.9) (Hair et al., 2014).

Given the model indexes in **Table 4**, such as the chi-square/df, RMSEA, GFI, AGFI, NFI, CFI, and IFI, all were acceptable. DO3, DF1, DF2, DF4, DF8, DI1, DI5, AS1, AS5, and AS6 were deleted. The 17 remaining items were used for further analysis, including design and organization (4 items), discourse facilitation (3 items), direct instruction (3 items), assessment (3 items), and technological support (4 items).

Convergence Validity Analysis for Framework

Specifically, the composite reliabilities (CR) of all items were higher than 0.80 (>0.7) which is considered to be good (Hair et al., 2014). It shows that the dimension has a

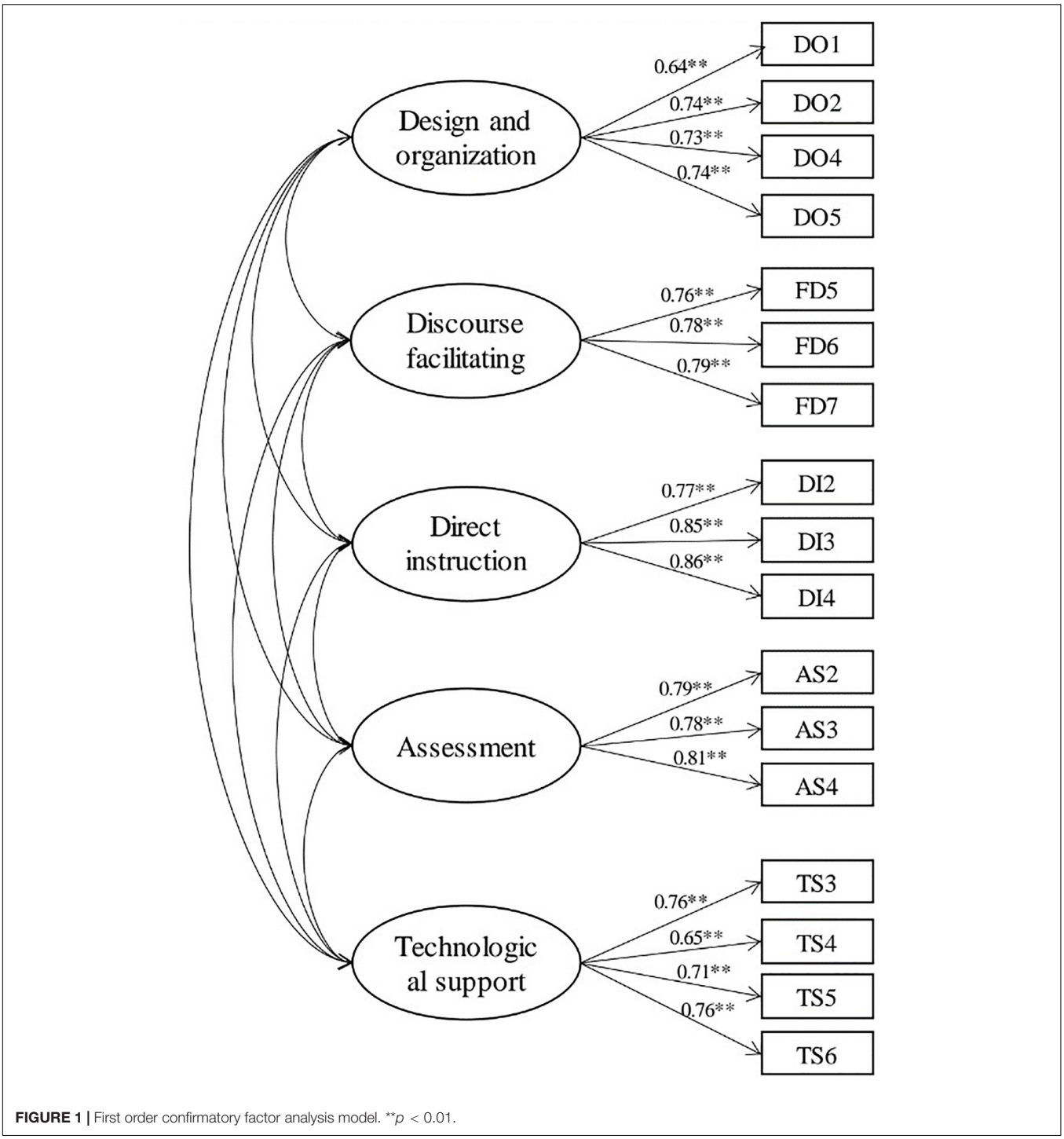

FIGURE 1 | First order confirmatory factor analysis model. $^{**}p < 0.01$.

convergence effect if the Average Variance Extracted (AVE) exceeds 0.5 (Fornell and Larcker, 1981; see **Table 5**). That is, the framework in this study is reasonable and the questionnaire has high validity.

Reliability Analysis of the Scale

The reliability of the questionnaire was scaled with the Cronbach's alpha and composite reliabilities. After exploratory factor analysis and confirmatory factor analysis, DO1, DO2, DO4, DO5, FD5, FD6, FD7, DI2, DI3, DI4, AS2, AS3, AS4, TS4, TS5, and TS6 were retained. The Cronbach's alpha of adjusted scale was 0.930 and the Cronbach's alpha of DO, DF, DI, AS, and TS were 0.804, 0.817, 0.866, 0.834, and 0.812, respectively. The composite reliabilities of DO, DF, DI, AS, and TS were 0.8063, 0.8167, 0.8668, 0.8347, and 0.8135, respectively, which were considered to be high by Bagozzi and Yi (1988).

TABLE 4 | Framework fitting index.

Type	Fitting index	Threshold	Values	Results
Absolute fit index	Chi-square/df	<3	1.183	Supported
	RMSEA	<0.08	0.030	Supported
	Goodness-of-fit index (GFI)	>0.8	0.933	Supported
	Adjust fitness index (AGFI)	>0.8	0.906	Supported
Relative fit indexIncremental fit index	Normed fitness index (NFI)	>0.9	0.932	Supported
	Non-normalized fitness index (NNTI/TFI)	>0.9	0.986	Supported
	Comparative fitness index (CFI)	>0.9	0.989	Supported
	Incremental fitness index (IFI)	>0.9	0.989	Supported
	Relative fitness index (RFI)	>0.9	0.915	Supported
Streamlining fit indexParsimonious fit index	Simplify the specification fitness index (PNFI)	>0.5	0.747	Supported
	Streamlining fitness indicators (PGFI)	>0.5	0.665	Supported

Discriminant Validity Analysis for Framework

The structural discriminant validity analysis of the tool is shown in **Table 6**. In general, the square root of AVE for each dimension should be higher than the absolute value of the Pearson correlation coefficient between the two dimensions, which can be identified as discriminant validity. This result demonstrated that the framework had good discriminant validity (Schumacker and Lomax, 2016).

The five-factor framework has good convergence validity and discriminatory validity through the first-order confirmatory factor analysis. That is, the model can be used to interpret the data.

Item Analysis

The purpose of item analysis is to test the appropriateness and discrimination of questions. Item analysis examines two main aspects: the first aspect is the decisive value, and the second aspect is the correlation coefficient between question items and the total score of the dimensions. That is, an independent samples *t*-test was conducted for question items in the high group versus the low group. The top 27% and bottom 27% in the sample of 408 participants in the item analysis were defined as the high and low groups, referring to Aridag and Yüksel (2010). Items that did not reach a significant difference between the two groups were deleted.

Specifically, questions with dimensional Pearson correlation coefficients less than 0.4 and questions with standardized factor loadings less than 0.45 needed to be deleted (Kim, 2014). Based on these criteria, after item analysis of the questionnaire, the decisive values of the remaining items were all greater than 0.3, and the total correlation coefficient between items and questions was greater than 0.4. Therefore, through the item analysis, the remaining 17 questions met the criteria.

TABLE 5 | Results of confirmatory factor analysis.

Latent variable	Measure item	Standardized factor loading	CR	AVE
Design and organization (DO)	DO1	0.639	0.8063	0.5109
	DO2	0.742		
	DO4	0.734		
	DO5	0.739		
Discourse facilitation (DF)	DF5	0.757	0.8167	0.5977
	DF6	0.776		
	DF7	0.786		
Direct instruction (DI)	DI2	0.773	0.8668	0.6848
	DI3	0.848		
	DI4	0.859		
Assessment (AS)	AS2	0.792	0.8347	0.6274
	AS3	0.777		
	AS4	0.807		
Technological support (TS)	TS3	0.759	0.8135	0.5226
	TS4	0.764		
	TS5	0.651		
	TS6	0.712		

CR represents Composite reliability; AVE represents Average variance extracted.

The Relationship of the Five Factors in the Framework

Based on the findings and the Community of Inquiry framework proposed by Garrison et al. (2001), this study constructed a teaching presence measurement framework. The results show that instructors' teaching presence can be measured according to five aspects: design and organization, discourse facilitation, direct instruction, assessment, and technological support. There are correlations among these five factors. Perceived importance is scored from 1 to 5, with 1 being the most important and 5 being the least important. The results of the perceived importance question were processed in

TABLE 6 | Correlation coefficient matrix and square roots of AVE.

Construct	DO	DF	DI	AS	TS
DO	0.715				
FD	0.607**	0.773			
DI	0.547**	0.620**	0.828		
AS	0.563**	0.636**	0.625**	0.792	
TS	0.521**	0.655**	0.593**	0.630**	0.723

The data at the diagonal is the square root of AVE, and the rest of the data is Pearson correlation coefficient.
***p < 0.01.*

TABLE 7 | The perceived importance of the five dimensions of teaching presence.

Dimensions	Average	Rank
Design and organization (DO)	3.65	1
Discourse facilitation (DF)	3.15	2
Direct instruction (DI)	2.69	3
Assessment (AS)	2.02	4
Technological support (TS)	1.81	5

reverse. Therefore, the higher the score, the more important the factor. The result is shown in **Table 7**. The learners' perceived importance of the five dimensions of teaching presence is: design and organization > discourse facilitation > direct instruction > assessment > technological support.

Therefore, it can be concluded that the design and organization, discourse facilitation, and direct instruction are three key elements of the framework (see **Figure 2**). The external teaching environment is created by instructors' technological support and assessment. The perceived importance of technological support is higher than that of the assessment which indicated that the technological support in online teaching was essential. Discourse facilitation is aimed at promoting learners' social interaction. Direct instruction is aimed at promoting learners' cognitive construction. Design and organization are adopted to design teaching activities. Discourse facilitation and instruction are used to construct discourse-based teaching. Design and organization, and discourse facilitation are to create an interactive learning environment. Design and organization, as well as direct instruction are applied to organize teaching content. Students' interaction and collaborative knowledge construction can be facilitated with assessment and technological support in the whole learning process. That is, the teaching presence measurement framework can provide a reference for instructors' online teaching.

DISCUSSION

Online teaching presence is a comprehensive reflection of instructors' online teaching competencies. Thus, the construction of the teaching presence measurement framework in the online community of inquiry can not only provide a reference for online teaching assessment but can also promote teaching by assessment. It provides instructors with practical suggestions from the perspectives of design and organization, discourse facilitation, direct instruction, technological support, and

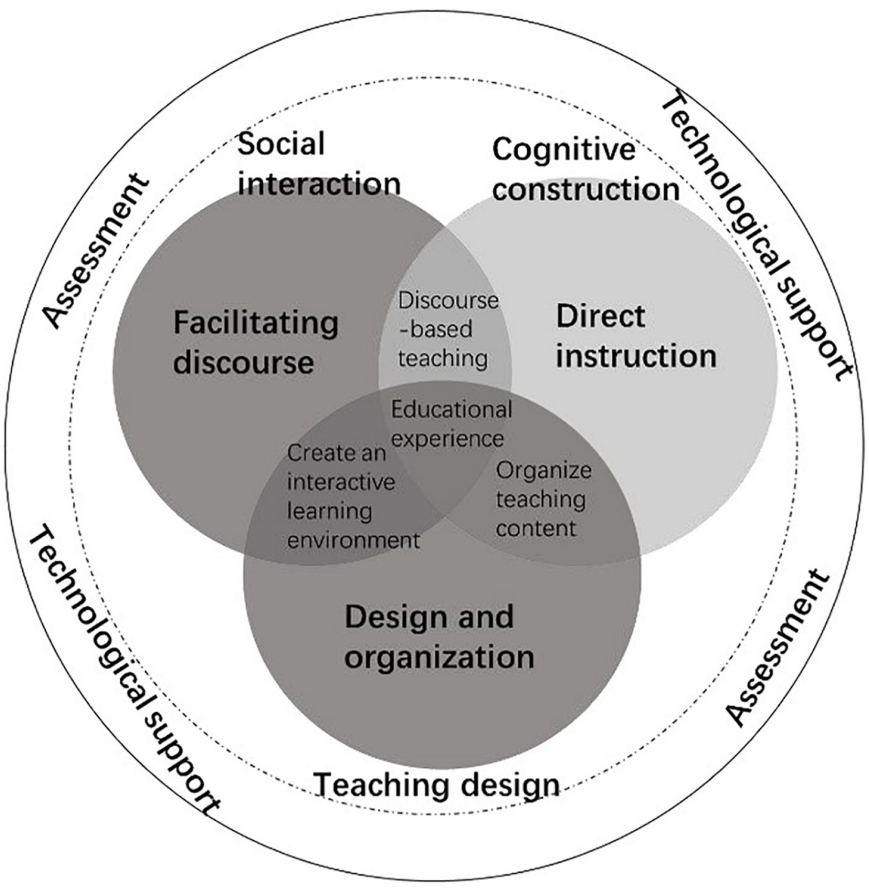

FIGURE 2 | Teaching presence measurement model.

assessment. Furthermore, learners' perceived importance of the five dimensions of teaching presence also indicates that instructors should pay attention to online learning activities design, discourse facilitation in online discussions, direct instruction, technological support, as well as learning assessment.

The measurement framework constructed in this study differs from that of Shea et al. (2010) who proposed that teaching presence in online learning environments consisted of design and organization, discourse facilitation, direct instruction, and assessment. Two possible reasons could be used to explain this discrepancy. One may be the different research backgrounds. This study was conducted in China, whereas that of Anderson et al. (2001) was conducted in the United States Chinese and western students' expectations of teaching and learning may differ. Chinese students prefer learning independently and tend to be modest and emphasize the importance of order and respect for authority (Sit, 2013), whereas Western students tend to communicate with others and stress egalitarianism, individual development, and cooperation (Elbers, 2010). That is, more importance is attached to discourse facilitation in western online education, while more importance is attached to direct instruction and technological support in Chinese online education. Another reason may be the different online learning environments in Chinese and western countries. For example, platform construction and video lecture design are emphasized in Chinese online education (Zhao et al., 2021b), whereas reading, discussion, collaboration, and reflection are dominant online learning activities in western countries (Misko et al., 2004). For this reason, the perceived technological support was relatively higher in China and hence the technological support becomes a significant dimension of the teaching presence measurement framework. It does not mean, however, that teachers should invest more in direct instruction and technological support. Since the perceived importance of the five dimensions of teaching presence supports that design and organization and discourse facilitation are key to the community of inquiry, teachers could improve their teaching practice based on the online teaching presence framework.

CONCLUSION

Since there is no consensus on the online teaching presence measurement, it is valuable to explore the latent factors of teaching presence to examine whether they provide a reliable solution for the measurement of online teaching presence. In this study, the item analysis, EFA, and CFA were applied to construct a five-factor teaching presence framework. This framework consists of design and organization, discourse facilitation, direct instruction, assessment, and technological support. It can serve as an effective tool to support teaching presence measurement and to provide guidance for instructors' online teaching.

Implications

There are two contributions made by this study. On one hand, this study carried out research on the teaching presence measurement method. It has been reported that there are some differences in online teaching in China and western countries (Liu and Meng, 2009). That is, studies in western countries may not satisfy the needs of Chinese online learners. As such, it is valuable to further explore the teaching presence measurement framework in China. It can also be a support tool for other Asian countries like China. On the other hand, the results of the item analysis, EFA, and CFA support the reliability and validity of the five-factor framework which indicates that the online teaching presence measurement framework consists of design and organization, discourse facilitation, direct instruction, assessment, and technological support.

Limitations and Future Study

The present study contributes to the field. However, there are still limitations to this study that should be noted. For example, the sample in this study was from several provinces of China selected by random sampling, which cannot cover all the universities in the whole country. More and larger representative samples will be needed in the future to assess the extent to which the findings are applicable to other population groups and other countries to confirm the conclusion of the study. Additionally, all the courses in this study were instructed by the same teacher which limits the application of more robust analytic methods. Hence, in the future study, it would be valuable to further explore the teaching presence measurement framework based on data collected from multiple teachers, which allows us to adopt the more appropriate multilevel confirmatory factor analysis method given that the items, despite being rated by students, measure the traits of the teachers (Stapleton et al., 2016a,b).

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The experimental data they provided was anonymous and would not be of any commercial use or influence their final course scores. All the students agreed to participate in the study. Written informed consent from the college students/participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

All authors contributed equally to the conception of the idea, implementing and analyzing the experimental results, and writing the manuscript and read and approved the final manuscript.

FUNDING

This work was supported by the Project of National Natural Science Foundation of China (No. 62107023).

REFERENCES

Akyol, Z., Arbaugh, J. B., Cleveland-Innes, M., Garrison, D. R., Ice, P., Richardson, J. C., et al. (2009). A response to the review of the community of inquiry framework. *J. Distance Educ.* 23, 123–135.

Anderson, T., Liam, R., Garrison, D. R., and Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *J. Asynchr. Learn. Netw.* 5, 1–17. doi: 10.24059/olj.v5i2.1875

Arbaugh, J. (2008). Does the community of inquiry framework predict outcomes in online MBA courses? *Int. Rev. Res. Open Distrib. Learn.* 9, 1–21. doi: 10.19173/irrodl.v9i2.490

Arbaugh, J. B., and Hwang, A. (2006). Does "teaching presence" exist in online MBA courses? *Internet High. Educ.* 9, 9–21. doi: 10.1016/j.iheduc.2005.12.001

Aridag, N. C., and Yüksel, A. (2010). Analysis of the relationship between moral judgment competences and empathic skills of university students. *Kuram ve Uygulamada Egitim Bilimleri* 10, 707–724.

Bagozzi, R. P., and Yi, Y. (1988). On the evaluation of structural equation models. *J. Acad. Mark. Sci.* 14, 33–46. doi: 10.1007/bf02723327

Caskurlu, S. (2018). Confirming the subdimensions of teaching, social, and cognitive presences: a construct validity study. *Internet High. Educ.* 39, 1–12. doi: 10.1016/j.iheduc.2018.05.002

Caskurlu, S., Yukiko, M., Richardson, J. C., and Lv, J. (2020). A meta analysis addressing the relationship between teaching presence and students' satisfaction and learning. *Comput. Educ.* 157:103966. doi: 10.1016/j.compedu.2020.103966

Chen, C. M., Li, M. C., Chang, W. C., and Chen, X. X. (2021). Developing a topic analysis instant feedback system to facilitate asynchronous online discussion effectiveness. *Comput. Educ.* 163:104095. doi: 10.1016/j.compedu.2020.104095

Conway, J. M., and Huffcutt, A. I. (2016). A review and evaluation of exploratory factor analysis practices in organizational research. *Organ. Res. Methods* 6, 147–168. doi: 10.1177/1094428103251541

Coppola, N. W., Hiltz, S. R., and Rotter, N. G. (2002). Becoming a virtual professor: pedagogical roles and asynchronous learning networks. *J. Manag. Inf. Syst.* 18, 169–189. doi: 10.1080/07421222.2002.11045703

Elbers, E. (2010). "Learning and social interaction in culturally diverse classrooms," in *International Handbook of Psychology in Education*, eds K. Littleton, C. Wood, and J. Kleine Staarman (Bingley: Emerald).

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., and Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychol. Methods* 4, 272–299.

Fornell, C., and Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* 18, 39–50. doi: 10.1177/002224378101800312

Foster, J., Barkus, E., and Yavorsky, C. (1993). *Understanding and Using Advanced Statistics*. Thousand Oaks, CA: SAGE Publications.

Garrison, D. R., Anderson, T., and Archer, W. (2000). Critical inquiry in a text-based environment: computer conferencing in higher education. *Internet High. Educ.* 2, 87–105.

Garrison, D. R., Anderson, T., and Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *Am. J. Distance Educ.* 15, 7–23. doi: 10.1080/08923640109527071

Garrison, D. R., Cleveland-Innes, M., and Fung, T. S. (2010). Exploring causal relationships among teaching, cognitive and social presence: student perceptions of the community of inquiry framework. *Internet High. Educ.* 13, 31–36. doi: 10.1016/j.iheduc.2009.10.002

Gurley, L. E. (2018). Educators' preparation to teach, perceived teaching presence, and perceived teaching presence behaviors in blended and online learning environments. *Online Learn.* 22, 197–220. doi: 10.24059/olj.v22i2.1255

Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2014). *Multivariate Data Analysis*, 7th Edn. Upper Saddle River, NJ: Pearson Prentice Hall.

Khalid, M. N., and Quick, D. (2016). Teaching presence influencing online students' course satisfaction at an institution of higher education. *Int. Educ. Studies* 9, 62–70. doi: 10.5539/ies.v9n3p62

Kieffer, K. M. (1998). "Orthogonal versus oblique factor rotation: a review of the literature regarding the pros and cons," in *Paper Presented in the Annual Meeting of the Mid-South Educational Research Association*, New Orleans, LA, 4–32.

Kim, K. U. (2014). Measurement of quality of life in patients with end-stage cancer. *Cancer Nurs.* 37, 44–49. doi: 10.1097/NCC.0b013e31827b5bdc

Kirschner, P., Strijbos, J.-W., Kreijns, K., and Beers, P. J. (2004). Designing electronic collaborative learning environments. *Educ. Technol. Res. Dev.* 52:47. doi: 10.1007/BF02504675

Koehler, M., and Mishra, P. (2009). What is Technological Pedagogical Content Knowledge (TPACK)? *Contemp. Iss. Tech. Teacher Educ.* 9, 60–70.

Kyei-Blankson, L., Ntuli, E., and Donnelly, H. (2019). Establishing the importance of interaction and presence to student learning in online environments. *J. Interact. Learn. Res.* 30, 539–560.

LaPointe, D. K., and Gunawardena, C. N. (2004). Developing, testing and refining of a model to understand the relationship between peer interaction and learning outcomes in computer-mediated conferencing. *Distance Educ.* 25, 83–106. doi: 10.1080/0158791042000212477

Law, K. M. Y., Geng, S., and Li, T. (2019). Student enrollment, motivation and learning performance in a blended learning environment: the mediating effects of social, teaching, and cognitive presence. *Comput. Educ.* 136, 1–12. doi: 10.1016/j.compedu.2019.02.021

Lee, J. E., and Recker, M. (2021). The effects of instructors' use of online discussions strategies on student participation and performance in university online introductory mathematics courses. *Comput. Educ.* 162:104084. doi: 10.1016/j.compedu.2020.104084

Liu, H., Shao, M., Liu, X., and Zhao, L. (2021). Exploring the influential factors on readers' continuance intentions of e-Book APPs: personalization, usefulness, playfulness, and satisfaction. *Front. Psychol.* 12:640110. doi: 10.3389/fpsyg.2021.640110

Liu, S., and Meng, L. (2009). Perceptions of teachers, students and parents of the characteristics of good teachers: a cross-cultural comparison of China and the United States. *Educ. Assess. Eva. Acc.* 21, 313–328. doi: 10.1007/s11092-009-9077-z

Martine, F., Sun, T., and Westine, C. D. (2020). A systematic review of research on online teaching and learning from 2009 to 2018. *Comput. Educ.* 159, 0360–1315. doi: 10.1016/j.compedu.2020.104009

Misko, J., Choi, J., Hong, S. Y., and Lee, I. S. (2004). *E-Learning in Australia and Korea: Learning from Practice*. Adelaide, SA: National Centre for Vocational Education Research (NCVER).

Preisman, K. A. (2014). Teaching presence in online education: from the instructor's point of view. *Online Learn.* 18, 1–16.

Schumacker, R. E., and Lomax, R. G. (2016). *A Beginner's Guide to Structural Equation Modeling*, 4th Edn. New York, NY: Routledge.

Shea, P., and Bidjerano, T. (2010). Learning presence: towards a theory of self-efficacy, self-regulation, and the development of a communities of inquiry in online and blended learning environments. *Comput. Educ.* 55, 1721–1731. doi: 10.1016/j.compedu.2010.07.017

Shea, P., Hayes, S., Uzuner-Smith, S., Gozza-Cohen, M., Vickers, J., and Bidjerano, T. (2014). Reconceptualizing the community of inquiry framework: an exploratory analysis. *Internet High. Educ.* 23, 9–17. doi: 10.1016/j.iheduc.2014.05.002

Shea, P., Hayes, S., and Vickers, J. (2010). Online instructional effort measured through the lens of teaching presence in the community of inquiry framework: a re-examination of measures and approach. *Int. Rev. Res. Open Distrib. Learn.* 11, 127–154. doi: 10.19173/irrodl.v11i3.915

Shea, P., Li, C. S., and Pickett, A. (2006). A study of teaching presence and student sense of learning community in fully online and web-enhanced college courses. *Internet High. Educ.* 9, 175–190. doi: 10.1016/j.iheduc.2006.06.005

Shea, P., Li, C. S., Swan, K., and Pickett, A. (2005). Developing learning community in online asynchronous college courses: the role of teaching presence. *J. Asynchr. Learn. Netw.* 9, 59–82.

Shulman, L. S. (1986). Those who understand: a conception of teacher knowledge. *Educ. Res.* 15, 4–14.

Sit, H. H. W. (2013). Characteristics of Chinese students' learning styles. *Int. Proc. Econ. Dev. Res.* 62, 36–39. doi: 10.7763/IPEDR.2013.V62.8

Stapleton, L. M., McNeish, D. M., and Yang, J. S. (2016a). Multilevel and single-level models for measured and latent variables when data are clustered. *Educ. Psychol.* 51, 317–330. doi: 10.1080/00461520.2016.1207178

Stapleton, L. M., Yang, J. S., and Hancock, G. R. (2016b). Construct meaning in multilevel settings. *J. Educ. Behav. Stat.* 41, 481–520. doi: 10.3102/1076998616646200

Stein, D. S., and Wanstreet, C. E. (2017). *Jump-Start Your Online Classroom: Mastering Five Challenges in Five Days*. Sterling, VA: Stylus Publishing, LLC.

Szeto, E. (2015). Community of Inquiry as an instructional approach: what effects of teaching, social and cognitive presences are there in blended synchronous learning and teaching? *Comput. Educ.* 81, 191–201. doi: 10.1016/j.compedu.2014.10.015

Vogel, D. L., Wade, N. G., and Ascheman, P. L. (2009). Measuring perceptions of stigmatization by others for seeking psychological help: reliability and validity of a new stigma scale with college students. *J. Couns. Psychol.* 56, 301–308. doi: 10.1037/a0014903

Wang, Y., and Liu, Q. (2020). Effects of online teaching presence on students' interactions and collaborative knowledge construction. *J. Comput. Assist. Learn.* 36, 370–382. doi: 10.1111/jcal.12408

Wang, Y., Wang, Y., Stein, D., Liu, Q., and Chen, W. (2021). The structure of Chinese beginning online instructors' competencies: evidence from Bayesian factor analysis. *J. Comput. Educ.* 8, 411–440. doi: 10.1007/s40692-021-00186-9

Yurdakul, I. K., Odabasi, H. F., Kiliçer, K., Çoklar, A. N., Birinci, G., and Kurt, A. A. (2012). The development, validity and reliability of TPACK-deep: A technological pedagogical content knowledge scale. *Comp. Educ.* 58, 964–977. doi: 10.1016/j.compedu.2011.10.012

Zhang, H., Lin, L., Zhan, Y., and Ren, Y. (2016). The impact of teaching presence on online engagement behaviors. *J. Educ. Comput. Res.* 54, 887–900. doi: 10.1177/0735633116648171

Zhao, L., He, W., and Su, Y. S. (2021a). Innovative pedagogy and design-based research on flipped learning in higher education. *Front. Psychol.* 12:577002. doi: 10.3389/fpsyg.2021.577002

Zhao, L., Liu, X. H., and Su, Y. S. (2021b). The differentiate effect of self-efficacy, motivation, and satisfaction on pre-service teacher students' learning achievement in a flipped classroom: a case of a modern educational technology course. *Sustainability* 13:2888. doi: 10.3390/su13052888

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 24 November 2021
doi: 10.3389/fpsyg.2021.733865

Experiences and Perceived Self-Efficacy in Distance Learning Among Teachers of Students With Special Educational Needs

Jenny Maurer[1,2]*, *Angelika Becker*[1,2], *Johanna Hilkenmeier*[2,3] and *Monika Daseking*[1,2]

[1] Educational Psychology, Helmut Schmidt University, University of the Federal Armed Forces Hamburg, Hamburg, Germany, [2] IDeA Research Center for Individual Development and Adaptive Education of Children at Risk, Frankfurt, Germany, [3] Faculty of Education, University of Hamburg, Hamburg, Germany

The COVID-19 pandemic has had a great impact on school learning so far, creating a new and potentially stressful situation during school closures for teachers and students. The sudden switch to distance learning might have been especially hard to cope with for students with special educational needs (SEN). Teachers of student with SEN might thus face greater obstacles when establishing and dealing with distance learning. Teachers' self-efficacy (TSE) is a well-known factor for students' academic achievement and motivation. Little is yet known about TSE in distance learning, especially not with students with SEN. The present study aimed to investigate the experiences and the perceived TSE in distance learning of teachers teaching students with SEN at special schools and inclusive schools during the COVID-19 pandemic in Germany during June 2020 and January 2021. $N = 96$ teachers from both special schools and inclusive schools were involved in the study and were asked to complete a self-report online questionnaire. The study follows an exploratory design to give a first overview of the experiences of teachers of students with SEN and their TSE during the school closures and distance learning. Results showed that no major difference in overall teaching experiences could be found between teachers teaching at special schools or inclusive schools. The identification of difficulties in reading at distance and the support of students with difficulties in reading at distance was perceived by the teachers as most difficult. Difficulties in writing was being rated significantly less easy to identify at distance than difficulties in mathematics. Further, the support of students with difficulties in mathematics was perceived as being significant more challenging than the identification of difficulties in mathematics. TSE in distance learning was rather low, regardless if the teachers taught at a special school or inclusive school in this time period. TSE correlated positively with the perceived goodness of identification of difficulties and support of students with difficulties in reading, writing, and mathematics. Possible reasons and implications are discussed as well as implications of the overall results for distance learning of students with SEN.

Keywords: teachers' self-efficacy, special educational needs, distance learning, COVID-19, learning disorders, DigitLern

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff,
University of Oxford, United Kingdom

Reviewed by:
Marie Catherine White,
Gordon College, United States
Eunice Pui-yu Yim,
Open University of Hong Kong, China

***Correspondence:**
Jenny Maurer
j.maurer@hsu-hh.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *05 October 2021*
Published: *24 November 2021*

Citation:
Maurer J, Becker A, Hilkenmeier J and Daseking M (2021) Experiences and Perceived Self-Efficacy in Distance Learning Among Teachers of Students With Special Educational Needs. Front. Psychol. 12:733865. doi: 10.3389/fpsyg.2021.733865

INTRODUCTION

Due to the worldwide COVID-19 pandemic school life and learning changed rapidly in spring 2020 in Germany. In-class learning had to switch very fast to distance learning with little or no in-class schooling. This led to great challenges for both teachers and students. Students with special educational needs (SEN) might be an especially vulnerable group when it comes to difficulties with the adaptation to and the coping with different forms of distance learning. Teachers with students with SEN in their classes might thus have faced more and different challenges in distance learning than teachers without students with SEN in their classes.

There are already a few studies on the experiences of students, their families and teachers during the school closures due to the COVID-19 pandemic from different countries and school systems (e.g., Garbe et al., 2020; Huber and Helm, 2020; König et al., 2020; OECD, 2020; Vuorikari et al., 2020; Steinmayr et al., 2021; Thorell et al., 2021), but only a few studies so far investigated the situation of students with SEN during the COVID-19 pandemic (e.g., Goldan et al., 2020; Nusser, 2021; Scheer and Laubenstein, 2021; Thorell et al., 2021). Those results indicate that students with SEN might go through more negative experiences and more problems whilst dealing with distance learning and challenging situations during school closures than students without SEN. Reich et al. (2020) stated that students with higher school achievement seemed to be less affected by distance learning while more vulnerable student groups were experiencing greater problems with it.

For a better understanding, in the following a short overview of the German school system is given [for more information see the detailed description of the Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany (Kultusministerkonferenz) (Eckhardt, 2019)]. In Germany, all students attend primary school, then after class-level 4 or 6, students attend a secondary school where they either can graduate with basic general education (9th grade, e.g., in German: "Hauptschule"), extensive general education (10th grade, e.g., in German: "Realschule"), or in depth general education (12th or 13th grade, e.g., in German: "Gymnasium"). Further, there are comprehensive schools where different kinds of the degrees mentioned before can be obtained. Beside this, there are special schools (e.g., in German: "Förder-/Sonderschule"), which offer primary education and education to the 10th grade for students with SEN.

Since the United Nations Convention on the Rights of Persons with Disabilities entered into force in Germany in 2009, students with SEN or disabilities shall equally participate in the German educational system, thus an inclusive school system is pursued (Klemm and Preuss-Lausitz, 2017). In an inclusive school system, students with and without SEN are being taught together and learn together (Eckhardt, 2019). If students with SEN are not able to follow the mainstream curriculum, teachers must then prepare different educational plans for their students (Sansour and Bernhard, 2018).

There are eight different so-called support focuses for students with SEN in Germany: learning, emotional and social development, speech, sight, hearing, mental development, physical and motor development and instruction for sick students (Eckhardt, 2019). In 2016, about 7% (n = 523.813 students) of all students in compulsory schooling (1st till 9th or 10th grade, depending on school form) had a support focus (Eckhardt, 2019). The three most common support focuses are learning (n = 191.169 students, 2.6%), mental development (n = 87.516 students, 1.2%), and emotional and social development (n = 86.794 students, 1.2%) (Eckhardt, 2019).

At special schools, students are taught by special education teachers. At inclusive schools, the regular teachers are supported by special education teachers, who support students with SEN (Eckhardt, 2019). The decision whether a student with SEN attends a special school or an inclusive school is up to the parents or legal guardians (Eckhardt, 2019).

Various reasons might lead to greater struggles of students with SEN than students without SEN with distance learning. For example, students with SEN often differ from students without SEN regarding their parental socioeconomic status. In Germany, students from families with a low socioeconomic status are three times more often diagnosed with SEN than students from a family with a high socioeconomic status (Kölm et al., 2017). The percentage of students with SEN from families with low socioeconomic status is significant higher at special schools than at inclusive schools (Kölm et al., 2017). A first systematic overview of international studies investigating effects of the COVID-19-related school closures in spring 2020 showed that especially younger students' academic achievement and the academic achievement of students from families with lower socioeconomic status dropped under the school closures (Hammerstein et al., 2021). Helm et al. (2021) came to a similar conclusion in their review on studies that investigated the situation of distance learning during the pandemic-related school closures in Germany, Austria and Switzerland: students from families with low socioeconomic status are disadvantaged in terms of their learning achievement. Among other things, there was a positive association between the socioeconomic status of the families and students' learning success, students' learning motivation, parental competencies to support students in learning as well as the technical equipment of families during distance learning observed (Helm et al., 2021). Conversely, students from families with low socioeconomic status showed lower learning success, lower motivation to learn, less parental competencies for support in their learning, and had reportedly less technical equipment during distance learning.

At the beginning of the COVID-19 pandemic, teachers and schools in Germany were partially not well-prepared for distance learning, especially concerning digital learning (Runge et al., 2021). It should be noted that distance learning does not necessarily involve digital learning, but all different forms of learning that are not carried out in-class. Regarding digital learning, the International Computer and Information Literacy Study (ICILS) showed that before the COVID-19 pandemic, not even one-third of teachers in Germany had received further training in digital learning and teaching (Eickelmann et al., 2019).

With regard to the use of digital media by students with SEN, further training of teachers was as low as 4.6% (Eickelmann et al., 2019). A study from Huber and Helm (2020) carried out in Germany, Austria, and Switzerland, in which also students, parents, and teachers were surveyed during school closures in 2020 revealed that Germany's education system lags behind in terms of several aspects regarding digital learning and teaching and not only teachers but also schools were not well-prepared for distance learning. Technical capacities and resources for digital learning were significantly rated lower by the school staff (most of them teachers) in Germany than in its neighboring countries Austria and Switzerland (Huber and Helm, 2020). Therefore, 56% of the school staff disagreed or strongly disagreed with the statement that "technical capacities in the school are sufficient for web-based formats" (Huber and Helm, 2020, p. 251). Likewise, the school staff in Germany rated their digital competencies significantly lower than school staff in Austria or Switzerland (Huber and Helm, 2020). Furthermore, digital competencies of the school staff were associated with technical resources of the schools for digital learning (Huber and Helm, 2020). During the school closures, the majority of students in Germany spent most of their time doing school assignments in self-study, with little contact to their teachers (Thorell et al., 2021). Teachers' feedback to students, as well as teachers' individual support, again seems to work better in Germany's neighboring countries (Huber and Helm, 2020). It was shown that technical capacities of schools were positively associated with more feedback and individual support for students from teachers (Huber and Helm, 2020). Altogether, the situation in schools in Germany during the school closures 2020 was stressful for a large proportion of both teachers and students (Huber and Helm, 2020).

Some studies also investigated specifically the situation of students with SEN during school closures in Germany. Nusser (2021) examined in a study differences between students with SEN and without SEN. During the school closures 2020, students with SEN spent more than twice as many hours studying as students without SEN (16 vs. 35 hours per week) (Nusser, 2021). Likewise, these students also were supported by their parents more than twice as many hours with their schoolwork than students without SEN (5 vs. 11 hours per week) (Nusser, 2021). Another study investigating experiences during school closures in 2020 in several European Countries observed that a large proportion of parents of German students with SEN reported that whilst special educational support was given to them (more than 70%), the amount of given support was not sufficient. Likewise, two thirds of parents reported that no communication with the school about the special educational support had taken place (Thorell et al., 2021). A study by Scheer and Laubenstein (2021) also shows that students with support focus in emotional and social development could not adapt as well to distance learning as students without SEN. Similarly, they were more likely to be exposed to psychosocial hazards than students without SEN (Scheer and Laubenstein, 2021). Further, externalizing problems increased slightly in these students during distance learning (Scheer and Laubenstein, 2021). Moreover, a support focus in emotional and social development is associated with a decrease in emotional well-being related to school during distance learning (Scheer and Laubenstein, 2021). Based on investigations of an experimental school for inclusive education, the following aspects were summarized to support students with SEN well, even in distance learning: adapted individual tasks, sufficient feedback by teachers, a good relationship and contact between teachers and students as well as their parents (Goldan et al., 2020). Becker et al. (2020) indicated that students with ADHD showed more difficulties with distance learning than their peers without an ADHD diagnosis that are not only due to preexisting academic problems. The authors stress that schools need to provide support especially to students with mental health and/or learning difficulties. There is a big intersection between students with ADHD and SEN (see for example representative data of the US: Schnoes et al., 2006). Thus, investigating the effects of school closures on students with SEN has been identified as a key research priority (Holmes et al., 2020).

It is important to point out that in Germany the average level of achievement between students with SEN and students without SEN differs. Students with SEN show a mean delay in school achievement of at least 2 years compared to students without SEN (Wocken and Gröhlich, 2007). Students with SEN in special schools have significantly lower skills in reading, mathematics, and science than students without SEN in inclusive schools (Müller et al., 2017). Thus, if students with SEN already had a delay in school achievement before the COVID-19 pandemic this gap could now even widen more.

The above described problems in digitalization at German schools, uncertainties and new challenges in distance learning might have led to a low teachers' self-efficacy (TSE) during the school closures in spring 2020. TSE is a well-known and studied factor for successful teaching and instructional practice as well as for students' academic achievement and motivation as well for the emotional well-being of teachers (e.g., Klassen et al., 2009; Zee and Koomen, 2016). Thus, TSE might be a major factor in the successful implementation and establishment of distance learning.

In general, self-efficacy is understood as the conviction that an effect can be achieved through one's own actions (Bandura, 1977, 1997). In accordance to Bandura (1977, 1997), Skaalvik and Skaalvik (2010) define TSE as "individual teachers' beliefs in their own ability to plan, organize, and carry out activities that are required to attain given educational goals." (p. 1059).

A few studies have already looked at TSE in school closures during the COVID-19 pandemic (e.g., König et al., 2020; Börnert-Ringleb et al., 2021; Kast et al., 2021). Börnert-Ringleb et al. (2021) reported that during the COVID-19 pandemic TSE related to the use of digital learning in special needs education (special and inclusive schools) in Germany is a predictor for the perceived quality of digital learning, whereas a more generalized TSE is not a predictor. In another study conducted in Austria, TSE during the school closures was significantly lower with regard to students with SEN compared to a group of students with high academic achievements in school and a control group (Kast et al., 2021). König et al. (2020) showed that TSE is a predictor for successful adapting tasks to the students' demands and giving feedback to students during school closures.

Before the COVID-19 pandemic, Viel-Ruma et al. (2010) observed in a study no significant differences between TSE of special needs educators in different teaching settings (self-contained, resource, or inclusion). In inclusive schooling, Schwab (2019) found that the TSE of special education teachers were higher than of regular teachers toward students with SEN. Furthermore, it can be assumed that teachers with more years of experience in teaching have a higher TSE than teachers with less years of experience in teaching (Flores et al., 2004).

Given that students with SEN might especially struggle with distance learning and that the TSE in regard to distance learning might be one of the crucial factors for successful distance learning, this study is focusing among other experiences at the TSE of teachers teaching students with SEN.

In this study, we followed an exploratory approach and tried to get a broad descriptive overview to get a first insight of the overall situation of teachers of students with SEN during the first year of the COVID-19 pandemic. We addressed following questions: Did the number of hours per week teachers used digital learning before and since the COVID-19 pandemic change? How could teachers identify difficulties and support students with difficulties in reading, writing, and mathematics in the context of distance learning? How was the perceived TSE in distance learning in supporting students with SEN? Is there an association between TSE in distance learning and the identification of difficulties as well as the support of students with difficulties in reading, writing or mathematics in distance learning? Are there factors within the teachers that might have had an influence on the perceived TSE (e.g., gender, age, or years of work experience)? Furthermore, for all of these questions, we investigated whether there are differences between teachers at special schools and inclusive schools.

MATERIALS AND METHODS

Procedure and Instruments

This study was conducted between June 2020 and January 2021 within the project DigitLern with an anonymous self-report online questionnaire. Teachers throughout Germany were invited to participate in the study via e-mail by distribution lists of special education associations. Before participation informed consent was given.

A self-developed questionnaire was used that included demographic data of the teachers [gender (male, female, diverse), age, years of work experience], data related to their teaching experiences (school form where the teachers work, number of students with special educational needs, support focuses of those students), and data related to distance learning (used devices in distance learning, perceived helpful methods in distance learning, hours of digital learning used in teaching). Further, possibilities of identification of difficulties and support of students with difficulties in reading, writing, and mathematics at distance, as well as the TSE in distance learning were ascertained.

For the factors school form [e.g., primary school, school where students can graduate with basic general education (e.g., Hauptschule), special school] and support focuses (e.g., support focus in learning, support focus in emotional and social development), multiple answers were possible. There were predefined answers for helpful methods (e.g., learning apps, worksheets; 0 = not helpful to 4 = helpful) and used devices (e.g., computer, laptop; 0 = never to 4 = always). Goodness of identification of difficulties as well as the support of students with difficulties in reading, writing, and mathematics at distance were assessed with single items (e.g., "Difficulties in reading can be well identified at distance."; "Students with difficulties in reading can be supported well at distance"; 0 = disagree; 1 = rather disagree; 2 = undecided 3 = rather agree; 4 = agree). As the identification of difficulties and support of students with difficulties in the academic skills reading, writing, and mathematics requires domain-specific material and competencies (e.g., Ise et al., 2012a,b), teachers were asked to answer separately for all three disciplines.

TSE in distance learning was assessed by a self-developed scale. Although there exist quite a couple of TSE scales in general, no existing and already evaluated and validated TSE scale that posed questions fitting to the research question here was found. Therefore, the authors decided to go with an exploratory approach and developed the scale by themselves. The scale contains twelve items (e.g., "I experience teaching at distance as effective.") with a five-point response scale (0 = disagree; 1 = rather disagree; 2 = undecided 3 = rather agree; 4 = agree).

For the development of the TSE scale, a principal component analysis (PCA) with orthogonal rotation was performed with the 13 items. The Kaiser-Meyer-Olkin (KMO) value, which indicates the sampling adequacy, was 0.886 for all 13 variables. A value >0.8 is meritorious (Kaiser and Rice, 1974). Bartlett's test was significant. Because of the high KMO value and significant Bartlett's test, a PCA could be performed.

The PCA showed that two components had an eigenvalue above 1.0 and an explained variance above 10%. The first component had an eigenvalue of 6.58 and an explained variance of 50.6%. The second component showed an eigenvalue of 1.33 and an explained variance of 10.2%. Further, the scree plot indicated one component. Due to the low eigenvalue and the low explained variance of the second component as well as the scree plot's indication, a one-component solution was chosen.

The analysis was performed again with one fixed component. Thus, one variable showed a loading below 0.3. This variable was excluded from the scale. The TSE scale was finally formed with 12 items. The final scale shows high internal consistency (*Cronbach's* $\alpha = 0.92$; $n = 90$).

Participants

In total $N = 118$ teachers answered the questionnaire. For the data cleansing, all participants who answered the questionnaire in a time span too short to be able to answer the questionnaire reasonable (<5 minutes) were excluded ($n = 11$). Further, teachers who do not teach any students with special educational needs were excluded from the data ($n = 11$). The final sample included $N = 96$ teachers (female = 81 (84.4%); age: $M = 46.48$, $SD = 11.20$; years of work experience: $M = 18.38$, $SD = 10.83$).

More than half of them ($n = 52$; 54.2%) taught in special schools. For group comparisons, two groups of teachers were formed. The first group includes teachers from special schools,

the second groups includes teachers, who work at inclusive schools. Five of the 52 teachers reported working at a special school as well as at an inclusive school. For the analysis, they were placed in the group of special school teachers. A chi-^{2} test and unpaired *t*-test were performed to determine if both groups of teachers (teachers at special schools and teachers at inclusive schools) are comparable to each other regarding gender, age, and years of work experience.

Analysis

First, the data was analyzed descriptively. For the scale of TSE in distance learning means were calculated. For this, a maximum of 30% missing values was tolerated. For one person no mean could be calculated.

T-tests (unpaired and paired) were conducted to determine differences between teachers at special schools and inclusive schools regarding hours of digital learning and further differences in digital learning before the COVID-19 pandemic and since the COVID-19 pandemic.

To analyze if there were differences between the perceived goodness of how the teachers could respond to the students' needs in distance learning in regard to the different academic skills, the identification of difficulties and support of students with difficulties in those academic skills and between the school forms where the teachers taught, a mixed analyses of variance (ANOVA) was conducted. It included the within factor academic skills (reading vs. writing vs. mathematics), the within factor handling (identification of difficulties vs. support of students with difficulties) and the between factor school form taught at (special school vs. inclusive school). To test the assumptions of sphericity, mauchly's test was conducted for the main and interaction effects. The assumption of sphericity was violated for the main effects of academic skills, $\chi^2(2) = 37.405$, $p < 0.001$. For the corrections of the degrees of freedom, Greenhouse-Geisser test was used ($\varepsilon = 0.74$). As effect size, partial eta-square was calculated. According to Cohen (1988), for the partial eta-square there is a small effect at $\eta^2_{part} = 0.01$, a medium effect at $\eta^2_{part} = 0.06$, and a large effect at $\eta^2_{part} = 0.14$. Then *t*-tests were conducted to further explore possible differences between the perceived goodness of identification of difficulties and the support of students with difficulties and the different academic skills. In the *t*-tests, the between factor school taught at was not taken into account, since the ANOVA did not reveal any differences between the two groups of teachers.

To further explore possible differences in the TSE in distance learning between teachers of special schools and inclusive schools, unpaired *t*-tests were computed.

Furthermore, correlation analyses (Pearson correlations) were performed to detect associations between gender, age, and years of work experience with the TSE at distance learning. Also, correlations analyses (Pearson correlations) were conducted to explore associations between TSE in distance learning with the identification of difficulties as well as the support of students with difficulties in reading, writing, or mathematics in distance learning. Effect sizes according to Cohen (1988) are small at $r = 0.10$, medium at $r = 0.30$ and large at $r = 0.50$. Since the previous *t*-test did not identify any difference between the two groups of teachers (teachers at special schools or inclusive schools) in terms of TSE, the correlation analyses were performed for all teachers.

The size of the *n* varies among the analyses. In order not to reduce the sample size further, no listwise exclusions were made here. A significance level of $\alpha = 0.05$ was set for all analyses. The IBM SPSS Statistics Version 27 program from IBM Corp. was used for data analysis.

RESULTS

Descriptive Analyses

The two subsamples (special school teachers and inclusive school teachers) are comparable to each other and do not differ significantly regarding gender, age, and work experience (see **Table 1**).

More than half of the teachers from inclusive schools work at primary schools ($n = 22$; 50%). For further detail, see **Table 2**.

Teachers at inclusive schools teach an average of 12.63 students with SEN (see **Table 3**). In both school forms the range for taught students per teacher varies widely.

At special schools and inclusive schools the largest groups of students have the support focus in learning (special schools: $n = 31$; 59.6%; inclusive schools: $n = 40$; 90.9%) as well as in emotional and social development (special schools: $n = 24$; 46.3%; inclusive schools: $n = 33$; 75%), (see **Table 4**).

The two devices that were most frequently identified as often or always used for distance learning by teachers from special schools were laptop ($n = 29$; 55.8%) and smartphone ($n = 26$; 50%). Teachers from inclusive schools identified most frequently laptop ($n = 29$; 65.9%) and telephone ($n = 24$; 54.6%) as often or always used for distance learning.

The methods that most teachers at special schools rated as helpful or somewhat helpful were worksheets ($n = 38$; 73.1%), visual aids ($n = 36$; 69.2%), and working with exercise books and/or textbooks ($n = 33$; 63.5%). The methods that most teachers at inclusive schools rated as helpful or somewhat helpful were also worksheets ($n = 39$; 88.6%) and working with exercise books and/or textbooks ($n = 30$; 68.2%), as well as visual aids ($n = 29$; 65.9%) and learning apps ($n = 29$; 65.9%).

Digital Learning

The analyses neither showed significant differences in hours of digital learning used in teaching before the COVID-19 pandemic between teachers of special schools and teachers of inclusive schools [$t(88) = -0.938$; $p = 0.351$], nor during the survey period [$t(86) = -0.049$; $p = 0.961$].

Significant differences were found between hours of digital learning before the COVID-19 pandemic and during the survey period (see **Table 5**). The average number of hours has more than doubled. These results were evident for both subsamples.

Furthermore, a wide range before the COVID-19 pandemic in the number of hours of digital learning was observed. The range was even wider since the school closures related to the beginning of the COVID-19 pandemic.

TABLE 1 | Gender, age, and years of work experience.

		Gender		Age		Years of work experience	
	n	female *n* (%)	male *n* (%)	*M*	*SD*	*M*	*SD*
Teachers at special schools	52	43 (82.7)	9 (17.3)	45.88	11.32	17.86	10.68
Teachers at inclusive schools	44	38 (86.4)	6 (13.6)	47.18	11.14	19.00	11.10
All teachers	96	81 (84.4)	15 (15.6)	46.48	11.20	18.38	10.83

All teachers = teachers of special schools and teacher of inclusive schools. No significant differences between teachers of special schools and teachers of inclusive schools.

TABLE 2 | School forms of the inclusive schools teachers work at.

	n	%
Primary school	22	50.0
School where students can graduate with basic general education (e.g., "Hauptschule")	6	13.6
School where students can graduate with extensive general education (e.g., "Realschule")	4	9.1
School where students can graduate with in-depth general education (e.g., "Gymnasium")	1	2.3
Comprehensive forms (e.g., "Gesamtschule")	13	29.5
Other	5	11.4

Multiple answers possible.

TABLE 3 | Number of students with SEN.

	n	*M*	*SD*	min.	max.
Teachers at special schools	52	20.38	17.36	2	96
Teachers at inclusive schools	43	12.63	12.21	2	78

Identification of Difficulties and Support of Students With Difficulties in Reading, Writing, and Mathematics

All means of stated goodness of identification of difficulties and support of students with difficulties in reading, writing, and mathematics are rather low (see **Tables 6**, **7**).

Significant main effects were found for the factor academic skills, $F(1.49, 132.22) = 12.726$, $p < 0.001$, $\eta^2_{part} = 0.13$ as well as for the factor handling, $F(1, 89) = 8.157$, $p = 0.005$, $\eta^2_{part} = 0.08$. The interaction of the within factor academic skills and the factor handling was significant, $F(2, 178) = 3.396$, $p = 0.036$, $\eta^2_{part} = 0.04$. None of the interactions with the between factor school form reached significance, pointing to no differences between teachers teaching at special schools or at inclusive schools.

T-tests (see **Table 6**) showed that teachers perceived it harder to identify difficulties in reading at distance than difficulties in writing and mathematics. Teachers' rated also that difficulties in writing are significantly less easy to identify at distance than difficulties in mathematics. Teachers rated the support of students with difficulties in reading as significantly harder at distance than the support of students with difficulties in writing and mathematics at distance.

TABLE 4 | Support focuses.

	Teachers at special schools		Teachers at inclusive schools		All teachers	
Support focus	*n*	%	*n*	%	*n*	%
Learning	31	59.6	40	90.9	71	74.0
Emotional and social development	24	46.2	33	75.0	57	59.4
Mental development	20	38.5	18	40.9	38	39.6
Physical and motor development	10	19.2	19	43.2	29	30.2
Other	14	26.9	18	40.9	32	33.3

Answered by teachers; multiple answers possible; N = 96; teachers at special schools n = 52; teachers at inclusive school n = 44; all teachers = teachers of special schools and teachers of inclusive schools.

Further, a significant difference between the perceived goodness of identification of difficulties in mathematics and support of students with difficulties in mathematics at distance could be found. For difficulties in reading and writing, no significant differences were found.

Teachers' Self-Efficacy in Distance Learning

Analyses show that TSE in distance learning is generally low for all teachers (see **Table 8**). No significant differences between teachers of special schools and teacher of inclusive schools could be found [$t(93) = -0.204$; $p = 0.838$].

TSE in distance learning is not associated with gender, age nor years of work experience (see **Table 9**). However, an association could be found between TSE in distance learning and perceived goodness of identification of difficulties as well as support of students with difficulties in reading, writing, and mathematics (see **Table 10**).

DISCUSSION

This study provides important results, which give a first impression on the experiences with distance learning of teachers teaching students with SEN at special schools and at inclusive schools in Germany during the COVID-19 pandemic. No

TABLE 5 | Differences between hours of digital learning before the COVID-19 pandemic and since the COVID-19 pandemic regarding school form.

	Hours per week before the COVID-19 pandemic					Hours per week since the COVID-19 pandemic					*t*-test		
	n	*M*	*SD*	min.	max.	*n*	*M*	*SD*	min.	max.	*t*	*df*	*p* (2-sited)
Special schools	48	2.38	4.09	0	21	48	8.23	9.08	0	36	−4.413	47	< 0.001
Inclusive schools	40	3.40	5.83	0	25	40	8.33	9.12	0	40	−2.901	39	0.006

Answered by teachers.

TABLE 6 | Differences between reading, writing, and mathematics regarding identification and support.

		Reading		Writing		Mathematics		*t*-test		
	n	*M*	*SD*	*M*	*SD*	*M*	*SD*	*t*	*df*	*p* (2-sited)
Identification	94	1.10	1.10	1.45	1.21	–	–	−2.703	93	0.008
	93	1.10	1.08	–	–	1.66	1.156	−4.591	92	< 0.001
	92	–	–	1.42	1.21	1.64	1.154	−2.418	91	0.018
Support	93	0.97	0.85	1.27	0.99	–	–	−3.493	92	0.001
	94	0.97	0.85	–	–	1.28	1.031	−3.184	93	0.002
	93	–		1.27	0.99	1.28	1.036	−0.179	92	0.859

Answered by teachers. Answers could be given on a five-point response scale (0 = disagree; 1 = rather disagree; 2 = undecided; 3 = rather agree; 4 = agree).

TABLE 7 | Differences between identification of difficulties and support of students with difficulties in reading, writing, and mathematics.

		Identification		Support		*t*-test		
	n	*M*	*SD*	*M*	*SD*	*t*	*df*	*p* (2-sited)
Reading	94	1.12	1.10	0.97	0.85	1.620	93	0.109
Writing	92	1.45	1.22	1.26	0.99	1.571	91	0.120
Mathematics	93	1.66	1.16	1.28	1.04	4.166	92	< 0.000

Answered by teachers. Answers could be given on a five-point response scale (0 = disagree; 1 = rather disagree; 2 = undecided 3 = rather agree; 4 = agree).

TABLE 8 | Teachers report of their TSE in distance learning.

	n	*M*	*SD*	min.	max.
Teachers at special schools	52	1.18	0.79	0	2.92
Teachers at inclusive schools	43	1.21	0.71	0.08	2.75
All teachers	95	1.19	0.75	0	2.92

Answers could be given on a five-point response scale (0 = disagree; 1 = rather disagree; 2 = undecided; 3 = rather agree; 4 = agree). All teachers = teachers of special schools and teachers of inclusive schools.

TABLE 9 | Correlations between teachers' gender, age, years of work experience, and TSE in distance learning.

		TSE		
		n	*r*	*p* (2-sited)
All teachers	Gender	95	0.00	0.978
All teachers	Age	95	0.08	0.434
All teachers	Years of work experience	95	−0.04	0.726

Point-biseral and Pearson-correlation. All teachers = teachers from special schools and teachers from inclusive schools. No separate analyses for teachers of special schools and teachers of inclusive schools because they are not significantly different in terms of age and work experience nor in their TSE in distance learning.

significant differences between teachers of special schools and teachers of inclusive schools regarding the use of digital learning, in the perceived goodness of identification of difficulties and support of students with difficulties in reading, writing, and mathematics, as well as the TSE in distance learning in general was observed here.

The results for all teachers surveyed show that teachers perceived difficulties in reading to be significantly less easy to identify than difficulties in writing and mathematics at distance. Teachers also perceived the support of students with difficulties in reading as less easy than those with difficulties in writing or in mathematics at distance. Likewise, teachers rated students with difficulties in writing significantly less easy to be identified at distance than students with difficulties in mathematics. Further, the support of students with difficulties in mathematics is perceived significantly more difficult than the identification of difficulties.

The TSE in distance learning stated by the teachers is rather low. In addition, positive correlations between identification of

TABLE 10 | Correlations between identification of difficulties as well as support of students with difficulties in reading, writing, and mathematics and TSE in distance learning.

			TSE		
			n	*r*	*p* (2-sited)
All teachers	Identification	Reading	94	0.36	<0.001
		Writing	93	0.51	<0.001
		Mathematics	93	0.53	<0.001
	Support	Reading	94	0.51	<0.001
		Writing	93	0.72	<0.001
		Mathematics	94	0.68	<0.001

Pearson-correlation. All teachers = teachers from special schools and teachers from inclusive schools. No separate analyses for teachers of special schools and teachers of inclusive schools because they are not significantly different in their TSE in distance learning.

difficulties as well as support of students with difficulties in reading, writing, and mathematics and TSE in distance learning could be found.

Teachers at Special School and Teachers at Inclusive Schools

The two groups of teachers were comparable in regard to gender, age, and years of work experience. In the descriptive analyses, the three most frequent support focuses of students supported by the teachers of special schools and teachers of inclusive schools are the support focuses in learning, emotional and social development as well as mental development. This is consistent with the most common support focuses in Germany (Eckhardt, 2019). Further, no major differences between the two groups of teachers with regard to the used devices and the most helpful methods could be investigated. As the most helpful methods in distance learning were rated no digital methods, but paper and books. Another study from Germany also shows that, especially in elementary school, tasks in distance learning are set with paper (Dincher and Wagner, 2021). This shows that distance learning in this sample of teachers of students with SEN is by definition not digital learning, but digital learning is one part of distance learning.

Digital Learning

For digital learning before the COVID-19 pandemic and digital learning since the COVID-19 pandemic no significant differences between both teacher groups could be obtained. However, significant differences were determined for all teachers in hours of digital learning before the COVID-19 pandemic and since the COVID-19 pandemic with a significant larger amount of digital learning after the beginning of the school closures due to the COVID-19 pandemic. Our data shows that a large part of distance learning is still conducted offline with worksheets, paper, and books. In addition, in the observed period, schools were not closed the whole time entirely, but many different approaches in schooling due to the pandemic containment were seen in Germany (e.g., alternating presence teaching or hybrid lessons).

Identification of Difficulties and Support of Students With Difficulties in Reading, Writing, and Mathematics

Moreover, low values could be determined for both teacher groups regarding the perceived identification of difficulties and support of students with difficulties in reading, writing, and mathematics. Apparently, difficulties in reading are perceived to be most difficult to identify and students with difficulties in reading are perceived to be the most difficult to support at distance, compared to writing, and mathematics. Likewise, difficulties in mathematics were perceived to be identified easier than difficulties in writing at distance. These results may be due to the fact that identification and support in different skills (reading, writing, and mathematics) require different competencies and materials. Previous research showed that precise identification and support of specific skills or competencies – in contrast to general supporting strategies – is crucial for a positive development of domain-specific competencies in the acquisition of academic skills (Ise et al., 2012a,b). Further research in this area is needed to explore the reasons for the differences between the academic skills (reading, writing, and mathematics) further.

The result that supporting students with difficulties in mathematics at distance is perceived significantly more challenging than identifying difficulties in mathematics at distance is supported by another study in which educational therapists were surveyed and who were asked identical questions about identification of difficulties and support of students with difficulties in reading, writing, and mathematics (Maurer et al., 2021). Based on a systematic review, Lafay et al. (2019) suggested that students with difficulties in mathematics could potentially benefit from using concrete or virtual materials (so-called manipulatives e.g., blocks or play money) in learning mathematics.

It might be possible that there are difficulties in supporting students with difficulties in mathematics in distance learning due to a lack of use of concrete materials. However, more research is needed to explore this topic further.

However, these results are very important for the time after the COVID-19 pandemic and thus, after the distance learning. It could be suggested due to the challenges in the identification of difficulties and support of students with difficulties in reading, writing, and mathematics, there is a great need for support in the matter of these academic skills in students with SEN.

Teachers' Self-Efficacy in Distance Learning

Furthermore, this study shows that TSE in distance learning is generally low for all teachers of students with SEN, regardless

of whether teachers taught at special or at inclusive schools. Because this was an online survey, it can be assumed that teachers with a greater affinity for digital media are more likely to have participated. Therefore, it could be assumed that the TSE in distance learning is possibly even lower for teachers with less affinity for digital media. Further, no significant differences could be found between both teacher groups. Studies conducted before the COVID-19 pandemic point also to no significant differences regarding TSE of teachers in special education between different teaching settings (Viel-Ruma et al., 2010). The low TSE for both, teachers from special schools and inclusive schools in this study could be due to the fact that the teachers surveyed teach students with SEN. A previous study would support these assumption, which already found that TSE during school closures was significantly lower in regard to students with SEN than to students with high achievement and a control group (Kast et al., 2021). Börnert-Ringleb et al. (2021) stated in their study that during the COVID-19 pandemic the TSE regarding the use of digital learning in special needs education is a predictor for the perceived use of digital learning. This fits with the results of the present study, because the TSE is low in this sample and the methods identified by teachers as most helpful were not digital methods, but based on paper and books. After all, two thirds of teachers of inclusive schools still named learning apps as helpful or somewhat helpful. In this study, the TSE in distance learning is not related to gender, age, nor years of work experience. Hence, the results are not consistent with previous findings with respect to TSE and years of work experience (Flores et al., 2004). Perhaps this is due to the fact that teachers have not had any experience with distance learning in their careers so far and the situation during the COVID-19 pandemic is new and challenging for everyone, regardless of gender, age, and work experience. However, a positive correlation between TSE and the perceived identification of difficulties as well as the support of students with difficulties could be found. On the one hand, this means that teachers with a higher TSE are more likely to identify difficulties in reading, writing, and mathematics. And that they feel they can better support students with difficulties in reading, writing, and mathematics at distance.

Promoting TSE in distance learning of teachers teaching students with SEN is essential. In the case of possible further school closures and distance learning in the future, teachers teaching students with SEN should be better prepared for distance learning (e.g., training in the use of digital learning in regard to students with SEN, intervisions regarding e.g., methods between the teachers), which would probably increase TSE in distance learning of teachers of students with SEN. This could promote positive effects like students' school achievement and their motivation to study (Zee and Koomen, 2016). This would be especially important for students with SEN, as these students are likely to be particularly disadvantaged and are more struggling by the distance learning during the COVID-19 pandemic (Reich et al., 2020; Scheer and Laubenstein, 2021).

LIMITATIONS

As an ad-hoc study, the results only provide insight into the distance learning situation of teachers of students with SEN during one time period of the COVID-19 pandemic in Germany. The fact that the survey was conducted online may have resulted in a sample selection. Therefore, the results cannot be generalized.

In this study the focus was laid on the teachers' experiences and perceptions only. Conclusions were only made by a self-reported questionnaire. Further studies should explore the perspective of students with SEN further as well as the effects of the school closures on academic achievements and learning motivations of students with SEN.

Moreover, due to the sample size, no distinction was made between the different support focuses. Maybe there will be found differences in future studies.

Also, comparisons between students with SEN and students without SEN should be considered. There is a risk, that due to the school closures students with SEN might fall behind students without SEN further regarding school achievement and motivation. Which could widen the gap of achievement levels between these group of students.

CONCLUSION

Due to the special learning situations that have arisen as a result of the COVID-19 pandemic, special attention must be paid to students with SEN (Holmes et al., 2020). This study is a further contribution to bringing the needs of these students and their supporting teachers into focus.

The results of this study are essential to students with SEN and their teachers. It is important to identify challenges in distance learning for students with SEN early to enable them for an equal opportunity for learning and participation.

To increase TSE in teachers of students with SEN digital skills and equipment should be promoted.

Another focus should be on identifying difficulties and supporting students with difficulties in reading, writing, and mathematics, on the one hand in case schooling have to be held at distance again and on the other hand to compensate and reduce any deficits that may have arisen during the distance learning.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because all research questions have not yet been addressed. Requests to access the datasets should be directed to Jenny Maurer, j.maurer@hsu-hh.de.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation

and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JM, AB, JH, and MD contributed to conception, design of the study, and wrote sections of the manuscript. JM organized the database, performed the statistical analysis, and wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

FUNDING

The open access publication fees were funded by the library of the Helmut Schmidt University/University of the Federal Armed Forces Hamburg.

REFERENCES

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychol. Rev.* 84, 191–215. doi: 10.1037/0033-295X.84.2.191

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York, NY: Freeman.

Becker, P. S., Breaux, R., Cusick, C. N., Dvorsky, M. R., Marsh, N. P., Sciberras, E., et al. (2020). Remote learning during COVID-19: examining school practices, service continuation, and difficulties for adolescents with and without attention-deficit/hyperactivity disorder. *J. Adolesc. Health* 67, 769–777. doi: 10.1016/j.jadohealth.2020.09.002

Börnert-Ringleb, M., Casale, G., and Hillenbrand, C. (2021). What predicts teachers' use of digital learning in Germany? Examining the obstacles and conditions of digital learning in special education. *Eur. J. Spec. Needs Educ.* 36, 1–18. doi: 10.1080/08856257.2021.1872847

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences, 2nd Edn*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Dincher, M., and Wagner, V. (2021). Teaching in times of COVID-19: determinants of teachers' educational technology use. *Educ. Econ.* 29, 461–470. doi: 10.1080/09645292.2021.1920000

Eckhardt, T. (ed.) (2019). *The Education System in the Federal Republic of Germany 2017/2018. A Description of the Responsibilities, Structures and Developments in Education Policy for the Exchange of Information in Europe*. Berlin: Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany. Available online at: https://www.kmk.org/fileadmin/Dateien/pdf/Eurydice/Bildungswesen-engl-pdfs/dossier_en_ebook.pdf (accessed April 9, 2021).

Eickelmann, B., Bos, W., and Labusch, A. (2019). "Kapitel I. Die Studie ICILS 2018 im Überblick–Zentrale Ergebnisse und mögliche Entwicklungsperspektiven. [Chapter I. The ICILS 2018 study at a glance-key findings and possible development perspectives]," in *Computer-und informationsbezogene Kompetenzen von Schülerinnen und Schülern im zweiten internationalen Vergleich und Kompetenzen im Bereich Computational Thinking*, eds B. Eickelmann, W. Bos, J. Gerick, F. Goldhammer, H. Schaumburg, K. Schwippert, M. Senkbeil, and J. Vahrenhold (Münster, NY: Waxmann), 7–31.

Flores, B. B., Desjean-Perrotta, B., and Steinmetz, L. E. (2004). Teacher efficacy: a comparative study of university certified and alternatively certified teachers. *Action Teach. Educ.* 26, 37–46. doi: 10.1080/01626620.2004.10463322

Garbe, A., Ogurlu, U., Logan, N., and Cook, P. (2020). Parents' experiences with remote education during COVID-19 school closures. *Am. J. Qual. Res.* 4, 45–65. doi: 10.29333/ajqr/8471

Goldan, J., Geist, S., and Lütje-Klose, B. (2020). "Schüler*innen mit sonderpädagogischem Förderbedarf während der Corona-Pandemie. Herausforderungen und Möglichkeiten der Förderung – das Beispiel der Laborschule Bielefeld. [Students with special educational needs during the Corona pandemic. Challenges and possibilities of support – the example of the Laborschule Bielefeld]," in *Langsam vermisse ich die Schule. Schule während und nach der Corona-Pandemie*, eds D. Fickermann, and B. Edelstein (Münster, NY: Waxmann), 189–201. doi: 10.31244/9783830992318.12

Hammerstein, S., König, C., Dreisoerner, T., and Frey, A. (2021). Effects of COVID-19-related school closures on student achievement – A systematic review. *Front. Psychol.* 12:746289. doi: 10.31234/osf.io/mcnvk

Helm, C., Huber, S., and Loisinger, T. (2021). Was wissen wir über schulische Lehr-Lern-Prozesse im Distanzunterricht während der Corona-Pandemie? – Evidenz aus Deutschland, Österreich und der Schweiz. [Meta-Review on findings about teaching and learning in distance education during the Corona pandemic–evidence from Germany, Austria and Switzerland]. *Zeitschrift für Erziehungswissenschaft* 24, 237–311. doi: 10.1007/s11618-021-01000-z

Holmes, E. A., O'Connor, R. C., Perry, V. H., Tracey, I. T., Wesseley, S., Arseneault, L., et al. (2020). Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry* 7, 547–560. doi: 10.1016/S2215-0366(20)30168-1

Huber, S. G., and Helm, C. (2020). Covid-19 and schooling: evaluation, assessment and accountability in times of crises – reacting quickly to explore key issues for policy, practice and research with the school barometer. *Educ. Assess. Eval. Account.* 32, 237–270. doi: 10.1007/s11092-020-09322-y

Ise, E., Engel, R. R., and Schule-Körne, G. (2012a). Was hilft bei der Lese-Rechtschreibstörung? Ergebnisse einer Metaanalyse zur Wirksamkeit deutschsprachiger Förderansätze. *Kindheit und Entwicklung* 21, 112–136. doi: 10.1026/0942-5403/a000077

Ise, E., Engel, R. R., and Schule-Körne, G. (2012b). Effektive Förderung rechenschwacher Kinder. Eine Metaanalyse. *Kindheit und Entwicklung* 21, 181–192. doi: 10.1026/0942-5403/a000083

Kaiser, H. F., and Rice, J. (1974). Little jiffy, mark IV. *Educ. Psychol. Meas.* 34, 111–117. doi: 10.1177/001316447403400115

Kast, J., Lindner, K. T., Gutschik, A., and Schwab, S. (2021). Austrian teachers' attitudes and self-efficacy beliefs regarding at-risk students during home learning due to COVID-19. *Eur. J. Spec. Needs Educ.* 36, 114–126. doi: 10.1080/08856257.2021.1872849

Klassen, R. M., Bong, M., Usher, E. L., Har Chong, W., Huan, V. S., Wong, I. Y. F., et al. (2009). Exploring the validity of a teachers' self-efficacy scale in five countries. *Contemp. Educ. Psychol.* 34, 67–76. doi: 10.1016/j.cedpsych.2008.08.001

Klemm, K., and Preuss-Lausitz, U. (2017). *Inklusion in Progress. Analysen, Herausforderungen, Empfehlungen. [Inclusion in Progress. Analyses, Challenges, Recommendations]*. Washington, DC: Heinrich-Böll-Stiftung.

Kölm, J., Gresch, C., and Haag, N. (2017). "Hintergrundmerkmale von Schülerinnen und Schülern mit sonderpädagogischem Förderbedarf an Förderschulen und an allgemeinen Schulen [Background characteristics of students with special educational needs at special schools and at general schools]," in *Kompetenzen in den Fächern Deutsch und Mathematik am Ende der 4. Jahrgangsstufe im zweiten Ländervergleich*, eds P. Stanat, S. Schipolowski, C. Rjosk, S. Weirich, and N. Haag (Münster, NY: Waxmann), 291–301.

König, J., Jäger-Biela, D., and Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany. *Eur. J. Teach. Educ.* 43, 608–622. doi: 10.1080/02619768.2020.1809650

Lafay, A., Osana, H. P., and Valat, M. (2019). Effects of interventions with manipulatives on immediate learning, maintenance, and transfer in children with mathematics learning disabilities: a systematic review. *Educ. Res. Int.* 2019:2142948. doi: 10.1155/2019/2142948

Maurer, J., Hilkenmeier, J., Becker, A., and Daseking, M. (2021). *Digitale Lerntherapie – Neue Wege während der Corona-Pandemie.* [Digital educational therapy–New directions during the Corona pandemic]. MedienPädagogik.

Müller, K., Prenzel, M., Sälzer, C., Mang, J., Heine, J. H., and Gebhardt, M. (2017). Wie schneiden Schülerinnen und Schüler an Sonder- und Förderschulen bei

PISA ab? Analysen aus der PISA 2012-Zusatzerhebung zu Jugendlichen mit sonderpädagogischem Förderbedarf. [How do students in special and special needs schools perform in PISA? Analyses from the PISA 2012 supplementary survey on adolescents with special educational needs]. *Unterrichtswissenschaft* 45, 175–192.

Nusser, L. (2021). Learning at home during COVID-19 school closures – How do German students with and without special educational needs manage? *Eur. J. Spec. Needs Educ.* 36, 51–64. doi: 10.1080/08856257.2021.1872845

OECD (2020). *Strengthening Online Learning When Schools are Closed: The Role of Families and Teachers in Supporting Students During the COVID-19 Crisis*. Paris: OECD.

Reich, J., Buttimer, C. J., Fang, A., Hillaire, G., Hirsch, K., Larke, L., et al. (2020). *Remote Learning Guidance from State Education Agencies During the COVID-19 Pandemic: A First Look*. Available online at: https://osf.io/b457v/ (accessed June 21, 2021).

Runge, I., Rubach, C., and Lazarides, R. (2021). Digitale Kompetenzselbsteinschätzung von Lehrkräften–Welche Bedeutung haben Schulausstattung und Fortbildungsteilnahme angesichts aktueller Herausforderungen? [Digital competence self-assessment of teachers–what is the importance of school equipment and training participation in the face of current challenges?]," in *Jahrbuch Schulleitung,* ed S. G Huber (Kronach and Köln: Carl Link). Available online at: https://www.uni-potsdam.de/fileadmin/projects/schulnetzwerkdigital/Dokumente/Runge_Lazarides_Digitale_Selbsteinscha%CC%88tzung_von_Lehrkra%CC%88ften.pdf

Sansour, T., and Bernhard, D. (2018). Special needs education in Germany and Sweden. *Alter* 12, 127–139. doi: 10.1016/j.alter.2017.12.002

Scheer, D., and Laubenstein, D. (2021). The impact of COVID-19 on mental health and psycho-social conditions of students with and withound special educational needs in emotional and behavioral disorders in Germany. *[Preprint]*. doi: 10.35542/osf.io/qfsv2

Schnoes, C., Reid, R., Wagner, M., and Marder, C. (2006). ADHD among students receiving special education services: a national survey. *Counc. Except. Stud.* 72, 483–496. doi: 10.1177/001440290607200406

Schwab, S. (2019). Teachers' student-specific self-efficacy in relation to teacher and student variables. *Educ. Psychol.* 39, 4–18. doi: 10.1080/01443410.2018.1516861

Skaalvik, E. M., and Skaalvik, S. (2010). Teacher self-efficacy and teacher burnout: a study of relations. *Teach. Teach. Educ.* 26, 1059–1069. doi: 10.1016/j.tate.2009.11.001

Steinmayr, R., Lazarides, R., Weidinger, A. F., and Christiansen, H. (2021). Teaching and learning during the first COVID-19 school lockdown: realization and associations with parent-perceived students' academic outcomes. *Zeitschrift für Pädagogische Psychol.* 35, 85–106. doi: 10.1024/1010-0652/a000306

Thorell, L. B., Skoglund, C., de la Peña, A. G., Baeyens, D., Fuermaier, A. B., Groom, M. J., et al. (2021). Parental experiences of homeschooling during the COVID-19 pandemic: differences between seven European countries and between children with and without mental health conditions. *Eur. Child Adolesc. Psychiatry*. doi: 10.1007/s00787-020-01706-1. [Epub ahead of print].

Viel-Ruma, K., Houchins, D., Jolivette, K., and Benson, G. (2010). Efficacy beliefs of special educators: the relationships among collective efficacy, teacher self-efficacy, and job satisfaction. *Teach. Educ. Spec. Educ.* 33, 225–233. doi: 10.1177/0888406409360129

Vuorikari, R., Velicu, A., Chaudron, S., Cachia, R., and DiGioia, R. (2020). *How Families Handled Emergency Remote Schooling During The Covid-19 Lockdown in Spring 2020–Summary of Key Findings From Families With Children in 11 European Countries*. Ridgefield: JRC.

Wocken, H., and Gröhlich, C. (2007). "Kompetenzen von Schülerinnen und Schülern an Hamburger Förderschulen. [Competencies of students at Hamburg special schools]," in *KESS 7: Kompetenzen und Einstellungen von Schülerinnen und Schülern der Jahrgangsstufe* 7, eds W. Bos, and M. Bonsen (Münster, NY: Waxmann), 133–142.

Zee, M., and Koomen, H. M. (2016). Teacher self-efficacy and its effects on classroom processes, student academic adjustment, and teacher well-being: a synthesis of 40 years of research. *Rev. Educ. Res.* 86, 981–1015. doi: 10.3102/0034654315626801

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 30 November 2021
doi: 10.3389/fpsyg.2021.733428

How Children and Adolescents Perceive Their Coping With Home Learning in Times of COVID-19: A Mixed Method Approach

Inga Simm, Ursula Winklhofer, Thorsten Naab, Alexandra N. Langmeyer and Anja Linberg*

German Youth Institute (DJI), Munich, Germany

With the COVID-19 pandemic, children and adolescents confronted a completely new learning situation. Instead of learning in class, they had to cope with home learning to achieve academically. This mixed-method study examines how children and adolescents in Germany perceive their coping success with home learning during the COVID-19 pandemic and how personal, school, family, and peer context factors relate to this self-perceived coping success. Quantitative data from an online survey of $n = 141$ children ($m_{age} = 10{,}8$y) and $n = 266$ adolescents ($m_{age} = 15{,}2$y; study 1) were used to analyze the questions with multiple regression analysis. With the qualitative data from 10 interviews with parents and their children (study 2), we examined the process of how school, family, and peer groups interact with students' way of coping with home learning. Quantitative data show that most children and adolescents perceived their coping with home learning as successful and that school joy before COVID-19, parental support, and available equipment during home learning are still relevant for children, and family climate, calm place to learn, and equipment during home learning are important for adolescents learning at home. Qualitative data show that students apply individual ways of coping with home learning, where family and peers have a vital role, especially when contact with teachers is limited. Quantitative data confirm the importance of family context for students' self-perceived coping success.

Keywords: home learning, COVID-19, children and adolescents, student characteristics, coping, mixed-method analysis, family, peers

OPEN ACCESS

Edited by:
Sina Fackler,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Jennifer Paetsch,
University of Bamberg, Germany
Zhi Hong Wan,
The Education University of Hong Kong, Hong Kong SAR, China
Anna Volodina,
University of Bamberg, Germany

****Correspondence:***
Inga Simm
simm@dji.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *04 November 2021*
Published: *30 November 2021*

Citation:
Simm I, Winklhofer U, Naab T, Langmeyer AN and Linberg A (2021) How Children and Adolescents Perceive Their Coping With Home Learning in Times of COVID-19: A Mixed Method Approach. Front. Psychol. 12:733428. doi: 10.3389/fpsyg.2021.733428

INTRODUCTION

Depending on student characteristics and the context of their support, learning already holds challenges for many students in school (Wang et al., 1993; Doll and Prenzel, 2004; Helmke, 2007). However, with the COVID-19 pandemic, new challenges arose, and many existing ones intensified (Blume et al., 2021). Due to school closures in spring 2020 related to COVID-19 restrictions in Germany, schools no longer offered a learning environment characterized by students' interactive and analog learning with peers (Schiepe-Tiska et al., 2016a; Eickelmann et al., 2019) under the guidance and support of the teacher (Hattie, 2010). Instead, home

learning became the main form of scholastic learning. In Germany, this meant teachers provided exercises, and parents were required to offer learning support, while physical contact with classmates was restricted (Wildemann and Hosenfeld, 2020; Wößmann et al., 2020). Therefore, digital devices gain importance to participate in scholastic learning.

Students, parents, and teachers expected home learning to adversely affect the learning behavior of children and adolescents (Helm et al., 2021). However, initial results showed that students in Germany cope differently with home learning. The amount of time students spent learning was lower than before and showed high variances between students (Wößmann et al., 2020; Helm et al., 2021). At the same time, many students reported having no problems with self-organization (Helm et al., 2021).

A well-studied finding is that students' states and traits and their school, family, and peer context influence learning outcomes (Wang et al., 1993; Doll and Prenzel, 2004; Helmke, 2007). Like in-class learning, there are more or less supporting variables for children and adolescents' in-home learning in the COVID-19 pandemic (Müller and Ehmke, 2016). Compared to adolescents, children tend to ask more for support from their parents to cope with a new situation. In line with this finding, parents of children compared to adolescents reported a higher amount of time needed to support students' home learning in Germany in times of COVID-19 (Wildemann and Hosenfeld, 2020). Further results on learning during the COVID-19 pandemic showed that students who have good grades tend to spend more time learning at home than others. Furthermore, students from higher socio-economic backgrounds report higher perceived learning success, higher learning motivation, more autonomy, and more parental support in home learning. Nevertheless, current studies about home learning (Fickermann and Edelstein, 2020; Huber and Helm, 2020; Thorell et al., 2020) miss out on students' peer context even though peers play an important role in class learning. Classmates can support each other by motivating or explaining on eye level (Wecker and Fischer, 2014).

Therefore, the present study examines students' self-evaluation and process of coping successfully with home learning and its relation to students' support from school, family, and peers. The study applies a mixed-methods design that extends previous research by combining quantitative data about the self-perceived coping success with qualitative data about the process of coping to provide a more complete and nuanced picture than would have been possible with either approach alone. In addition to its value for current research, our paper adds to the knowledge of models of home learning in times of school closures. Finally, considering policymakers, administrators, and school personnel, our paper highlights critical factors that promote or hinder successful home learning.

COPING WITH HOME LEARNING

Lazarus and Folkman (1984) defined coping as constantly changing cognitive and behavioral efforts to address specific value-related demands. Studies indicate the importance of coping strategies to facilitate positive, adaptive outcomes (Sprang and Silman, 2013). Due to the COVID-19 lockdown, children and adolescents experienced a dramatic shift in how school learning works. To achieve academically in times of COVID-19 lockdown, students must learn to cope with the demands of this new learning situation. Theory and research on coping and learning, therefore, provide a framework to empirically examine students' coping with learning at home during the COVID-19 pandemic. The way students cope with new situations depend on personal predispositions and their context (La Fuente et al., 2017). Thus, we distinguish in our model between context, person, and outcome (**Figure 1**).

Like other models of home learning before the COVID-19 pandemic (e.g., Trautwein et al., 2006) and in times of the COVID-19 pandemic (Helm et al., 2021), we consider the impact of student characteristics and school and family context on students' coping with home learning. Similar to homework, children and adolescents in home learning are confronted with school-related tasks in the home environment. Therefore, homework models (e.g., Trautwein et al., 2006; Moroni et al., 2015) provide a basis for considering the relationships among achievement, homework behavior, homework motivation, student characteristics, parent role, and learning situation. They hypothesize that student characteristics, parent role, and learning situation are central factors in student motivation and behavior, which in turn affect student achievement. The models focus on three main protagonists: students, teachers, and parents. In our theoretical model, we included student peer group as an additional source of help for students in times of home learning.

Students' Characteristics: Children's and Adolescents' Achievement and Motivational-Affective Prerequisites in the COVID-19 Pandemic

Children and adolescents who have bad grades, do not believe in their own abilities, and do not enjoy learning are more likely challenged with learning (Bandura, 1993; Seidel, 2006; Helmke, 2007). Therefore, students' academic achievement, self-efficacy, and school joy might also play a central role in successfully coping with home learning. Furthermore, students of different age and gender cope differently with demands.

Academic achievement includes students' success in learning. In school, grades are a conventional way to display students' academic achievement. Although grades are not without controversy, they appear to be a significant indicator of students' prior knowledge, engagement, and success in school and a predictor of subsequent professional careers (Elsäßer, 2018). Therefore, it can be expected that students who cope successfully with learning before the COVID-19 pandemic might also cope with home learning in the COVID-19 pandemic.

Self-efficacy and *school joy* are essential motivational-affective prerequisites of students. While self-efficacy is one's subjective belief in the ability to complete specific tasks in school and overcome obstacles and difficulties (Schwarzer and Jerusalem, 1999), school joy is more connected to the affective part of

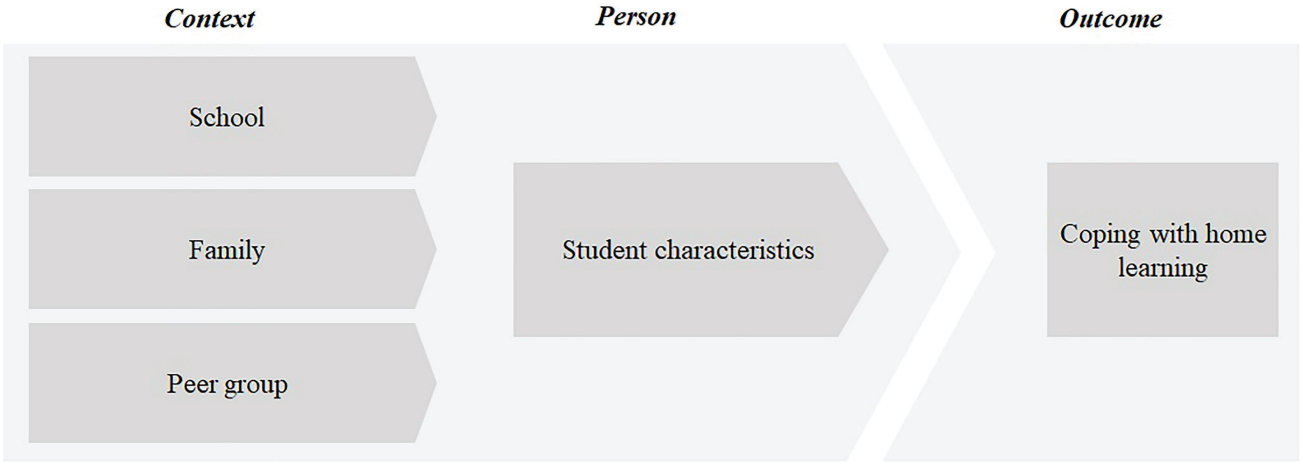

FIGURE 1 | Theoretical model.

the motivation. Self-efficacy is nurtured by comparing with others and feedback from people in their social background (Bandura, 1977). While self-efficacy and enjoyment are strongly related to students' academic achievement, believing in one's abilities and enjoying learning might also help students cope with challenging learning situations. Previous studies showed that children and adolescents who have and believe in having the necessary abilities show more effort and perseverance in learning even when they face obstacles (Bandura, 1993; Parker et al., 2014).

Furthermore, self-efficacious people are more likely to cope with new situations and challenges (Bandura, 1977; Wigfield et al., 2015). Children compared to early adolescents show more self-efficacy, and girls compared to boys tend to underestimate their abilities (Schiepe-Tiska et al., 2016b; Skinner and Saxton, 2019). Moreover, children and girls show a higher tendency to seek the help of others to cope with challenging situations (Skinner and Saxton, 2019). Besides the well-known *gender* differences between boys' and girls' self-efficacy, Blume et al. (2021) showed that primary students' gender also correlates with their task enjoyment in times of COVID-19.

Studies showed variances in students' academic achievement and motivation during home learning due to the COVID-19 pandemic. A first review showed that between one-fifth and one-half of the young respondents expect negative consequences on their learning success (Helm et al., 2021), while a third of them enjoyed learning at home (Helm et al., 2021). Students who have difficulties organizing and motivating themselves show more problems in coping with learning at home than in school (Becker et al., 2020; Goldan et al., 2020). Parents predominantly describe their children and adolescents as motivated and expected consistent achievements, while most teachers disagree with parents' impressions (Wildemann and Hosenfeld, 2020; Helm et al., 2021).

The importance of *age differences* is well known for successful coping (Zimmer-Gembeck and Skinner, 2011; Skinner and Saxton, 2019). While children need more help from others (e.g., parents and teachers), more independent adolescents are asked to organize and encourage themselves (Zimmer-Gembeck and Skinner, 2011). In help-seeking, family members are central contact persons in childhood. In the shift to adolescence, peers become more important to ask for help (Berndt, 1999).

From this point of view, we support the need for differentiation between children and adolescents and their achievement and self-efficacy to examine the effect on their coping with home learning.

Contextual Effects for Children's and Adolescents' Coping With Learning in the COVID-19 Pandemic

Besides individual factors, children and adolescents are embedded in contexts. Central factors that describe contexts are relationships with people, processes, and materials (Bronfenbrenner, 1986). Also, being in the same context, these factors can be perceived very differently by different people.

These contexts play a central role in students' learning (Seidel and Shavelson, 2007; Bronfenbrenner, 2012; Ditton, 2013; Vollet et al., 2017; Skinner and Saxton, 2019; Lyell et al., 2020). The most common contexts that affect children's and adolescents' learning are school, family, and peer group.

School Context

School is an institutional context that familiarizes children and adolescents with different forms and contents of systematic learning. Schools were ill-prepared for the pandemic-related school closures. They lacked digital infrastructure, especially in primary schools (Eickelmann et al., 2019; Eickelmann and Gerick, 2020).

During this time, teachers offered most students digital learning materials (Huber and Helm, 2020), which they received *via* email, learning platform, cell phone, or video conference (Huebener et al., 2020; Helm et al., 2021). Between 40 and 70% of students report that digital teaching was offered within

the first weeks after school closure, while others did not. Furthermore, students perceived teaching as having little cognitive activation or individual support (Helm et al., 2021). Between one-third and one-half of students missed contact with their teachers, stating that personal contact with teachers was rare (Helm et al., 2021).

As the time students spend learning seems to play a central role in school (Seidel and Shavelson, 2007), the variance of time students spend in home learning and contact with their teacher must be considered (Helm et al., 2021). Studies show that video conferences and teacher contact were reported more frequently by students from Gymnasium (Germany's highest school track) than in other types of schools (Huebener et al., 2020; Helm et al., 2021).

Family Context

Besides the school context, students' family economic, social, and cultural backgrounds have always been directly and indirectly linked to student outcomes and development (Boudon, 1974; Conger and Donnellan, 2007; Helmke, 2007; Bourdieu, 2012). Family stress models and family investment models emphasize the importance of parental economic situation for the development and well-being of children and adolescents (Conger and Donnellan, 2007). This link was often explained by the broader possibilities of sufficient income or certain educational attainment to support children and adolescents (Maaz et al., 2014; Moroni et al., 2015; Müller and Ehmke, 2016) and the stress that economic pressure can cause in families (Conger and Donnellan, 2007). School engagement of parents was likely to enhance students' school engagement and achievement even for lower performing students (Im et al., 2016). During early adolescence, it is more the indirect forms of parent involvement in school (e.g., parent-child communication about the school, discussing educational aspirations) that are associated with achievement than direct forms (e.g., helping with homework; Fan and Chen, 2001; Hill and Tyson, 2009). Compared to other countries, the direct and indirect relations between students' socio-economic backgrounds and students' coping with learning are highly linked in Germany (Müller and Ehmke, 2016).

As the contact with the teacher was limited in times of the COVID-19 pandemic in Germany, many parents reported having helped, especially their children but also adolescents, more in home learning than before (Thorell et al., 2020; Wildemann and Hosenfeld, 2020; Helm et al., 2021). Besides the learning situation itself, the COVID-19 pandemic confronted families with different challenges like financial problems or social isolation that can cause stress. Households with lower socio-economic status and single parents were especially threatened by this (Zinn and Bayer, 2021). Some parents also described their relationship with their children and adolescents as more strained than in the past (Wildemann and Hosenfeld, 2020). In families where the COVID-19 pandemic changed family dynamics and interactions, children and adolescents' well-being and coping with learning may deteriorate (Achterberg et al., 2021).

Besides the financial burdens families face, parents need to engage with educational media matters: To receive learning material or contact their teacher, students in primary and secondary school need technical equipment. As children and adolescents might not be familiar with handling technical equipment, parents supported particularly young children's media use (Gerhardts et al., 2020; Züchner and Jäkel, 2021). Most students reported that necessary equipment was available (Wildemann and Hosenfeld, 2020), while between 3 and 25% had difficulties with the availability of technical equipment at home (Helm et al., 2021).

Peer Group Context

In recent years, research on learning has included friends, classmates, and peer groups (Kindermann and Skinner, 2009; Wentzel and Ramani, 2016). For peers' effect on learning, the most common perspective is that peers, like families and school, are sources of motivation, aspiration, and interaction partners (Hanushek et al., 2003). Compared to teachers or parents, peer groups are relationships where children and adolescents can explore, try new things, encourage, inspire, and support each other on eye level (Brandes and Schneider-Andrich, 2017). By functioning as informational support or role models, by motivating each other to hang on to a task, or by stabilizing each other emotionally, peers have been a valuable resource for learning (Youniss, 1994; Hanushek et al., 2003; Kindermann and Skinner, 2009; Ditton, 2013; Brandes and Schneider-Andrich, 2017). Nevertheless, children and adolescents are more strongly influenced by peers with whom they have high-quality interactions (Barry and Wentzel, 2006). It is therefore important that research also focuses on the quality of interactions and how satisfied children and adolescents are with their relationships with their peers.

Due to contact restrictions and social distancing, many children and adolescents did not see their friends and peers physically (Wildemann and Hosenfeld, 2020). Thanks to modern technology, most students reported getting support from friends virtually (Medienpädagogischer Forschungsverbund Südwest, 2020). Previous studies also show that the engagement of students' peer groups thereby influences students' school behavior (Kindermann and Skinner, 2009). However, other studies showed that children's naturally existing peer groups have only a modest effect on academic development (Kindermann and Skinner, 2009).

While based on homework research, central models about home learning in times of the COVID-19 pandemic hardly take students' peer context into account (Huber and Helm, 2020). Therefore, limited attention has been given to the mechanisms through which peers affect outcomes.

THE PRESENT STUDY

The current mixed-methods study examines the variance in students' learning in times of COVID-19 concerning characteristics and contextual resources within their school, family, and peer context. Therefore, this study addresses three research questions:

RQ1: What challenges do students and parents face in home learning, and how do they cope with them?

RQ2: How do individual characteristics (academic achievement, motivational-affective prerequisites, age group, and gender) relate to students' self-perceived coping success?

RQ3: What effect does school, family, and peer support have on students' self-perceived coping success?

Thus far, studies on this topic are limited to either qualitative or quantitative data. With the present study, we use a mixed-methods design to answer our research questions. Mixed-method research collects, analyzes, and mixes quantitative and qualitative data in a single study (Creswell and Plano Clark, 2018). We collected data simultaneously within different sample groups. Study 1 addresses the relationships between individual, family, and institutional contexts with self-perceived coping success (RQ2 and RQ3). For this purpose, we analyzed data from an online survey to validate our theoretical model. Study 2 looks at the individual perspectives of children and their parents on the changes in their (learning) everyday life due to the home learning situation. On the one hand, the study focuses on the personal challenges experienced and how they are overcome (RQ1), but on the other, the study elaborates the importance of parental and peer support for the home learning contexts of the students (RQ3). We addressed these questions through semi-structured interviews with students and their parents. Our interviews focused on students' learning situations and their strategies to adapt to the new teaching and learning situation and cope with the associated challenges. Especially the role of teachers, parents, and peers can be presented in detail. We integrate the quantitative and qualitative data to gain a better understanding of students' self-perceived coping success. The operationalization and basis of investigation can be seen in **Figure 2**.

STUDY 1

Method

Sample

Our analysis uses data from the first wave of the large-scale, representative German survey "Growing up in Germany" (Aufwachsen in Deutschland: Alltagswelten; AID:A; Kuger et al., 2021) collected in 2019 and data from a COVID-19-specific add-on module during summer and fall 2020. Both datasets were collected *via* standardized computer-assisted personal interviews. The AID:A 2019 probability sample focuses on 0- to 32-year-old target persons sampled with all household members following a stratified sampling process. For the COVID-19 survey, all target persons were contacted again. Our analysis included all students in general schools (except students with special needs) participating in both waves. This procedure resulted in a total sample size of 407 German children and adolescents from 330 households for study 1, which we analyzed in two subsamples: children aged 9–12 years ($n = 141$) and adolescents aged 13–18 years ($n = 266$). Further sample details can be found in **Table 1**.

Measures

Students' self-perceived coping success, characteristics, school context, family context, and peer group context were assessed by the following variables (for descriptives, see **Table 1**). Items for students' characteristics were collected between August and September 2019, while all others were collected in summer 2020. All variables were based on students' self-report. The COVID-19-specific items focused on the time of strict restrictions at the beginning of the COVID-19 pandemic in Germany, from mid-March to the end of April 2020.

Students' Coping With Home Learning

In order to assess students' coping with home learning, their perception of its success was assessed *via* a self-developed item. Students reported to what extent the statement "During the time of strict restrictions due to COVID-19, I did well with learning at home" applies to them. Participants indicated their level of agreement on a six-point scale ranging from (1) does not apply at all to (6) does fully apply.

Student's Characteristics

As students' characteristics, we included inherent characteristics such as *age* in years and students' *gender* (0 = boy, 1 = girl) as well as academic achievement and self-efficacy, which were reported in the 2019 survey: students' mean grade (combined math and literacy grade) in their last report card (in which 1 indicates the best and 6 the worst grade), their *self-efficacy*, which was assessed *via* four items on a four-point scale (e.g., "I can find a solution to any problem"; Cronbach's $\text{alpha}_{\text{children}} = 0.57$; Cronbach's $\text{alpha}_{\text{adolescents}} = 0.68$) ranging from (1) is not true – (4) is totally true (Schwarzer and Jerusalem, 1999), as well as in the children's sample *school joy* ("All in all, I like going to school;" four-point scale (4) does fully apply (1) does not apply at all).

School Context

For the school context, we considered student-reported *teacher contact*, which was given if students indicated that during the time of strict COVID-19 restrictions, they had regular contact with their teachers *via* video conferencing or chats (0 = no 1 = yes). Furthermore, the *amount of time* spent with home learning was considered, for which students were asked how long per day they worked at home for school during the time of strict restrictions (1 = not at all, 2 = less than 2 h daily, 3 = 2–4 h daily, and 4 = over 4 h daily). In addition, we considered the *school track* in the respective sample. In the children sample, a dummy indicated if children attended primary school in 2019 and in the adolescent sample if the students attended the highest school track (gymnasium; both 0 = no; 1 = yes).

Family Context

As socio-economic characteristics of the family, we included in our analysis *highest socio-economic status in the household* (highest ISEI 08; Ganzeboom, 2010), *migration background* (based on country of birth; 0 = neither student nor parent was born abroad, 1 = student or at least one parent was born abroad), as well as

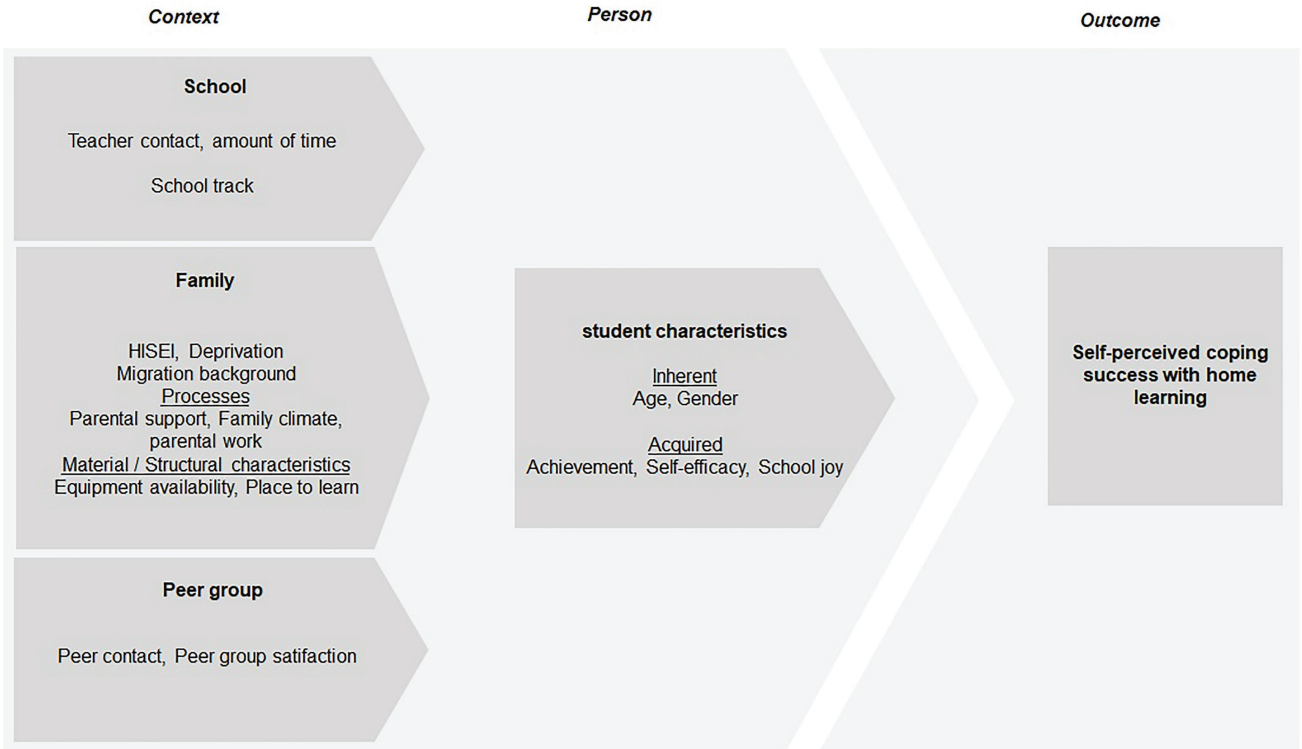

FIGURE 2 | Operationalising model.

financial deprivation of the family. Families' level of *deprivation* was assessed with three indicators. Respondents were asked to indicate whether the following statements applied to their financial situation (1 = yes; 2 = no because of financial reasons; 3 = no because of other reasons): "We can put away money each month," "We can replace furniture," and "We can pay for unexpected expenses." We generated a sum score of all negative replies to these three items (indicating 0 = no deprivation; 1 = deprivation, counting one or more; Townsend, 1979; Berg et al., 2018). Furthermore, we considered *family climate*, which was assessed *via* four items [e.g., "I like being with my family," "In our family, we can talk about everything," on a six-point scale (Cronbach's alpha $_{children} = 0.76$; Cronbach's $alpha_{adolescents} = 0.58$); Moos and Moos, 1981]. Moreover, students reported for the time of strict COVID-19 restrictions, the frequency of *parental support* of their learning at home, if all needed technical *equipment were available*, and if they had a *calm place to learn* (1 = never, 2 = sometimes, 3 = often, and 4 = always). Furthermore, the *parental work* in times of COVID-19 pandemic (0 = no; 1 = yes) was reported using parents' information if they use any possibility to work less (e.g., short-time work and vacation).

Peer Context

For peer context, we included two single items. Students provided information about their *peer group satisfaction* by answering how satisfied they currently are with their peer group. They could indicate this on a six-point scale ranging from (1) not at all satisfied to (6) totally satisfied. In addition, they were asked in a multiple response question whom they had asked for advice and support in difficult situations during the period of severe restrictions imposed by COVID-19. We coded *peer support* (0 = no; 1 = yes).

Analytical Strategy

A stepwise and robust multigroup regression analysis was run to examine the variance of students' self-perceived coping success with home learning and its relation to students' characteristics and context. Covariances and clustered SEs were used to take the nested data structure (children in households) into account. Missing values of the variables (max. 27% for peers support) were treated using full information maximum likelihood estimation (Enders, 2001; Acock, 2013) and all valid information of all observations with Stata 15. Analyses were performed separately for primary and secondary school children.

Results

Descriptive Results on Children's and Adolescents' Self-Perceived Coping Success

Descriptive results demonstrate that, on average, children ($M = 4.44$; $SD = 1.50$) and adolescents ($M = 4.47$; $SD = 1.34$) assessed their coping with home learning to be good. However, 22.0% of children and 21.8% of adolescents reported low values (scale level 1–3) in self-perceived coping success with home learning. Within their home learning, children received exercises from their school digitally (90.8%) and in person or by mail

TABLE 1 | Descriptives.

	Children					Adolescents				
	n	*M*	*SD*	Min	Max	*n*	*M*	*SD*	Min	Max
Student's coping with home learning	141	4.44	1.50	1	6	266	4.47	1.35	1	6
Students' characteristics										
Age	141	10.9	0.96	9	12	266	15.2	1.60	13	18
Gender (0 = boy; 1 = girl)	141	0.52	0.50	1	2	266	0.53	0.50	1	2
Self-efficacy	140	2.95	0.53	1	4	266	2.89	0.44	1	4
Grade	132	2.09	0.74	1	5	259	2.42	0.78	1	5
School joy	134	3.35	0.71	1	4					
School context										
Teacher contact	141	0.34	0.48	0	1	266	0.14	0.35	0	1
Amount of time: home learning	141	2.78	0.63	1	4	265	2.96	0.75	1	4
School track: primary school	141	0.18	0.39	0	1					
School track: gymnasium						263	0.68	0.47	0	1
Family context										
HISEI	137	65.1	17.7	22.2	88.7	263	64.4	18.4	11.7	89.0
Deprivation	140	0.23	0.42	0	1	264	0.19	0.39	0	1
Migration background	139	0.20	0.40	0	1	266	0.20	0.40	0	1
Parental support	129	3.51	0.71	1	4	266	2.52	1.05	1	4
Family climate	129	5.21	0.61	3.75	6	265	4.70	0.96	1.50	6
Equipment availability	140	3.71	0.62	1	4	266	3.70	0.58	1	4
Calm place to learn	141	3.51	0.68	1	4	266	3.64	0.64	1	4
Parental work situation	84	0.67	0.47	0	1	120	0.68	0.47	0	1
Peer context										
Peer support	113	0.44	0.50	0	1	193	0.78	0.42	0	1
Peer group satisfaction	128	5.41	0.98	2	6	266	5.19	1.08	1	6

(34.0%). Almost all adolescents reported having received exercises from their school digitally (99.6%), and 13.9% of adolescents received exercises in person or by mail. Furthermore, 34.8% of the children and more than half of adolescents were frequently in contact with their teachers by video or chat.

To examine the role of family context for students' self-perceived coping success with learning in times of COVID-19 (Q3), correlations within children's (see **Table 1**, **Appendix**) and adolescents' (see **Table 2**, **Appendix**) family contexts are reported. There is a significant correlation between children's and adolescents' equipment availability with HISEI ($r_{children} = 0.27$, $p < 0.05$, and $r_{adolescents} = 0.16$, $p < 0.05$) and deprivation ($r_{children} = 0.35$, $p < 0.001$, and $r_{adolescents} = -0.32$, $p < 0.001$). For children, there is a strong correlation between equipment availability and parental support ($r_{children} = 0.24$, $p < 0.01$) and between calm place to learn and deprivation ($r_{children} = -0.28$, $p < 0.001$). For adolescents, the highest correlation is between calm place to learn and family climate ($r_{adolescents} = 0.35$, $p < 0.001$). Further bivariate correlations are displayed in **Table 1** for children and **Table 2** for adolescents.

The Relation Between Children's and Adolescents' Self-Perceived Coping Success With Their Characteristics and Context: Multiple Regression Analysis

A multiple regression analysis was applied regarding children's and adolescents' self-perceived coping success with learning and the effect of individual characteristics and school, family, and peer support (RQ2 and RQ3). **Table 2** summarizes its results by reporting standardized coefficients (β), SE, and p values (p) for children and **Table 3** for adolescents.

In Model 1, children's characteristics explained 8% of the variance in their self-perceived coping success with home learning ($R^2 = 0.08$). For adolescents, their characteristics explained 11% of the variance in their learning success ($R^2 = 0.11$). Adolescents' grades negatively predicted their self-perceived coping success with home learning ($\beta = -0.28$, $p < 0.001$) as grade 1 in the German school system is "very good," and six is "insufficient."

Regarding students' and adolescents' school context only (Model 2), between 1% for children's ($R^2 = 0.01$) and 2% of adolescents' ($R^2 = 0.02$) variance in their self-perceived coping success with home learning can be explained. For adolescents, the amount of time they spend in home learning positively predicts their self-perceived coping success with home learning ($\beta = 0.15$, $p < 0.05$).

With variables of students' family context (Model 3), 19% of the variance for children's self-perceived coping success with home learning ($R^2 = 0.19$) and 18% of adolescents' self-perceived coping success with home learning ($R^2 = 0.18$) were explained. Adolescents' self-perceived coping success with home learning is predicted by their family climate ($\beta = 0.22$, $p < 0.01$), equipment availability ($\beta = 0.16$, $p < 0.05$), and calm place to learn ($\beta = 0.23$, $p < 0.01$).

TABLE 2 | Individual and contextual predictors of children's self-perceived coping success with home learning.

Predictors of student's coping with home learning	Model 1			Model 2			Model 3			Model 4			Model 5		
	β	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*
Students' characteristic															
Age	−0.024	0.089	0.786										−0.059	0.101	0.561
Gender	−0.039	0.082	0.636										0.016	0.083	0.851
Self-efficacy	0.090	0.087	0.303										0.110	0.090	0.219
Grade	−0.151	0.115	0.192										−0.029	0.096	0.764
School joy	0.160	0.081	0.050										**0.200**	**0.080**	**0.014**
School context															
Teacher contact				0.071	0.083	0.387							0.108	0.080	0.179
Amount of time: home learning				−0.030	0.076	0.690							0.029	0.077	0.708
School track: primary school				−0.041	0.083	0.623							−0.004	0.100	0.968
School track: gymnasium															
Family context															
HISEI							0.092	0.077	0.233				0.040	0.085	0.638
Deprivation							0.061	0.095	0.519				0.033	0.100	0.744
Migration background							0.046	0.106	0.663				0.013	0.129	0.920
Parental support							0.133	0.081	0.103				**0.168**	**0.082**	**0.042**
Family climate							0.044	0.081	0.589				−0.080	0.090	0.372
Equipment availability							**0.238**	**0.116**	**0.040**				0.204	0.114	0.074
Calm place to learn							**0.201**	**0.102**	**0.049**				**0.220**	**0.104**	**0.035**
Parental work							−0.095	0.098	0.331				−0.130	0.106	0.223
Peer context															
Peer support										−0.067	0.089	0.454	−0.052	0.093	0.579
Peer group satisfaction										0.155	0.094	0.099	0.121	0.103	0.242
R^2	**0.075**			**0.007**			**0.185**			**0.028**			**0.294**		

n = 141 children. β = standardized coefficients, SE = robust standard error, bold = p < 0.05; and gender (0 = boy; 1 = girl).

TABLE 3 | Individual and contextual predictors of adolescents' self-perceived coping success with home learning.

Predictors of student's coping with home learning	Model 1			Model 2			Model 3			Model 4			Model 5		
	β	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*
Students' characteristics															
Age	−0.098	0.056	0.080										−0.090	0.050	0.073
Gender	0.077	0.060	0.197										0.073	0.059	0.214
Self-efficacy	0.094	0.060	0.120										0.033	0.066	0.618
Grade	**−0.278**	**0.056**	**0.000**										**−0.228**	**0.054**	**0.000**
School joy															
School context															
Teacher contact				−0.001	0.066	0.926							0.011	0.059	0.847
Amount of time: home learning				**0.148**	**0.072**	**0.039**							0.030	0.063	0.631
School track: primary school															
School track: gymnasium				0.036	0.064	0.575							−0.048	0.061	0.430
Family context															
HISEI							0.000	0.062	0.997				−0.033	0.061	0.589
Deprivation							−0.004	0.074	0.958				−0.017	0.075	0.809
Migration background							0.004	0.060	0.946				−0.036	0.075	0.630
Parental support							−0.018	0.059	0.761				−0.074	0.058	0.201
Family climate							**0.216**	**0.066**	**0.001**				**0.160**	**0.071**	**0.024**
Equipment availability							**0.156**	**0.061**	**0.010**				**0.159**	**0.060**	**0.008**
Calm place to learn							**0.225**	**0.072**	**0.002**				**0.211**	**0.073**	**0.004**
Parental work							0.051	0.091	0.057				0.050	0.097	0.603
Peer context															
Peer support										0.043	0.082	0.603	0.054	0.080	0.498
Peer group satisfaction										**0.183**	**0.080**	**0.022**	0.078	0.076	0.303
R^2	**0.105**			**0.024**			**0.174**			**0.040**			**0.246**		

n = 266 adolescents. β = standardized coefficients, SE = robust standard error, bold = p < 0.05; gender (0 = boy; 1 = girl).

In Model 4, children's and adolescents' peer groups did not explain any variance in their self-perceived coping success with home learning ($R^2 = 0.00$). Adolescents' self-perceived coping success with home learning is predicted by peer group satisfaction ($\beta = 0.18$, $p < 0.05$).

Parental support ($\beta = 0.18$, $p < 0.05$) and equipment availability ($\beta = 0.26$, $p < 0.05$) positively predict children's self-perceived coping success with home learning.

In the overall Model 5, which contains students' characteristics, school context, family context, and peer context, between 29% of children's ($R^2 = 0.29$) and 25% of adolescents' ($R^2 = 0.25$) variance in their self-perceived coping success with home learning can be explained. For children's self-perceived coping success with home learning, parental support ($\beta = 0.18$, $p < 0.05$) and calm place to learn ($\beta = 0.21$, $p < 0.05$) are significant. For adolescents' self-perceived coping success with home learning, their grade ($\beta = -0.23$, $p < 0.001$), family climate ($\beta = 0.16$, $p < 0.05$), equipment availability ($\beta = 0.16$, $p < 0.01$), and calm place to learn ($\beta = 0.21$, $p < 0.01$) are significantly predictive.

STUDY 2

The second study sheds light on the subjective experiences of families during school closures due to the COVID-19 pandemic. The focus is on reconstructing the strategies children and their parents developed to adapt to the new teaching and learning situation and cope with the associated challenges.

Method

Semi-standardized telephone interviews with children and their parents provide the empirical basis for this study. The interviews were conducted in May and June 2020 as part of the study by Langmeyer et al. (2020) on the living situation during the first COVID-19 lockdown in Germany. Participating families were recruited *via* a corresponding supplemental question at the end of the quantitative survey (cp. study 1). We selected a quota sample of 21 families from the group of 2,798 parents who agreed to participate in a supplemental qualitative interview of parents and children as part of study 1. Quota sampling was based on the gender of the children (50% girls), the degree of urbanization of the place of residence (two-thirds urban, one-third rural), siblings (two-thirds with, one-third without siblings), and the age of the children (between 6 and 14 years). In addition, we included families' socio-economic background (perceived coping with income) and state of residence in Germany in the sampling procedure. We included 10 interviews with children between the ages of 10 and 14, including four girls and six boys, in the analyses for this paper. The parent interviews were conducted with the mother of the participating child in nine families, and in one family, the corresponding interview was conducted with the father. Eight of the 10 families have more than one child. About the care situation, the families implemented different models. In four families, one parent is mainly responsible for the care tasks (three mothers, one father); in five families, both parents share the childcare, and in one family, the child is cared for by family friends. **Table 4** provides an overview of the sample.

Considering the interview procedure, the interviews with the parents and the interviews with the children started with an open-ended question that addressed current changes in their everyday life due to the COVID-19 pandemic. This approach provided a first impression of the most important aspects of the issue from an individual perspective and the general mood in the family. After that, the interviews focused on the circumstances of homeschooling, the possible restart of school, and the family's general childcare situation. Furthermore, children and parents provided information about the living situation, siblings, grandparents, and friendships, and activities and mood in the family. The interviews took about 40–60 min per family, where the interviews with the children lasted between 20 and 25 min. All participants found the interviews a welcome opportunity to talk about their experiences during the COVID-19 pandemic. Although studies with children present particular challenges for researchers (Ólafsson et al., 2013; Wagner, 2016), the older children included in our analysis were remarkably detailed and open about the changes in various aspects of their daily lives and experiences related to the crisis.

Analytical Strategy

The texts were transcribed and completely anonymized. The analysis followed the procedure of content structuring qualitative content analysis (Kuckartz, 2018). The categories for the analysis were formed both deductively from the questionnaire and inductively from the interview material. Coding and analysis of the interviews were done by three researchers using MAXQDA software. **Tables 3**, **4** in the **Appendix** of the paper present the final categories, their descriptions, and anchor examples from the interviews with the children and parents, respectively.

Results

The analysis of the interviews allows for a more detailed insight into how children and parents experience the situation of home learning. Despite the abundance of material gathered from conversations with the children and their parents, at this point, complementary to the findings of study 1, three central arguments will be elaborated. Considering RQ1, we elaborate children's perception of home learning challenges they faced at the onset of the COVID-19 pandemic. Subsequently, we elaborate parents' perspectives on their performance in ensuring their children's participation in school-based educational opportunities and their view of school support services for their children during home learning (RQ3). Finally, we shed light on the importance of peers and their contribution to students' coping with the home learning situation (RQ3).

Children's Perceptions of Home Learning Challenges

In the interviews with children, it is clear that pandemic-related home learning represents a profound change in their daily lives. This is particularly evident in the detailed narratives about the challenges posed by the changed living situation.

TABLE 4 | Composition of the qualitative sample.

Aliases	Age	Gender	Grade	Siblings	Parental interviewee	Educational background	Parental care situation
Maja	11	Female	5th grade	Brother (18y)	Mother	University degree	Mother responsible for care work; works 10 h per week as cleaner father: gastronomy management
Benny	11	Male	5th grade	Two brothers (6y, 9y)	Father	University degree	care work is shared between father and mother
Heike	11	Female	5th grade	No siblings	Mother	University degree	mother works full time in home office; father, who lives separately, takes over a substantial part of the care tasks
Jan	14	Male	8th grade	Sister (11y)	Mother	University degree	mother is primarily responsible for childcare; father works in home office
Marcus	10	Male	5th grade	No siblings	Mother	Master craftsman certificate	both parents work full time; Marcus is cared for by family friends
Lars	11	Male	5th grade	Two sisters (8y, 14y)	Mother	University degree	care work is shared between father and mother
Andrea	11	Female	6th grade	Sister (9y)	Mother	University degree	both parents work full time in homeoffice
Maria	11	Female	6th grade	Brother (8y)	Mother	University degree	care work is shared between father and mother
Jonas	11	Male	5th grade	Three adult siblings; brother (24y) living in the family household	Mother	University degree	care work is shared between father and mother; older brother supports parents'care work
Thomas	14	Male	8th grade	Brother (12y)	Mother	University degree	mother is primarily responsible for childcare; father works one day per week in homeoffice

On the one hand, the children's reports draw comparisons to the pre-COVID situation, and on the other, they refer to newly developed routines and ways of successfully coping with the situation.

The loss of school attendance due to contact restrictions unsettled many children at the beginning of the first lockdown (**Table 4**, cat. 1a). Benny (11y) experienced the whole situation as being "very uneasy and critical"…"because you did not know exactly what to do now." Physically attending school as a place of learning has been an essential part of the children's daily routine, while the home has been a place of preparation and follow-up for school. Therefore, a key challenge initially was to coordinate the conditions and processes for successful home learning between children, parents, and school. Thus, it is not surprising that the children frequently bring up that they can learn better at school. They miss their teachers' explanations that increase their understanding of learning materials. In addition, the school setting helps them concentrate and motivates them better. In this context, students feel overwhelmed by many tasks with mostly little support from the school. "We get the assignments from school by email, and you have a bit of a feeling that you somehow get more assignments than you would normally if you went to school, and you also cannot learn or understand things as well as in normal lessons" (Maja, 11y).

Considering the rearrangement of their daily routines, the students developed a new daily structure with the support of their parents, who set working hours and partly helped them maintain work discipline (**Table 4**, cat. 4a; **Table 3**, cat. 4a). Exemplarily, Benny (11y) describes the difficulty of the challenge to self-organize and complete a multitude of tasks independently: "How am I supposed to manage all the tasks? That was a big problem at the beginning, but then I and my mother also found appropriate solutions with apps that show the time, that I worked for 3 h and 30 min every day. And then we also made plans, and then also with such a list to check off, which then worked very well with school after a while."

Against this background, it is not surprising that the children report difficulties concentrating and maintaining motivation (**Table 4**, cat. 1b). While it is a drastic experience to be left alone with the challenge of successfully completing a multitude of school tasks, distractions from mobile phones, television, and other media are within reach. Consequently, some students fear the risk of missing a large amount of learning. Maria (11y) reflects this situation as "When I am home alone […] it is difficult to concentrate […]. It is the same at school, but

at home, I have something like a mobile phone or TV, where I would rather do that and think it does not matter so much if I miss 1 day, but there [at home] I somehow miss 3 days."

In contrast, it is helpful if lessons are held *via* video conference (**Table 4**, cat. 3), which was usually only offered very sporadically in this first phase of school closures, which the students regret: "I would have actually wished for a bit more, because I always thought it was such a change, not just sitting at a desk, because I somehow could not motivate myself so well to just do homework alone at a desk, so I thought that was pretty cool" (Jan, 14y).

Despite challenging conditions, the students also describe experiences of coping successfully with learning (**Table 4**, cat. 2). Marcus, who worked with his friend on their school tasks, proudly reported, "We managed everything that was assigned, even additional tasks." In addition, children with special needs can benefit from the intensive support of their parents – as long as they have time for it. Heike, who has a learning disability, reported that with intensive support from her father, "I learned a bit more because I could ask more questions."

Support From Parents – Parents' Perspective

Parents face the challenge of finding new arrangements in balancing work and family life. In addition to possible pandemic-related changes in their daily work lives, school closures have put parents on notice to support their children's home learning. Against the background of our third research question, we asked parents their perspective of the support needs and processes for their children's home learning (RQ3). Our interviews with parents revealed that accompanying the children in home learning was very demanding and time-consuming (**Table 3**, cat. 1a), especially, the coordinating of professional and childcare while working from home led to stressful situations, as Benny's father describes: "You cannot look after three children and work 7 h at the same time, it does not work like that. […] Yes, of course, it is a burden, the food has to be cooked, both children have to be taught, the third one also wants his attention and to be looked after. So that is already a higher burden than normal weeks" (Father of Bernd, Jonas, and Benny, 6y, 9y, and 11y).

From the parents' point of view, the extent of support needed in home learning depends mainly on their children's ability to solve home learning tasks independently (**Table 3**, cat. 2) and the amount of support from the school (**Table 3**, cat. 3). Considering the ability to learn independently, parents often contrasted older and younger siblings. While younger children of primary school age (6–10y) needed intensive guidance with explanations and substantial instructions to solve given tasks, pupils in secondary school were sometimes already able to work quite independently. In this context, the interviews show that parents had to support their children in dealing with digital technology and digital work processes (**Table 3**, cat. 4c; **Table 4**, cat. 4c). Bernd's father reports, "My wife, in particular, structured [incoming tasks; …] and then printed everything out accordingly and put it down and then sent it back again if necessary" (Father of Bernd, Jonas and Benny, 6, 9, and 11y). The mother of Jan (14y) confirms that her daughter, in particular, has "no connection to it at all yet." In addition to a tight time budget, the families interviewed hardly have the spatial and technical infrastructure to enable all family members to use a digital workplace undisturbed. At least, as Andrea's mother summarizes the technical challenges, Andrea (11y) "has also learned a lot about media and IT, so that she can print or scan what she needs herself and send it back. […] [B]ut for an elementary school child, [Andrea's sister (9y)], that means […] [however] being asked over and over again, 'What do I do now?' and why something did not work […]. And that alongside somehow teleconferencing and email […] and that really makes you very tired."

Directly related to their children's independence in home learning, parents see the level of support their children receive from the school (**Table 3**, cat. 3). The more interactive the exchange with the school and the more frequently parents perceive feedback from teachers, the less intensively they report their excessive demands in our interviews. Two cases can be contrasted here; on the one hand, Andrea's mother, who reports that the school was able to switch to digital teaching very quickly: "In Andrea's class, it works very well, almost from day one they switched to online school. They are well looked after, and accordingly, we have to do less," on the other, Jan's (14y) mother compares the situation of her two children. Concerning the younger daughter (11y), she describes that the lack of contact with teachers resulted in a high need for support: "Well, we have experienced teachers where you really have the impression that a bunch of worksheets is emailed without any instructions, explanations, help, and also without demanding feedback, and you had the impression, well, the child is now working for the thick folder, so to speak, and does not know at all what for. And so I then partly did not succeed at all in motivating her, only with lots of sweets and any promises."

Based on this statement, which many of the interviewed parents shared, it becomes clear that supporting the children was also about maintaining motivation, concentration, and work discipline (**Table 3**, cat. 4b; **Table 4**, cat. 4b). Maja's mother, for example, reported, "The first few times [of home learning], I sat with her and did some of the tasks with her or just watched her so that she did not distract herself."

One aspect parents and children rarely address in the interviews is content support for their children (**Table 3**, cat. 4d; **Table 4**, cat. 4d). Due to their comparatively high level of education, parents are unlikely to have any problems following their children's schoolwork content. Instead, the lack of time to deal with home learning is a more significant issue (**Table 3**, cat. 1b). Especially families with unique burdens reach their limits under the conditions of school closures. It is their children who suffer from a lack of support. Exemplary is the case of Maria, whose parents are at capacity by accompanying her younger brother, who has special needs due to ADHD: "I think that if we were to sit next to her as intensively as with her brother […], she would certainly be able to do more […], but that is simply not possible. […] We simply had to set priorities so that we could keep

Hannes (8y) on track somehow, who has problems at school anyway. And unfortunately, that is at the expense of Maria's school; it has to be said quite clearly. But on the other hand, we have to get our work done."

Support From Peers

Through the narratives of the children and adolescents, it becomes clear that connectedness and support from peers is a central strategy to cope with the new demands of home learning (RQ3). Networking with classmates and friends makes it easier to cope with school tasks. At the same time, interacting with peers has a positive effect on motivation and mood. Using media plays a crucial role in maintaining contact, be it telephoning, writing text messages, or networking *via* online platforms (**Table 4**, cat. 5a). For example, Jan (14y) reports: "Yes, we have such a program, so 'Discord' is the name of it, which we also always use when we play computer games or something (laughs), and then we always met at a time and just did the tasks together."

Considering home learning challenges, students seek mutual support with questions about understanding the assignments, helping with explanations, or giving tips when solving difficult tasks (**Table 4**, cat. 5c). Marcus (11y) describes how mutual support leads to success when working together with his friend: "So, for example, if my friend did not know something or I did not know something, then we gave each other tips or something about what it could be, and then we sometimes, so often, came up with the right solution." For Marcus, who comes from a non-academic home, an additional strategy is to ask the "smartest" students from the class for advice: "We also wrote a lot like that, if tasks were not clear so that I and my friend did not know and his mother did not know either, we sometimes asked the smartest from our class."

Maja (11y) admits, "We talked a lot on the phone […] and then just did the tasks together when studying because it is just a bit stupid alone" (Maja, 11y; **Table 4**, cat. 5b). Thus, the class is strengthened as a social community if the digital platforms of the schools enable pupils to network with each other. Overall, it becomes apparent in the interviews that support from the peers and the contact associated with it contributes to increasing the motivation for home learning and conveys the feeling of self-efficacy in successfully and independently coping with this situation.

DISCUSSION AND CONCLUSION

At first glance, the COVID-19 pandemic has significantly changed the way children are schooled. In Germany, face-to-face instruction has been replaced by various formats of home learning, in which parents primarily support their children in coping with school obligations. With this in mind, this paper argues that the home learning situation can be described as analogous to parental monitoring of their children's homework. In the literature review, we identified factors that describe the extent to which children cope with the home learning situation. We illuminate this general thought through the presentation of two studies in a mixed-methods approach that examines how students cope with the home learning situation during school closures due to the COVID-19 pandemic in Germany. Study 1 shows, through a quantitative online study, that children with differences in school joy, parental support, and quiet place to study, and adolescents with differences in grade, family climate, availability of technological devices, and a quiet place to study cope differently with home learning. The results of the second study highlight, using qualitative telephone interviews with children and youth, students' challenges in solving and completing their assignments, time management, work discipline, and self-motivation. It also reveals that children and adolescents ask parents and peers for help. Parents experienced answering their children's calls for support as an immense effort. In line with previous findings of home learning in times of the COVID-19 pandemic (Huber and Helm, 2020; Wößmann et al., 2020), children's and adolescents' characteristics and their school, family, and peer context affect how students cope with the new home learning situation. Whereas in study 1, based on the mean values, it seems that children and adolescents are coping quite well with the learning situation at home, Study 2 shows that the changed learning situation is accompanied by a series of adaptations, which are also clearly stressful for students.

Nevertheless, we discuss what factors are essential for home learning due to the COVID-19 pandemic and whether models on homework and learning in class are appropriate. Based on research on homework (Trautwein et al., 2006; Moroni et al., 2015), we choose a model that incorporates student characteristics and student contexts. Among the students' characteristics, the pre-pandemic grade was found to be particularly significant for adolescents. It is noteworthy, however, that this effect is absent for children. In addition, our results show that children's enjoyment of school before the COVID-19 pandemic contributed to their ability to cope better in the current learning situation at home. Apparently, children and young people who were already better at learning before the COVID-19 pandemic are finding it easier to do so during the pandemic. This result fits with the findings of the interview study that besides solving tasks and completing them, students need to develop new structures in their time organization and a new form of work discipline, for which, in turn, concentration and motivation are essential prerequisites.

In contrast to previous research on homework, which emphasizes the importance of teachers and exercises (Trautwein et al., 2006), in study 1, it seems that the school context is less important. In study 2, it becomes clear that the exchange between teachers and students is central to how motivated the students are. The new, unfamiliar situation is particularly stressful because the students have to work alone for the school. In this respect, coming to terms with this situation is also about overcoming the isolation of being "alone at your desk" and creating social connectedness. One possible explanation why the school context is less important in study 1 than reported in previous studies on homework is that home learning has radically changed in times of the COVID-19 pandemic, and the previous results are not directly transferable. Another

explanation could be that we only looked at the first period of home learning with the study: Possible differences between different school contexts, such as differences in the type of school, were not (yet) visible. In this first, early phase of the pandemic in Germany, many parents worked at home or were on reduced hours and thus may have been able to support their children in their learning. However, the differences may also be due to our operationalization of the school context with few variables. Furthermore, the study mainly analyzes the quantity of contact and the working time. The quality, on the other hand, was not part of the quantitative study. However, this could also be decisive for the children and adolescents' perceived coping ability.

Concerning the family context, in study 1, the most important factor is equipment availability and a calm place to learn. If the children and young people have the essential work resources for home learning, such as computers or laptops, printers, and a calm place, the self-perceived coping success with home learning is greater. The bivariate correlations show that children in deprivation are less well equipped than other children and deprived children report lower coping success. The regression analysis suggests a mediation effect, as the effect of deprivation is removed when equipment availability is controlled for. Thus, it can be stated that children in deprivation are disadvantaged by not having all the necessary resources at their disposal, which affects their self-perceived coping success with home learning. Future research needs to observe whether these results in more substantial long-term disadvantages than children in deprivation already have.

Interestingly, we observe a link of the family climate to coping success only for adolescents. If the adolescents experience the climate in their families as positive with strong cohesion, they also seem better prepared for the new challenges. For children, this connection seems to have less significance, which might be due to the fact that most of the children consider their family climate to be particularly positive, while adolescents are more critical of their family climate.

Regarding the importance of children's and adolescents' support in their family and peer context, we found a discrepancy between qualitative and quantitative data. While in study 1, we see less importance of students' family and peer context for students' self-perceived coping success with home learning, it becomes clear in study 2 that this context does have significance in the subjective reconstructions of the situation. Thus, the interview study shows that this means not just explaining the tasks correctly. Parents are challenged in their competencies regarding the current learning material and as "managers" of home learning by helping the children organize the working day, divide and structure the school tasks, and keep track of the work tasks that have been done and those that still need to be done. Furthermore, they often have to act as "motivation coaches" and support concentration and motivation. An explanation for the discrepancy between the quantitative and qualitative data might be that parents can provide support without their children and adolescents noticing it. Suppose parents can support adequately; this changed learning situation can also have positive aspects: At least one of the interviewed children (Heike) reports advantages of learning at home. She is better supported there than at school due to the 1:1 learning situation.

Considering the significance of peers in home learning situations, research literature in the context of the COVID-19 pandemic appears sparse. While study 1 suggests, at least in the overall models, that satisfaction with the peer group and peer support are not significant contributors for the young people's coping with home learning, study 2 clarifies that networking and cooperation with peers is an essential strategy to cope with the new situation and new demands. In line with previous research, support from friends and classmates not only helps in a very concrete way to understand and solve tasks but also contributes significantly to overcoming the feeling of being alone and isolated and to creating social connectedness (Lyell et al., 2020; Sun et al., 2020). Furthermore, the interviews indicate that support from classmates is essential for children from families without an academic background, where parents cannot provide support in terms of explanations of the learning material. This shows that the role of peers is not negligible and should be looked at more deeply, especially in quantitative studies of learning at home, which have been rather neglected so far.

Comparing the three contexts in our studies, it seems that the family context is very important for self-perceived coping success with home learning. This result is an all-important finding, as it is well known that family background has always played a significant role in school success in Germany (Müller and Ehmke, 2016). Thus, the COVID-19 pandemic is likely to exacerbate existing disadvantages among children and youth. It can be assumed that similar results will be seen in Germany as in the Netherlands, where it could be shown that the pandemic results in losses in learning success, especially for children from disadvantaged backgrounds (Engzell et al., 2021). Therefore, it is important that special attention is paid to these children after the COVID-19 pandemic and that they are given unique opportunities to catch up on their learning.

Considering the theoretical framework, our studies suggest that homework theories (Trautwein et al., 2006; Dumont, 2012) only partially represent the COVID-19 situation. Student characteristics, school characteristics, and the role of parents are indeed important in the current COVID-19 period. However, the respective characteristics are partly different than in the homework situation. This is hardly surprising, as the home learning situation is different from the homework situation: Students spend more time alone doing exercises without getting much feedback than in the pre-pandemic homework situation. Furthermore, the digital changes of the school situation can influence students' achievement and motivation in home learning. Mainly, younger pupils must first acquire the corresponding skills and competencies. In line with the homework model by Trautwein et al. (2006) or the home learning model of Huber and Helm (2020), parents play a central role. Nevertheless, compared to checking children's and adolescents' tasks, it might be more challenging to support and accompany children in this often new digital learning space. Especially in study 2, the importance of peers becomes visible; this has rarely been considered in the homework literature so far but does not

appear in recent models developed for home learning (Huber and Helm, 2020). It is important that this aspect is taken up in both theoretical considerations and quantitative studies.

LIMITATIONS

Even though the present study provides added value to the existing literature, the study's limitations should also be noted. First, the conclusions of the present analysis are restricted to the study's sample. Second, it should be noted that the AID:A COVID-19-specific add-on was only able to reach a portion of the respondents in 2019. Third, students from the highest school track are overrepresented among our sample. We took into account students up to the age of 18, and students in Germany's highest school track go to school for a longer period of time than in other German school tracks. Fourth, our study is only cross-sectional, limited to the period of the initial lockdown. As a result, no causalities can be verified. Longitudinal data are also needed to examine the interaction of the different contexts. The first study shows that school and family context differs between the first time of strict school closures in Germany due to the COVID-19 pandemic and the second time of school closures (Wößmann et al., 2021). Therefore, to get a more holistic view of students' learning situation due to the COVID-19 pandemic, the different periods should be regarded.

Furthermore, the construct of *self-perceived coping success with home learning* was only measured with one single indicator. Additional information about students' learning success in the form of grades or tests would be a valuable source for getting more insights into the long-term effects of students' coping with home learning and their performance. The problem of single indicator measures also applies to some predictors in our models (e.g., peer support). This could also be an explanation for the fact that some correlations do not occur as expected. Finally, it should also be noted that no extensive information was available on the individual contexts, so possible central aspects were not taken into account here, which is why the school context, for example, appears to be of little importance.

OUTLOOK

Nevertheless, the study offers starting points for further research as well as for practical work with children. As already mentioned, the disadvantages of certain groups of students have to be made up for in the post-pandemic period. If the pandemic lasts longer, or if other situations arise in which learning at home is necessary, it must be ensured that the family is not ascribed such a central role in the learning situation, in addition to adequate equipment necessary for all students. Not all families can adequately support their children. It was already true before COVID-19 and is becoming even more critical in times of home learning.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found at: doi: 10.17621/aida2009.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

IS, TN, ALa, and ALi planned study 1. UW planned study 2. All authors wrote the manuscript. IS and ALi prepared the data and performed all statistical analyses regarding study 1. Considering study 2, UW and TN prepared the data and performed all analyses. All authors contributed to the article and approved the submitted version.

FUNDING

Data collection has been supported by the German Youth Institute, which is funded by the German Federal Ministry for Family Affairs, Senior Citizens, Women, and Youth.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.733428/full#supplementary-material

REFERENCES

Achterberg, M., Dobbelaar, S., Boer, O. D., and Crone, E. A. (2021). Perceived stress as mediator for longitudinal effects of the COVID-19 lockdown on wellbeing of parents and children. *Sci. Rep.* 11:2971. doi: 10.1038/s41598-021-81720-8

Acock, A. C. (2013). *Discovering Structural Equation Modeling Using Stata*. Revised Edn. A Stata Press publication. StataCorp LP.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of Behavioral change. *Psychol. Rev.* 84, 191–215. doi: 10.1037/0033-295X.84.2.191

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educ. Psychol.* 28, 117–148. doi: 10.1207/s15326985ep2802_3

Barry, C. M., and Wentzel, K. R. (2006). Friend influence on prosocial behavior: The role of motivational factors and friendship characteristics. *Dev. Psychol.* 42, 153–163. doi: 10.1037/0012-1649.42.1.153

Becker, S. P., Breaux, R., Cusick, C. N., Dvorsky, M. R., Marsh, N. P., Sciberras, E., et al. (2020). Remote learning During COVID-19: examining school practices, service continuation, and difficulties for adolescents With and Without attention-deficit/hyperactivity disorder. *J. Adolesc. Health* 67, 769–777. doi: 10.1016/j.jadohealth.2020.09.002

Berg, M., Cramer, R., Dickmann, C., Gilberg, R., Jesske, B., Kleudgen, M., et al. (2018). Codebuch und Dokumentation des 'Panel Arbeitsmarkt und soziale Sicherung' (PASS) * Welle 1–11 [Codebook and documentation of the 'Panel Labor Market and Social Security' (PASS) * Wave 1–11.]. FDZ-Datenreport.

Berndt, T. (1999). Friends' influence on students' adjustment to school. *Educ. Psychol.* 34, 15–28. doi: 10.1207/s15326985ep3401_2

Blume, F., Schmidt, A., Kramer, A. C., Schmiedek, F., and Neubauer, A. B. (2021). Homeschooling during the SARS-CoV-2 pandemic: The role of students' trait self-regulation and task attributes of daily learning tasks for students' daily self-regulation. *Z. Erziehwiss.* 1–25. doi: 10.1007/s11618-021-01011-w [Epub ahead of print].

Boudon, R. (1974). *Education, Opportunity, and Social Inequality: Changing Prospects in Western Society. Wiley Series in Urban Research* Wiley.

Bourdieu, P. (2012). "Ökonomisches Kapital, kulturelles Kapital, soziales Kapital [Economic capital, cultural capital, social capital]" in *Handbuch Bildungs- und Erziehungssoziologie*. eds. U. Bauer, U. H. Bittlingmayer and A. Scherr (VS Verlag für Sozialwissenschaften), 229–242.

Brandes, H., and Schneider-Andrich, P. (2017). Die Bedeutung der Gleichaltrigen in Kindertageseinrichtungen: Ein soziologischer und entwicklungspsychologischer Blick auf Peerbeziehungen jüngerer Kinder [The importance of peers in day care settings: A sociological and developmental psychological look at peer relationships of younger children.]. Frühe Kindheit, 22–29.

Bronfenbrenner, U. (1986). "Recent advances in research on the ecology of human development," in *Development as Action in Context: Problem Behavior and Normal Youth Development*. eds. R. K. Silbereisen, K. Eyferth and G. Rudinger (Springer)

Bronfenbrenner, U. (2012). "Ökologische Sozialisationsforschung – Ein Bezugsrahmen [ecological socialization research—A frame of reference]" in *Handbuch Bildungs- und Erziehungssoziologie*. eds. U. Bauer, U. H. Bittlingmayer and A. Scherr (VS Verlag für Sozialwissenschaften), 167–176.

Conger, R. D., and Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annu. Rev. Psychol.* 58, 175–199. doi: 10.1146/annurev.psych.58.110405.085551

Creswell, J. W., and Plano Clark, V. L. (2018). *Designing and conducting mixed methods research. 3rd Edn.* Sage.

Ditton, H. (2013). "Kontexteffekte und Bildungsungleichheit: Mechanismen und Erklärungsmuster [context effects and educational inequality: mechanisms and explanatory patterns]" in *Bildungskontexte*. eds. R. Becker and A. Schulze (Springer Fachmedien), 173–206.

Doll, J., and Prenzel, M. (eds.) (2004). *Bildungsqualität von Schule: Lehrerprofessionalisierung, Unterrichtsentwicklung und Schülerförderung als Strategien der Qualitätsentwicklung* Waxmann.

Dumont, H. (2012). Elterliche Hausaufgabenhilfe unter dem Blickwinkel sozialer Disparitäten: Eine Untersuchung pädagogisch-psychologischer Prozesse [Parental homework help from the perspective of social disparities: an investigation of pedagogical-psychological processes] [Dissertation]. Eberhard Karls Universität, Tübingen.

Eickelmann, B., and Gerick, J. (2020). "Lernen mit digitalen Medien," in *Langsam vermisse ich die Schule…*. eds. D. Fickermann and B. Edelstein (Waxmann), 153–162.

Eickelmann, B., Gerick, J., Labusch, A., and Vennemann, M. (2019). "Schulische Voraussetzungen als Lern- und Lehrbedingungen in den ICILS-2018-Teilnehmerländern [school conditions as learning and teaching conditions in ICILS 2018 participating countries]" in *ICILS 2018 #Deutschland: Computer- und informationsbezogene Kompetenzen von Schülerinnen und Schülern im zweiten internationalen Vergleich und Kompetenzen im Bereich Computational Thinking*. eds. B. Eickelmann, W. Bos and J. Gerick (Waxmann)

Elsäßer, S. (2018). Komponenten von schulischen Leistungen [Components of academic performance] Dissertation, Ludwig-Maxmilians-Universität, München. GBV Gemeinsamer Bibliotheksverbund.

Enders, C. K. (2001). The performance of the full information maximum likelihood estimator in multiple regression models with missing data. *Educ. Psychol. Meas.* 61, 713–740. doi: 10.1177/0013164401615001

Engzell, P., Frey, A., and Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proc. Natl. Acad. Sci. U. S. A.* 118:e2022376118. doi: 10.1073/pnas.2022376118

Fan, X., and Chen, M. (2001). Parental involvement and Students' academic achievement: A meta-analysis. *Educ. Psychol. Rev.* 13, 1–22. doi: 10.1023/A:1009048817385

Fickermann, D., and Edelstein, B. (2020). *Langsam vermisse ich die Schule…* Waxmann.

Ganzeboom, H. B. G. (2010). *A new international socio-economic index (ISEI) of occupational status for the international standard classification of occupation 2008 (ISCO-08) constructed with data from 11the ISSP 2002-2007*. Paper presented at the Annual Conference of International Social Survey Programme, Lisbon.

Gerhardts, L., Kamin, A.-M., Meister, D. M., Richter, L., and Teichert, J. (2020). Lernen auf Distanz – Einblicke in den familialen Alltag des Homeschoolings und Formen der Bewältigung [learning at a distance—insights into the everyday life of homeschooling families and forms of coping]. *Fortschr. Med.* 58:26. doi: 10.21243/MI-02-20-30

Goldan, J., Geist, S., and Lütje-Klose, B. (2020). "Schüler*innen mit sonderpädagogischem Förderbedarf während der Corona-Pandemie [pupils with special educational needs during the Corona pandemic]" in *Langsam vermisse ich die Schule…*. eds. D. Fickermann and B. Edelstein (Waxmann), 189–201.

Hanushek, E. A., Kain, J. F., Markman, J. M., and Rivkin, S. G. (2003). Does peer ability affect student achievement? *J. Appl. Econ.* 18, 527–544. doi: 10.1002/jae.741

Hattie, J. (2010). *Visible Learning: A Synthesis of over 800 Meta-Analyses Relating to Achievement (Reprinted.)* Routledge.

Helm, C., Huber, S., and Loisinger, T. (2021). Was Wissen wir über schulische Lehr-Lern-Prozesse im Distanzunterricht während der Corona-Pandemie? – Evidenz aus Deutschland, Österreich und der Schweiz [meta-review on findings about teaching and learning in distance education during the Corona pandemic-evidence from Germany, Austria and Switzerland]. *Z. Erzieh.* 1–75. doi: 10.1007/s11618-021-01000-z [Epub ahead of print].

Helmke, A. (2007). *Unterrichtsqualität Erfassen, Bewerten, Verbessern: Dieses Buch Ist Franz-Emanuel Weinert Gewidmet [Recording, Evaluating, Improving the Quality of Teaching: This Book Is Dedicated to Franz-Emanuel Weinert]*. 6th Edn Kallmeyer.

Hill, N. E., and Tyson, D. F. (2009). Parental involvement in middle school: A meta-analytic assessment of the strategies that promote achievement. *Dev. Psychol.* 45, 740–763. doi: 10.1037/a0015362

Huber, S. G., and Helm, C. (2020). Covid-19 and schooling: evaluation, assessment and accountability in times of crises-reacting quickly to explore key issues for policy, practice and research with the school barometer. *Educ. Assess. Eval. Account.* 1–34. doi: 10.1007/s11092-020-09322-y [Epub ahead of print].

Huebener, M., Spieß, C. K., and Zinn, S. (2020). SchülerInnen in Corona-Zeiten: Teils deutliche Unterschiede im Zugang zu Lernmaterial nach Schultypen und -trägern [students in Corona times: Some significant differences in access to learning materials by school type and agency]. *DIW Wochenbericht* 47, 866–875. doi: 10.18723/DIW_WB:2020-47-1

Im, M. H., Hughes, J. N., and West, S. G. (2016). Effect of trajectories of Friends' and Parents' School involvement on Adolescents' engagement and achievement. *J. Res. Adolesc.* 26, 963–978. doi: 10.1111/jora.12247

Kindermann, T. A., and Skinner, E. A. (2009). How do naturally existing peer groups shape Children's academic development During sixth grade? *Int. J. Dev. Sci.* 3, 27–38. doi: 10.3233/DEV-2009-3105

Kuckartz, U. (2018). *Qualitative Inhaltsanalyse: Methoden, Praxis, Computerunterstützung [Qualitative Content Analysis: Methods, Practice, Computer Support] Grundlagentexte Methoden*. 4. Auflage Edn Beltz Juventa.

Kuger, S., Walper, S., and Rauchenbach, T. (2021). *Aufwachsen in Deutschland 2019: Alltagswelten von Kindern, Jugendlichen und Familien [Growing Up in Germany 2019: Everyday Worlds of Children, Youth and Families] (1. Auflage)* wbv Media.

La Fuente, J. D., Fernández-Cabezas, M., Cambil, M., Vera, M. M., González-Torres, M. C., and Artuch-Garde, R. (2017). Linear relationship between resilience, learning approaches, and coping strategies to predict achievement in undergraduate students. *Front. Psychol.* 8:1039. doi: 10.3389/fpsyg.2017.01039

Langmeyer, A., Guglhör-Rudan, A., Naab, T., Urlen, M., and Winklhofer, U. (2020). Kind sein in Zeiten von Corona: Ergebnisbericht zur Situation von Kindern während des Lockdowns im Frühjahr 2020 [Being a Child in Times of Corona. Report on the situation of children during the spring 2020 lockdown in Germany].

Lazarus, R. S., and Folkman, S. (1984). *Stress, Appraisal, and Coping* Springer.

Lyell, K. M., Coyle, S., Malecki, C. K., and Santuzzi, A. M. (2020). Parent and peer social support compensation and internalizing problems in adolescence. *J. Sch. Psychol.* 83, 25–49. doi: 10.1016/j.jsp.2020.08.003

Maaz, K., Neumann, M., and Baumert, J. (eds.) (2014). *Zeitschrift für Erziehungswissenschaft Sonderheft: Vol. 24. Herkunft und Bildungserfolg von der frühen Kindheit bis ins Erwachsenenalter: Forschungsstand und Interventionsmöglichkeiten aus interdisziplinärer Perspektive [Origin and Educational Success from Early Childhood to Adulthood: State of Research and Possibilities for Intervention from an Interdisciplinary Perspective]*. Springer.

Medienpädagogischer Forschungsverbund Südwest (2020). JIM-Studie 2020: Jugend, Information, Medien [JIM Study 2020: Youth, Information, Media].

Moos, R. H., and Moos, B. S. (1981). *Family Environment Scale Manual* Consulting Psychologists Press.

Moroni, S., Dumont, H., Trautwein, U., Niggli, A., and Baeriswyl, F. (2015). The need to distinguish Between quantity and quality in research on parental involvement: The example of parental help With homework. *J. Educ. Res.* 108, 417–431. doi: 10.1080/00220671.2014.901283

Müller, K., and Ehmke, T. (2016). "Soziale Herkunft und Kompetenzerwerb [social background and acquisition of competencies]" in *PISA 2015: Eine Studie zwischen Kontinuität und Innovation*. eds. K. Reiss, C. Sälzer, A. Schiepe-Tiska, E. Klieme and O. Köller (Waxmann), 285–316.

Ólafsson, K., Livingstone, S., and Haddon, L. (2013). How to research children and online technologies? Frequently asked questions and best practice. London. EU Kids Online. Available at: http://eprints.lse.ac.uk/50437/ (Accessed November 15, 2021).

Parker, P. D., Marsh, H. W., Ciarrochi, J., Marshall, S., and Abduljabbar, A. S. (2014). Juxtaposing math self-efficacy and self-concept as predictors of long-term achievement outcomes. *Educ. Psychol.* 34, 29–48. doi: 10.1080/01443410.2013.797339

Schiepe-Tiska, A., Schmidtner, S., Müller, K., Heine, J.-H., Neumann, K., and Lüdtke, O. (2016a). "Naturwissenschaftlicher Unterricht in Deutschland in PISA 2015 im internationalen Vergleich [Science Teaching in Germany in PISA 2015 in International Comparison]" in *PISA 2015: Eine Studie zwischen Kontinuität und Innovation*. eds. K. Reiss, C. Sälzer, A. Schiepe-Tiska, E. Klieme and O. Köller (Waxmann), 133–175.

Schiepe-Tiska, A., Simm, I., and Schmidtner, S. (2016b). "Motivationale Orientierungen, Selbstbilder und Berufserwartungen in den Naturwissenschaften in PISA 2015 [motivational orientations, self-perceptions, and career expectations in science in PISA 2015]" in *PISA 2015: Eine Studie zwischen Kontinuität und Innovation*. eds. K. Reiss, C. Sälzer, A. Schiepe-Tiska, E. Klieme and O. Köller (Waxmann), 99–132.

Schwarzer, R., and Jerusalem, M. (eds.). (1999). Skalen zur Erfassung von Lehrer- und Schülermerkmalen. Dokumentation der psychometrischen Verfahren im Rahmen der Wissenschaftlichen Begleitung des Modellversuchs Selbstwirksame Schulen [Scales for the Assessment of Teacher and Student Characteristics. Documentation of the psychometric procedures within the framework of the scientific monitoring of the pilot project Self-Efficacious Schools]. Freie Universität Berlin.

Seidel, T. (2006). The role of student characteristics in studying micro teaching–learning environments. *Learn. Environ. Res.* 9, 253–271. doi: 10.1007/s10984-006-9012-x

Seidel, T., and Shavelson, R. J. (2007). Teaching effectiveness research in the past decade: The role of theory and research Design in Disentangling Meta-Analysis Results. *Rev. Educ. Res.* 77, 454–499. doi: 10.3102/0034654307310317

Skinner, E. A., and Saxton, E. A. (2019). The development of academic coping in children and youth: A comprehensive review and critique. *Dev. Rev.* 53:100870. doi: 10.1016/j.dr.2019.100870

Sprang, G., and Silman, M. (2013). Posttraumatic stress disorder in parents and youth after health-related disasters. *Disaster Med. Public Health Prep.* 7, 105–110. doi: 10.1017/dmp.2013.22

Sun, Y., Lin, S.-Y., and Chung, K. K. H. (2020). University Students' perceived peer support and experienced depressive symptoms during the COVID-19 pandemic: The mediating role of emotional well-being. *Int. J. Environ. Res. Public Health* 17:9308. doi: 10.3390/ijerph17249308

Thorell, L. B., Skoglund, C. B., Giménez de la Peña, A., Baeyens, D., Fuermaier, A. B. M., Groom, M. J., et al. (2020). Psychosocial effects of homeschooling during the COVID 19 pandemic: differences between seven European countries and between children with and without mental health conditions. PsyArxiv [Preprint]. doi: 10.31234/osf.io/68pfx

Townsend, P. (1979). *Poverty in the United Kingdom* Penguin Books.

Trautwein, U., Lüdtke, O., Schnyder, I., and Niggli, A. (2006). Predicting homework effort: support for a domain-specific, multilevel homework model. *J. Educ. Psychol.* 98, 438–456. doi: 10.1037/0022-0663.98.2.438

Vollet, J. W., Kindermann, T. A., and Skinner, E. A. (2017). In peer matters, teachers matter: peer group influences on students' engagement depend on teacher involvement. *J. Educ. Psychol.* 109, 635–652. doi: 10.1037/edu0000172

Wagner, U. (2016). "Heranwachsen mit Medien. Qualitative Methoden in der Forschung zu Kindern und Medien [growing up with media. Qualitative methods in research on children and media]" in *Handbuch nicht standardisierte Methoden in der Kommunikationswissenschaft*. eds. S. Averbeck-Lietz and M. Meyen (Springer NachschlageWissen), 559–572.

Wang, M. C., Haertel, G. D., and Walberg, H. J. (1993). Toward a Knowledge Base for school learning. *Rev. Educ. Res.* 63, 249–294. doi: 10.3102/00346543063003249

Wecker, C., and Fischer, F. (2014). "Lernen in Gruppen," in *Pädagogische Psychologie*. eds. T. Seidel and A. Krapp (Beltz), 277–296.

Wentzel, K., and Ramani, G. B. (2016). *Handbook of Social Influences in School Contexts*. New York: Routledge.

Wigfield, A., Eccles, J. S., Fredricks, J. A., Simpkins, S., Roeser, R. W., and Schiefele, U. (2015). "Development of achievement motivation and engagement," in *Handbook of Child Psychology and Developmental Science*. ed. R. M. Lerner (John Wiley and Sons, Inc.), 1–44.

Wildemann, A., and Hosenfeld, I. (2020). Bundesweite Elternbefragung zu Homeschooling während der Covid 19 Pandemie: Erkenntnisse zur Umsetzung des Homeschoolings in Deutschland [Nationwide parent survey on homeschooling during the Covid 19 pandemic: findings on homeschooling implementation in Germany]. Universität Koblenz Landau.

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Werner, K., and Zierow, L. (2020). Bildung in der Coronakrise: Wie haben die Schulkinder die Zeit der Schulschließungen verbracht, und welche Bildungsmaßnahmen befürworten die Deutschen? [Education in the Corona Crisis: How have schoolchildren spent the period of school closures, and what educational measures do Germans favor?]. *Ifo Schnelldienst* 73, 25–39.

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Werner, K., and Zierow, L. (2021). Bildung erneut im Lockdown: Wie verbrachten Schulkinder die Schulschließungen Anfang 2021? *Ifo Schnelldienst* 74, 36–52.

Youniss, J. (1994). Rearing children for society. *New Dir. Child Adolesc. Dev.* 1994, 37–50. doi: 10.1002/cd.23219946605

Zimmer-Gembeck, M. J., and Skinner, E. A. (2011). Review: The development of coping across childhood and adolescence: An integrative review and critique of research. *Int. J. Behav. Dev.* 35, 1–17. doi: 10.1177/0165025410384923

Zinn, S., and Bayer, M. (2021). Subjektive Belastung der Eltern durch die Beschulung ihrer kinder zu Hause zu Zeiten des Corona-bedingten lockdowns im Frühjahr 2020 [Parents' subjective burden of home schooling their children at times of the Corona-related lockdown in spring 2020]. *Z. Erziehwiss.* 1–27. doi: 10.1007/s11618-021-01012-9 [Epub ahead of print].

Züchner, I., and Jäkel, H. R. (2021). Fernbeschulung während der COVID-19 bedingten Schulschließungen weiterführender Schulen: Analysen zum Gelingen aus Sicht von Schülerinnen und Schülern [distance learning during the COVID-19-related school closings: the perspective of students from secondary schools]. *Z. Erziehwiss.* 1–24. doi: 10.1007/s11618-021-01006-7 [Epub ahead of print].

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 08 December 2021
doi: 10.3389/fpsyg.2021.751120

Cognitive and Affective-Motivational Factors as Predictors of Students' Home Learning During the School Lockdown

Kathrin Lockl, Manja Attig, Lena Nusser and Ilka Wolter*

Department Competencies, Personality, Learning Environments, Leibniz Institute for Educational Trajectories, Bamberg, Germany

OPEN ACCESS

Edited by:
Fien Depaepe, KU Leuven, Belgium

Reviewed by:
Annelies Raes, KU Leuven Kulak, Belgium
Delphine Sasanguie, Hogeschool Gent, Belgium

***Correspondence:**
Kathrin Lockl
kathrin.lockl@lifbi.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *31 July 2021*
Accepted: *10 November 2021*
Published: *08 December 2021*

Citation:
Lockl K, Attig M, Nusser L and Wolter I (2021) Cognitive and Affective-Motivational Factors as Predictors of Students' Home Learning During the School Lockdown. Front. Psychol. 12:751120. doi: 10.3389/fpsyg.2021.751120

During the COVID-19 pandemic, students were facing great challenges. Learning was shifted from the classroom to the home of the students. This implied that students had to complete their tasks in a more autonomous way than during regular lessons. As students' ability to handle such challenges might depend on certain cognitive and motivational prerequisites as well as individual learning conditions, the present study investigates students' cognitive competencies as well as affective-motivational factors as possible predictors of coping with this new learning situation at home. The study uses data of Starting Cohort 2 of the German National Educational Panel Study (NEPS). Data of two measurement points are analyzed: Predictors were assessed at the earlier time point, when students ($N = 1{,}452$; $M_{age} = 12$ years, 8 months; 53.4% female) mostly attended seventh grade of a secondary school. They completed competence tests in reading as well as mathematics and rated affective-motivational aspects in terms of willingness to exert effort, learning enjoyment, and intrinsic motivation. One and a half years later – during the COVID-19 pandemic and the first period of school closures – the second measurement point took place. Students' parents rated the situation of learning at home with respect to students' coping with the new situation and parents' difficulties to motivate them. Regression analyses controlling for school track, students' gender, and parents' educational level and parental stress revealed that students' reading competencies and their willingness to exert effort were significant predictors of their coping with the new learning situation at home. Moreover, parents reported that boys were more difficult to motivate to learn during this time as compared to girls. Other predictors (e.g., learning enjoyment) turned out to be non-significant when entered simultaneously in the regression analyses. The results point to the importance of children's prerequisites for autonomous learning situations without structuring elements by teachers within the school context.

Keywords: home learning, COVID-19, longitudinal, motivation, competencies

INTRODUCTION

During the COVID-19 pandemic, enormous challenges in all life domains emerged. They affected not only people's work, leisure time, and family life but also educational processes in formal and non-formal learning environments. In order to prevent the spread of SARS-Cov-2, educational institutions like childcare facilities, schools, and universities closed and shifted learning from the classroom to the homes of the students. That is, home teaching was implemented as an alternative to classroom teaching. This shift implied that students had to complete their tasks in a more autonomous way without or with less educational assistance and teacher support than during regular lessons at school. The challenges were particularly wearing during the first school closures in spring 2020 when teachers and students were forced to adjust to distance teaching with little to no time for preparation (for an overview regarding the situation in Germany, Austria and Switzerland in spring 2020 see Helm et al., 2021).

As surveys showed (Huber et al., 2020; Letzel et al., 2020), one of the greatest challenges for students themselves was taking over more responsibility for their own learning activities and this seems to have been associated with certain difficulties. For example, during this time, students stated to have problems with initiating their daily learning sessions, concentrating on the homework, and structuring their day (Huber et al., 2020). Letzel et al. (2020) reported that there was little contact between teachers and their students and that about 50% of students would have liked more support and feedback from their teachers. These examples suggest that the structure provided by teachers was much less emphasized during that time compared to regular instruction during school hours. In this novel situation with little external structure, students had to invest more in self-structuring and self-organizing of their daily schedule. In this context, students' cognitive and affective-motivational prerequisites to coping with home schooling are expected to be relevant. The present study therefore investigates the role of such prior student prerequisites on their coping with home learning during the first school closures in Germany. In doing so, we focus on two components of coping in this situation: a cognitive component of coping with the demands of home learning as well as an affective-motivational component of being motivated to engage in learning activities during school closures.

From a scientific perspective, home learning during the Covid-19 pandemic is still a relatively new situation. Therefore, there is no explicit or comprehensive theoretical framework that addresses students' learning during the school closures. However, some theoretical approaches and empirical findings related to learning in general may help to shed light on the mechanisms that foster students' autonomous learning. For instance, research on instructional quality (Klieme et al., 2009), on self-regulated learning (Zimmermann, 2001), on homeschooling (Ray, 2020), or on distance education (Simonson et al., 2011) suggests a theoretical background to examine different aspects related to home learning as well. Another line of related research refers to research on homework (Trautwein et al., 2006). Although framed to explain how students deal with work assignments that are rather limited in time and that are meant to be carried out during non-school hours, research on homework is especially informative when it comes to the impact of several student prerequisites (e.g., cognitive and affective-motivational factors) on learning behavior. Against this background, in the following sections, we first review work on cognitive prerequisites that might be relevant to deal with home learning before turning to affective-motivational factors.

PREDICTORS OF HOME LEARNING

Cognitive Prerequisites

Cognitive prerequisites refer to cognitive bases that are necessary for learning and that can influence how students are able to cope with home learning and how they engage in learning situations in different ways. For instance, prior knowledge provides a structure into which new information can be encoded and from which it can be retrieved later (e.g., Ericsson and Kintsch, 1995). Therefore, it supports the acquisition of new knowledge and helps in future learning (Hambrick, 2003). However, prior achievement and general cognitive abilities do not only affect further achievement (Anderson et al., 1989; Slavin et al., 1990) but also students' behavioral engagement (e.g., Chen et al., 2013; Garon-Carrier et al., 2016). Accordingly, research demonstrated effects of general cognitive abilities and prior academic achievement on behavioral homework engagement (Trautwein et al., 2002; Trautwein and Köller, 2003; Rodriguez et al., 2019).

Moreover, cognitive prerequisites may also influence students' engagement in learning situations in an indirect way. That is, higher cognitive abilities and prior academic achievement have been shown to exert a positive effect on motivation (Valentine and Dubois, 2005; Trautwein et al., 2006; Schöber et al., 2018) probably because students with high cognitive abilities are more confident of being able to complete the assignments (Trautwein et al., 2006).

Most of the studies that investigated the contribution of cognitive prerequisites to an engaged learning behavior used relatively broad and unspecific measures of cognitive functioning. Furthermore, these measures were often used in the sense of control variables. In order to investigate achievement gains, some studies included domain-specific achievement tests (e.g., in the area mathematics, Trautwein et al., 2002). However, to our knowledge, no studies have yet examined whether domain-specific competencies support students' learning engagement across different school subjects.

The relevance of domain-specific competencies (e.g., reading and mathematical competencies) has been emphasized by international large-scale assessments of students' performance (e.g., Programme for International Student Assessment (PISA); OECD, 2016). These basic competencies measured in different application situations are subject to domain-specific development in the early years but can be conceptualized along the lifespan as cross-subject basic competencies (Weinert

et al., 2019). Reading competence is not only important in the school subject "German" (or other language arts), but also for coping with the educational requirements in other domains. The range of reading occasions is very wide and reading fulfills different functions at the same time (*cf.* Groeben and Hurrelmann, 2004). Especially in the situation of home learning, the ability to understand written texts may be an essential prerequisite for being able to complete the written assignments.

Besides reading, mathematical literacy is an important key competence since the requirement to understand and apply mathematical data and methods in a variety of situations is becoming increasingly important (Mullis et al., 2012). Mathematical competencies are necessary in many different settings where calculations must be made, mathematical or abstract problems must be solved, or different representations of numbers must be understood. Therefore, it may also be relevant for other school subjects, e.g., mathematical concepts and procedures are necessary to solve problems in science or economics.

Based on these assumptions highlighting the importance of reading and mathematical competencies, the present study includes both competencies as prerequisites to predict students dealing with the home learning situation during the pandemic-related school closures.

Affective-Motivational Prerequisites

Moreover, students' learning (behavior) also depends on affective and motivational factors (Steinmayr and Spinath, 2009; Murayama et al., 2013). The affective-motivational aspects include emotions related to a specific situation or interest and motivation related to a task or subject matter. Therefore, those can be the value connected or assigned to a subject or task, the experienced enjoyment, or the intrinsic motivation to engage in this task or situation. Previous research showed that enjoyment eventually contributes to students' intrinsic motivation (*cf.* Ryan and Deci, 2000a), yet it is considered an emotion and as such also a strong indicator of students' sustainable effort and persistence in learning. In comparison, intrinsic motivation should be mostly initiated by interest and the way in which students' attention and exploratory behavior are directed. In comparison to test anxiety as a negative emotion related to achievement outcomes (e.g., Elliot and McGregor, 1999; Steinmayr et al., 2016), positive emotions, such as learning enjoyment, are less often in the focus of research on learning outcomes, even though previous research highlights the impact of positive emotions on the achievement of students (e.g., Pekrun et al., 2002). To this end, both positive emotions, such as learning enjoyment, as well as motivational aspects, such as the intrinsic motivation, might have affected students' learning efforts during school closures in addition to their willingness to exert effort. Affective-motivational factors are most relevant predictors of human behavior (McAdams and Olson, 2010) and students with more positive emotions have been found to show higher achievement gains over time (Stipek et al., 2010).

During the school closures due to the COVID-19 pandemic, students' affective and motivational prerequisites may have been even more important than during normal school times. In school, teachers support children's learning by structuring lessons, e.g., through instruction, individual assignments, or group work. In contrast, when there is no teacher present, students are responsible for regulating their own learning process. Therefore, self-regulated learning (Corno, 1994; Zimmermann, 2001; Boekaerts, 1999; Brunstein and Spörer, 2001) and motivational components (e.g., intrinsic motivation), which are assumed to influence self-regulated learning (Boekaerts, 1999; see also Pintrich, 1999), are expected to be central factors in this self-organized learning situation.

In the present study, we focus on three aspects of students' learning behavior (Domínguez et al., 2010) and that we assume to be particularly important to home learning: intrinsic motivation, willingness to exert effort, and learning enjoyment. First, as previous studies have shown, students' motivation is positively associated with indicators of their learning behavior and predicts achievement outcomes beyond cognitive prerequisites (Steinmayr and Spinath, 2009). More motivated students show higher learning engagement, e.g., with regard to the time spent on homework (Dettmers et al., 2009; Regueiro et al., 2015), the management of homework time (Núñez et al., 2015), and the amount of homework done (Regueiro et al., 2017). Moreover, research suggests that students' engagement depends on the type of motivation for a task (Ryan and Deci, 2000b). In particular, intrinsic motivation is considered a beneficial precondition since students who work on tasks driven by intrinsic reasons more likely show high levels of persistence, achievement, and engagement (Flink et al., 1992; Bouffard et al., 2001; Coutts, 2004).

Second, willingness to make an effort is a very relevant coping strategy of staying persistent when facing challenges (Moore et al., 2015). Persistent learning behavior at the beginning of primary school even predicts academic outcomes of achievement and college graduation several years later (McClelland et al., 2013). Persistence in task engagement and in learning also has as a mediating effect between the quality of the learning environment and academic achievement (Domínguez et al., 2010; Schmerse, 2020). This is especially relevant with respect to the novel situation of learning at home and an uncertain quality of learning offers and instruction. Moreover, willingness to exert effort is related to consciousness (Vasalampi et al., 2014) which has been found to have positive effects on educational engagement and attainment (De Raad and Schouwenburg, 1996).

Finally, enjoyment in learning represents a positive emotion toward learning requirements that may occur during task completion (Pekrun et al., 2002). Various studies have demonstrated that students who enjoy learning tend to exert more effort and to persist for longer even when they struggle with difficult tasks, which results in an increase in their success rates (Yaratan and Kasapoğlu, 2012; García et al., 2016). The associations between learning enjoyment and positive learning behavior as being more engaged (Reschly et al., 2008) and being more persistent (Gendolla, 2003) leads to more academic progress over time

(Hagenauer and Hascher, 2014). Thus, intrinsic motivation, willingness to exert effort, and learning enjoyment represent mechanisms to explain learning success over time (Moore et al., 2015).

RESEARCH QUESTIONS

Against this background, the present study focuses on how students managed the novel situation of learning at home during the first school closure in spring 2020. Based on previous research, it is plausible to assume that cognitive prerequisites and affective-motivational factors shape learning behavior – even when learning takes place under new circumstances as it was the case during school closures.

With respect to the dependent variables, managing the situation of relatively self-organized learning at home includes two different components: A cognitive component that refers to cognitively being able to understand instructions and master the requirements of the tasks as well as an affective-motivational component that involves being engaged in learning activities and staying focused on the tasks.

Thus, we were interested in how cognitive and affective-motivational factors contributed to successful coping with and sufficient motivation to engage in learning activities during that time. Therefore, we examined if prior cognitive competencies (reading and mathematical competencies) and affective-motivational factors (willingness to exert efforts, learning enjoyment, and intrinsic motivation) predict how well students cope with home learning during the pandemic-related school closures and how difficult it was to motivate them for home learning. In addition, we aimed at evaluating possible differential effects of the predictors on the outcome measures. That is, from a theoretical perspective, it could be argued that cognitive competencies might be more relevant for the cognitive aspect of coping with home learning, whereas affective-motivational factors could be assumed to be more important for students' motivation in this situation.

MATERIALS AND METHODS

In the present study, we analyzed data from Starting Cohort 2 of the longitudinal German National Educational Panel Study (NEPS; Blossfeld et al., 2011). Starting Cohort 2 was initiated in 2010 with kindergarten children throughout Germany. With the beginning of elementary school, additional classmates were recruited and included in the sample. Participation was voluntarily. Parents gave informed consent for themselves and/or their child to participate in the study. Both children and their parents have been continuously followed since then ($n = 9{,}337$). The annual survey program includes parental and child interviews on educationally relevant constructs (e.g., resources at home, parental engagement, and motivation) and family background as well as competence testing in various domains. Due to the COVID-19 pandemic in spring 2020, all parents were invited to an additional online survey. It covered relevant characteristics of learning at home during school closure (including students' coping with learning at home and motivational difficulties).

Sample

The analytic sample comprises $N = 1{,}452$ students whose parents participated in the additional online survey during the COVID-19 pandemic in spring 2020. In the sample, 53.4% of the students were female and students' mean age was 14 years and 2 months (range = 12 years and 7 months to 15 years and 5 months, $SD = 4.2$ months). Whereas 66.6% of the students attended the highest school track (i.e., Gymnasium) at the start of the 2019/2020 school year, 33.4% of the students attended other school tracks. Furthermore, 61.3% of the families had an academic background (with at least one parent having a university degree), whereas 38.7% of the families had a non-academic educational background. Families' highest international socioeconomic status (HISEI; see Ganzeboom et al., 1992; Ganzeboom, 2010) that combines income and education to indicate the status of an occupation was on average 64.7 ($SD = 15.4$). The lowest value of the index is 16 (e.g., support staff and cleaners), the highest 90 (judges). In comparison, the mean HISEI of students in Germany in the year 2008 was 47.6 (Nold, 2010). These data suggest that a relatively high proportion of higher educated parents participated in the additional survey of NEPS. In the analyses, we used sample weights to deal with this bias in the sample composition (see below). More information about NEPS, Starting Cohort 2, and the NEPS-C additional online survey can be found online at https://www.neps-data.de.

Measures

Our analyses draw on two measurement points of Starting Cohort 2. The earlier measurement point took place in fall 2018 when students were attending Grade 7. At this time point, all predictor variables were assessed including students' competence in reading and mathematics as well as affective-motivational aspects in terms of willingness to exert effort, learning enjoyment, and intrinsic motivation. The later measurement point refers to the aforementioned additional online survey and covered outcomes including relevant characteristics of learning at home during school closure (including students' coping with learning at home and motivational difficulties).

Predictor Variables

Cognitive Competence Measures

The competence tests were administered by trained interviewers as paper-pencil tests in individual sessions at students' homes. The test duration was 28 min each for the reading and mathematical competence test. Please note that due to time constraints in the survey, a randomly assigned rotation design was applied which resulted in a reduced number of students with data in the competence tests ($n = 798$ for reading; $n = 843$ for mathematics). The sequence of the tests was also randomly assigned to all study participants.

Reading Competence. The framework for the assessment of reading competence in the NEPS considers different text functions as well as cognitive requirements of the test items to assess reading competence (Gehrer et al., 2013; Weinert

et al., 2019). Reading comprehension was measured using five text functions, namely: (a) informational texts, (b) commenting or arguing texts, (c) literary texts, (d) instructional texts, and (e) advertising texts (Gehrer et al., 2013). The cognitive requirements of test items were finding information in the text, drawing text-related conclusions, and reflecting and assessing. Most of the tasks were designed using a multiple-choice answering format. The rest of the tasks used a decision-making or matching response format (Gehrer et al., 2013). The reading competence test in Grade 7 was administered in two different versions with varying degrees of difficulty and assigned to the students dependent on prior competence assessments in Grade 4. The unidimensional tests included either 29 or 30 items and showed good item fit. The reliability of the reading competence test was good with EAP/PV reliability = 0.83 and WLE reliability = 0.79 (Krannich et al., 2017).

Mathematical Competence. The underlying framework of the tests on mathematical competence used in the NEPS combines mathematical content areas with mathematical and cognitive processes (see Neumann et al., 2013). The content areas refer to (a) quantity, (b) space and shape, (c) change and relationships, and (d) data and chance. The six cognitive processes refer to mathematical communication, mathematical argumentation, and modeling, using representational forms, mathematical problem solving as well as technical abilities and skills. Similar to the reading competence tests, there were two levels of difficulty which were assigned according to the prior competence level in Grade 4. Both mathematics tests consisted of 21 items requiring either multiple-choice or short constructed responses. The test showed good item fit and good reliability (EAP/PV reliability = 0.77, WLE reliability = 0.74; Kock et al., 2021).

Both tests were scaled using models of the item response theory (Pohl and Carstensen, 2012) and weighted maximum likelihood estimates (WLEs) were used in the analyses.

Affective-Motivational Factors

The survey items were integrated in a student questionnaire that could be completed either as a paper version or as an online version. Items on the child's affective-motivational factors were taken from the German questionnaire on emotional and social school experiences of children (Rauer and Schuck, 2003) and adapted from Schiefele et al. (2002).

Intrinsic Motivation. Students' intrinsic motivation was addressed with a scale containing four items, e.g., "I study for school because I enjoy working with the subject matter" and "I study for school because I think the contents are relevant" (Schiefele et al., 2002). The rating scale ranged from 1 (does not apply at all) to 4 (does completely apply) and had a good internal consistency (Cronbach's alpha) with $\alpha = 0.83$.

Willingness to Exert Effort. This scale focuses on students' willingness to exert effort especially when faced with great challenges and difficult tasks. It includes four items, e.g., "I try hard even when tasks are difficult" and "I complete all tasks with great accuracy." The items were rated on a 4-point-Likert scale ranging from 1 (completely disagree) to 4 (completely agree). Internal consistency (Cronbach's alpha) of this scale was acceptable ($\alpha = 0.62$).

Learning Enjoyment. The scale on learning enjoyment refers to students' positive attitudes toward school and learning and includes three items, e.g., "I like attending school" and "I really enjoy learning at school." Again, the items were rated on a 4-point Likert scale ranging from 1 (completely disagree) to 4 (completely agree). The scale on learning enjoyment showed a good internal consistency (Cronbach's alpha) with $\alpha = 0.89$.

For all three scales, mean values were used in the following analyses.

Outcome Variables

The variables assessed at the second measurement point were based on parents' ratings about their children's learning at home during school closure. In detail, the parents had to state to what extent the following statements applied to them: (1) "My child coped well with the demands of home learning." and (2) "It was difficult to motivate my child to study at home." Students' coping with learning at home and their motivational difficulties were assessed on a 5-point-Likert scale ranging from 1 (does not apply at all) to 5 (does completely apply). In the analyses, each item was treated as a distinct variable.

Control Variables

Additionally, we included several variables which might be correlated with the predictor and outcome variables. Control variables were the education of the parents, which was assessed with the International Standard Classification of Education (ISCED; Schroedter et al., 2006), students' gender and the school type they attended at the beginning of the school year 2019/2020. Furthermore, we controlled for parents' perception of their own stress and burden during the COVID-19 pandemic because this might have influenced their assessment of their children's dealing with the home learning situation. To assess their stress and burden, parents had to indicate on a 5-point-Likert scale to what extent the following statements applied to them: "I was very stressed by the school closure and the demands of home schooling."

Analyses Plan

In order to investigate whether students' prior cognitive competencies and affective-motivational factors were significant predictors of their learning at home, we computed separate regression analyses predicting parents' ratings on (a) children's coping with home learning and (b) the difficulty to motivate them. As we aimed to evaluate the relative and incremental impact of cognitive competencies and affective-motivational factors, we applied a stepwise procedure. In the first step (model 1), only the background variables including the highest education level of the parents (HISCED), the school track the students were attending, their gender and the level of stress that parents perceived during the COVID-19 pandemic were considered.

To investigate whether cognitive competencies (model 2) or affective-motivational factors (model 3) additionally contributed to the prediction of the outcome variables, these indicators were added next. Finally, all variables were entered to investigate whether students' cognitive competencies and affective-motivational factors accounted for separate or overlapping variance in explaining students' coping with learning at home.

The regression analyses were carried out using MPlus version 7.4 (Muthén and Muthén, 2015). To deal with missing data, we applied the full information maximum likelihood (FIML) approach (e.g., Arbuckle, 1996) that is implemented in MPlus and uses valid information of all observations for model estimation. FIML has been shown to be superior to other missing data strategies (e.g., listwise deletion or mean replacement) and to provide more accurate estimates of regression coefficients and variance accounted (Enders, 2001). To support the FIML approach and to offer a broader data basis to deal with missing data, we included children's cognitive competencies assessed at Grade 4 and affective-motivational factors (willingness to exert effort, learning enjoyment, and intrinsic motivation) measured at Grades 4, 5, and 6 as auxiliary variables.

In order to account for the biased sample composition, sample weights were used in the analyses (Würbach et al., 2021). Because the data were weighted and post-stratified in the analyses, statements can be generalized.

RESULTS

In the following sections, we first report descriptive results regarding the predictor variables assessed in Grade 7 and the outcome measures assessed one and a half years later. Moreover, the intercorrelations among these measures are presented. Finally, we show the results of multiple regression analyses to examine the contribution of each predictor variable on the outcome variables.

Preliminary Analyses of Predictor and Outcome Variables

A summary of the descriptive statistics for children's cognitive competencies, their affective-motivational factors, and parents' rating of the home learning situation is displayed in **Table 1**. Reading and mathematical competencies were estimated as weighted maximum likelihood estimates (Pohl and Carstensen, 2012) and, as a result of the scaling, the corresponding mean scores are approximately zero. Furthermore, on average students reported their willingness to exert effort to be relatively high ($M = 3.02$; $SD = 0.50$). In comparison, they estimated their enjoyment of learning ($M = 2.65$; $SD = 0.77$) and their intrinsic motivation ($M = 2.42$; $SD = 0.62$) to be somewhat lower. Parents' judgments concerning their children's coping with home learning during the COVID-19 pandemic had a mean value of $M = 3.66$ ($SD = 1.04$) which was in the upper range of the scale. Furthermore, there was considerable variance with regard to parents' rating on how difficult it was to motivate their children ($M = 3.03$; $SD = 1.33$). Finally, parents perceived stress had a mean value of $M = 2.76$ ($SD = 1.30$), which is near the middle of the scale, and a quite large variance as well.

TABLE 1 | Descriptives of the predictor and outcome variables.

	N	Min	Max	*M*	*SD*
Reading competence	798	–	–	−0.10	1.51
Mathematical competence	843	–	–	−0.25	1.32
Willingness to exert effort	1,249	1	4	3.02	0.50
Enjoyment of learning	1,246	1	4	2.65	0.77
Intrinsic motivation	1,246	1	4	2.42	0.62
Coping with home learning	1,452	1	5	3.66	1.04
Difficult to motivate	1,452	1	5	3.03	1.33
Parental stress	1,452	1	5	2.76	1.30

Descriptives are based on sample weights.

Table 2 shows the intercorrelations among the variables included in the study. First, as expected, there was a high correlation between students' reading and mathematical competencies ($r = 0.66$; $p < 0.001$). Similarly, moderate to high correlations emerged among the different aspects concerning students' affective-motivational factors, i.e., their willingness to exert effort, their enjoyment of learning, and their intrinsic motivation ($r = 0.44$ to $r = 0.70$; all $p < 0.001$). More interestingly, parents' ratings regarding their children's coping with the home learning were positively associated with all indicators of children's cognitive competencies and affective-motivational factors assessed one and a half years earlier ($r = 0.14$ to $r = 0.26$; all $p < 0.001$). In contrast, there were negative correlations among parents' ratings concerning the difficulty to motivate their children and indicators of children's cognitive competencies and affective-motivational factors ($r = -0.15$ to $r = -0.28$; all $p < 0.001$). Furthermore, as expected, the two ratings concerning the situation of learning at home (i.e., students' coping with home learning and parents' difficulties to motivate them) were negatively associated with each other ($r = -0.54$; $p < 0.001$).

Next, we tested whether the correlations of different predictor variables with a particular outcome variable were significantly different from each other. For instance, for coping with home learning, we examined whether the correlation of reading competence with coping ($r = 0.21$) differed significantly from the correlation of mathematical competence with coping ($r = 0.23$). The calculation according to Eid et al. (2011) (single-sided test) showed that there was no significant difference between these two correlations ($z = 0.48$; $p = 0.32$). However, the correlation of willingness to exert effort with coping ($r = 0.26$) was significantly larger than the correlation of enjoyment of learning and coping ($r = 0.14$; $z = 3.79$; $p < 0.001$), and the correlation of intrinsic motivation and coping ($r = 0.19$; $z = 2.65$; $p = 0.004$). Moreover, there was a significant difference between the correlations of enjoyment of learning with coping and intrinsic motivation with coping ($z = -1.88$; $p = 0.03$).

For the outcome variable difficulty to motivate, the correlation between reading competence and parents' difficulty in motivating

TABLE 2 | Pearson correlations of the predictor, outcome, and control variables.

	1	2	3	4	5	6	7	8	9	10	11
1. Reading Competence	–	0.66**	0.13**	0.14**	0.17**	0.21**	−0.28**	0.29**	0.03	0.40**	−0.10**
2. Mathematical Competence	0.61	–	0.34**	0.08**	0.30**	0.23**	−0.15**	0.12**	−0.17**	0.42**	−0.16**
3. Willingness to exert effort	0.09	0.24	–	0.44**	0.54**	0.26**	−0.26**	−0.12**	0.08**	0.20**	−0.14**
4. Enjoyment of learning	0.13	0.08	0.43	–	0.70**	0.14**	−0.24**	−0.16**	0.25**	0.14**	−0.29**
5. Intrinsic motivation	0.12	0.21	0.54	0.70	–	0.19**	−0.18**	−0.16**	0.11**	0.26**	−0.19**
6. Coping with home learning	0.24	0.19	0.27	0.15	0.19	–	−0.54**	−0.02	0.11**	0.17**	−0.27**
7. Difficult to motivate	−0.29	−0.15	−0.30	−0.23	−0.20	−0.54	–	0.32	−0.23**	−0.08**	0.21**
8. Educ. background (HISCED)	0.28	0.16	−0.13	−0.12	−0.14	−0.00	0.03	–	−0.04	0.00	−0.04
9. Gender	0.09	−0.18	0.04	0.23	0.09	0.11	−0.23	−0.05	–	−0.08**	−0.01
10. School type	0.38	0.42	0.20	0.17	0.29	0.16	−0.08	0.03	−0.07	–	−0.14**
11. Parental stress	−0.08	−0.17	−0.12	−0.28	−0.17	−0.27	0.21	−0.05	−0.01	−0.11	–

*Intercorrelations based on the available data are presented above the diagonal, estimated intercorrelations based on the FIML are presented below the diagonal; all intercorrelations were calculated using sample weights (no significance level is displayed for the estimated intercorrelations). *$p<0.05$, **$p<0.01$.*

their children ($r=-0.28$) was significantly larger than the correlation between mathematical competence and parents' difficulty in motivating their children ($r=-0.15$; $z=2.81$; $p=0.002$). Furthermore, the correlation of willingness to exert efforts with motivation difficulties ($r=-0.26$) was significantly larger than the correlation of intrinsic motivation and motivation difficulties ($r=-0.18$; $z=2.83$; $p=0.002$). There was also a significant difference between the correlations of enjoyment of learning with motivation difficulties ($r=-0.24$) and intrinsic motivation and motivation difficulties ($r=-0.18$; $z=-2.91$; $p=0.002$). Finally, the correlations of willingness to exert efforts with motivation difficulties and the correlation of learning enjoyment and motivation difficulties did not significantly differ from each other ($z=0.43$; $p=0.34$).

Prediction of Students' Learning at Home

As a next step, we computed regression analyses predicting parents' ratings on children's coping with home learning (see **Table 3**). The analysis in model 1 revealed that students' school type ($\beta=0.14$; $p=0.03$) was a significant predictor, whereas parents' educational level ($\beta=-0.02$; $p=0.76$) did not significantly explain variance of students' coping with learning at home. There was no gender difference ($\beta=0.12$; $p=0.054$) in students' coping with the situation during the pandemic-related school closures. Finally, parents' perceived stress during the COVID-19 pandemic ($\beta=-0.25$; $p<0.001$) was negatively correlated with their ratings of how well their children were coping. In model 2, students' cognitive competencies were added as predictors but neither reading competencies nor mathematical competencies significantly contributed to the prediction of the students' coping. As shown in **Table 3** (model 2), the effect of school type diminished when students' cognitive competencies were included, suggesting a covariation of these variables. Model 3, which includes affective-motivational factors instead of cognitive competencies, revealed that students' willingness to exert effort ($\beta=0.22$; $p<0.001$) was relevant for students' coping with home learning, whereas their enjoyment of learning ($\beta=-0.11$; $p=0.24$) and their intrinsic motivation ($\beta=0.07$; $p=0.43$) did not significantly explain variance in this outcome variable. Further, there was a gender difference when including affective-motivational prerequisites in that girls were better able to cope with the situation of home learning ($\beta=0.13$; $p=0.047$). Moreover, parental stress was a significant predictor of students' coping during school closures ($\beta=-0.25$; $p<0.001$). Finally, the analysis in model 4 with all variables showed that willingness to exert effort ($\beta=0.23$; $p<0.001$) remained to be a significant predictor when students' cognitive competencies and affective-motivational factors were added simultaneously. Interestingly, the impact of students' reading competencies ($\beta=0.21$; $p=0.028$) on their coping with home learning also became significant in the final and complete model 4. Regarding the control variables, only parental stress was a significant predictor, whereas there were no differences regarding gender and school type.

Overall, the amount of variance in the outcome measure explained by the predictor variables was rather low for model 1 with $R^2=0.10$ but increased to $R^2=0.18$ in model 4 when all variables were entered. This increase in the amount of explained variance suggests that cognitive competencies and affective-motivational factors independently contributed to the prediction of students' coping with home learning.

Table 4 shows the results of the regression analyses predicting parents' difficulty in motivating their children. Regarding the background variables in model 1, a negative correlation was found between students' gender and the difficulty in motivating them ($\beta=-0.24$; $p=0.001$). Meaning that, parents reported to have less difficulties to motivate girls as opposed to boys. Moreover, parents' perceived stress during the COVID-19 pandemic ($\beta=0.20$; $p=0.001$) was positively correlated with their ratings of how difficult it was to motivate their children. The educational level of the parents ($\beta=0.03$; $p=0.68$) and the school type ($\beta=-0.17$; $p=0.35$) did not significantly explain variance in this outcome variable. When students' cognitive competencies were added in model 2, the analyses revealed that students' reading competencies were ($\beta=-0.28$; $p=0.003$) significant predictors of the difficulty to motivate them. Parents reported to have more difficulties to motivate their children when their reading competencies were lower. In contrast, the mathematical competencies of the students ($\beta=-0.03$; $p=0.76$) did not significantly predict motivation problems reported by

TABLE 3 | Regression analyses predicting "Coping with Home Learning."

	Model 1			Model 2			Model 3			Model 4		
	b	***SE***	***ß***	***b***	***SE***	***ß***	***b***	***SE***	***ß***	***b***	***SE***	***ß***
Intercept	*3.79*			*3.96*			*2.52*			*2.76*		
Background variables												
HISCED (Ref. no acad. background)	−0.04	0.13	−0.02	−0.15	0.13	−0.07	0.03	0.12	0.01	−0.10	0.12	−0.04
School (Ref. no Gymnasium)	0.30	0.14	0.14*	0.13	0.15	0.06	0.20	0.14	0.10	0.06	0.14	0.03
Gender (Ref. male)	0.25	0.13	0.12	0.22	0.15	0.10	0.27	0.14	0.13*	0.20	0.15	0.10
Parental Stress	−0.26	0.07	−0.25**	−0.25	0.07	−0.24**	−0.26	0.07	−0.25**	−0.26	0.06	−0.25**
Cognitive competencies												
Reading				0.11	0.08	0.15				0.15	0.07	0.21*
Mathematics				0.04	0.08	0.05				−0.03	0.08	−0.03
Affective-motivational factors												
Willingness to exert efforts							0.45	0.12	0.22**	0.47	0.12	0.23**
Enjoyment of learning							−0.15	0.12	−0.11	−0.17	0.12	−0.13
Intrinsic motivation							0.11	0.14	0.07	0.12	0.14	0.07
		$R^2 = 0.10$			$R^2 = 0.13$			$R^2 = 0.15$			$R^2 = 0.18$	

*$p < 0.05$, **$p < 0.01$.

TABLE 4 | Regression analyses predicting "Difficulty to Motivate."

	Model 1			Model 2			Model 3			Model 4		
	b	***SE***	***ß***	***b***	***SE***	***ß***	***b***	***SE***	***ß***	***b***	***SE***	***ß***
Intercept	*3.39*			*3.00*			*5.47*			*4.98*		
Background variables												
HISCED (Ref. no acad. background)	0.08	0.19	0.03	0.32	0.19	0.11	−0.03	0.18	−0.01	0.20	0.17	0.07
School (Ref. no Gymnasium)	−0.20	0.21	−0.07	0.12	0.22	0.04	−0.07	0.19	−0.02	0.20	0.20	0.07
Gender (Ref. male)	−0.63	0.21	−0.24**	−0.54	0.20	−0.20**	−0.58	0.20	−0.22**	−0.47	0.20	−0.18*
Parental Stress	0.27	0.08	0.20**	0.26	0.08	0.19**	0.23	0.09	0.17**	0.24	0.08	0.18**
Cognitive competencies												
Reading				−0.26	0.09	−0.28**				−0.28	0.09	−0.31**
Mathematics				−0.03	0.10	−0.03				0.05	0.10	0.05
Affective-motivational factors												
Willingness to exert efforts							−0.67	0.23	−0.26**	−0.67	0.22	−0.26**
Enjoyment of learning							−0.07	0.15	−0.04	−0.04	0.15	−0.02
Intrinsic motivation							0.06	0.23	0.03	0.05	0.22	0.02
		$R^2 = 0.11$			$R^2 = 0.17$			$R^2 = 0.17$			$R^2 = 0.23$	

*$p < 0.05$, **$p < 0.01$.

parents. Similar to students' coping with learning at home, model 3 showed that students' willingness to exert effort ($\beta = -0.26$; $p = 0.004$) significantly predicted parents' judgments on motivation problems, whereas students' enjoyment of learning ($\beta = -0.04$; $p = 0.63$) and their intrinsic motivation ($\beta = 0.03$; $p = 0.79$) did not contribute to the prediction of motivation problems. In model 4, which included all predictor variables, the results remained the same. Students' willingness to exert effort ($\beta = -0.26$; $p = 0.002$), their reading competence ($\beta = -0.31$; $p = 0.001$) as well as their gender ($\beta = -0.18$; $p = 0.014$) and parents' perceived stress ($\beta = 0.18$; $p = 0.002$) were significant predictors of motivation problems reported by parents. The other predictor variables did not explain additional variance in this outcome variable.

Again, the amount of variance in the outcome measure explained by the predictor variables increased when more variables were entered in the analyses $R^2 = 0.23$, indicating that cognitive competencies and affective-motivational factors were equally important but independent predictors of parents' perception of motivation problems during the pandemic-related school closures.

DISCUSSION

The present study focused on students' situation of home learning during the first school closures due to the COVID-19 pandemic. Probably, the most important contribution of the

study is that – due to the longitudinal nature of this study – it allows for a detailed inspection of cognitive and affective-motivational prerequisites that might have been important in dealing with the situation of home learning.

First, overall, parents reported in our study that their children were coping rather well with the new learning situation. This finding is in line with the results of a study by Wößmann et al. (2020) according to which parents' assessment of the overall situation was rather positive. This result coincides with the perceptions of students themselves: More than half of the 15-year-old students in a study by Letzel et al. (2020) partly or fully agreed that, overall, they can handle home schooling very well. However, this rather positive impression should not conceal possible difficulties related to home learning. Our findings also showed that there was considerable variability with regard to parents' ratings of their children's motivation. About one third of parents (34%) reported that there were few to no difficulties motivating their children to learn at home. However, another third of the parents (35%) thought that their children were rather or quite difficult to motivate to learn. The remaining third (32%) were in the middle category. In a similar vein, Wildemann and Hosenfeld (2020) reported that around half of the parents of elementary and secondary school students stated that their children had low motivation or were not motivated at all. Furthermore, as also documented in the homework literature, the study revealed gender differences in motivation, with boys being more difficult to motivate than girls (Trautwein et al., 2006).

In addition, considering students' prerequisites that were measured one and a half years before the pandemic revealed several interesting findings. Both cognitive and affective-motivational prerequisites of the students predicted students' ability to handle the situation of home learning. More specifically, with regard to cognitive prerequisites, their reading competence turned out to be a significant predictor, whereas, with regard to affective-motivational factors, students' willingness to exert efforts significantly predicted their coping of home learning and motivation. Contrary to our expectations, other cognitive (mathematics competence) and affective-motivational (enjoyment of learning and intrinsic motivation) prerequisites did not significantly contribute to the prediction of the dependent variables when entered simultaneously in the regression analyses.

Looking at cognitive competencies, reading competencies turned out to be a significant predictor not only for students' coping of the new learning situation but also for their motivation during school closures as reported by their parents. Even though, the bivariate correlations of reading and mathematics competences with the two outcome variables were relatively low and differed only for motivation difficulties significantly from each other, the results of our study tentatively support the assumption that reading competencies can be considered as important basic cross-subject competencies (Weinert et al., 2019) that help to handle the situation of home learning. A cautious interpretation could be that compared to regular classroom instruction, dealing with written text materials, e.g., reading texts in schoolbooks or reading work instructions could have been of even greater relevance when students were studying at home. Studies showed that teachers often used online platforms or email as communication tools to distribute learning materials and work assignments (Wolter et al., 2020) during this first period of school closures in Germany and, at the same time, the opportunities for teachers to provide verbal instruction or give immediate feedback were substantially reduced. Experiencing comprehension difficulties may have resulted in lower confidence of being able to complete the assignments and in less positive expectancy beliefs (Trautwein et al., 2006), leading to lower motivation when working autonomously on the tasks.

In contrast to reading competencies, mathematical competencies were no significant predictors of students' dealing with home learning when entered simultaneously in the regression analyses. However, when interpreting this finding, it has to be acknowledged that reading and mathematical competencies share common proportions of variance. Consistent with other findings, our results showed that mathematical and reading competencies were highly intercorrelated (e.g., Hooper et al., 2010). This correlation may be traced back to the fact that underlying abilities or skills, such as short-term memory, working memory, and executive functioning, are important preconditions for both reading and mathematical competencies (e.g., Alloway et al., 2006; Bull et al., 2008; Knievel et al., 2010). Therefore, these underlying abilities or skills may also have played an important role when students had to handle the situation of home learning. However, our results suggest there is no unique variance in the outcomes variables that could be explained by mathematical competencies when reading competencies were accounted for. One possible reason for this could be that the range of school subjects in which reading competencies were important, in particular in the case of rather self-organized home learning, was comparatively larger than for mathematical competencies.

With respect to the affective-motivational factors, willingness to exert effort predicted students' behavior during school closures while intrinsic motivation and learning enjoyment were not relevant for their coping with the new learning situation. According to parents, students were more able to cope with the situation and showed fewer difficulties in motivation when students had higher levels of willingness to exert effort with respect to prior learning circumstances. Willingness to exert effort is especially relevant in challenging and demanding situations (Moore et al., 2015) and thus a crucial prerequisite in the novel times of school closures and learning at home when hardly any external structure was provided and the ability of students to regulate their own learning progress was particularly important. Based on our findings, willingness to exert effort might potentially serve as a relevant mediator of further motivational predictors leading to more engagement and ultimately to more successful coping strategies in learning (Reschly et al., 2008; Hagenauer and Hascher, 2014).

In contrast to our expectations and previous work (e.g., Trautwein et al., 2006; Hong et al., 2009; Xu, 2017; Suárez et al., 2019), students' intrinsic motivation seemed to be less relevant in this learning situation at home. Similar to the

findings regarding cognitive competencies, it could be considered that there is shared variance in the affective-motivational constructs that were included in the analyses. Nevertheless, our data indicated that in the special situation of home learning, the willingness to make an effort might have been more relevant compared to intrinsic motivation or learning enjoyment. Even though we cannot infer this directly from our data this could be due to the requirements in this novel situation, e.g., many tasks that had to be completed in a self-regulated way without sufficient support or immediate feedback provided by teachers. That fact that enjoyment in learning was not important in the present study might also be traced back to its operationalization. Items were closely related to learning at school and thus, maybe less related to learning activities at home. In fact, the learning situation at school and the one arising in spring 2020 were most likely not directly comparable.

In summary, the results revealed that children's cognitive and affective-motivational factors independently contributed to how the situation of learning at home during school closures were experienced by parents. Although differential effects were expected against the theoretical background, the findings did not support the presumption that cognitive components were closer related to coping with the learning situation at home and that affective-motivational factors were more important for students' motivation. Rather, both reading competence and willingness to exert effort simultaneously predicted both outcome variables, i.e., coping of learning at home and difficulties in motivation during school closures.

Strength and Limitations

This study provides important findings on relevant predictors of coping with the special situation of home learning during pandemic-related school closures in Germany. Using the advantages of the large longitudinal sample of the NEPS, the present study considered data one and a half years prior to the pandemic regarding two competence domains of students as well as three affective-motivational factors. However, besides the manifold benefits of longitudinal data, we cannot rule out that especially the affective-motivational constructs were specific to the situation. Even though, results on earlier time points showed that there is moderate stability of these measures (with *r*'s between 0.50 and 0.60 over the course of 1 year from Grade 6 to Grade 7), we cannot be sure of the stability of these measures in the face of the new situation which might have changed students' willingness to exert effort, intrinsic motivation, and enjoyment of learning. Further, to increase representativeness of the present sample and to allow generalizable statements, sample weights were used. Yet overall, the amount of explained variance was relatively low with $R^2 = 0.18$ for coping with home learning and $R^2 = 0.23$ for motivation difficulties.

Nevertheless, some additional limitations should be noted. A limitation concerns the fact that the dependent variables were based on single items instead of using scales to measure students' handling of home learning. Using a different way of operationalization not only would have allowed to compute standard reliability measures but also to measure a more heterogeneous composite of these constructs. At the time, the study was planned, the situation of home learning was both new and unexpected and therefore only a few findings from other studies were available (e.g., forsa, 2020). Therefore, it was barely possible to rely on existing scales on home learning and, consequently, the questions were designed for the current study to depict the situation and to address research questions from different research fields. Furthermore, instead of interviewing the students, the parents reported from their perspective on how their children were dealing with the situation of home learning. Consequently, it is not quite clear yet how students themselves perceived the situation. Although other studies showed that parents' and children's perceptions concerning home learning during the COVID-19 situation led to similar outcomes (Letzel et al., 2020; Wößmann et al., 2020), we might have obtained a better overall picture of the situation if it had been possible to include both perspectives. Later assessments of Starting Cohort 2 of the NEPS will help to address this limitation and will provide further information on how students themselves perceived the situation of learning from home.

Moreover, concerning the scales to measure affective-motivational factors it has to be noted that 4-point-Likert scales were used which were initially addressed to somewhat younger children in the course of this study. As the children have been participating in the longitudinal study since elementary school age, the scale was conducted without changes over time in order to maintain consistency. However, this may have led to restricted variance of these predictor variables.

Another limitation lies in the fact that due to the design of the study at the previous measurement point, there was a relatively high number of missing data in the reading and mathematical competence tests. In order to alleviate the problem, we used the FIML approach and added auxiliary variables from previous competence tests which should have provided a reliable basis for the estimation of the coefficients. Furthermore, it is important to mention that the missing values in the competence tests were missing at random and therefore, it can be assumed that the results were not biased in a specific way.

Conclusion

To conclude, the present study extends previous research on the situation of home learning due to the COVID-19 pandemic by integrating prior cognitive and affective-motivational factors as predictors of students' coping with home learning in secondary school in Germany. The findings suggest that in particular students' reading competence and their willingness to exert effort contributed to their coping of home learning. Even though only tentative recommendations can be made on the basis of our study, it might be important to give special attention to comprehensible and less complex language in the text material and instructions that students have to work on in order to support students with lower reading

competencies. Synchronous and interactive teaching elements in which students can approach teachers for questions might help clarifying problems of understanding. Moreover, the high variability that was found with regard to students' motivation suggests that a relatively high proportion of students had problems to work on the tasks in a self-regulated way. Therefore, fostering self-regulation skills, e.g., by formulating concrete goals and expectations and by providing feedback might help to overcome these problems. Finally, more research is needed to investigate how children's prerequisites influence their learning behavior and how interventions in the educational field could help to deal with challenging situations, such as home learning.

DATA AVAILABILITY STATEMENT

The present article analyzed data of the National Educational Panel Study in Germany. The anonymized data are available for the scientific community at: https://www.neps-data.de.

ETHICS STATEMENT

The NEPS study is conducted under the supervision of the German Federal Commissioner for Data Protection and Freedom of Information (BfDI) and in coordination with the German Standing Conference of the Ministers of Education and Cultural Affairs (KMK) and – in the case of surveys at schools – the Educational Ministries of the respective Federal States. All data collection procedures, instruments, and documents were checked by the data protection unit of the Leibniz Institute for Educational Trajectories (LIfBi). The necessary steps are taken to protect participants' confidentiality according to national and international regulations of data security. Participation in the NEPS study is voluntary and based on the informed consent of participants. This consent to participate in the NEPS study can be revoked at any time. All parents of the Starting Cohort 2 of the NEPS gave their written consent for themselves and their child for participation in the study. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

All authors contributed to the conception and the design of the article and provided feedback and ideas. KL performed the statistical analysis. KL and LN took the lead in writing the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

The authors have not received any funding for the publication of this article.

ACKNOWLEDGMENTS

This paper uses data from the National Educational Panel Study (NEPS): Starting Cohort Kindergarten, *doi: 10.5157/NEPS:SC2:9.0.0* and the supplementary survey on the COVID-19-pandemic Corona_CAWI_C2. From 2008 to 2013, NEPS data were collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS has been carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in co-operation with a nationwide network. We would like to thank all families who participated in the NEPS.

REFERENCES

Alloway, T. P., Gathercole, S. E., and Pickering, S. J. (2006). Verbal and visuospatial short-term and working memory in children: are they separable? *Child Dev.* 77, 1698–1716. doi: 10.1111/j.1467-8624.2006.00968.x

Anderson, L. W., Ryan, D. W., and Shapiro, B. J. (1989). *The IEA Classroom Environment Study*. Oxford: Pergamon Press.

Arbuckle, J. L. (1996). Full information estimation in the presence of incomplete data. In G. A. Marcoulides & R. E. Schumacker (Eds.), *Advanced structural equation modeling: Issues and Techniques* (pp. 243–277). Mahwah, NJ: Erlbaum.

Blossfeld, H.-P., Roßbach, H.-G., and von Maurice, J. (Eds.) (2011). Education as a lifelong process: The German National Educational Panel Study (NEPS). *Z. Erziehungswiss.* [Special Issue 14]. Wiesbaden: VS Verlag für Sozialwissenschaften.

Boekaerts, M. (1999). Self-regulated learning: where we are today. *Int. J. Educ. Res.* 31, 445–457. doi: 10.1016/S0883-0355(99)00014-2

Bouffard, T., Boileau, L., and Vezeau, C. (2001). Students' transition from elementary to high school and changes of the relationship between motivation and academic performance. *Eur. J. Psychol. Educ.* 16, 589–604. doi: 10.1007/BF03173199

Brunstein, J. C., and Spörer, N. (2001). "Selbstgesteuertes Lernen [Self-regulated learning]," in *Handwörterbuch Pädagogische Psychologie*. ed. J. Rost (Weinheim, Germany: Beltz), 622–629.

Bull, R., Espy, K. A., and Wiebe, S. A. (2008). Short-term memory, working memory, and executive functioning in preschoolers: longitudinal predictors of mathematical achievement at age 7 years. *Dev. Neuropsychol.* 33, 205–228. doi: 10.1080/87565640801982312

Chen, S. K., Yeh, Y. C., Hwang, F. M., and Lin, S. S. J. (2013). The relationship between academic self-concept and achievement: a multicohort-multioccasion study. *Learn. Individ. Differ.* 23, 172–178. doi: 10.1016/j.lindif.2012.07.021

Corno, L. (1994). "Student volition and education: outcomes, influences, and practices," in *Self-Regulation of Learning and Performance*. eds. D. H. Schunk and B. J. Zimmerman (NJ: Erlbaum, Hillsdale), 229–251.

Coutts, P. M. (2004). Meanings of homework and implications for practice. *Theory Pract.* 43, 182–188. doi: 10.1207/s15430421tip4303_

De Raad, B., and Schouwenburg, H. C. (1996). Personality in learning and education: A review. *Eur. J. Personal.* 10, 303–336. doi: 10.1002/(SICI)1099-0984(199612)10:5<303::AID-PER262>3.0.CO;2-2

Dettmers, S., Trautwein, U., and Lüdtke, O. (2009). The relationship between homework time and achievement is not universal: evidence from multilevel analyses in 40 countries. *Sch. Eff. Sch. Improv.* 20, 375–405. doi: 10.1080/09243450902904601

Domínguez, X., Vitiello, V. E., Maier, M. F., and Greenfield, D. B. (2010). A longitudinal examination of young children's learning behavior: child-level and classroom-level predictors of change throughout the preschool year. *Sch. Psychol. Rev.* 39, 29–47. doi: 10.1080/02796015.2010.12087788

Eid, M., Gollwitzer, M., and Schmitt, M. (2011). *Statistik und Forschungsmethoden [Statistics and Research Methods]*, *2nd Edn*. Weinheim: Beltz.

Elliot, A. J., and McGregor, H. A. (1999). Test anxiety and the hierarchical model of approach and avoidance achievement motivation. *J. Pers. Soc. Psychol.* 76, 628–644. doi: 10.1037/0022-3514.76.4.628

Enders, C. K. (2001). The performance of the full information maximum likelihood estimator in multiple regression models with missing data. *Educ. Psychol. Meas.* 61, 713–740. doi: 10.1177/0013164401615001

Ericsson, K. A., and Kintsch, W. (1995). Long-term working memory. *Psychol. Rev.* 102, 211–245. doi: 10.1037/0033-295X.102.2.211

Flink, C., Boggiano, A. K., Main, D. S., Barrett, M., and Katz, A. (1992). "Children's achievement-related behaviors: The role of extrinsic and intrinsic motivational orientation," in *Achievement and Motivation: A Social Developmental Perspective*. eds. A. K. Boggiano and T. S. Pittman (New York, NY: Cambridge University Press), 189–214.

forsa (2020). Das Deutsche Schulbarometer Spezial Corona-Krise [The German school barometer–Coronaviruscrisis special]. Available at: https://deutsches-schulportal.de/unterricht/das-deutsche-schulbarometer-spezial-corona-krise/ (Accessed November, 19, 2021).

Ganzeboom, H. B. (2010). "A new International Socio-Economic Index (ISEI) of occupational status for the International Standard Classification of Occupation 2008 (ISCO-08) constructed with data from the ISSP 2002–2007." in Annual Conference of International Social Survey Programme, Lisbon, May 2010 Portugal.

Ganzeboom, H. B. G., De Graaf, P. M., and Treiman, D. J. (1992). A standard international socio-economic index of occupational status. *Soc. Sci. Res.* 21, 1–56. doi: 10.1016/0049-089X(92)90017-B

García, T., Rodríguez, C., Betts, L., Areces, D., and González-Castro, P. (2016). How affective-motivational variables and approaches to learning predict mathematics achievement in upper elementary levels. *Learn. Individ. Differ.* 49, 25–31. doi: 10.1016/j.lindif.2016.05.021

Garon-Carrier, G., Boivin, M., Guay, F., Kovas, Y., Dionne, G., Lemelin, J., et al. (2016). Intrinsic motivation and achievement in mathematics in elementary school: a longitudinal investigation of their association. *Child Dev.* 87, 165–175. doi: 10.1111/cdev.12458

Gehrer, K., Zimmermann, S., Artelt, C., and Weinert, S. (2013). NEPS framework for assessing reading competence and results from an adult pilot study. *Journal for Educational Research Online* 5, 50–79.

Gendolla, G. H. E. (2003). "Mood effects and effort mobilisation in learning: theory and experimental evidence", in *Learning Emotions. The Influence of Affective Factors on Classroom Learning*. eds. Ph. Mayring and Ch. von Rhoeneck (Frankfurt, Germany: Peter Lang), 29–46.

Groeben, N., and Hurrelmann, B. (Hrsg.) (2004). *Lesesozialisation in der Mediengesellschaft: Ein Forschungsüberblick*. Weinheim: Juventa.

Hagenauer, G., and Hascher, T. (2014). Early adolescents' enjoyment experienced in learning situations at school and its relation to student achievement. *J. Educ. Train. Stud.* 2, 20–30. doi: 10.11114/jets.v2i2.254

Hambrick, D. Z. (2003). Why are some people more knowledgeable than others? A longitudinal study of knowledge acquisition. *Mem. Cogn.* 31, 902–917. doi: 10.3758/BF03196444

Helm, C., Huber, S., and Loisinger, T. (2021). Was wissen wir über schulische Lehr-Lern-Prozesse im Distanzunterricht während der Corona-Pandemie? – Evidenz aus Deutschland, Österreich und der Schweiz [Meta-Review on findings about teaching and learning in distance education during the Corona pandemic – Evidence from Germany, Austria and Switzerland]. *Z. Erziehwiss.* 24, 1–75. doi: 10.1007/s11618-021-01000-z

Hong, E., Peng, Y., and Rowell, L. L. (2009). Homework self-regulation: grade, gender, and achievement-level differences. *Learn. Individ. Differ.* 19, 269–276. doi: 10.1016/j.lindif.2008.11.009

Hooper, S. R., Roberts, J., Sideris, J., Burchinal, M., and Zeisel, S. (2010). Longitudinal predictors of reading and math trajectories through middle school for African American versus Caucasian students across two samples. *Dev. Psychol.* 46, 1018–1029. doi: 10.1037/a0018877

Huber, S. G., Günther, P. S., Schneider, N., Helm, C., Schwander, M., Schneider, J. A., and Pruitt, J. (2020). COVID-19 und aktuelle Herausforderungen in Schule und Bildung [COVID-19 and the current challenges in education]. Waxmann. Available at: https://www.pedocs.de/volltexte/2020/20579/pdf/Gruber_et_al_2020_COVID-19_und_aktuelle_Herausforderungen.pdf (Accessed November, 19, 2021).

Klieme, E., Pauli, C., and Reusser, K. (2009). "The Pythagoras study: investigating effects of teaching and learning in Swiss and German mathematics classroom," in *The Power of Video Studies in Investigating Teaching and Learning in the Classroom*. eds. T. Janík and T. Seidel (Münster: Waxmann), 137–160.

Knievel, J., Daseking, M., and Petermann, F. (2010). Kognitive Basiskompetenzen und ihr Einfluss auf die Rechtschreib- und Rechenleistung [cognitive skills and their predictive values for spelling and math achievement]. *Z. Entwicklungspsychol. Pädagog. Psychol.* 42, 15–25. doi: 10.1026/0049-8637/a000002

Kock, A.-L., Litteck, K., and Petersen, L. A. (2021). NEPS Technical Report for Mathematics - Scaling Results of Starting Cohort 2 in Seventh Grade (NEPS Survey Paper No. 83). Leibniz Institute for Educational Trajectories.

Krannich, M., Jost, O., Rohm, T., Koller, I., Pohl, S., Haberkorn, K., Carstensen, C. H., Fischer, L., and Gnambs, T. (2017). NEPS Technical Report for Reading: Scaling Results of Starting Cohort 3 for Grade 7 (NEPS Survey Paper No. 14). Bamberg, Germany: Leibniz Institute for Educational Trajectories, National Educational Panel Study.

Letzel, V., Pozas, M., and Schneider, C. (2020). Energetic students, stressed parents, and nervous teachers: A comprehensive exploration of inclusive homeschooling during the COVID-19 crisis. *Open Educ. Stud.* 2, 159–170. doi: 10.1515/edu-2020-0122

McAdams, D. P., and Olson, B. (2010). Personality development: continuity and change across the life course. *Annu. Rev. Psychol.* 61, 517–542. doi: 10.1146/annurev.psych.093008.100507

McClelland, M. M., Acock, A. C., Piccinin, A., Rhea, S. A., and Stallings, M. C. (2013). Relations between preschool attention span-persistence and age 25 educational outcomes. *Early Child. Res. Q.* 28, 314–324. doi: 10.1016/j.ecresq.2012.07.008

Moore, K. A., Lippman, L. H., and Ryberg, R. (2015). Improving outcome measures other than achievement. *AERA Open* 1, 233285841557967. doi: 10.1177/2332858415579676

Mullis, I. V. S., Martin, M. O., Foy, P., and Arora, A. (2012). TIMSS 2011 international results in mathematics. Chestnut Hill, MA and Amsterdam: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College and International Association for the Evaluation of Educational Achievement (IEA).

Murayama, K., Pekrun, R., Lichtenfeld, S., and vom Hofe, R. (2013). Predicting long-term growth in students' mathematics achievement: The unique contributions of motivation and cognitive strategies. *Child Dev.* 84, 1475–1490. doi: 10.1111/cdev.12036

Muthén, L. K., and Muthén, B. (2015). *Mplus version 7.4 [Computer software]*. Los Angeles, CA: Muthén & Muthén.

Neumann, I., Duchhardt, C., Grüßing, M., Heinze, A., Knopp, E., and Ehmke, T. (2013). Modeling and assessing mathematical competence over the lifespan. *J. Educ. Res. Online* 5, 80–109. doi: 10.25656/01:8426

Nold, D. (2010). Sozioökonomischer Status von Schülerinnen und Schülern 2008. Ergebnisse des Mikrozensus. [Socioeconomic status of schoolchildren 2008. Results from the microcensus.]. *Wirtschaft und Statistik* 2, 138–149.

Núñez, J. C., Suárez, N., Cerezo, R., González-Pienda, J. A., Rosário, P., Mourão, R., et al. (2015). Homework and academic achievement across Spanish compulsory education. *Educ. Psychol.* 35, 726–746. doi: 10.1080/01443410.2013.817537

(OECD) (2016). *PISA 2015 Assessment and Analytical Framework: Science, Reading, Mathematic and Financial Literacy*. Paris, France: OECD.

Pekrun, R., Goetz, T., Titz, W., and Perry, R. (2002). "Positive emotions in education," in *Beyond Coping: Meeting Goals, Visions and Challenges*. ed. E. Frydenberg (Oxford: Elsevier), 149–174.

Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *Int. J. Educ. Res.* 31, 459–470. doi: 10.1016/S0883-0355(99)00015-4

Pohl, S., and Carstensen, C. H. (2012). NEPS Technical Report - Scaling the Data of the Competence Tests (NEPS Working Paper No. 14). Otto-Friedrich-Universität, Nationales Bildungspanel: Bamberg.

Rauer, W., and Schuck, K.-D. (2003). *Fragebogen zur Erfassung emotionaler und sozialer Schulerfahrungen von Grundschulkindern dritter und vierter*

Klassen [Questionnaire to assess emotional and social school experiences of elementary school children in third and fourth grades] (FEESS 3–4). Göttingen: Hogrefe.

Ray, B. D. (2020). Research facts on homeschooling. Available at: https://www.nheri.org/research-facts-on-homeschooling/ (Accessed June 25, 2021)

Regueiro, B., Suárez, N., Valle, A., Núñez, J. C., and Rosário, P. (2015). Homework motivation and engagement throughout compulsory education. *Revista de Psicodidáctica* 20, 47–63. doi: 10.1387/RevPsicodidact.12641

Regueiro, B., Valle, A., Núñez, J. C., Rosário, P., Rodríguez, S., and Suárez, N. (2017). Changes in involvement in homework throughout compulsory secondary education. *Educ. Cult.* 29, 254–278. doi: 10.1080/11356405.2017.1306988

Reschly, A. L., Huebner, E. S., Appleton, J. J., and Antaramian, S. (2008). Engagement as flourishing: the contribution of positive emotions and coping to adolescents 'engagement at school and with learning. *Psychol. Sch.* 45, 419–431. doi: 10.1002/pits.20306

Rodriguez, S., Nunez, J. C., Valle, A., Freire, C., Ferradas, M. M., and Rodriguez-Llorente, C. (2019). Relationship between students' prior academic achievement and homework behavioral engagement: The mediating/moderating role of learning motivation. *Front. Psychol.* 10:1047. doi: 10.3389/fpsyg.2019.01047

Ryan, R. M., and Deci, E. L. (2000a). Intrinsic and extrinsic motivations: classic definitions and new directions. *Contemp. Educ. Psychol.* 25, 54–67. doi: 10.1006/ceps.1999.1020

Ryan, R. M., and Deci, E. L. (2000b). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am. Psychol.* 55, 68–78. doi: 10.1037/0003-066X.55.1.68

Schiefele, U., Moschner, B., and Husstegge, R. (2002). Skalenhandbuch SMILE-Projekt. Universität Bielefeld.

Schmerse, D. (2020). Preschool quality effects on learning behavior and later achievement in Germany: moderation by socioeconomic status. *Child Dev.* 91, 2237–2254. doi: 10.1111/cdev.13357

Schöber, C., Schütte, K., Köller, O., McElvany, N., and Gelvany, M. M. (2018). Reciprocal effects between self-efficacy and achievement in mathematics and reading. *Learn. Individ. Differ.* 63, 1–11. doi: 10.1016/j.lindif.2018.01008

Schroedter, J. H., Lechert, Y., and Lüttinger, P. (2006). Die Umsetzung der Bildungsskala ISCED-1997 für die Volkszählung 1970, die Mikrozensus-Zusatzerhebung 1971 und die Mikrozensen 1976–2004 (Version 1) [Implementation of the ISCED-1997 education scale for the 1970 census, the additional microcensus survey in 1971 and the microcensuses between 1976 and 2004 (version 1)]. (ZUMA-Methodenbericht, 2006/08). Mannheim: Zentrum für Umfragen, Methoden und Analysen -ZUMA-. Available at: https://www.ssoar.info/ssoar/handle/document/26239 (Accessed November, 19, 2021).

Simonson, M., Schlosser, C., and Orellana, A. (2011). Distance education research: A review of the literature. *J. Comput. High. Educ.* 23, 124–142. doi: 10.1007/s12528-011-9045-8

Slavin, R. E., Karweit, N. L., and Madden, N. A. (1990). Effective programs for students at risk. *NASSP Bull.* 74, 118–120. doi: 10.1177/019263659007452319

Steinmayr, R., Crede, J., McElvany, N., and Wirthwein, L. (2016). Subjective well-being, test anxiety, academic achievement: testing for reciprocal effects. *Front. Psychol.* 6:1994. doi: 10.3389/fpsyg.2015.01994

Steinmayr, R., and Spinath, B. (2009). The importance of motivation as a predictor of school achievement. *Learn. Individ. Differ.* 19, 80–90. doi: 10.1016/j.lindif.2008.05.004

Stipek, D., Newton, S., and Chudgar, A. (2010). Learning-related behaviors and literacy achievement in elementary school-aged children. *Early Child. Res. Q.* 25, 385–395. doi: 10.1016/j.ecresq.2009.12.001

Suárez, N., Regueiro, B., Estévez, I., del Mar Ferradás, M., Guisande, M. A., and Rodríguez, S. (2019). Individual precursors of student homework behavioral engagement: The role of intrinsic motivation, perceived homework utility and homework attitude. *Front. Psychol.* 10, 941. doi: 10.3389/fpsyg.2019.00941

Trautwein, U., and Köller, O. (2003). The relationship between homework and achievement - still much of a mystery. *Educ. Psychol. Rev.* 15, 115–145. doi: 10.1023/A:1023460414243

Trautwein, U., Köller, O., Schmitz, B., and Baumert, J. (2002). Do homework assignments enhance achievement? A multilevel analysis of 7th grade mathematics. *Contemp. Educ. Psychol.* 27, 26–50. doi: 10.1006/ceps.2001.1084

Trautwein, U., Lüdtke, O., Schnyder, I., and Niggli, A. (2006). Predicting homework effort: support for a domain-specific, multilevel homework model. *J. Educ. Psychol.* 98, 438–456. doi: 10.1037/0022-0663.98.2.438

Valentine, J. C., and Dubois, D. L. (2005). "Effects of self-beliefs on academic achievement and vice versa: separating the chicken from the egg," in *New Frontiers for Self-Research, International Advances in Self-Research. Vol. 2*. eds. H. W. Marsh, R. Craven and D. M. McInerney, (Greenwich, CT: Information Age Publishing), 53–77.

Vasalampi, K., Parker, P., Tolvanen, A., Lüdtke, O., Salmela-Aro, K., and Trautwein, U. (2014). Integration of personality constructs: The role of traits and motivation in the willingness to exert effort in academic and social life domains. *J. Res. Pers.* 48, 98–106. doi: 10.1016/j.jrp.2013.11.004

Weinert, S., Artelt, C., Prenzel, M., Senkbeil, M., Ehmke, T., Carstensen, C. H., et al. (2019). "Development of competencies across the life course," in *Education as a Lifelong Process: The German National Educational Panel Study (NEPS), Edition ZfE. 2. überarbeitete Aufl.* eds. H.-P. Blossfeld and H.-G. Roßbach (Wiesbaden: Springer), 57–82.

Wildemann, A., and Hosenfeld, I. (2020). Bundesweite Elternbefragung zu Homeschooling während der Covid 19-Pandemie. Erkenntnisse zur Umsetzung des Homeschoolings in Deutschland [Nationwide parent survey on homeschooling during the COVID-19 pandemic. Findings on the implementation of homeschooling in Germany]. Universität Koblenz-Landau; Institut für Bildung im Kindes- und Jugendalter; Zentrum für empirische Pädagogische Forschung. Available at: http://www.zepf.eu/wp-content/uploads/2020/06/Bericht_HOMEschooling2020.pdf (Accessed November, 19, 2021).

Wolter, I., Nusser, L., Attig, M., and Fackler, S. (2020). Corona-bedingte Schulschließungen – und nun funktioniert alles digital? [Corona-related school closures - and now everything works digitally?] (NEPS Corona & Bildung Bericht Nr. 1). LIfBi: Bamberg, Germany. Available at: https://www.lifbi.de/Portals/13/Corona/NEPS_Corona-und-Bildung_Bericht_1-Schule.pdf (Accessed November, 19, 2021)

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Werner, K., and Zierow, L. (2020). Bildung in der Coronakrise: Wie haben die Schulkinder die Zeit der Schulschließungen verbracht, und welche Bildungsmaßnahmen befürworten die Deutschen? [education during the coronavirus crisis: how have school children spent the time over the school closures and which educational measures do Germans prefer?]. *Ifo Schnelldienst* 73, 25–39.

Würbach, A., Landrock, U., Schnapp, T., Ziesmer, J., and Bergrab, M. (2021). *NEPS Technical Report for Weighting – the Additional Corona Survey of the National Educational Panel Study* (NEPS Survey Paper No. 89). Bamberg, Germany: Leibniz Institute for Educational Trajectories, National Educational Panel Study. doi: 10.5157/NEPS:SP89:1.0

Xu, J. (2017). Homework expectancy value scale for high school students: measurement invariance and latent mean differences across gender and grade level. *Learn. Individ. Differ.* 60, 10–17. doi: 10.1016/j.lindif.2017.10.003

Yaratan, H., and Kasapoğlu, L. (2012). Eighth grade students' attitude, anxiety, and achievement pertaining to mathematics lessons. *Procedia. Soc. Behav. Sci.* 46, 162–171. doi: 10.1016/j.sbspro.2012.05.087

Zimmermann, B. J. (2001). "Theories of self-regulated learning and academic achievement: an overview and analysis," in *Self-Regulated Learning and Academic Achievement: Theoretical Perspectives*. eds. B. J. Zimmermann and D. H. Schunk (Mahwah: Erlbaum), 1–37.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 08 December 2021
doi: 10.3389/fpsyg.2021.733633

Teaching and Learning in COVID-19 Lockdown in Scotland: Teachers' Engaged Pedagogy

Tracey Colville, Sarah Hulme, Claire Kerr, Daniela Mercieca and Duncan P. Mercieca*

School of Education and Social Work, University of Dundee, Dundee, United Kingdom

This paper reports on a study of teachers' perceptions of teaching and learning in Scotland during the COVID-19 pandemic through the lens of engaged pedagogy and the ideas of bell hooks. It aimed to explore the different ways that teachers experienced teaching and learning during this time and the impact this may have had on teacher identity. Sixty teachers and head teachers were interviewed using MS Teams in the period April-June, 2020. For this paper, 18 transcripts were analyzed by members of the research team. Four key themes emerged from the interview data: Working from home, parental engagement, teacher identity, and changes in pedagogy. Each of these themes were discussed in terms of concepts such as engaged pedagogy, agency, self-actualization, recognition and boundary transgression situated in the work of bell hooks. The idea of boundaries wove itself throughout our data as teachers expressed how the transgression of boundaries was occurring in multiple, and often contradictory, ways in pedagogical, professional, institutional and personal spaces and systems. We see in our data evidence of a shift in practice not just in the way teachers are 'doing' education but also, perhaps, in the way that teachers are 'being' as educators as they adapt to different ways of knowing. This study provides a unique exploration of a time and space in Scotland during 2020. However, the themes and understandings that emerged are of relevance to educators internationally. Schools across the world were impacted by various lockdowns imposed by the Covid-19 pandemic and teachers faced a common set of challenges that were resolved via re-negotiation and recognition of individual and collective agency to create new pedagogies.

Keywords: COVID-19 lockdown, learning and teaching, engaged pedagogy, bell hooks, Scotland

OPEN ACCESS

Edited by:
Karin Gehrer,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Angela Anderka,
University of Bamberg, Germany
Nerissa Naidoo,
Mohammed Bin Rashid University of Medicine and Health Sciences, United Arab Emirates

****Correspondence:***
Daniela Mercieca
dmercieca001@dundee.ac.uk

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *25 October 2021*
Published: *08 December 2021*

Citation:
Colville T, Hulme S, Kerr C, Mercieca D and Mercieca DP (2021) Teaching and Learning in COVID-19 Lockdown in Scotland: Teachers' Engaged Pedagogy. Front. Psychol. 12:733633. doi: 10.3389/fpsyg.2021.733633

INTRODUCTION

Schooling is a fundamental part of society's fabric. The COVID-19 pandemic and its lockdowns have offered a dilemmatic context where the processes of teaching and learning and being a teacher have been re-visited and re-negotiated. This paper draws from a study which was carried out during the first COVID-19 lockdown in Scotland that looked at the lived experiences of primary school teachers and Head Teachers of teaching and learning during this time. It offers a unique insight into the lived experiences of teachers – how did they manage/adapt and what was important to

them. It was stated by the Scottish Government (2020a,b), that teaching, learning and support during school lockdown would continue but in a different way, with teachers mostly connecting with pupils through distance and online learning. Although the research was based in Scotland, the themes are of international relevance to teachers working across the world, who have all been impacted by the global pandemic. This paper explores how teachers experienced these different ways of teaching and learning, and asks, what was the teacher's experience during this lockdown?

The next section concerns both the literature and national context in which this research project was carried out, followed by an outline of the methodology which framed this research project, the analysis of the data, and the write up of this particular paper. We consider the relevance of the ideas of bell hooks as the theoretical framework within which the interviews were analyzed, and from which four themes emerged: Change in Pedagogies, Agile and Flexi-working, Teachers' Identities, and Parental Engagement.

Teaching and Learning During the COVID-19 Pandemic Lockdown

As researchers internationally have sought to capture the experiences of both teachers and pupils in this unique set of circumstances, literature is starting to emerge which seeks to explore different impacts that the lockdown has had for different groups across a range of areas. As some point out, the lockdown provided the circumstances for 'a shocking, and at many times, painful natural experiment' (Jones and Kessler, 2020, para 3) that many researchers have endeavored to capture.

A range of areas relevant to teaching and learning have been reported so far. Authors have focused on the challenges of incorporating a digital pedagogy into the learning environment (Wong, 2020; Greenhow et al., 2021), teacher identity (Jones and Kessler, 2020) as well as changes in practice and teacher reactions that the lockdown necessitated (Collie, 2021). Much of the current literature seeks to understand the unique space that teachers found themselves in during online teaching and the tensions that teachers have found themselves having to navigate between systems, identities, practice, and pedagogy. For the purposes of this paper, we have focused on capturing the experiences of teachers in Scotland, and have reported on the literature in more depth in the relevant sections of our theory led thematic analysis as per this model.

Scottish Context

During the first pandemic lockdown, the United Nations Policy Brief [6] in April 2020 reported that 188 countries had imposed nationwide school closures, affecting more than 1.5 billion children and young people (p. 2). This led to uncertainty and tentative planning with unknown timescales. In Scotland, all schools were closed on 20 March by the Scottish Government on advice of the Scientific Advisory Group for Emergencies (SAGE). Exceptions were for vulnerable children or children of key workers who attended "hubs" run by volunteer teachers. Schools re-opened on 11 August, 2020 with phased returns to school for different age groups. By late December, 2020 Scotland entered the second lockdown with another phased return on 25 February, 2021. The time period for interviews in this study was March – June, 2020; during the first lockdown. Participants were teaching on-line or in education hubs at the time of interviews.

Following the abrupt disruption of schooling caused by closures, teachers had the challenge to find alternative and innovative ways to reach and teach all children and young people. Support services such as Educational Psychology had to find new ways to support school, families, and children. This led to distance and online learning with as much continuity as possible, including on-line Getting It Right For Every Child (GIRFEC) meetings. In Scotland the GIRFEC framework (Scottish Government, 2006), which embodies the UNCRC (United Nations Convention for the Rights of the Child), promotes good practice in supporting the wellbeing of children and aims for young people to receive "the right help, at the right time, from the right people" (Scottish Government, 2008). For most learners this support moved online unless they were vulnerable or had parents who were keyworkers. In such instances they were supported via education 'hubs.' A range of guidance, national and local was published to support practitioners move their practice online with confidence (British Psychological Society, 2020; Education Scotland, 2020; Scottish Government, 2020a,b). This guidance aimed to scaffold equity of support for children and their families including those with Additional Support Needs (ASN) in relation to digital teaching and learning. In addition, many parents found themselves in the position of working from home and home schooling. The Scottish Government stated that parents would not be expected to engage with their children's learning formally nor to act as teachers.

The nature of the educational infrastructure in Scotland meant that this guidance could be interpreted and enacted differently at local authority and school level. Responding to this shift, schools and staff developed new models of service delivery, so that there was variation both across and within authorities in terms of format and speed of change. Schools that had previously embraced the national digital technology strategy were more prepared for this rapid shift. The most commonly used digital platforms within Scottish education during the initial lockdown were the national intranet GLOW, Microsoft Teams, Google Classroom, and the Seesaw App.

The teachers interviewed in this research offered narratives of their lived experience of teaching online during this time and their individual experiences reflect the flexibility of how guidance and change were implemented within their local authority. Some practitioners were involved in providing both face to face teaching in 'hubs' for vulnerable or keyworker children and online teaching for their own classes. At this point in the pandemic the teaching experience was focused upon reinforcement and consolidation of the key areas of literacy, numeracy and health and wellbeing. Alongside this many of our interviewees were additionally home schooling their own children. The researchers of this study were academic researchers and educational psychologists some of whom were supporting

schools and staff at this time and thus had insight into the narratives being heard.

METHODOLOGY

As past teachers and currently trainers of teachers and educational psychologists, indeed, as parents of children who attend schools, we were acutely aware of the flurry of activity going on in schools in March 2020 as it became increasingly clear that school closure was imminent. The experience of confusion and uncertainty motivated a desire to capture others' experience of this, especially others involved in education. There was recognition that this was unprecedented and that we wanted to pause and document the experiences of a group of professionals (teachers) whose working lives, and indeed, whole pedagogical approaches had been disrupted by the pandemic. We were aware that time was a factor and that this particular set of circumstances was boundaried in that it would evolve quickly. We were therefore under a pressure of time to capture as many experiences via interview that we could.

We, the authors, are part of a larger group of researchers from the School of Education and Social Work at the University of Dundee, all of whom were keen to capture the impact of this unique time on the lives of children, their families and educators. A decision was taken to carry out qualitative research with teachers and Head Teachers working in Scottish primary schools, focusing upon narratives and detailed insights into the lived experiences of teachers who had volunteered for interview. We could not ethically gather more data than we could realistically manage to analyze, although the availability of it was tantalizing. Reluctantly, we made the decision not to pursue the stories of educators in secondary schools or those of families and children themselves for this particular study but recognize the need for further research with these groups. The research leads of this project came up with questions which they thought could prompt conversations covering the whole experience of the sudden lockdown and the slow realization of the implications of the lockdown. As Hayes writes about her research, "there were interviews which took the form of conversations, but in which I made sure that the conversation covered half a dozen specific points" (p. 103). These questions were reviewed by critical colleagues interested in supporting the project. Also, the research teams through their contact with teachers asked for teachers working in primary contexts who were willing to give feedback on interview questions from their perspective. Two primary teachers offered, and feedback was given as to the relevance of the questions, the language used, and the sensitivity of the issues raised. These were not considered as pilot interviews, and therefore not included as data. The questions are listed as an **Appendix** at the end of this paper.

A decision was taken to carry out qualitative research with teachers and Head Teachers working in Scottish primary schools, focusing upon narratives and detailed insights into the lived experiences of teachers who had volunteered for interview. We opted to interview primary school teachers (from Primary 1 to Primary 7) and Head Teachers of Primary schools for two main reasons. Second, most of the research teams were primary school teachers themselves, before training into other professions such as educational psychology or teacher educators. Reluctantly, we made the decision not to pursue the stories of educators in secondary schools or those of families and children themselves for this particular study, but we recognize the need for further research with these groups.

Following ethical clearance from the University of Dundee, teachers and Head Teachers in Primary schools in Scotland were invited through two social platforms: Facebook and Twitter to participate in an in-depth oral interview to capture their lived experiences of the pandemic lockdown in real time. Sixty teachers contacted the lead researcher and volunteered to participate in the research. These online interviews were carried out through MS Teams, starting from the second week of lockdown (March 2020) until the end of the scholastic year in June 2020. The interviews lasted between 30 and 90 min. We are aware that this implies teachers and Headteachers who had access to technology and access to these two platforms could get information about the research. Given that the research started from the second week of the first lockdown, social media platforms were the only way we could communicate as schools and Local Authorities were closed.

The research aimed at gathering teachers' understanding of their experiences and the impact of these on how they viewed their work and role as teachers. What were teachers' perceptions of their current experiences of work and how did this reflect on what they valued in their teaching and learning as they supported children and families during the lockdown? The participants who volunteered to be interviewed reported that they relished the opportunity to pause and reflect on their experience and also to appreciate the numerous ways in which they adjusted to the changes in their lives and their practice in a short span of time and under intense pressure. Nine questions guided the interviews, with the interviewers reporting that most participants needed little prompting as they were very articulate and fluent.

It is important to point out that due to the urgency of the research, it was not possible to delay the start of data collection until a proposal could be submitted to apply for research funding, which would have covered costs of making the recorded data ready for analysis.

The research group was not seeking a representative sample of educators which was distributed according to certain criteria. The aim was not to gather a sociological understanding of teachers' experiences based on the geographical and socio-economic contexts of the Scottish schools in which they worked, nor to collect a representative sample of educators and elicit collective themes from the corpus of data which could be claimed as generalizable. Rather, we aimed to capture the educators' personal thoughts about these experiences. We recognize that as we did not stipulate conditions of participation (e.g., time in teaching, or age group of class) then we would not be able to comment on how such conditions might interact with the experiences of the participating teachers. However, this was not our aim. Instead, we hoped to capture the immediate and lived experience of those primary teachers who felt able to participate

at a point in time during the first lockdown. As Beauchamp et al. (2021) pointed out about their own research during the pandemic, the circumstances surrounding our research project lent an urgency to our gathering of the educators' recounting of their experiences. We took the steps outlined above to ensure that our questions and data gathering process was robust and sensitive to participants. Given the time sensitive nature of the research project, we aimed to gather the verbal responses of any teacher or Head Teacher that volunteered to be interviewed, including all those who met the inclusion criteria of teaching in a primary school in Scotland. The number of volunteers happened to be sixty and we decided to form groups of researchers, taking a small number of interviews each group, and to analyze these interviews according to the specific slant that the group decided on. This decision was arrived at following several conversations about the interviews among the group members.

We were aware that this approach would not adhere to a traditional scientific conceptualization of generalizability (Williams, 1976; Law, 2006) however, we decided to align ourselves with the work of Hollway (1989) who suggests that "generalizability has to be established according to theoretical rather than statistical principles" (p. 16). In the Rogerian sense of what is most personal is most general, we believe that the issues emerging from our process of analysis (explained below) are generalizable conceptually and theoretically. When disseminating our research findings in online seminars, we have had feedback that viewers have resonated with the participants' expressed thoughts and feelings (Rogers, 2001, p. 26).

Out of the 16 interviews, eight groups of researchers have so far been looking at different interviews with different theoretical frameworks. This paper reports on one of these groups. Other papers have so far been published on Head Teachers' understanding of care and how this informed their actions during the closure of schools (Ferguson et al., 2021), the reciprocal caring relationships between teachers, children and parents in those first weeks of school closure (McLennan et al., 2020), and teachers' responses to the increased need to engage with digital technology during the first lockdown (Brown et al., 2021). We see the results emerging from each paper as complementing each other, while each one has its unique stance on the data. For this paper, we drew upon eighteen interviews, most of which were conducted by the authors themselves as the familiarity with the text lent itself to the analysis. The focus of this paper is on teaching and learning during COVID-19 school lockdown from the perspective of teachers – a focus yet unexplored from the data. We also used a theoretical framework derived from bell hooks' work on engaged pedagogy which stands on its own in relation to the different theoretical frameworks that we have used in other papers that have derived from this research. The methodology of all the papers is similar and therefore we acknowledge that there are moments when this is very similar to the other papers.

Theory-Led Thematic Analysis

In qualitative research, themes can be derived inductively (empirically induced from the data) or deductively from prior theorizing (*a priori* themes) (Cohen et al., 2017; Silverman, 2017). *A priori* themes may be based upon knowledge of the evidence-base or literature around the topic under investigation, from authors' theoretical orientations and previous empirical research, and from everyday constructs (Denzin and Lincoln, 2011; Corbin and Strauss, 2014). Many researchers will use both techniques to align with theoretical positioning and to derive themes empirically from the data (Miles et al., 2019). While this paper used a theory-led thematic analysis, the authors are aware of the limitations of both approaches. In being theory-led, formation of new ideas and connections may be missed and there is a risk of finding only what you are looking for in the data, conversely, lack of theory in thematic development limits connections between empirical data and the research questions (Creswell and Creswell, 2018). The approach used in this paper is influenced by the work of Hayes (1997) who uses theory-led analysis. Two of the authors of this paper have also used this approach in several publications.

The process of analysis can be visualized in the form of two spirals which seemed to weave closer and closer together as they progressed, one spiral being the work on bell hooks and the other is the interviews. Following an initial discussion in which impressions of carrying out interviews were shared, it was decided that, in the first instance, each researcher would analyze one interview transcript individually and separately. Following this activity, the researchers discussed recurring points and emerging themes, formulating a tentative guide around which we could analyze other interviews. Thirteen over-arching themes were identified in total with the initial themes being built upon with each subsequent interview analysis. Due to the volume of data it was necessary to be selective in our focus for this paper. Four themes were selected that yielded the largest volume of data and were thought to best represent the overall experiences of the teachers/headteachers in relation to learning and teaching. From these, sub-themes and illustrative quotes were derived which gave voice to the over-arching themes and made direct links between the raw interview data and the researcher derived theme. An illustration of this within the 'Parental Engagement' theme is the link of the sub-theme of 'collaborative approach with parents' and the quote from a teacher 'We're kind of shepherding each other through, cause we're a whole flock together and that's how we need to get through this.' We chose 18 interviews, most of which were conducted by the authors themselves – the richness of each interview contributed amply to each theme and satisfied our aim of conceptual and theoretical generalizability mentioned above. The authors of this paper initially took one interview analyzed it collectively. The interviews were then divided amongst the authors for analysis. Several meetings took place during this process to check out that the thematic analysis was reliably done by all of us and there was consistency in the process and analysis. Also, these meetings helped us support each other in reading about bell hooks and interpret the data in the light of hooks' ideas. In this way, our discussions could be seen as taking part within our own evolving understanding of the unique and unprecedented context that the COVID-19 pandemic brought about as we sought to understand others' experiences also. This was a dynamic process and akin to Wenger's (1998) conceptualization of a Community of Practice. Our desire to make sense of what was happening was linked to our practice,

as educators and with educators, in exploring the meanings that we jointly created as a community of researchers.

Our discussions also led to a consideration of the work of bell hooks, an American author writing under the lowercase pseudonym of her great-grandmother's name. Her writing about transgression against and beyond boundaries struck us, as we felt it resonated the freedom which ensued following with the removal of physical boundaries due to the closure of schools. Since a key theme that emerged from the data was the freedoms and changes in relationships between teachers, young people and families, we decided to pursue bell hooks' writing on 'opening boundaries' and 'engaged pedagogy' to inform our analysis of how teachers described changes in interactions and power dynamics caused by the COVID-19 pandemic. The barriers imposed by structures of the education system and cultural expectations for achievement were suspended and there was tentative, and later, more bold exploration of what was possible. Interestingly, the pandemic brought with it new boundaries and restrictions in people coming together, and there seemed to be a sense of 'we are all in this together' as teachers shifted from their customary role of class teacher causing personal boundaries to blur as they managed the stresses of the restrictions on their lives and the present unknown. As bel hooks stated:

> I cross boundaries to take another look, to contest, to interrogate, and in some cases to recover and redeem (hooks, 1994b, p. 5).

The two spirals were further woven as the authors read further about the works of bell hooks, while at the same time becoming more and more immersed in the data. As Hollway and Jefferson (2000) stress, "after a whole day working on the transcripts . . . (a process we often referred to as 'immersion') we would be inhabited by that person in the sense that our imagination was full of him or her" (p. 69). The authors met online several times to discuss their thoughts about the literature and the interviews, with themes becoming more tangible, following Hollway's idea that the significance of the interviews is not only "a property of the extract, but of the work it is put to do" (Hollway, 1989, p. 36). Hayes also writes about this process in her edited book, where she mentions "theory-driven themes, rather than the analysis being based on themes which arose spontaneously from the data" (p. 99). This was thus a theory-led thematic analysis (Hayes, 1997) based on the works of bell hooks, where both theory and interviews 'speak' to each other while at the same time challenging each other. This influenced the structure of this paper, with no distinction between findings and discussion, but rather themes with merging data and theory, thus 'making complex' the lived experiences of the teachers. There is always the tension of how the data and theory speak to each other – what influences what in developing the themes. We read the transcribed interviews and reading hooks simultaneously. It was through a continual conversation between us authors that we felt that we needed to focus on four main themes as will be described below.

A last point about interviewing educators who volunteered: we are aware of the possibility of these respondents presenting as models of hard work and enthusiastic professionalism. We have mentioned elsewhere that these need to be seen as experiences of people willing to share their story and that there are others whose stories may not tally. Yet, there have been many who have 'recognized' our interpretations and analyses, that is, the sense that we made out of them can be shared through the subjectivity of others (Hollway and Jefferson, 2000, p. 80). Our work, as well as being theoretically led, is solidly empirical in the sense that supporting and challenging evidence is available (Hollway and Jefferson, 2000, p. 80).

Engaged Pedagogy: Introducing Bell Hooks' Ideas

For those who have not engaged with the writings of bell hooks, it is important to start with a reflection of the name *per se*. Born Gloria Jean Watkins in 1952, bell hooks grew up in segregated Kentucky (United States) in a nuclear family of five sisters, a brother, a mother and a father, with nearby extended family. *Ain't I a Woman: Black Women and Feminism* (hooks, 1981) was written when she was a 19-year-old undergraduate. Her great-grandmother was 'a sharp-tongued woman, a woman who spoke her mind, a woman who was not afraid to talk back' (hooks, 1989, p. 9). Hooks put the name in lowercase letters not only 'to distinguish [herself from] her great-grandmother,' but because she wants readers to focus on the 'substance of books, not who I am' (Williams, 2013). Her renaming was itself 'a gesture of defiance that heals, that makes new life and new growth possible' (hooks, 1989, p. 9). As she notes, "choosing this name as a pseudonym was a rebellious gesture' (hooks, 1989, p. 163). The act of the name thus signifies an act in reconstituting and reinventing her identity (see Guadalupe Davidson and Yancy, 2009). The issue of challenging and reconstituting one's identity is a fundamental aspect of hooks work and will be discussed further in the theme on Teachers' Identities.

The focus of hooks work seems to be on opening 'boundaries,' 'transgressing boundaries' (hooks, 1994a, p. 13), 'crossing boundaries' (hooks, 1994b, p. 5) and 'movements of ideas, exchanges by everyone' (hooks, 2009, p. 21). Hooks words capture this movement between boundaries:

> I celebrate teaching that enables transgressions – a movement against and beyond boundaries. It is a movement which makes education the practice of freedom (hooks, 1994a, p. 17).

The crossing of boundaries implies freedom, or at least envisages ways that such freedom of movement that can be experienced by everyone. Spaces, for hooks, are political. They need to be revolutionary, as contrasting to oppressed (see Freire, 1972). Yet, spaces are 'progressive cultural revolution[ary]' (hooks, 1994b, p. 8) when everyone involved learns to do everything differently, to challenge the politics of domination. The emphasis on 'everyone' is a fundamental cornerstone in hooks work. In her work on education (hooks, 1994a, 2003), it is the student and the teacher that need to transgress/cross boundaries.

Engaged pedagogy begins with the assumption that we learn best when there is an interactive relationship between students and teachers. It requires the active contributions of both being 'active participant[s], not passive consumer[s]' (hooks, 1994a, p. 14). Teachers need to find out, to discover what students

know and what they want to know (hooks, 2009, p. 19). For hooks this interactive relationship is an intimate one – hooks repeatedly writes that engaged pedagogy 'respects and cares for the souls of students' (hooks, 1994a, p. 13). The attention here is on recognition (hooks, 1994a, p. 13) as will be discussed in the theme on Agile and Flexi-Working in the analysis section. The teachers' and students' recognition of each other as active participants (hooks, 1994a, p. 14) is a foundational part of the teaching/learning process. There is a 'will and desire to respond to our unique beings' (hooks, 1994a, p. 13). This is the Freirean influence on hooks where praxis is understood as 'action and reflection upon the world in order to change it' (hooks, 1994a, p. 14).

The issue of 'knowledge' is fundamental to the student-teacher relationship as knowledge creates dominance over groups of people. We need knowledge that does not create spaces of domination over others (this will be explored further in the theme around Parental Engagement of the analysis). It is therefore not a question of epistemologically substituting old forms of knowing with new forms of knowledge, 'but [is about]. learning about and genuinely valuing ways of knowing and understanding.' Hooks shifts the issue from content to process. The epistemological emphasis should not be about (common) identities and backgrounds, but a shared desire to know:

> What we all ideally share [then] is *the desire to learn* to receive actively knowledge that enhances our intellectual development and our capacity to live more fully in the world (our emphasis, hooks, 1994a, p. 40).

It is the intellectual inquiry that counts, and not the communality (or not) of those participating in it. Hooks recommends that everyone (teachers and students as forming a learning community) recognize and learn the 'cultural codes' of others. This implies that we 'learn to accept different ways of knowing, new epistemologies, in the multicultural settings' (hooks, 1994a, p. 41). Knowledge is a field in which everyone 'labors' (hooks, 1994a, p. 137) and no one is excluded.

Engaged pedagogy insists that the teacher has the responsibility to work toward self-actualization, to be aware of themselves as practitioners and as human beings, if they wish to teach students in a non-threatening, anti-discriminatory, empowering way. The focus here is on the dynamic and fluid nature of engaged pedagogy with critical reflection as core to teaching and learning. There are clear links here to Friere and Giroux's critical pedagogy, to Dewey's democratic education, Maslow's self-actualization and the work of AS Neill, the Scottish educationalist who advocated for freedom in the process of learning and teaching as a child-centered approach. Self-actualization, according to bell hooks, should be the goal of the teacher as well as the student although she recognizes that this is not easy:

> It was difficult to maintain fidelity to the idea of the intellectual as someone who sought to be whole-well-grounded in a context where there was little emphasis on spiritual wellbeing, on the care of the soul. Indeed, the objectification of the teacher within bourgeois educational structures seemed to denigrate notions of wholeness and uphold the idea of the mind/body split, one that promotes and supports compartmentalization' (hooks, 1994a, p. 16).

Self-actualization is needed to confront internalized racism, class privilege, and political entitlement in oneself and others. This requires secure, mature emotional skills and a powerful ability to communicate. It is the ability to recognize one's own privilege and power and address this. The body, mind, emotions are all interrelated for hooks. Her argument is that education tends to focuses on the mind and gives little or no space to the body and emotions. Questioning repressions and denials due to oppression(s) (this could be clearer) helps to develop a feeling for wholeness, that strives for actions, intellect and voice (see hooks, 2009, p. 21). This implies that those involved in such processes are at times exposed and vulnerable. For example, in engaged pedagogy, teachers can face their deep-seated fears about loss of control of the classroom to a community of inquiry, where students, in various ways, bring to the classroom their lived experiences and the knowledges emerging from these.

Four of the authors of this paper are educational psychologists who are or where in practice and who are involved in the training future educational psychologists. This is pertinent as pedagogy is central in the work on an educational psychologist. Yet we are aware that over the years general pedagogy has become a more performative task. All teaching and learning is now being measured and calculated, where criteria and proformas make claims on educators' attention and time while they are also keen to develop relationships within their educational contexts. bell hooks' engaged pedagogy offers an alternative voice – a challenging one, but certainly one that opens up possibilities. The data set was particular as it was capturing a unique moment where school builds and classroom were closed, and all the performative and measurable criteria usually leading action lost their place. This allowed different approaches to learning and teaching to be thought about and acted on. Hooks' work was thus seen as appropriate as it provided us with a language that could help us articulate ideas emerging from the data.

THEMATIC ANALYSIS AND DISCUSSION

Thirteen over-arching themes emerged from the interviews. These were Technology, Agile and Flexi-working, Staff Collaboration, Managing Transitions, Change in Pedagogies, Parental Engagement, Hubs, Local Authority/Union Stance, Teachers' Identities, Meeting Needs, Future, Uncertainty and Space. Due to the volume of data it was necessary to be selective in our focus for this paper. Four themes were selected that yielded the largest volume of data and were thought to best represent the overall experiences of the teachers interviewed. Each is explored in relation to the data and also the theoretical framework offered by hooks. These four themes are Change in Pedagogies, Agile and Flexi-working, Teachers' Identities, and Parental Engagement.

Theme One: Change in Pedagogies: 'Extra Creative'

Learning is commonly associated with 'classroom space.' Outdoor learning (Education Scotland, 2010) is often seen as an alternative learning approach to classroom learning. While

this is gaining more visibility within Scottish schools, classroom-based learning is still the dominant way of providing for learning supported by alternative learning approaches. According to Flores (2020) "the COVID-19 pandemic has changed our everyday life in many ways and, in particular, the education sector" (p. 297). With the arrival of the COVID-19 pandemic, the closure of schools challenged the idea of classroom-based learning as well as student–teacher (face-to-face or the physical presence) interaction, both of which were part of our everyday life. These two challenges are at the heart of hook's philosophy. For hooks, the classroom is 'the most radical space of possibility in the academy' (hooks, 1994a, p. 12). The classroom, with all its limitations, is elevated as a location of possibility, for it offers a possibility for anyone (students, teachers and, to a certain degree, families) to 'learn' (hooks, 1994a, p. 13). It is a space where interactions between with two main characters, students and teachers, can 'transgress those boundaries' (hooks, 1994a, p. 13). We question how the closure of schools challenged 'learning' given that the classroom space was not available? How did the student-teacher interaction manifest itself during the COVID-19 school closure?

Several teachers who were interviewed argued that 'it's the happiness and the wellbeing of the children that come first, not the actual learning.' In this quote the teacher seems to be differentiating between learning and happiness/wellbeing. There seems to be a further assumption that happiness and wellbeing are similar or referring to the same thing, that in any case they are based at the other end of the spectrum to learning. It begs the question: does learning make students (and similarly their teachers) unhappy or unwell?

Many other teachers argued that a different learning was happening:

> Yes, children are missing out on learning but I think the learning is taking a different shape and I think it is more that the relationships with families that we have to think about and for what the children really capable of.

The complexity and contradiction in this quote may reflect more generally the experiences of teachers during lockdown. Billig's concept of *dilemmatic thinking*, when something 'is and is-not' is useful in this context (Billig et al., 1988). It is difficult to say what the teacher is implying in this quote when the teacher talks about 'missing out on learning.' From our experiences as primary school teachers and now involved in teacher-education, we could infer this to mean learning of literacy and numeracy. We think that the relationship-based learning mentioned in the quote above is very interesting as it is a learning that "is taking a different shape." The word 'shape' here is very evocative, and hooks' work influences our reading of this. Who shapes this learning? Does the teacher or the student–teacher relationship have this influence? And is this space shaped in a way that allows for 'freedom' which is 'deep and intimate' (hooks, 1994a, p. 13)? In hook's words: '. . .our work is not merely to share information but to share in the intellectual and spiritual growth of our children' (hooks, 1994a, p. 13).

During the first school's lockdown in Scotland teachers were advised not to give new content material to students but to consolidate learning that they had previously done in schools. Since the first lockdown started with the onset of the spring season, many teachers resorted to the outside space as a source of inspiration and resource: 'Sometimes going outside picking up stones and sticks that actually can be just as valuable and you don't need to spend all that time laminating.' This is always haunted by the question whether this is learning and what sort of learning it is:

> Made me [teacher] appreciate how much children can get from activities that a lot of parents don't see as learning. We don't need to be sitting down at a table to, you know, to do some writing in order to develop your literacy skills.

One of the terms used by some teachers was contextual learning:

> Because it's putting it into context, it's putting their learning into context. It makes it memorable as well. Sitting doing a page of maths out of a textbook isn't memorable learning to me but if you're doing something, for example, through baking or practical tasks, they, they, they're more memorable for children.

The focus of memorable learning, as different from 'rote, assembly line approach to learning' (hooks, 1994a, p. 13) is brought about by distinguishing between acts of sitting (doing a page of maths out of a textbook) and acts of doing (baking). Another teacher spoke about recording activities for her students on her croft – using her croft as a 'doing' context. She shared her lifestyle with students and their families through these video recordings in which she was constantly accompanied by her toddler son, putting into question the professional – personal life boundary. This is revisited in Theme 3 when exploring identities. It is not only the learning which is contextualized but also the teaching. We can read the above teacher's quote in a romantic Rousseauian way, and it also brings to mind hook's claim that 'learning is a place where paradise can be created. . . In that field of possibility we have the opportunity to labor for freedom, to demand of ourselves and our comrades, an openness of mind and heart that allows us to face reality even as we collectively imagine ways to move beyond boundaries, to transgress. This is education as the practice of freedom' (hooks, 1994a, p. 207). We couple this quote from hooks with one from our teachers interviewed:

> I think this time has allowed me to see lots of different creative ways. . . like, extra creative,

and with an exhortation by Mushtaque et al. (2021) that since

> COVID-19 has the ability to fundamentally reshape our world; . . . remarkable creativity and student responses must be encouraged, giving educators autonomy and flexibility to work collaboratively (p. 21).

This creative way of 'doing' learning and teaching was acting as a catalyst with some teachers to question the systems, structures and performative culture they worked in. Several issues were mentioned from

> the climate of worry about taking children out with the school (going to the park or going to go down to the river) – that puts people [teachers] off,

to the fastness of the curriculum:

> 'I think that will definitely change when we go back [to schools] be more reflective and how slowly we take things sometimes instead of us teachers always wanting to do everything at once and get all children doing everything.'

The boundaries of what defines the systems, structures and performative culture are being challenged. Maybe to use the word 'transgress' as hooks does, might be claiming too much, but certainly there is desire on the part of several teachers interviewed to change, and take this time away from schools and classrooms to reflect, not only on their identity (see Theme 3 in this section) but also on their perspectives of teaching and learning. We feel that the following quote captures this sentiment:

> I feel as a teacher that going back, I'm not going back as the person I was before. . . I feel more, I feel more, I have more ownership. I've always felt that I've got quite a lot of ownership but I feel I've got more ownership and increased sense of ownership.

Often teacher-education and teachers' discourse is silent on the issue of Eros. Yet, in this sub-theme there are many moments when the Platonic and cartesian distinction between thinking and body remerges. We conclude this sub-theme with a reflection from hooks that encapsulates some of the ideas presented. Hooks constantly reminds us to acknowledge the body, of all those involved in learning and teaching. She posits Eros as that which is other than merely sexual, as that which transforms potentialities to actualities (hooks, 1994a, p. 194). Dealing with our passions makes our lives whole (hooks, 1994a, p. 195). It is through confronting Eros that hooks actually ties in our efforts at self-actualization, and the concepts of engaged pedagogy (being engaged in body, spirit and mind) and liberatory practice.

Theme 2: Agile and Flexi-Working

Agile and flexible working in the digital age has been subject to academic study prior to the pandemic in terms of new ways of working to meet service and market needs (Grant and Russell, 2020). However, the demands of lockdown necessitated a sudden shift to home working for millions of people and these concepts are now being discussed more generally across society. This period of rapid change, unpreparedness, fear and uncertainty has taken its psychological toll on people with demands to adapt to different ways of working and learning whilst experiencing simultaneously a marked reduction in physical/social contact and travel (Tehrani, 2010; British Psychological Society, 2020). Basile and Beauregard (2020) refer to one of the challenges that agile/flexible working present to work-life balance as an 'always on' or 'switched on' work culture and the need for clear work/home boundaries to mitigate against negative impact on health and wellbeing.

Professional and public faced guidance documents were produced by the British Psychological Society including advice about working from home and taking trauma-related work home. Specific documents were published for educational contexts (British Psychological Society, 2020). United Kingdom and Scottish Governments also published guidance documents to advise and support the move to remote learning and teaching across early years, primary, secondary, tertiary and higher educational settings [Scottish Government, 2020a,b; Department of Education (DoE), 2021]. Many research studies during the pandemic focused upon its impact on remote teaching and learning from the perspectives of parents, teachers and learners (Kidd and Murray, 2020; Kim and Asbury, 2020; Zhou and Wolstencraft, 2020). Participants in our study recognized advantages and disadvantages of remote working and this is reflected in many findings from studies over the last 2 years (Beattie et al., 2021; Dempsey and Burke, 2021).

The idea of being 'always on' is reflected in teachers' experiences as a disadvantage of homeworking during the pandemic and this is also a concern for hooks. In a very different context, hooks' shares her narratives and those of other teachers who feel the negative impact of being constantly within classrooms engaging with students and also of navigating schooling systems that can often be 'racially biased' (hooks, 2003, p. 17). During the COVID-19 pandemic lockdown, the constant engagement which hooks refers to and which Basile and Beauregard as being 'always on' was happening at an intensified level, and on many aspects of teachers' lives. Hooks' concept of recognition offers a means by which to resolve such challenges. Recognition, for hooks, is fundamental if we want

> to address and resolve issues. . .[and that it is] needed to generate anew and inspire a spirit of ongoing resistance (hooks, 2003, p. xiv).

In our analysis of the interviews, we noted that some teachers were trying to recognize signs of being hopeful in their teaching and students' learning during the pandemic. In this theme we identify different 'recognitions' that teachers working in Scotland were experiencing.

Recognizing Some Benefits and Challenges of Home Working

Several of our interviewee respondents referred specifically to the benefits of working from home during the pandemic. These include undertaking continuing professional development activities, more time to prepare work tasks, more timely assessment feedback, developing skills, less pressure from work and reduced time at work.

> I've managed to do so much more than I would if I was in the classroom.

> You wouldn't normally have the kind of time to learn all about that, develop skills, that's been quite good.

> Definitely feel like I don't have the same pressures.

These quotes above from teachers show an awareness and appreciation of the advantages of not being physically in class with students. Kim and Asbury's (2020) study that focused upon teachers' experiences, identified factors that mediated against pandemic working conditions including supportive professional relationships that extended to the wider community of teachers together with stronger relationships with families and young people. Teachers reported being less busy and pressurized with extra time for planning. Another study focused upon

the experiences of senior education leaders who cited the benefits of flexible working as: improved staff morale and HWB; skills development, and team-working/sharing practice (Cooper Gibson Research, 2020). For these educational leaders, additional factors included recruitment of skilled staff, succession planning at leadership level and development of strategic capacity. One participant in our study identified advantages of remote learning during the pandemic:

> . . .definitely the pros have outweighed the cons and where we are as a school now, taking those couple of weeks to just kind of really get down and kind of in about it, our school is, honestly, everybody is amazing [laughs] at it, and how much they've embraced it.. . . the amount of work that I'm, and kind of learning that I'm providing the children has lessened down to essentially half an hours' worth of work a day for the children, compared to nine to half two normally, so that has been easy.

However, remote working was also challenging to some teachers. Greenhow et al. (2021) highlight a contradiction: while calling it 'unsurprising' that teachers in the United Kingdom needed more training in digital pedagogy due to the rapid shift to remote learning, 'in response to the overnight switch to remote teaching, teachers rapidly developed skills and adapted pedagogies' (p.13). Several studies show that remote teaching was often difficult and stressful during the closure of school due to the pandemic (McLennan et al., 2020; Brown et al., 2021; Ferguson et al., 2021), "leading a heavy burden on teachers, who sometimes lack the social-emotional competencies to cope with such circumstances" (van der Spoel et al., 2020, p. 624; see also Hadar et al., 2020). In Cooper Gibson's study (2020) with senior education leaders, key challenges included: school/teacher capacity to carry out tasks, available digital resources and skills to use them, leadership and accountability, online meetings and methods of communication. Participants in our study expressed similar views but also recognized the challenges of competing demands at home, particularly for those teachers who are also parents:

> I mean, I find that I'm working all the way through till like six o'clock. Okay I might take a break here and there, but it's very busy because when the children are sending in comments or pieces of work, I think it's really important that they know that I'm here.
>
> It's quite difficult because I sometimes feel like I'm ignoring everybody when I'm working. Like if the children want to play and I'm like, 'I can't, I've got to work'. I think that's quite difficult. It's easier being away and having home and work as separate completely.

In Scotland, some teachers volunteered to work in education hubs and in specialist provisions whilst others worked entirely from home. One participant had to take her children to work as she was working in one of education hubs.

> My children have to come to work with me, cause if I'm on at the hub then they also have to come too.

Recognizing the Importance of Identity, Agency, and Boundary Setting

It is important to acknowledge how the sense of time and work/home boundaries have overlapped during the pandemic and the impact of these on the lived experiences of people depending on individual and work circumstances (British Psychological Society, 2020). Teachers with young children found home working difficult but for those who lived alone there were also feeling of isolation, loneliness and presenteeism (Beattie et al., 2021; Dempsey and Burke, 2021). Kim and Asbury suggest that concepts such as teacher identity, self-stories and sense of agency may serve as mediators against work/home demands during the pandemic (Kim and Asbury, 2020). In their study, teachers cited the need for planning, caring about pupils, interacting with others and doing their job (see also Zuo et al., 2020, who argue that one innovation during COVID-19 was coordinating multiple institutions to share resources to support learning). They argue that it is important to understand how teachers have drawn meaning from their experiences during lockdown and how this may impact on education recovery over the next few years. One participant in our study reported that:

> I've started my level 1 in BSL while still being able to mark and respond and give feedback to the pupils work immediately. It's amazing.

However, several respondents highlighted the limitations of teaching remotely from home in terms of monitoring children's well-being and supporting families:

> It's not possible to do everything that we do before, so daily we'd have emotional check-ins. We knew these children inside out. . . but we're not able to support the families in anywhere close to how we were before. . .
>
> Even just knowing what's kind of going on in the children's lives beforehand, you could tell if a child was hungry, you could kind of gauge by their appearance whether you're needing to kind of give them stuff from our food bank, but now we've not got any idea, of kind of what's going on there.
>
> It's nearly impossible to replicate what we're doing in school when you're online.

This concern of teachers for children's well-being is reflected in the national GIRFEC practice framework in Scotland but it also aligns with bell hooks' definition of self-actualization that views the body, mind, emotions as being interrelated. Her argument is that education traditionally tends to focus on the mind and gives little or no space to the body and emotions. Whilst GIRFEC's eight well-being indicators are commendable in underpinning children's well-being, learning and development in Scotland, the pandemic highlighted to many teachers the limitations of online teaching/working from home in terms of monitoring and safeguarding children's well-being (we return to this limitation in the theme on teacher identity). Interestingly, in a study conducted by Vilchez et al. (2021) in California during the COVID-19 pandemic, it is argued that creating personalized and creative strategies as well as adequate support helped the development of students' well-being.

Recognizing Protective and Risk Factors for Teachers Working From Home

Kim and Asbury (2020) and Collie (2021) have used the Job Demands-Resources Model (Bakker and Demerouti, 2007)

to consider the factors that buffered or mediated the effects of job demands and home working on teachers during the pandemic. For example, Collie (2021) undertook a series of studies to explore teachers' work-related experiences during the pandemic. She applies Job Demands-Resources theory (Bakker and Demerouti, 2007) to consider the impact of leadership factors as predictors of teacher resilience or workplace buoyancy as a personal resource around challenges of home working. The two roles of leadership are autonomy-supportive and autonomy-thwarting. A key finding indicated that autonomy-supportive leadership mediated work challenges for staff and that workplace buoyancy increased as work demand reduced.

One participant in our study referred explicitly to the leadership style of her boss:

> cause I kind of tried to make my day as a kind of normal school day and I wasn't wanting to be contactable or wasn't wanting to respond to things sort of at seven o'clock at night, whereas some of my colleagues were doing that, and actually it was the boss who said, he was like, 'look, you cannae be doing that, you need to make a cut-off point.'

Using the same theoretical framework, Kim and Asbury (2020) identified six job demands that contribute to poor mental health and well-being (uncertainty, workload, societal perceptions of the teaching profession, concerns for others, health struggles and multiple roles with competing demands). Three resources that were found to promote positive health and well-being were social support, work autonomy and personal coping strategies. A sense of control and flexibility in working from home were viewed by some participants as protective factors. One participant in our study reported that:

> I would say it's had a positive effect; I've been able to do things, set everything up in the morning, put it all out before the children are even awake, get on with my own little tasks I've been able to do like Open University courses.
>
> Better work/life balance...working fully shorter hours.

We started this section using the idea of 'recognition' from hooks and this theme focuses on moments of recognition as suggested by the data. Teachers shared with us their awareness and recognition of the lived experiences of the moment in relation to teaching and learning and their interviews highlight the complexity and the uniqueness of each teacher's lived experiences of teaching at home and in hubs during the pandemic. The interviews indicate that teachers' moments of recognition were also action based, both in their own development and more evidently when supporting students and their families, as has been discussed in the previous theme and will be elaborated further in the next Theme.

We were encouraged by many instances in the teachers' interviews where they describe their actions, while working from home, which focused on finding a solution that provided 'hope' for their learners. bell hooks would say that these moments of recognition for some of our participants engendered a sense of agency, liberation and resistance, recognizing that teaching as work and vocation could look different in a good way. For others, however, reduced agency to monitor children's well-being was a key concern arising from teaching at home. For hooks', recognition is fundamental to resolution of issues yet recognition on its own, that is naming the problem, without 'a constructive focus on resolution, . . .[can] take away hope' (hooks, 2003, p. xiv). We will return to this point in the conclusion of this paper.

Theme 3: Teachers' Identities

The challenges of teaching from home were not insubstantial and presented a challenge to how the participating teachers viewed themselves as a classroom practitioner. hooks' work is a constant renegotiation between, on the one hand acknowledging who one is, asserting particular identities, while on the other hand constructing and reimaging one's own life and identities. This section tries to capture this struggle. As hooks (1984) writes, 'the ability to see and describe one's own reality is a significant step in the long process of self-recovery; but it is only a beginning' (p. 24). For hooks, there is a difference between recognizing oppression and resisting it. Hooks constantly questions:

> . . .how do we create an oppositional worldview, a consciousness, an identity, a standpoint that exists not only as that struggle which also opposes dehumanization but as that movement which enables creative, expansive self-actualization? (hooks, 1990 p. 15)

Yet hooks reminds and challenges us to see that identities should not be seen as entirely as personal attributes (see the title of the next sub-theme), reduced to solely the experience that people have of their race, class, and gender (and others). If this is the case, then we fail to acknowledge 'the objective structures of inequality produced by specific historical forces (such as capitalist production relations) that mediate the subjective understandings of both individuals and groups' (Jaramillo and McLaren, 2009, p. 29). This is evident in this theme where we see the tensions play out between claiming a particular identity as a personal attribute and how this can potentially become problematic if we do not consider the interactions of that identity with the structures that surround it.

This theme of classroom practitioner incorporated a sub theme of blurring of boundaries and uncertainty.

I Am a Classroom Practitioner

For some of our participants, the uncertainty of the situation they found themselves in led to a repeated statement of their role throughout the interview. This repetition of their view of themselves as a classroom teacher was striking in its strength, almost meant to remind or convince themselves of who they were and what their role was during this uncertain time.

> My strengths are as a classroom teacher
>
> I feel my strengths are as a classroom practitioner
>
> And that's where I, that's where I prefer to be, is actually working in the classroom
>
> I've got a quite, a quite a kind of distinct role within the school. Kind of, I don't know, the experienced class teacher.

This repeated confirmation of identity as a classroom practitioner was further strengthened by reference to the tasks of the role, and a desire to continue these tasks and ways of working as far as possible. One of our participants talked about how she

approaches her work as a teacher: 'I'm quite a kind of stickler for knowing what I'm doing' and comparing this to her colleagues 'I think we're tending to do the similar sort of, well like we're, we're kind of setting tasks on a daily basis.' She talked about being very structured and organized in how she set the work in the online environment and trying to keep the same structure as she would normally have in the classroom space. One teacher described how her planning had evolved into a routine that she felt comfortable with as a teacher

> But then also how it's evolved as well, I've kind of, we're sort of now into a routine of Monday/Tuesday is a kind of normal day in the fact that I would set maybe a literacy task and a numeracy task, a health and wellbeing activity, and maybe something else. Then a Wednesday, I'm doing a grid, a grid for the day, and we're just calling it Rainbow Wednesdays, and it's just like lots of sort of interesting things for them to try.
>
> And then a Thursday, we're doing topic ideal stuff on a Thursday. And then a Friday, it's more of a kind of, like we'll do a quiz and, well I'll set a quiz and I'll get them to try and make quizzes up or I'll give them a, you know, just sort of fun kind of things, just to kind of try. And also, I'm trying to get them to do a diary entry 'cause we always did diaries on a Friday at school. And some of them have been doing it, and some of them haven't, but you know.

As a teacher, the sense of being able to impose some order onto a novel teaching and learning environment strengthened how she saw her identity as a classroom practitioner and also the work that she does as part of this. She talked about not being able to focus or concentrate for the first couple of weeks of lockdown and how she couldn't make sense of things. Being able to relate to the same kind of approach as she did in the classroom, chunking the day and the week, and imposing an order onto her work, appeared to help her to make sense of what her role was. As mentioned earlier, hooks challenges us not to reduce our identities to solely personal attribute. This does not allow the acknowledgment of the structures and discourses that contribute to the construction of our identity but also to the inherent inequality that exists in the interactions between ourselves and the objects/structures around us. Foucault (1979) also reminds us that a sense of self cannot develop independently of such structures. Our beliefs around who we are as teachers comes from societal beliefs around what teachers 'should' do, and how schools operate in our society. In this research, our teachers attempted to make sense of what it meant to be a teacher when they found themselves in such an unfamiliar and uncertain space by appealing to their understandings of a 'collective' notion of what it meant to be a teacher. Spicksley et al. (2021) found a similar leaning toward a collective rather than a personal identity when they conducted a discourse analysis exploring teacher's experiences during lockdown.

Boundary Blurring/Uncertainty

This translation of the classroom order into the online environment was problematic though and led to confusion and uncertainty around identity as a classroom practitioner. One teacher commented how

> you were trying to do exactly what you'd do in the classroom, but in the home instead, just trying to lift one model into another and they weren't going together?'.

In many respects, this echos Jones and Kessler (2020) view who argue that the complexity of separating out personal and professional identity during lockdown when these identities are so enmeshed is not possible. This teacher recognizes and names the tension of trying to integrate her personal identity in the home and her professional, classroom identity. It is almost impossible to do this when the two are so interrelated during the lockdown period. Although the literature in teacher identity in the lockdown is currently limited, other researchers have also found this theme (Kim and Asbury, 2020).

Later on, this teacher reflected on the difficulties she experienced when she tried to merge the classroom structure into the online environment

> So, you know, I think for me, I needed for me to have that structure in my life, cause I'm quite, I need to, I need to have that structure, and I think I did do a sort of transferral, I was like, right, okay, well this is what my day on a Monday would look like at school, so therefore, this is what we're going to do

And then:

> I suppose that was a bit of an eye opener for me because it wasn't any, I wasn't giving them any more than I would expect them to do at school, but then obviously they're not at school.

This teacher reflects on the challenges of being the same kind of teacher as she was in the classroom, also making reference to how she will need to be a different kind of teacher in the classroom when she returns. This presents a challenge to her identity as a classroom practitioner though which is yet to be resolved. On the one hand, she talks about teaching 'in the same manner as I did before' but then almost immediately presents a dilemma recognizing that 'we're not gonna be able to treat them as, you know, as the same learners as we had before. . .' and grappling with the uncertainty that this brings 'I'll need to get straight in my head, well, where does the, where is the connection made. . .'. She seems to resolve this boundary blurring, at least temporarily, by recognizing her work as a teacher as being related to the health and wellbeing of the children.

Not only was there tension evident in the blurring of boundaries between identity as a teacher in the classroom and what this meant when the 'classroom' was online, but also in the boundaries between professional and personal life. One teacher talked about the 'stress inducing. . .and anxiety-provoking' nature of trying to carry out her role as a teacher but from the home. There was evidence in this theme of the clashing of professional and personal boundaries

> It's quite difficult because I sometimes feel like I'm ignoring everybody when I'm working. Like if the children want to play and I'm like, 'I can't, I've got to work'. I think that's quite difficult. It's easier being away and having home and work as separate completely.

This potential conflict between professional and personal boundaries resulted in some reflection on how the physical space

interacts with identity. Some of this was expressed as frustration at how this was working out for both themselves as teachers but also for their children who were being expected to complete schoolwork from home in their bedrooms:

And although I'm a teacher, it doesn't make me any better at being a teacher at home, because at home I'm a mum so, you know, I don't change into teacher role, because that would be wrong as well and it just wouldn't fit.

> And, you know, your bedroom is the place that you play, it's not the place you sit down to do schoolwork.

The boundary blurring also extended to different and tasks that teachers found themselves undertaking:

> I mean, we're delivering food boxes, you know. I mean, so we're being the, the food boxes come from the council, arrive at school, and then teachers and pupil support assistants volunteer to distribute food boxes to families. So, you know, families seeing us in a different role as well, and caring for our families.

Again, this points to the potential resolving of the boundary blurring around identity as a classroom practitioner by focusing on wellbeing.

Theme 4: Parental Engagement

It has been well established in the research that parental engagement in children's learning has a positive impact on learner engagement and achievement (Fan and Williams, 2010; Goodall and Vorhaus, 2011). There is debate in the literature as to the definition of parental involvement, the differences between involvement and engagement and what they look like in practice (Goodhall and Montgomery, 2014). A continuum of ownership and agency has been suggested by Goodhall and Montgomery (2014) as a means of clarifying the shift of emphasis from parent-school interactions (involvement) to parent-child interactions (engagement). They suggest that although some families are less involved with school interactions that does not necessarily imply that they are less involved with their child's learning as barriers of confidence, cultural expectations, own educational experiences, health or work could prevent the desired level of school interactions. Parental support has never been so important as during COVID-19 when schools closed around the world and teaching and learning moved online with the agency for supporting children's learning shifting predominantly to parents however the Scottish Government (2020a) made clear that 'parents and carers were not expected to be teachers, nor to home educate in the formal sense' (p. 6). Greenhow et al. (2021) analyzed key news media publications in the United Kingdom and United States, and showed how news media in the United Kingdom portrayed this contradiction. While parents are portrayed as teachers and 'homeschoolers' (p. 15) they are also receiving messages that they are not responsible for teaching their children.

Engaging with the works of bell hooks and simultaneously reflecting about data with regards to parental engagement, two concepts continually came to our mind, that of conscientization and the banking concept of education. These two concepts run through all her works, and here one can immediately see the influence of Paulo Freire's work on hooks. From the data, as will be shown below, we believe that there were potentially moments of conscientization of parents on their children's learning during lockdown. The move from school and classrooms to online learning often was a revelation for parents on what children where learning. As our data focused on primary age, online teaching and learning was very often mediated through parents. Thus, giving them a unique view to learning that often is enclosed within the classroom. Regarding the banking concept that hooks writes about, similar to Freire, she argues this is the basis of much of our learning. The reference here is that students are containers of knowledge, being filled to be used when they leave school. This concept has been challenged during the pandemic as will be argued below.

Supporting Learning Online

Teachers reported a wide variation in parental engagement with online learning with some families taking it on board enthusiastically whilst others struggled to engage at all. Lack of Digital Technology, lack of parental skill or confidence and trying to balance work and home-schooling responsibilities were acknowledged as possible causes for some of the disengagement. These paralleled some of the themes found by Garbe et al. (2020) when they explored parents' experiences of children's online learning during the pandemic and is supported by other research (Abuhammad, 2020; Beattie et al., 2021). Bubb and Jones (2020) found parental engagement in their children's learning during lockdown increased and was partially motivated by the insight parents gained into their child's learning journey. In the current study there was a sense from teachers that initial engagement was high and then waned as lockdown continued and pressures on parents mounted. This can be understood through Bronfenbrenner (1979) ecological systems theory wherein changes in one part of a system impacts on that in other areas of the system.

Communication with families, particularly those that were perceived as vulnerable families, perhaps where there were known child protection concerns, emerged as a key theme. There was particular concern for children of vulnerable families who were not engaging and worry about the impact of poverty, including food poverty, financial circumstances, safety and domestic abuse. Having processes in place for promoted staff making contact when children of such families had not been 'seen' online allayed staff fears slightly. Other research has found similar concerns (Kim and Asbury, 2020).

Widening of Teaching and Learning Concepts

Teachers in the study aimed to keep contact with families and reduce the burden on parents, many of whom were home-schooling and working from home simultaneously, by setting tasks that could be done as a family experience. This was in recognition of the impact of pressure on parents' own health and well-being and an awareness of being reliant on parents to support the delivery of online learning, particularly for younger children (Beattie et al., 2021). One teacher stated that 'I made it very clear to the parents that we are a team in this.'

Inadvertently this led to a widening understanding of teaching and learning as something beyond the confines of curriculum syllabus and textbooks which contribute to the

banking style of learning, to the development of communication, life and transferable skills which could be learnt through day-to-day experiences such as conversations at the dinner table, gardening, playing board games and baking. The following quotes illustrates this:

As a school community we are trying to encourage families to come together and to use the time you know communicate, play games with each other, get outside to exercise, we are not wanting to be onerous.

> Made me appreciate how much children can get from activities that a lot of parents don't see as learning . . . we don't need to be sitting down at a table to, you know, to do some writing in order to develop your literacy skills.
>
> I'm just gonna do that lesson that I did on that the last time, I'll do that one, and I don't think that's good enough, and I think this time has allowed me to see lots of different creative ways.'
>
> And I think, in some ways I think that she's actually, maybe progressed further being at home because I've taken all the other distractions away that are in the classroom. They're not there.

Weaver and Swank (2021) found parents to value these daily learning experiences reporting them to be motivating and facilitating of creativity while Bubb and Jones (2020) found pupils themselves reporting most enjoyment with alternative creative tasks. From the chaos of the pandemic, opportunities to influence the future of Scottish education are emerging (Wrigley, 2020; Beattie et al., 2021). Zhao (2020) calls for rethinking education, questioning the 'what, the how and the where' as well as the 'by whom and when' (p. 31) of teaching and learning to create 'the best education opportunities for all children, instead of improving schools' (p. 30). Perceptions of the teachers in this study echo this thinking.

There were tensions inevitably; on the one hand teachers worried about parents not having the knowledge and skills of the craft of teaching to scaffold learning appropriately nor the understanding of formative learning and of learning from mistakes whilst on the other hand many acknowledged that there were many ways that learning could occur.

> What I'm really trying to say is, I'm trying to explain something sometimes as a science that's an art. I think it's working because we've got a relationship working.

For some teachers there were also pressure between managing the challenges of teaching online and managing the expectations of some parents as to the format of teaching. Some promoted staff reported discrepancies between good teaching and parental confidence in the teaching with a trend of higher parental confidence with higher teacher visibility regardless of the teaching itself.

> I think what these parents are seeing is a lovely person on screen saying, 'Hey everybody, good morning. I've had this for my breakfast this morning. I hope you have a brilliant day and this is a really good learning task. See you later.' Right? Because then what happens is when he posts really rubbish worksheets with the wrong answers, people forgive him more because they have seen him that morning, whereas with my other teacher who isn't even posting audio messages yet, the parents aren't reassured because they're not hearing her and they're not seeing her.

The concern about parents needing to be upskilled extended to ability to engage with the IT being used for teaching and learning (MS Teams and Seesaw in the main). Again, this reflected many teachers' self-concerns particularly if they had not previously been using such technology in their teaching.

Parent and School Relationships

Families and teachers were reported by many to be having similar experiences, feeling over- whelmed, anxious, uncertain and uncomfortable with the changes to their daily lives and expectations around learning. This commonality led to increased empathy with parents, a lowering of professional barriers and for many improved parental relationships as a sense of comradeship developed. Many teachers recognized the strength in this new type of relationship and spoke of wanting this to be nurtured further post pandemic. This necessitates 'a change of mindset on the part of many staff, a move from seeing "teaching" as the sole preserve of school staff' (Goodhall and Montgomery, 2014, p. 407) and the mindset of parents it can be argued, to that of a collaborative venture with shared agency in children's learning.

The pandemic context has enabled a dropping of professional boundaries which are sometimes barriers to authentic home–school relationships (Bryk and Schneider, 2002). A refocus on everyone supporting each other as human beings first and foremost, to navigate the restrictions on daily life that all were experiencing to varying levels of detriment took precedence.

> We're kind of shepherding each other, cause we're a whole flock together and that's how we need to get through this.

Valuing relationships with parents through the pandemic has been common (Kim and Asbury, 2020) and the shift in agency of learning to be informed by home and school information rather than just school-based information has increased trust between parents and school staff (Goodhall and Montgomery, 2014). We note a move toward hooks' conscientization as the voices of all parties is being recognized and valued more, possibly because of the loss of the boundaries that structures create.

Goodall and Vorhaus (2011) in their review of parental engagement stated 'Teachers often lack the confidence and knowledge to work with parents, and schools do not always recognize or value the ways in which parents are already engaged with children's learning' (p. 6). Responses in our research illustrate that the pandemic has offered a catalyst for re-evaluating parental involvement.

A heightened sense of school community was a common theme with staff and parents stepping out of their usual 'roles' to improve the lived experiences of all, e.g., parents and staff delivering food packages. A recognition of the benefits of increased harmony between school staff and parents (Goodhall and Montgomery, 2014) and the need for this to be nurtured and continued post pandemic emerged and will be interesting to follow up on the reality once the usual structures and ways of being filter back into our lives.

Priority of Health and Well-Being

The importance of health and well-being emerged as a strong theme with teachers recognizing the role that families had in promoting this. Teachers perceived the stress and anxiety of

the pandemic context as being a major barrier to learning and recognized the need to address this first and foremost. Learning through daily interactions and everyday tasks within family life was deemed to be a more valuable way of keeping learning live whilst supporting family connectedness. This ties in with the widening concept of teaching and learning. There was recognition that family connectedness could be a protective factor for children and young people's health and well-being and teachers saw 'family' tasks as being a means of providing this.

> Wellbeing is the most important. Yes, children are missing out on learning but I think the learning is taking a different shape and I think it is more that the relationships with families that we have to think about and for what the children really capable of.

Other Scottish research on teachers' lived experiences of the pandemic concurs (Beattie et al., 2021). In the Weaver and Swank (2021) study parents reported higher quality family interactions during lockdown and a desire for these to continue.

This theme highlighted instances of increased conscientization particularly on behalf of teachers about parents and the challenges faced at home. The compartmentalization of their input with children was removed when schools closed and the ensuing vagueness enabled an awareness and a listening to the other which was not possible before. As shown above, this changed the kind of teaching and learning that was expected, so that from the banking style of learning, teachers encouraged learning which was more about being together and about the attitudes which were thought to support children and families in this unprecedented time. The heightened awareness of the situations of parents and children enabled a new kind of listening to their voices and an appreciation of their participation in this new learning process.

Limitations of the Study

We gathered contextual data from participants by asking them 'tell us a bit about yourself.' This yielded information about designation (Class teacher, Head Teacher, etc.) of the participants and the number of years of teaching practice, etc. While a key theme was teacher identity, we did not set out to gather specific sociological demographics of the children and families that teachers work with. In turn, we did not draw conclusions about how certain contexts within which teachers work might influence their identity.

As the invitations to participate in this study was done through different social media platforms and the interviews were carried out through MS Teams, we are aware that this implies teachers and Headteachers had to have access to technology and access the different platforms. While this is a limitation, given that the research started from the second week of the first lockdown, social media platforms and video conferencing were the only way we could communicate with teachers and Head Teachers as schools and Local Authorities were closed and no face-to-face encounters was possible.

Our study was a snapshot in time during the pandemic and therefore exceptional and atypical in teachers' working experiences (Wong, 2020) thus making it unique to these circumstances. While the study is based on self-report during this time and is therefore is an appropriate research strategy (Collie, 2021), additional research may want to follow up participants' journeys and changing identities and experiences as the lockdown continued to provide an alternative picture of the Scottish teachers' lived experiences akin to van der Spoel et al. (2020) research with teachers in the Netherlands at two time points. Our study offered an in-depth exploratory study of primary teachers' experiences during the pandemic, but future research may need to focus upon larger-scale and longitudinal studies that also include teachers from Early Years and secondary sectors (Greenhow et al., 2021). Similarly, this study did not look at how primary teachers from different year groups were living this experience. Focusing on teachers according to their year group would have given us different set of data. Future research might investigate this and retrospectively explore the lived experience of teachers.

Our paper considered emerging themes through the lens of bell hooks. Future research could make use of different theoretical frameworks such as activity theory to consider the ways in which different educational systems have interacted with each other during the pandemic. This approach would also be useful to consider systemic contradictions experienced by teachers in the changing context of work locations as they return to face-to-face teaching (Greenhow et al., 2021).

CONCLUSION

We have used a theoretical framework inspired by bell hooks to explore and deepen our understandings of the experiences that teachers in Scotland reported to us in this research. It provides a unique exploration of a time and space in Scotland during 2020 that we were keen to capture. The taken for granted barriers which structure functioning within schools were removed and there seemed to be tentative exploration of possibilities, as we have shown above. Popa et al. (2020) refers to the opening of "Pandora's box" (p. 8726) so that even after the moment of pandemic crisis is over, what has been unleashed will still need to be contended with, whether that is positive or challenging. Although the research is based in Scotland, the themes and understandings that emerged are of relevance to educators internationally. Schools across the world were impacted by various lockdowns imposed by the COVID-19 pandemic and teachers faced a common set of challenges that required to be navigated. "The 'new normal' has been announced and has already started in some contexts, but it also brings with it a number of challenges." (Flores, 2020, p. 297).

Our research focused on four themes: change in pedagogy, agile and flexi working, teachers' identities and parental engagement. In the first theme we write about the creativity required from teachers after school closure, and how this creativity was transformative in itself, causing teachers to question assumptions and systems and to feel that they were not going to be the same professionals even after school closure had ended. The second theme, about agile and flexi working, concerns the difficulties of feeling constantly 'switched on' and issues arising from the necessity of working from home. The following theme about teachers' identities addresses the challenges to identities that our participants reported with the blurring of

boundaries, making them uncertain, and how teachers engaged with such challenges and negotiated them. Parental engagement constituted the fourth and final theme, and talked about how learning from home needed support, about the impact of this on relationships, and about the necessity to revisit ideas of teaching and learning to incorporate the possible benefits of learning from home.

Within and between these themes, we found bell hooks' ideas around engaged pedagogy to be a helpful framework to deepen the meanings that we were taking from our interviews. The idea of boundaries wove itself throughout our data as teachers expressed how the transgression of boundaries was occurring in multiple ways. We saw the exploration of the boundaries between pedagogical spaces (classroom vs. online) professional and personal boundaries and the boundaries of the systems in which education takes place. This has both challenged as well as opened up space for 'extra creativity' and new possibilities.

This research has offered a unique insight into the lived experiences of primary teachers working in Scotland with the interviews offering teachers spaces in which they could pause and reflect on the unexpected changes happening in their lives. Several teachers reported that the interview was in fact a chance for them to reflect on their actions in that unique moment. To our knowledge this is the only research that occurred from the second week of the COVID-19 school closure in Scotland. While the data is localized and specific, we think it contributes to a more general discourse of teachers and teaching and learning. The research contributes to thinking of how the absence of the school building gave teachers the possibility to think creatively about engaging with their students and their families. It is very rare that school closure occurs to that extent and for such a long period of time, and this research captures this. This also has helped question the relationship of teaching and learning outside of the classroom and school space and how teachers make sense of this. Furthermore, this research contributes to a unique discussion about the issue of the private/public life of the teacher, where working from home, often from their kitchen tables, with the available resources, was a practice that all teachers were engaged in. It has also highlighted the carry over between a teacher's personal life and her professional life, as the teachers' own experiences had an impact on their perspectives of the families whose children they taught.

We see in our data evidence of a shift in practice not just in the way teachers are 'doing' education but also, perhaps, in the way that teachers are 'being' as educators as they adapt to different ways of knowing. It is a way of understanding teaching that allows a more engaged pedagogy to develop.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University of Dundee, School of Education and Social Work. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication. Authors are listed alphabetically.

REFERENCES

Abuhammad, S. (2020). Barriers to distance learning during the COVID-19 outbreak: A qualitative review from parents' perspective. *Heliyon* 6:e05482. doi: 10.1016/j.heliyon.2020.e05482

Bakker, A. B., and Demerouti, E. (2007). The job demands-resources model: state of the art. *J. Manage. Psychol.* 22, 309–328. doi: 10.1108/02683940710733115

Basile, K. A., and Beauregard, T. A. (2020). "Boundary management: Getting the work-home balance right," in *Agile working and well-being in the digital age*, eds C. Grant and E. Russell (Springer Nature: Switzerland).

Beattie, M., Wilson, C., and Hendry, G. (2021). Learning from lockdown: examining Scottish primary teachers' experiences of emergency remote teaching. *Br. J. Educ. Stud.* 2021, 1–18. doi: 10.1080/00071005.2021.1915958

Beauchamp, G., Hulme, M., Clarke, L., Hamilton, L., and Harvey, J. (2021). 'People miss people': a study of school leadership and management in the four nations of the United Kingdom in the early stage of the COVID-19 pandemic. *Educ. Manag. Adm. Leadersh.* 49, 375–392. doi: 10.1177/1741143220987841

Billig, M., Condor, S., Edwards, D., Gane, M., Middleton, D., and Radley, A. (1988). *Ideological Dilemmas – A Social Psychology of Everyday Thinking*. London: Sage Publications, Inc.

British Psychological Society (2020). *Covid- related anxiety and stress in the workplace: a guide for employers and employees*. Available Online at: https://www.bps.org.uk/sites/www.bps.org.uk/files/Policy/Policy%20-%20Files/Covid-related%20anxiety%20and%20stress%20in%20the%20workplace.pdf (accessed March 12, 2021).

Bronfenbrenner, U. (1979). *The Ecology of Human Development*. Cambridge, MA: Harvard University Press.

Brown, J., McLennan, C., Mercieca, D., Mercieca, D. P., Robertson, D. P., and Valentine, E. (2021). Technology as thirdspace: teachers in Scottish schools engaging with and being challenged by digital technology in first COVID-19 lockdown. *Educ. Sci.* 11:136. doi: 10.3390/educsci1103 0136

Bryk, A. S., and Schneider, B. L. (2002). *Trust in Schools: A Core Resource for Improvement*. New York: Russell Sage Foundation Publications.

Bubb, S., and Jones, S. A. (2020). Learning from the COVID-19 home-schooling experience: Listening to pupils, parents/carers and teachers. *Improv. Schools* 23, 209–222. doi: 10.1177/1365480220958797

Cohen, L., Manion, L., and Morrison, K. (2017). *Research methods in education*, 8th Edn. Milton Park: Routledge-Falmer.

Collie, R. J. (2021). COVID-19 and teachers' somatic burden, stress, and emotional exhaustion: examining the role of principal leadership and workplace buoyancy. *AERA Open* 7, 1–15. doi: 10.12711/tjbe.2020.13.1.0139

Cooper Gibson Research (2020). *Exploring flexible working practice in schools. Final report*. United Kingdom: Department of Education, GSR.

Corbin, J. M., and Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*, 4th Edn. Thousand Oaks, CL: Sage Publications.

Creswell, J. W., and Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*, 5th Edn. Thousand Oaks, CL: Sage Publications.

Dempsey, M., and Burke, J. (2021). *Lessons Learned: The experience of teachers in Ireland during the 2020 pandemic*. Maynooth: Maynooth University.

Denzin, N. K., and Lincoln, S. L. (2011). *The SAGE handbook of qualitative research*. Thousand Oaks, CL: Sage Publications.

Department of Education (DoE) (2021). *Guidance for Schools: Coronavirus (COVID-19)*. Available online at: https://www.gov.uk/government/collections/guidance-for-schools-coronavirus-covid-19 (accessed February 15, 2021).

Education Scotland (2010). *Curriculum for Excellence Through Outdoor Learning*. Available online at: https://education.gov.scot/Documents/cfe-through-outdoor-learning.pdf (accessed February, 2020).

Education Scotland (2020). *Education Scotland summary guidance*. Available Online at: https://education.gov.scot/media/aayhddfv/es-summary-guidance-161220.pdf (accessed March 12, 2021).

Fan, W., and Williams, C. M. (2010). The effects of parental involvement on students' academic self-efficacy, engagement and intrinsic motivation. *Educ. Psychol.* 30, 53–74. doi: 10.1080/01443410903353302

Ferguson, P., McKenzie, M., Mercieca, D., Mercieca, D. P., and Sutherland, L. (2021). Primary Head Teachers' construction and re-negotiation of care in COVID-19 lockdown in Scotland. *Front. Educ.* 6:617869. doi: 10.3389/feduc.2021.617869

Flores, M. A. (2020). Preparing teachers to teach in complex settings: opportunities for professional learning and development. *Eur. J. Teacher Educ.* 43, 297–300. doi: 10.1080/02619768.2020.1771895

Foucault, M. (1979). *Discipline and Punish*. New York: NY Vintage.

Freire, P. (1972). *Pedagogy of the oppressed*. New York: Herder and Herder.

Garbe, A., Ogurlu, U., Logan, N., and Cook, P. (2020). COVID-19 and remote learning: experiences of parents with children during the pandemic. *Am. J. Qualit. Res.* 4, 45–65. doi: 10.29333/ajqr/8471

Goodhall, J., and Montgomery, C. (2014). Parental involvement to parental engagement: a continuum. *Educ. Rev.* 66, 399–410. doi: 10.1080/00131911.2013.781576

Goodall, J., and Vorhaus, J. (2011). *Review of Best Practice in Parental Engagement*. London: Department of Education.

Grant, C., and Russell, E. (2020). *Agile working and well-being in the digital age*. Switzerland: Springer Nature.

Greenhow, C., Lewin, C., and Willet, K. B. (2021). The educational response to Covid-19 across two countries: a critical examination of initial digital pedagogy adoption. *Technol. Pedag. Educ.* 30, 7–25. doi: 10.1080/1475939x.2020.1866654

Guadalupe Davidson, M., and Yancy, G. (2009). "Introduction," in *Critical Perspectives on bell hooks*, eds M. D. G. Davidson and G. Yancy (New York: Routledge).

Hadar, L. L., Ergas, O., Alpert, B., and Ariav, T. (2020). Rethinking teacher education in a VUCA world: student teachers' social-emotional competencies during the Covid-19 Crisis. *Eur. J. Teach. Educ.* 43, 573–586. doi: 10.1080/02619768.2020.1807513

Hayes, N. (1997). *Theory-led thematic analysis: social identification in small companies, Doing Qualitative Analysis in Psychology*. London: Psychology Press.

Hollway, W. (1989). *Subjectivity and Method in Psychology: gender, meaning and science*. London: Sage Publications.

Hollway, W., and Jefferson, T. (2000). *Doing Qualitative Research Differently*. London: Sage Publications.

hooks, B. (1981). *Ain't I a Woman: Black Women and Feminism*. New York: Routledge.

hooks, B. (1984). *Feminist Theory: From Margin to Center*. Boston: South End Press.

hooks, B. (1989). *Talking Back: Thinking Feminist, Thinking Black*. Boston: South End Press.

hooks, B. (1990). *Yearning: Race, Gender, and Cultural Politics*. Boston: South End Press.

hooks, B. (1994a). *Teaching to Transgress: Education as the Practice of Freedom*. New York: Routledge.

hooks, B. (1994b). *Outlaw Culture*. New York: Routledge.

hooks, B. (2003). *Teaching Community: A Pedagogy of Hope*. New York: Routledge.

hooks, B. (2009). *Teaching Critical Thinking: Practical Wisdom*. New York: Routledge.

Jaramillo, N. E., and McLaren, P. (2009). "Borderlines: bell hooks and the Pedagogy of Revolutionary Change," in , *Critical Perspectives on bell hooks*, eds M. D. G. Davidson and G. Yancy (New York: Routledge), 17–33.

Jones, A. L., and Kessler, M. A. (2020). Teachers' emotion and identity work during a pandemic. *Front. Educ.* 5:583775. doi: 10.3389/feduc.2020.583775

Kidd, W., and Murray, J. (2020). The Covid-19 pandemic and its effects on teacher education in England: how teacher educators moved practicum learning online. *Eur. J. Teach. Educ.* 43, 542–558.

Kim, L. E., and Asbury, A. (2020). Like a rug has been pulled from under you: The impact of COVID-19 on teachers in England during the first six weeks of the UK lockdown. *Br. J. Educ. Psychol.* 90, 1062–1083. doi: 10.1111/bjep.12381

Law, J. (2006). *After Method – Mess in Social Science Research*. London: Routledge.

McLennan, C., Mercieca, D., and Mercieca, D. (2020). What can I do? Teachers, students and families in relationship during COVID-19 lockdown in Scotland. *Malta Rev. Educ. Res.* 14, 163–181.

Miles, M. B., Huberman, A. M., and Saldana, J. (2019). *Qualitative data analysis-international student edition: A methods sourcebook*. Thousand Oaks, CL: Sage Publications.

Mushtaque, I., Rizwan, M., Dasti, R. K., Ahmad, R., and Mushtaq, M. (2021). Students' attitude and impact of online learning; role of teachers and classmates support during the COVID-19 Crisis. *Performance Improv.* 60, 20–27. doi: 10.1002/pfi.21982

Popa, D., Repanovici, A., Nore, M., and Coman, C. (2020). Using mixed methods to understand teaching and learning in COVID-19 Times. *Sustainability* 12:8726. doi: 10.3390/su12208726

Rogers, C. (2001). *A therapist's view of psychotherapy - On becoming a person*. London: Constable.

Scottish Government (2006). *Getting it right for Every Child*. Available Online at: https://www.gov.scot/policies/girfec/ (accessed March 12, 2021).

Scottish Government (2008). *Getting It Right For Every Child*. Available Online at: https://www.webarchive.org.uk/wayback/archive/20170104102702/https://www2.gov.scot/resource/doc/1141/0065063.pdf (accessed March 12, 2021).

Scottish Government (2020a). *Coronavirus (COVID 19) – supporting pupils, parents and teachers – learning during term 4*. Available online at: https://www.gov.scot/publications/supporting-pupils-parents-teacherslearning-during-term-4/ (accessed March 12, 2021).

Scottish Government (2020b). *Coronavirus (COVID-19) Support for continuity in learning*. Available Online at: https://www.gov.scot/publications/coronavirus-covid-19-support-for-continuity-in-learning/pages/overview/ (accessed March 12, 2021).

Silverman, D. (2017). *Doing qualitative research*, 5th Edn. Thousand Oaks, CL: Sage Publications.

Spicksley, K., Kington, A., and Watkins, M. (2021). We will appreciate each other more after this': Teachers' construction of collective and personal identities during lockdown. *Front. Psychol.* 12:703404. doi: 10.3389/fpsyg.2021.703404

Tehrani, N. (2010). *Managing trauma in the workplace: Supporting workers and organisations*. London: Routledge.

van der Spoel, I., Noroozi, O., Schuurink, E., and van Ginkel, S. (2020). Teachers' online teaching expectations and experiences during the Covid19- pandemic in the Netherlands. *Eur. J. Teach. Educ.* 43, 623–638. doi: 10.1080/02619768.2020.1821185

Vilchez, J. A., Kruse, J., Puffer, M., and Dudovitz, R. N. (2021). Teachers and school health leaders' perspectives on distance learning physical education during the COVID-19 Pandemic. *J. School Health* 91:541. doi: 10.1111/josh.13030

Weaver, J. L., and Swank, J. M. (2021). Parents' lived experiences with the COVID-19 Pandemic. *Family J.* 29, 136–142.

Wenger, E. (1998). *Communities of Practice: Learning, Meaning and Identity*. Cambridge: Cambridge University Press.

Williams, R. (1976). *Keywords – A Vocabulary of Culture and Society*. London: Fontana Press.

Williams, H. (2013). *Bell Hooks Speaks Up*. Heather Williams: The Sandspur.

Wong, R. (2020). When no one can go to school: does online learning meet students' basic learning needs? *Interact. Learn. Environ.* 2020, 1–17. doi: 10.1080/10494820.2020.1789672

Wrigley, T. (2020). Extraordinary times. *Improv. Schools* 23, 107–108.
Zhao, Y. (2020). Covid-19 as a catalyst for change. *Prospects* 49, 29–33. doi: 10.1007/s11125-020-09477-y
Zhou, X., and Wolstencraft, P. (2020). *Digital Masters? Reflecting on the readiness of students and staff for digital learning. BERA Blog post. Part of series: COVID-19, Education and educational research*. London: BERA.
Zuo, L., Dillman, D., and Juvé, A. M. (2020). Free access learning at home during COVID-19: A multi-institutional virtual learning collaboration. *Med. Educ. Adapt.* 54, 664–665. doi: 10.1111/medu.14194

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX INTERVIEW QUESTIONS.

Interview Question: What are educators' experiences of teaching from home/in hub during the COVID-19 lockdown in Scotland?

1. A little about yourself
2. What about your class?
3. What is your role as a teacher during this lockdown? Are you supporting home learning, or are you supporting children in a hub?
4. How has this experience affected your ideas of teaching, learning and curriculum?
5. How have you adapted to this new teaching situation?
6. What learning have you tried to focus on with your class? How far ahead can you plan or are there key areas on the horizon?
7. Can you provide an example of something that was challenging and something which was relatively easy.
8. What is the role of parents/carers in learning during this lockdown?
9. What are your thoughts about the impact of this on pupil transitions?

frontiers in Education

ORIGINAL RESEARCH
published: 13 December 2021
doi: 10.3389/feduc.2021.737064

Are Social and Ethnic Reading Inequalities Increasing During School Closures?—The Mediating Role of Parental Involvement in Distance Learning

Christoph Weber[1,2]*, *Christoph Helm*[3] and *David Kemethofer*[1]

[1]Department of Educational Sciences, University of Education Upper Austria, Linz, Austria, [2]Research Institute for Developmental Medicine, Johannes Kepler University Linz, Linz, Austria, [3]Department for Educational Research, Linz School of Education, Johannes Kepler University Linz, Linz, Austria

From spring 2020 many countries throughout Europe and beyond temporarily closed schools to tackle the spread of the coronavirus. First studies indicate that these school closures resulted in lower learning gains compared to learning gains in preceding years and widened social and ethnic disparities by affecting disadvantaged students more strongly than their more advantaged peers. Moreover, during school closures, parental involvement in distance learning is regarded as crucial for successful learning, especially for younger children. In the current study, we examine whether social and ethnic disparities in the reading achievement of primary school students widened during COVID-related school closures in spring 2020 and whether increased disparities are mediated by parental involvement in distance learning. We use data from 409 Austrian 2nd graders, whose teachers participated in an ongoing study on the use of learning progress assessment. Adopting a within-subject design, we first compare the effects of social and ethnic family background on reading achievement during a pre-lockdown period with the respective effects during a lockdown period of similar length. Controlling for pre-lockdown reading differences, we found that low socioeconomic status and non-German language use at home negatively predicted post-lockdown reading achievement, indicating that post-lockdown disparities were larger than expected due to disparities at pre-lockdown. In contrast, we found no such effects during the pre-lockdown period. Second, a series of mediation models did not provide any support for the hypothesis that parental involvement accounted for family background effects on reading achievement during the lockdown period.

Keywords: social and ethnic disparities, school closures, COVID-19, parental involvement, reading, primary school

OPEN ACCESS

Edited by:
Sina Fackler,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Chris Dixon,
University of Leeds, United Kingdom
Karen Roux,
University of Pretoria, South Africa

***Correspondence:**
Christoph Weber
christoph.weber@ph-ooe.at

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *06 July 2021*
Accepted: *02 November 2021*
Published: *13 December 2021*

Citation:
Weber C, Helm C and Kemethofer D (2021) Are Social and Ethnic Reading Inequalities Increasing During School Closures?—The Mediating Role of Parental Involvement in Distance Learning. Front. Educ. 6:737064. doi: 10.3389/feduc.2021.737064

INTRODUCTION

From spring 2020, many countries throughout Europe and beyond temporarily closed schools to tackle the spread of the coronavirus. Concerns quickly emerged that the children's competence development would be impeded by the school closures (Education Endowment Foundation, 2020; Kuhfeld et al., 2020). Drawing on longitudinal achievement data from pre-COVID school years and

research on the effects of being out of school (e.g., summer loss research or absenteeism research), Kuhfeld et al. (2020) projected that after school closures in spring 2020 students would start the school year 2020–2021 with substantially lower achievement levels in reading and mathematics relative to a typical school year. Meanwhile, these projections have been largely confirmed. Using a large sample of primary school students from the Netherlands, Engzell et al. (2021) show that students show lower learning gains in mathematics, reading, and spelling during the first school year with coronavirus in 2019–2020 compared to learning gains in preceding years. Similar results have been reported for a large sample of primary school students from Belgium (Maldonado and De Witte, 2020). Taking a different approach, Tomasik et al. (2020) used data from a computer-based formative assessment tool and compared students' learning gains over a period of 8 weeks before the school closures in Switzerland with an 8-week period during school closures. They found lower learning gains during school closures relative to the period before lockdown for primary school pupils, but not for secondary school students. In line with these results, Pier et al. (2021) report that learning loss is more pronounced in earlier grades, which is presumably associated with difficulties in successfully realizing distance education at these ages, that result from younger children's higher need for adult support and guidance to facilitate learning (Cottingham, 2020). Thus, beside the quality of teachers' distance instruction, parental involvement in the distance learning of their children seems crucial for primary school students' learning success during school closures (Education Endowment Foundation, 2020). However, as research on parental involvement in students' homework has demonstrated, it is not simply the quantity but the quality of involvement that contributes to child learning progress (Dumont et al., 2014; Moroni et al., 2015; Pomerantz and Grolnick, 2017). Drawing on Self-Determination Theory (SDT, Grolnick et al., 1997), several studies show that a more frequent involvement (i.e., quantity of involvement) might even have negative effects on child achievement (Moroni et al., 2015; Barger et al., 2019), whereas homework involvement that supports autonomy, provides structure and is not controlling (i.e., does not interfere with children's need for autonomy) positively predicts achievement (Dumont et al., 2014; Grolnick et al., 2015; Moroni et al., 2015).

Furthermore, various authors (Jæger and Blaabæk, 2020; Dietrich et al., 2021; Engzell et al., 2021; Reimer et al., 2021) hypothesize that students do not experience learning loss due to school closures equally. It is assumed that already disadvantaged student groups [e.g., students with low socioeconomic status (SES), students with migration backgrounds, etc.] are most strongly affected. Thus, well-documented pre-corona differences in academic achievement between students from different socioeconomic and ethnic backgrounds (Bradley and Corwyn, 2002; Sirin, 2005) are expected to grow during school closures. In a rapid evidence assessment, the Education Endowment Foundation (2020) projected–based on summer loss research–that the attainment gap between socioeconomically disadvantaged students and their peers will widen between 15 and 75%.

The current study takes up the issue of projected increasing educational inequalities due to COVID-related school closures and addresses the role of parental involvement in distance learning–conceptually equivalent to parental homework involvement–as a candidate mediator in the association between family background and learning progress during school closures. Specifically, using an Austrian sample of 409 primary school students, we examine whether socioeconomic and ethnic disparities in 2nd graders' reading skills have widened during school closures in spring 2020 and investigate whether widening achievement gaps can be explained by differences in parental involvement in distance learning.

Educational Inequalities Due to COVID-Induced School Closures

To date, several studies have provided evidence on increasing educational inequalities due to the first school closures in spring 2020. However, only a still limited number of studies have directly addressed socioeconomic and/or ethnic differences in learning loss. A recent systematic review on the effects of school closures on student achievement by Hammerstein et al. (2021) included in total eleven relevant studies (published till April 30, 2021), whereas only seven studies also reported results regarding socioeconomic and/or ethnic disparities. A more inclusive review (Helm et al., 2021b), also considering conference presentations and gray literature, identified twelve additional studies on educational inequalities. Notably, eleven of these 19 studies are from the United Kingdom and United States. In contrast to this body of research directly addressing achievement disparities, a considerably larger proportion of studies has indirectly addressed the issue by dealing with socioeconomic and/or ethnic differences in distance learning (time spent in learning, available IT-equipment, etc.), that might in turn, contribute to increasing educational inequalities [Andrew et al., 2020; Grewenig et al., 2020; Reimer et al., 2021; for a review of studies from Germany, Austria and Switzerland see Helm et al. (2021a)].

Using biannually collected achievement data of a sample of about 350,000 Dutch primary students (aged 8–11 years), Engzell et al. (2021) directly addressed increasing inequalities. The first test took place in January and February, thus in 2020 directly before the school closures in March, and the second test took place in June, at the end of the school year. The authors compared the learning gains during this period in 2020 with the learning gains during the same period in previous years and found that in 2020 students' learning progress–estimated using an achievement composite score covering mathematics, reading, and spelling–was about 0.08 SD lower than in previous years. Using various methods to control for confounders (e.g., propensity score weighting), they show that students with less educated parents (i.e., none of the parents has a degree above lower secondary education) experienced a significantly larger learning loss (≈0.1 SD) than their peers with higher educated parents (learning loss ≈0.075 SD). Notably, they did not find any differences in learning loss between age groups, and they did not test whether learning loss differs with the ethnic background of the students. In a

Belgian study, Maldonado and De Witte (2020) compared achievement data from 6th graders assessed at the end of the school year 2020 with respective data from the previous years. By linking aggregated data on the school level over time (i.e., a panel at school level not at individual level) and controlling for various school-level characteristics, they found that achievement differences in 2020, both within schools and between schools, were larger than in previous years. Moreover, they report that learning loss was more pronounced in schools with a higher share of students with low SES (determined by the mothers' educational level and students receiving financial support for schooling). However, they did not find an association between learning loss and the share of students who do not speak the instruction language at home. Note that this study used aggregated school-level data and thus inferring on the individual level is not warranted (ecological fallacy). Providing more support for increasing disparities, Pier et al. (2021) used formative assessment data from 18 Californian districts (about 50,000 students) to compare language and mathematics test score gains within the school year 2019/20 with test score gains within the previous year 2018/19. They found a larger learning loss for socioeconomically disadvantaged students and English language learners.

However, it should be mentioned that there are also some studies that do not find any new educational inequality due to coronavirus (for an overview see Helm et al., 2021b). Interestingly, whereas Helm et al. (2021b) show in their review that studies from English speaking countries (United States, United Kingdom, Australia), the Netherlands and Belgium very clearly confirm increased inequalities, none of the three studies from German speaking countries found support for growing disparities. For example, two German studies (Depping et al., 2021; Schult et al., 2021) compared student (grades 4 and 5) tests scores in reading and mathematics assessed in fall 2020 with test results from pre-corona cohorts and did not find evidence that disparities increased between schools with a disadvantaged student body (low SES, migration background) and schools attended by a lower share of disadvantaged students.

Beside these studies that provide direct support for the hypothesized increase in disparities, there are a growing number of studies that indirectly addressed COVID-induced inequalities by focusing on various aspects of learning during school closures that may account for a widening achievement gap between students with different family backgrounds.

Several surveys addressed the question of whether low SES students became less involved in learning during school closures than socioeconomically more advantaged students. The results of a German study by Dietrich et al. (2021) show that socioeconomically disadvantaged students spent less time on learning during school closures than their better off peers. Similar results are reported in a study from Spain by Bonal and González (2020) who show SES-differences in an opportunity to learn measure, covering the learning time, frequency of online lessons, and teacher contact during school closures. Also considering pre-lockdown differences in learning time, Andrew et al. (2020) and Grewenig et al. (2020) analyzed whether SES differences in learning time increased during lockdown. For England, Andrew et al. (2020) reported an increasing SES gap in learning time for primary school students, but not for secondary school students. Not differentiating between primary and secondary schools, Grewenig et al. (2020) did not support the increasing SES differences in learning time in a German study.

Using data from a reading app, a Danish study by Reimer et al. (2021) report that the time 4th and 5th graders spent using the reading app changed with the school closures. Notably, differences in reading time increased during the first lockdown phase (i.e., till the Easter holidays) with socioeconomically advantaged peers showing a steeper increase in reading time. However, no differences in the second phase (after the Easter holidays) were found, where students attended school on a limited schedule.

Various studies have also shown that socioeconomically disadvantaged students have limited access to learning resources at home (e.g., own study space, available computer, or tablet) as well as to those provided by schools [see for example the review on surveys in Germany, Austria, and Switzerland by Helm et al. (2021a)].

Moreover, several studies have examined whether there are socioeconomic or ethnic differences in the extent of parental support and involvement in distance learning. Bonal and González (2020) found no SES differences in parental support (whether parents helped children with school tasks during lockdown) among primary school children and upper secondary school children. However, for lower secondary school children, higher SES parents were more likely to report helping their children with school tasks than lower-SES parents. A German study by Sander et al. (2021) focusing on SES-differences in involvement found that higher-SES parents paid more attention to the establishment of structures during distance learning (e.g., regular study times). Interestingly, they found that lower-SES parents and non-German speaking parents reported more process-focused learning support (e.g., help to apply meaningful learning methods). Similarly, a study from Portugal (Ribeiro, et al., 2021) also found that lower-SES parents were more involved in terms of time in their children's learning during school closures.

To sum up, there is growing evidence that socioeconomically disadvantaged and ethnic minority students experienced a larger learning loss during school closures than their better off peers and ethnic majority peers, respectively. Moreover, disadvantaged students had restricted access to learning resources available at home and to those provided by schools and spent less time on learning during school closures. However, it is still unclear whether or not–and to what extent–these aspects of learning during school closures (e.g., time spent on learning) contributed to increased disparities in achievement. Moreover, little is also known about other factors of the learning context at home that may account for an increased learning gap. Here, parental involvement in the distance learning of their children might be of special importance (Education Endowment Foundation, 2020), as missing instruction due to school closures had to be at least partly compensated by parents. This is especially true for

younger children whose self-regulatory skills are still developing and who need more support and guidance for successful learning (Vandevelde et al., 2015; Cottingham, 2020). Several studies that have considered parental involvement in distance learning till date have largely assessed involvement only through few items focusing either on the quantity of involvement (e.g., Grewenig et al., 2020; Nusser, 2021; Ribeiro et al., 2021) or on the general provision of learning support during school closures (e.g., Bonal and González, 2020). Moreover, these studies provide mixed results on socioeconomic and ethnic differences in parental involvement. Therefore, a broader consideration of the concept of parental involvement seems to be purposeful.

Parental Involvement in Schooling

Parental childrearing practices in general (Pinquart, 2016) and especially parental involvement in schooling (Barger et al., 2019) are considered to affect children's academic achievement. Following Grolnick and Slowiaczek (1994), parental involvement in schooling is defined as the dedication of resources (e.g., time, energy, money) to the child's academic lives. It encompasses two broad forms: school-based involvement and home-based involvement (Barger et al., 2019). School-based involvement comprises–amongst others–parents' direct contacts with school. Home-based involvement is multifaceted, covering activities such as talking with children about school, encouraging them in their academic efforts, and helping children with homework (Pomerantz et al., 2007; Pomerantz and Grolnick, 2017). Primary school teachers' distance instruction during school closures was largely characterized by assigning homework-like tasks to students, which they had to complete at home (Grewenig et al., 2020; Weber et al., 2021). Thus, it is reasonable to put a special focus on parental involvement in distance learning, which is conceptually equivalent to homework involvement.

However, whereas research indicates that overall parental involvement in schooling is conducive for children's academic development (Barger et al., 2019), research on the effects of parental homework involvement is ambiguous. A meta-analysis of Patall et al. (2008) showed small positive correlations between homework involvement (helping, monitoring, etc.) and achievement in the primary school and high school years, but a negative correlation for middle school students. In contrast, the results of a recent meta-analysis that considered a larger body of studies indicated that homework involvement is negatively associated with academic outcomes irrespective of the children's developmental stage (Barger et al., 2019).

Distinguishing between quantity and quality of homework involvement appears to resolve some inconsistencies (Dumont et al., 2014; Moroni et al., 2015; Pomerantz and Grolnick, 2017). This body of research largely draws on self-determination theory (SDT; Grolnick et al., 1997; Grolnick, 2003, 2009). In a nutshell, SDT posits that children are born with three psychological needs which are facilitated by three parenting dimensions. By allowing children choices, supporting their initiative, and taking children's perspective (i.e., autonomy support), parents can support the need to feel autonomous. In contrast, controlling parenting–i.e., the conceptual opposite of autonomy support–is restricting children's choices and thus, frustrates the need for autonomy. Communicating clear rules and expectations–i.e., providing structure–facilitates the need for competence. Finally, the need to feel related to others is satisfied by caring, supportive, and positively involved parenting. Following SDT, the fulfillment of these needs fosters motivational resources necessary for developing competence (Grolnick, 2003, pp. 12–17, 2009, p. 165; Pomerantz and Grolnick, 2017). Applying this theoretical framework to the study of parental homework involvement, frequent assistance and helping with homework (i.e., quantity) is argued to be negatively associated with child achievement, because frequent helping inhibits children's autonomous motivation and feelings of competence and thus interferes with academic development (see also Silinskas et al., 2015; Pomerantz and Grolnick, 2017). In this vein, Silinskas et al. (2015) found that, controlling for achievement in grade 1, frequent helping with homework was related to lower mathematic achievement in grade 4. Similar results have been reported by Moroni et al. (2015). Moreover, several studies show that forms of parental homework involvement (i.e., quality) that are controlling and characterized by negative parental affect have harmful effects on children's academic development (Dumont et al., 2012; Moroni et al., 2015; Silinskas and Kikas, 2019). For example, Moroni et al. (2015) found that controlling involvement (e.g., parents interfere when child is doing her/his homework) predicted lower reading achievement in grade 5, and Dumont et al. (2012) reported that parent-child-conflicts during homework–indicating negatively affective involvement–predicted German and mathematics grades in 8th graders. Both studies have controlled for prior achievement. In contrast, parental homework involvement that is autonomy supportive, responsive to children's needs, provides structure and is characterized by positive affect is conducive to children's academic development (Grolnick et al., 2015; Moroni et al., 2015; Grolnick, 2016; Pomerantz and Grolnick, 2017; Silinskas and Kikas, 2019). For example, Grolnick et al. (2015) report results of a path analysis that show that autonomy supportive involvement (e.g., encouraging children to find solutions on their own) and structuring involvement (e.g., clear and consistent rules and expectations) predict English grades in 7th graders, even when controlling for grades of the previous year.

Parental Involvement as Mediator of the Effects of Family Background on Child Academic Outcomes

There has long been the hypothesis that the effects of socioeconomic status on various aspects of child development are mediated by parenting (Bradley and Corwyn, 2002; Grolnick, 2003; Conger and Donnellan, 2007). Amongst others, it is argued that parents with lower SES are more likely to experience economic stress, which in turn makes them more emotionally distressed and distracts their attention from childrearing (e.g., being less involved). Further, low SES parents invest less resources in their offsprings' development due to a lack of available resources (money, knowledge, etc.) or SES-specific values (Kohn, 1959;

Bradley and Corwyn, 2002; Conger and Donnellan, 2007). Similarly, the ethnic background of parents might be associated with different values that affect parenting and language barriers of immigrant parents can complicate involvement (Antony-Newman, 2019). In this context, Fleischmann and de Haas (2016) found in a Study from the Netherlands that Turkish and Moroccan parents more strongly value obedience in their children than their Dutch counterparts. However, ethnic differences in parental school involvement (Turkish and Moroccan parents reported lower levels of school involvement) were entirely explained by differences in parental education and language proficiency. Ethnic differences in parenting goals were not associated with differences in involvement. In the context of this study, low parental proficiency in the language of instruction could simply pose a challenge for helping students with their homework.

Regarding children's academic development, parental homework involvement is a candidate mediator of family background effects. In testing this hypothesis, Dumont et al. (2012) found no significant indirect effects of family background variables (SES-indicators and migration background) on achievement. Thus, mediation was not supported. However, SES-indicators and immigration status were associated with various aspects of homework involvement. Specifically, immigrant students reported that their parents are less supportive and less competent in helping them with homework, but also less controlling than parents from non-immigrant students. Low-SES students reported less support, less competence, and more homework-related conflicts than their socioeconomically more advantaged peers. Similar results regarding the association between SES and homework involvement are reported in various other studies (Silinskas et al., 2010; Moroni et al., 2014; Sander et al., 2021). For example, Moroni et al. (2014) found that higher SES was associated with more autonomy supportive involvement. Moreover, immigrant students reported less frequent parental involvement (quantity) and less autonomy supportive involvement. In contrast to Dumont et al. (2012), migrant students characterized their parents as more controlling than non-migrant students. Thus, there is evidence that higher-SES parents use more conducive and less detrimental forms of homework involvement. For parents with a migration background, research is somewhat inconclusive.

The Current Study

As outlined above, social and ethnic disparities in school achievement are expected to have grown during school closures. However, although there is growing research confirming the expected learning losses and growth of disparities, the number of studies is still small and largely limited to English-speaking countries (see Helm et al., 2021b; Hammerstein et al., 2021). Thus, our first research question (RQ 1) is:

> Did social and ethnic inequalities in reading comprehension of Austrian 2nd graders increase during the first school lockdown in spring 2020?

In line with the conclusion of recent reviews (Helm et al., 2021b; Hammerstein et al., 2021), we hypothesize that social and ethnic disparities have grown during school closures. Notably, whereas recent studies have analyzed achievement gaps between cohorts (e.g., comparing disparities in 6th graders of school year 2019/2020 with disparities of 6th graders from previous years), this study takes a within-subject perspective and analyzes whether social and ethnic disparities have grown during school closures compared to the pre-lockdown period of the school year 2019/2020.

Moreover, a plethora of studies has focused on the association between social and ethnic family background and variables such as learning time, parental involvement, and access to learning resources, that may account for growing disparities (Andrew et al., 2020; Bonal and González, 2020; Grewenig et al., 2020; Helm et al., 2021a; Dietrich et al., 2021; Reimer et al., 2021; Sander et al., 2021). However, all these studies are not based on achievement data and thus, do not directly address gaps in achievement.

From a mediation analytical perspective (e.g., MacKinnon, 2008, see also **Figure 1**), studies have tested c-paths (i.e., the effects of family background on learning loss without considering mediators) and a-paths (i.e., the effects of family background on mediators). To the best of our knowledge, however, no study has yet tested a mediation model to explore the reasons for grown disparities due to school closures. Using a panel sample of Austrian second graders, the current study focuses on a whole mediation process (see also **Figure 1**) by taking up parental involvement in distance education–conceptually equivalent to homework involvement–as mediators. In detail, we investigate the following research question (RQ2):

> If there are any increased social and ethnic disparities in reading comprehension, are they mediated by parental involvement in distance learning?

Taking an SDT-perspective on parental homework involvement (Grolnick, 2016; Pomerantz and Grolnick, 2017), we hypothesize that family background is associated with homework involvement in such a way that lower-SES parents show less conducive (e.g., autonomy supportive, structuring, positively affective) and more detrimental (e.g., controlling, negatively affective) forms of homework involvement (a-paths). As research on ethnic family background is inconclusive, we do not formulate a directional hypothesis. Socioeconomic and ethnic differences in parental involvement in distance learning might be due to differences in values and stress exposure that already existed before the coronavirus crisis, but which gain in importance due to the shift in learning from the classroom to the home. Put simply, it makes a difference if a parent tends to be controlling due to specific values or stress exposure and thus, gets involved in homework, in a controlling way, some days a week for up to an hour, or if she/he gets involved, in a controlling way, 5 days a week for several hours. Moreover, a recent research review indicates that lockdowns lead to more parental stress and stress outcomes (e.g., depression, burnout), especially in low SES families and in parents of younger

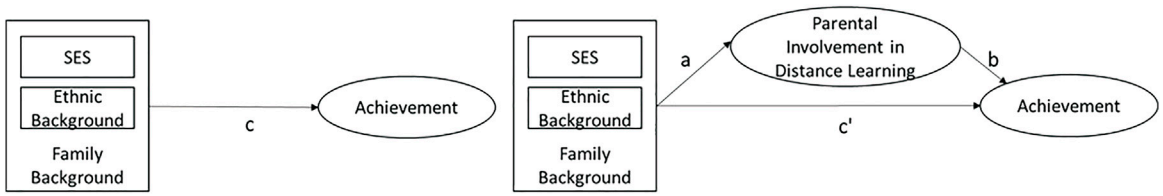

FIGURE 1 | Conceptual mediation model.

children, which was also accompanied by harsher and less warm parenting (Proulx et al., 2021). Thus, lockdowns might especially increase stress exposure of low SES parents, which in turn affects their involvement in distance learning.

Following research on parental homework involvement (Dumont et al., 2014; Silinskas et al., 2015), we argue that involvement in distance learning is associated with reading achievement (b-paths). Specifically, we hypothesize that autonomy supportive, structuring, and positively affective forms of parental involvement in distance learning are conducive to the development of reading achievement during school closures, whereas controlling and negatively affective involvement is detrimental (Pomerantz and Grolnick, 2017). Notably, whereas research on homework involvement indicates that more involvement is associated with lower achievement (Barger et al., 2019), this might not be the case for parental involvement in distance learning. Due to canceled teacher instruction in classrooms, children would have been left without direct adult support and guidance that largely had to be provided by parents. Thus, we argue that especially young children needed the support, guidance, and involvement of their parents on a largely daily basis (Vandevelde et al., 2015; Cottingham, 2020; Education Endowment Foundation, 2020).

Finally, we hypothesize that family background effects on reading achievement are at least partly mediated by parental involvement in distance learning. Thus, we expect significant indirect effects of background variables on reading, but background effects might still be significant after controlling for parental involvement (i.e., c'-paths). Significant c'-paths might be due to other factors such as the quality of distance teaching and the quality of the study space at home, that might differ between high-SES and low-SES schools (Andrew et al., 2020; Bonal and González, 2020), or SES-differences in child skills (e.g., self-regulation; Bradley and Corwyn, 2002) that affect learning during school closures.

MATERIALS AND METHODS

Sample and Procedures

This research partly draws on data from an ongoing study on the use of learning progress assessment (LPA) in primary school. The W3-study (W3 stands for "Wir Wollen's Wissen!" in English "We want to know how our students' skills are doing!"; Weber et al., 2020) started in school year 2018–2019. In fall 2018, schools were informed about the project *via* the Upper Austrian educational administrations. A total of 28 schools with 48 classes decided to participate in the study. Parents of 745 students gave their written consent to participate in the study. It was planned that 1st grade students of the 2018/19 school year would participate in the project over the entire span of primary school, which lasts 4 years in Austria. Some teachers, however, decided to leave the project after the first year. Thirty-five classes with 579 2nd graders remained in the project in 2019/20. Initially, it was planned that the students should complete eight short internet-based reading comprehension LPA tests (Souvignier et al., 2021) at fixed intervals of 3 weeks throughout the school year. The LPA tests are completed independently by students during self-study periods or group tests at school, depending on the number of available computers. It has been shown that students can complete the LPA test independently as early as grade 1 (Salaschek and Souvignier, 2013). Moreover, the students of our sample already had 1 year of experience in using the LPA tests. Four LPA tests between March and the end of June were largely not completed due to school closures, which started in Austria on the 16th March and ended on the 18th May. For example, the eighth LPA-test (test period during the first 3 weeks of June) was only used in eleven classes. Notably, although the whole predefined testing period of the eighth and last LPA-test was after school closures, a broader use was hampered by shift-schooling (see later) and three additional days off from school within this period. Moreover, the specific situation after returning to schools must be considered that kept teachers from LPA-testing. Thus, to ensure a broader post-lockdown reading assessment, teachers were asked to administer a standardized reading comprehension test (ELFE II; Lenhard et al., 2017) at the end of the school year (late June/early July). The ELFE II was chosen because it is conceptionally equivalent to the LPA-tests (see also *Reading Achievement* section) and has the advantage that it could be simultaneously administered within 30 min to the whole class. Although there is a computer version of the ELFE II, we choose to use the print version of the test, since most classes have only a few computers that could be used for testing. The test was administered by the teachers to their students, using standard instructions. Moreover, we also conducted a parent survey on different aspects of distance learning (including parental involvement). Twenty-five teachers agreed to administer the ELFE-test and we received parent questionnaires from 21 classes. A parent survey covering family background variables (including SES, ethnic background) was already conducted in the school year 2018/19. For the current study, we used data from 25 classes that regularly used the LPA tests before the school closures

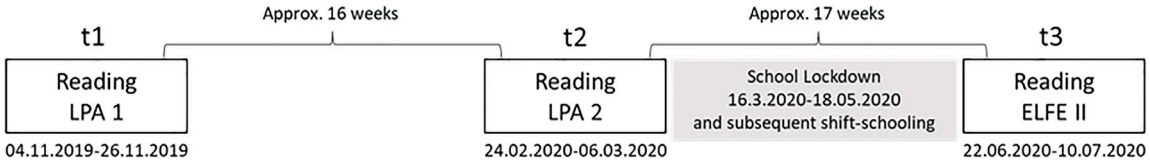

FIGURE 2 | Measurement points of the study.

and took the ELFE-test after lockdown (n = 409 students; 50.1% females). The mean age of the students at the beginning of the school year was M = 7.7 years (SD = 0.56). 14.8% of the students have a migration background, which is significantly below the rate for the Upper Austrian primary school population [23%; $\chi^2(1) = 10.937$, $p < 0.05$]. In about one-third (29.7%) of the families, at least one parent has a university degree. A further 22.5% have a university entrance qualification. Parental education in the sample is representative of the general parent population of Upper Austrian primary school students [$\chi^2(3) = 5.262$, $p > 0.05$].

For the current study we used three time points (see **Figure 2**). For t1 and t2, LPA reading data are available and for t3, we used data from the ELFE II test. LPA tests at t1 were carried out in November 2019 and LPA tests at t2 between the 24th February and the March 6, 2020. ELFE II tests were administered between the 22nd June and the July 11, 2020. The interval between t1 and t2 covers approximately 16 weeks (including 2 weeks Christmas holidays and 1 week semester break), thus, students regularly attended school for about 65 days (i.e., 13 weeks) in this period. The interval between t2 and t3 covers roughly 17 weeks, whereas schools have been closed in Austria from the 16th March to the 18th May (including one-and-a-half-weeks for the Easter holidays). To reduce class sizes after reopening schools, students attended classes only half the week (shift-schooling). One group of students had to learn at home, while the other group was attending classes. Taken together, students roughly attend classes between t2 and t3 for 25 days, that is, approximately 60 days less than normal.

Measures

Reading Achievement

Reading achievement was assessed using two tests. At t1 and t2, we used the LPA reading tests (www.quop.de), which are a fixed part of the W3-study. The LPA tests assess second grade reading skills in the areas of word comprehension (20 items per test; differentiating words from pseudo-words), sentence comprehension (13 items per test; identifying meaningful sentences), and text comprehension (13 items per test; deciding whether a sentence continues a text in a meaningful way). We estimated reading scores as the number of correct answers divided by the processing time for each subtest. Although the LPA tests have not been developed as outcome measures, they show good psychometric properties. Souvignier et al. (2014), 264pp report both satisfactory reliability (Cronbach's α between 0.76 and 0.89) and validity (correlations with standardized reading tests between 0.47 and 0.66) of the LPA tests (see also Förster and Souvignier, 2014; Förster et al., 2018).

At t3, the ELFE II (Lenhard et al., 2017) test was used to assess reading comprehension. Lenhard et al. (2017) provide comprehensive information on reliability (reliability estimates between 0.87 and 0.98) and convergent, and discriminative validity. Like the LPA, the ELFE II consists of three subtests. Word comprehension with max. 75 items (choose from four words the one that matches a picture), sentence comprehension with max. 36 items (select from five words the one that correctly completes the gap in sentence), and text comprehension with max. 26 items (choose one out of four statements that fits a text). Processing time is limited to 3 min for word and sentence comprehension and to 7 min for text comprehension. For further analyses, we transformed the number of correct answers per subscale into T-scores.

For the current study, we model reading comprehension as a latent variable, at each time point, assessed by three indicators (word, sentence, and text reading). To evaluate internal consistency, we calculated McDonald's ω, which–in contrast to Cronbach's α–does not rely on often violated assumptions such as equal factor loadings (Hayes and Coutts, 2020). Internal consistency was good for LPA_{t1} (ω = 0.817), LPA_{t2} (ω = 0.854), and ELFE II_{t3} (ω = 0.898).

Notably, the tests appear conceptually equivalent (i.e., they refer to the same construct reading comprehension on word, sentence, and text level), what is also supported by a latent correlation of r = 0.843 ($p < 0.001$) between ELFE II and the LPA-test at t3, estimated for the subsample of n = 141 students who completed both the ELFE II and the LPA-test after the school closures. Thus, ELFE II and LPA share at t3 about 71% (0.843 × 0.843) of their variance. However, a two-dimensional confirmatory factor analysis (CFA) model provides a better fit to the data than a unidimensional model, where ELFE and LPA subtests load on a single factor reading comprehension[1fn1]. This is presumably due to method differences between the tests (online vs. paper-pencil

[1]Two-dimensional CFA-model: $\chi^2(8) = 18.754$, $p = 0.016$; root mean square error of approximation (RMSEA) = 0.061, 90%-CI (0.025, 0.097); comparative fit index (CFI) = 0.987; Tucker-Lewis Index (TLI) = 0.975; standardized root-mean-square residual (SRMR) = 0.035. Uni-Dimensional CFA-model: $\chi^2(9) = 62.524$, $p < 0.001$; RMSEA = 0.127, 90%-CI (0.099, 0.158); CFI = 0.934; TLI = 0.890; SRMR = 0.048. MLR-χ^2-Difference(1) = 43.770, $p < 0.001$.

administration, differences in length and item format, no time limit vs. time limit, . . .).

Family Background Variables

Family background variables were assessed by a parent questionnaire in the initial stage of the W3-study.

Socioeconomic Status

We employed a SES composite score, computed as the mean of three z-scored SES measures. 1) Occupational status of the parents was assessed using the International Socioeconomic Index (ISEI, Ganzeboom, 2010), whereby we only used the highest ISEI score of the two parents. 2) Parental education was assessed on a 4-point scale (1 = lower secondary compulsory education, 2 = vocational education, 3 = university-preparatory upper secondary education, and 4 = tertiary education). Again, we used the highest education of the two parents. 3) The number of books at home was assessed on a 5-point scale (1 = 0–10 books, 2 = 11–25 books, 3 = 26–100 books, 4 = 101–200 books 5 = more than 200 books).

Ethnic Background

Two dichotomous measures of ethnic student background were considered. 1) Following the definition of the national education reporting in Austria (BIFIE, 2019), we regard a child as having a migration background when either she/he was born in a foreign non-German-speaking country or both parents were born in a non-German-speaking country (0 = no migration background, 1 = migration background). 2) Language use at home (0 = only German, 1 = at least sometimes another language other than German).

Parental Involvement in Distance Learning

Parental involvement in distance learning was assessed by a parent questionnaire administered after the lockdown. We selected and adopted items from previous work on parental homework involvement (e.g., Dumont et al., 2012; Dumont et al., 2014), largely taking an SDT-perspective. An overview of the involvement measures is presented in **Supplementary Table A1** in the supplement.

However, several restrictions regarding the measurement of parental involvement in this study should be noted in advance. First, to raise the response rate during challenging times, we kept the questionnaire as short as possible (see also Huber and Helm, 2020). Second, as previous work largely used student-reports in samples of secondary school students and our sample consists of second graders, some interesting aspects of involvement (e.g., parents interfere in homework) were not considered, because we excepted, that such aspects based on parent-reports would be subject to social desirability bias. Finally, due to unpredictable general conditions during and after the lockdown, there was little time to thoroughly develop items on involvement in distance education.

Structuring Involvement

Structuring involvement was assessed using two scales. 1) Establishing structures for distance learning was assessed by three items adopted from Dumont et al. (2014). The items [e.g., "I insisted that the tasks for school were done before my child could do other things (e.g., watch TV, etc.)," "I made sure that my child completed his or her tasks for school at fixed times (e.g., always in the morning from 8:00–12:00)"] refer to the parental authority component of structure (Grolnick et al., 2014) and were rated on a 5-point scale ranging from 1 = "does not apply" to 5 = "perfectly applies." Higher scores indicate that parents establish structures for distance learning by taking their leadership role. Internal consistency was adequate (ω = 0.743). 2) Moreover, three items refer to parental oversight activities, that refer to "checking" on the distance learning process (Hoover-Dempsey et al., 2001; e.g., "discussed with my child what she/he had to do for school," "checked whether my child has done his/her homework"). The items were rated on a 5-point scale ranging from 1 = "daily" to 5 = "never or almost never." Thus, the items also capture the quantity component of involvement. We recoded items so that high scores indicate frequent oversight activities. Internal consistency for this scale was rather low (ω = 0.635).

Interpersonal Involvement

Interpersonal involvement was captured by two scales. 3) Three items refer to the allocation of time and resources and to the interest shown in the child's learning ("asked my child what he or she had just learned," "discussed with my child the things he/she has read for school," "practiced reading with my child"), thus assessing positive interpersonal involvement (Grolnick et al., 1997). The parents rated the items on a 5-point frequency scale ranging from 1 = "daily" to 5 = "never or almost never." We recoded the items so that higher scores indicate more frequent positive involvement activities. Notably, the items also capture the quantity component of involvement. Internal consistency was adequate (ω = 0.763). 4) We used three items adopted from Dumont et al. (2012) to assess negative personal involvement. The items refer to parent-child conflicts about homework ("Homework has frequently been a cause of arguments," "When my child has homework, it has often come to arguments between me and my child") and parental negative affect ("I sometimes got angry when my child did not do his/her homework properly"). Items were rated on a 5-point scale (1 = "does not apply" to 5 = "perfectly applies." Thus, higher scores indicate that parental involvement during distance learning was characterized by negative affect. Internal consistency was excellent (ω = 0.903).

Autonomy Supportive vs. Controlling Involvement

Autonomy supportive vs. controlling involvement was assessed using three items. One item explicitly focuses on autonomy supportive involvement ("When my child needed help with tasks, I told him to think well on his own first before I helped him further.") and two items adapted from Dumont et al. (2014) assess controlling involvement ("I often sat next to my child when she/he did her/his homework and immediately corrected any of her/his mistakes," "I have threatened to punish my child (e.g., TV ban) if she/he has not done his/her homework for school properly."). Following an SDT-perspective, autonomy

TABLE 1 | Descriptive statistics and latent correlations.

		M (SD)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
LPA1 (t1)	(1)	19.03 (6.003)	1													
LPA2 (t2)	(2)	27.12 (7.572)	0.739***	1												
ELFE II (t3)	(3)	50.72 (7.811)	0.733***	0.663***	1											
Oversight activities	(4)	4.796 (0.429)	0.013	0.044	0.061	1										
Pos. interpersonal involvement	(5)	4.411 (0.613)	0.088	0.141	0.101	0.587***	1									
Neg. interpersonal involvement	(6)	2.567 (1.179)	0.033	0.011	0.007	0.109	−0.052	1								
Establishing structures	(7)	4.365 (0.636)	0.100	0.068	0.099	0.496***	0.211*	−0.091	1							
Controlling involvement	(8)	2.165 (1.383)	−0.106	−0.089	−0.146*	0.026	0.025	0.525***	−0.176*	1						
Intrusive involvement	(9)	3.164 (1.260)	−0.121	−0.189**	−0.202**	0.281***	0.246***	0.240***	0.019	0.260***	1					
Autonomy supportive involvement	(10)	3.942 (1.041)	0.076	0.007	0.127*	0.135	0.213**	−0.037	0.212**	−0.004	0.007	1				
SES	(11)	−0.052 (0.832)	0.234***	0.189**	0.352***	0.080	−0.029	−0.020	0.255**	−0.145*	−0.224**	−0.007	1			
non-German language use	(12)	21.4%	−0.239***	−0.157*	−0.400***	−0.134	−0.133	−0.101	−0.303**	0.167*	0.165*	−0.134	−0.386***	1		
Migration background	(13)	16.1%	−0.148**	−0.125*	−0.225***	−0.163	−0.016	−0.039	−0.242*	0.194*	0.138	0.061	−0.295***	0.683***	1	
Sex (female)	(14)	50.1%	0.037	0.001	0.038	−0.125*	−0.042	−0.123*	0.002	−0.201***	−0.086	0.072	0.042	0.039	0.029	1
Learning Time	(15)	0.005 (0.778)	−0.103	−0.092	−0.108	0.091	0.169**	0.012	0.079	−0.040	0.092	0.016	−0.107	−0.067	−0.025	0.092

*p < *0.05*, **p < *0.01*, ***p < *0.001*.

supportive and controlling behaviors are conceptualized as the opposite poles of a single dimension (Grolnick et al., 2014). However, the correlations between the autonomy support item and the control items are virtually zero ($r = 0.009$, $p > 0.05$; $r = -0.006$, $p > 0.05$), which is somewhat congruent with research establishing autonomy supportive and controlling parenting as distinct constructs (Silk et al., 2003). Moreover, the two controlling items are also only weakly correlated ($r = 0.258$, $p < 0.001$). Thus, we decided to include the three items as single item-measures. We label the item 5) "I often sat next . . . " as intrusive involvement, the item 6) "I have threatened . . . " as controlling involvement, and the item 7) "When my child . . . " as autonomy supportive involvement.

To confirm the conceptual differentiation of the involvement dimensions, we conducted a confirmatory factor analysis (CFA) considering the four multiple item measures, i.e., established structures, oversight activities, positive interpersonal involvement, and negative interpersonal involvement. The three single-item measures on autonomy supportive vs. controlling involvement were not used in the CFA. The four-factor model showed an adequate to good fit [$\chi^2(48) = 69.729$, $p = 0.022$; root mean square error of approximation (RMSEA) = 0.040, 90%-CI (0.016, 0.060); comparative fit index (CFI) = 0.979; Tucker-Lewis Index (TLI) = 0.971; standardized root-mean-square residual (SRMR) = 0.047], thus, supporting our conceptualization of involvement in distance education. In addition, the latent correlations of the four measures are of medium size (**Table 1**), which further supports the assumption of different but related constructs.

Control Variables

Regarding RQ 2 we include two control variables. First, child sex was included because of sex differences in reading achievement (e.g., Lynn and Mikk, 2009) and parental involvement (e.g., Muller, 1998; Kristjansson and Sigfúsdóttir, 2009). Moreover, we included a composite measure of learning time (mean of z-scores of time spent for reading tasks and time spent for all school assignments; $r = 0.208$, $p < 0.001$) during school closures. Learning time might be associated with family background (Andrew et al., 2020; Dietrich et al., 2021) and reading achievement. Moreover, the quantity of parental involvement and aspects of quality (e.g., negative involvement) might also be associated with the learning time. In detail, parents were asked how much time their children spent on average per day reading (reading tasks, reading exercises, ...) and learning (accomplishments of homework) for school. Overall, there is considerable variation in learning time. Whereas 25% spent on average no more than 2 h a day learning for school, about one third (35%) of the children were learning three or more hours a day. Most children (40%) spent between 2 and 3 h a day for school.

Statistical Analysis

We applied structural equation modeling (SEM) using M*plus* 8 (Muthén and Muthén, 1998–2017). To answer RQ1, we estimated the two models depicted in **Figure 3**: A pre-lockdown model and a lockdown model. Specifically, we regressed reading

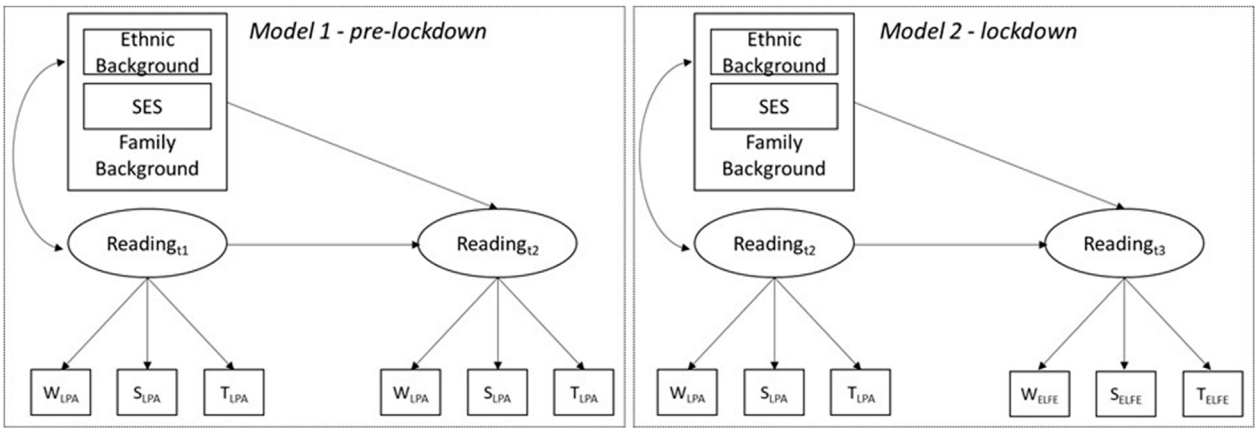

FIGURE 3 | SEM-Models for research question 1

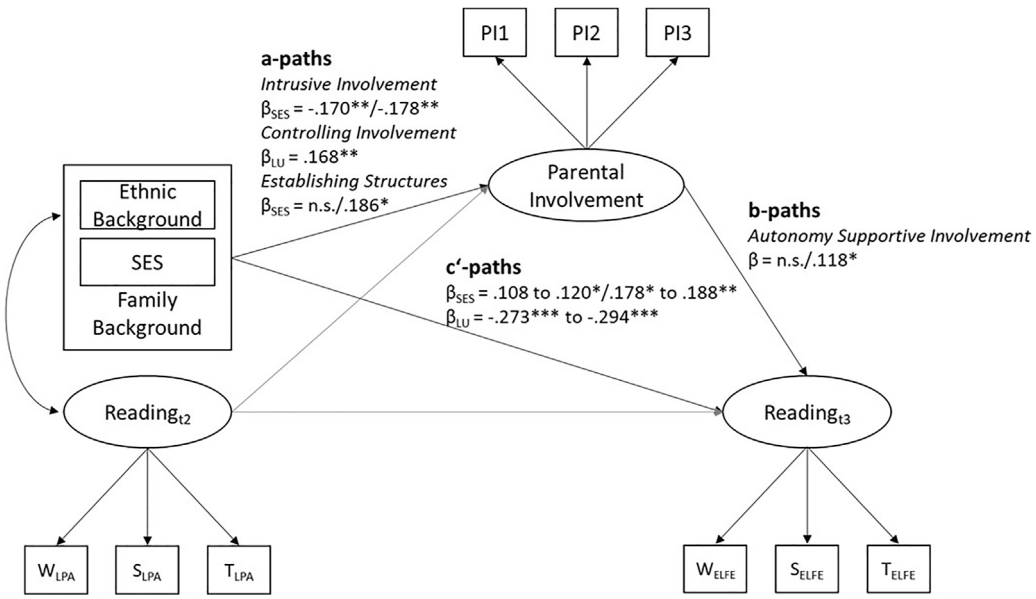

FIGURE 4 | SEM-Mediation model for research question 2. Note: Only significant a-paths, b-paths, and c'-paths are shown. All other coefficients are reported in the supplement. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

achievement at t2 and t3, respectively, on socioeconomic and ethnic family background variables and reading achievement assessed at the preceding time point t–1 (i.e., reading t2 was regressed on reading t1 and reading t3 was regressed on reading t2). Reading achievement was modeled as latent variables using the three subtests as indicators. Significant effects of family background variables would indicate that among students who started at t–1 with the same level of reading achievement, family background is associated with their achievement at the end of the respective period (pre-lockdown or lockdown). Looked at another way, family background effects imply that social and ethnic disparities at t2 and t3, respectively, are bigger than expected due to differences at t–1, and thus indicate a relative growth in the achievement gap. Note that due to different reading tests we cannot conclude whether disparities increase on a common scale.

To answer RQ2, we have extended the lockdown model to the latent mediation model shown in **Figure 4**. The single item measures of parental involvement were included as manifest variables. The mediation hypothesis would be supported if indirect effects are statistically significant (Cheong and MacKinnon, 2012). Due to the high number of parental involvement measures, we estimated separate models for each mediator. In doing so, we end up with seven mediation models. Finally, we included sex of child and learning time as a control variable in the mediation models.

Moreover, as the two ethnic background measures were highly correlated ($r = 0.68$, $p < 0.001$), we estimated separate models (for RQ1 and RQ2) for non-German language use and migration background.

To evaluate the fit of the SEMs, we used the cut-offs proposed by Schermelleh-Engel et al. (2003). A good fit is indicated by $\chi^2/df \leq 2$, CFI ≥ 0.97, RMSEA ≤ 0.05, left boundary of the 90% confidence interval (CI) of the RMSEA equals 0 and SRMR ≤ 0.05. An acceptable fit is indicated by $\chi^2/df \leq 3$, CFI ≥ 0.95, RMSEA ≤ 0.08, 90% CI close to the RMSEA and SRMR ≤ 0.10.

Given the multilevel structure of the data, we used TYPE = COMPLEX in M*plus* which applies a sandwich estimator that adjusts for biased standard errors due to clustering (students clustered in classes), provided that the sample size at cluster level is at least 25 (Huang, 2018).

The rate of missing data ranged from 1% (sex) to roughly 10% in the reading tests and about one-third for the parent reports. Whereas missing data on the reading tests were due to students' absence (e.g., illness) during the test period, missing data on parent reports are mainly due to unit nonresponse (i.e., parents did not fill out the questionnaire). As indicated by Little's MCAR-test (Little, 1988), the variable means significantly differed between missing data patterns [$\chi^2(1683) = 2004.28$, $p < 0.001$]. For example, children with missing family background variables (HISEI, parental education, migration background, etc.) scored significantly lower on the ELFE II test. Thus, the results suggest that missing data were the consequence of a missing at random (MAR; see Enders, 2010) mechanism, i.e., the missingness depends on other study variables. To appropriately deal with the missing data, we used a full information maximum likelihood (FIML) estimation, which is an appropriate treatment of missing data under the MAR mechanism (Rioux and Little, 2021).

Finally, as especially LPA-scores were non-normal (skewness ranged from 0.63 to 2.02 and kurtosis from 0.011 to 7.05) and we used ordinal parental involvement indicators, the models were estimated using a robust maximum likelihood estimation (MLR), with standard errors robust to the non-normality of observations and to the use of ordinal variables (Finney and DiStefano, 2006).

RESULTS

Table 1 shows means, standard deviations, and correlations of all variables. For latent variables, latent coefficients are reported. All three reading scores are highly correlated (rs = 0.663 to 0.739, all ps < 0.001). Moreover, the correlations of reading with SES, language use (LU) at home, and migration background (MB) are all small to moderate in size and significant. Notably, they are higher after the lockdown at t3 ($r_{ELFE,SES} = 0.352$, $p < 0.001$; $r_{ELFE,LU} = -0.400$, $p < 0.001$; $r_{ELFE,MB} = -0.225$, $p < 0.001$) than at t1 ($r_{LPA1,SES} = 0.234$, $p < 0.001$; $r_{LPA1,LU} = -0.239$, $p < 0.001$; $r_{LPA1,MB} = -0.148$, $p < 0.01$) and t2 ($r_{LPA2,SES} = 0.189$, $p < 0.01$; $r_{LPA2,LU} = -0.157$, $p < 0.05$; $r_{LPA2,MB} = -0.125$, $p < 0.05$). Reading at t3 is correlated with controlling involvement ($r = -0.146$, $p < 0.05$), intrusive involvement ($r = -0.202$, $p < 0.01$), and autonomy supportive involvement ($r = 0.127$, $p < 0.05$). Intrusive involvement is also correlated with reading at t2 ($r = -0.189$, $p < 0.01$). Thus, less intrusive, less controlling, and higher levels of autonomy supportive involvement are associated with better reading scores.

Research Question 1

Table 2 shows the results regarding RQ1. Fit indices indicate an acceptable fit. The columns labeled section A provide the results for the pre-lockdown and lockdown period using language use as an indicator of the ethnic background. The columns labeled section B present the results using migration background as predictor. Both models for the pre-lockdown period show that reading at t2 is associated only with reading at t1 (Section A: $\beta = 0.703$, $p < 0.001$; Section B: $\beta = 0.700$, $p < 0.001$). However, in the models for the lockdown period we found significant effects of SES (Section A: $\beta = 0.122$, $p < 0.05$; Section B: $\beta = 0.189$, $p < 0.01$) and non-German language use (Section A: $\beta = -0.274$, $p < 0.001$). The effect of migration background is not significant.

To statistically compare the effects of the pre- and peri-lockdown period, we estimated confidence intervals (CI) for the differences in β-coefficients (i.e., $\beta_{SES,Lockdown} - \beta_{SES,Pre\text{-}lockdown}$, etc.) applying the method proposed by Zou (2007) [2] and implemented in the cocor R-package (Diedenhofen and Musch, 2015). Moreover, we report the effect size Cohen's q (Cohen, 1988) to quantify differences in β-coefficients ($q < 0.1$ = no effect, $0.1 \leq q < 0.3$ = small effect; $0.3 \leq q < 0.5$ = moderate effect; $q \geq 0.5$ = large effect). These results are also reported in **Table 2**. The CIs for the difference in the SES-effects in section B [Pre-Lockdown vs. Lockdown: $q = 0.146$, 95%-CI (0.056, 0.231)] and the difference in the effects of non-German language use in section A [Pre-Lockdown vs. Lockdown: $q = -0.309$, 95%-CI (−0.387, −0.215)] do not contain 0, thus, indicating a significantly stronger effect of SES and non-German language use during the lockdown period than during the pre-lockdown period. However, SES-effects in section A do not differ significantly [Pre-Lockdown vs. Lockdown: $q = 0.072$, 95%-CI (−0.018, 0.160)].

To sum up, reading scores are associated with family background at t1, t2, and t3 (see **Table 1**). For the pre-lockdown period we found no effects of the family background variables on reading comprehension. Thus, social and ethnic disparities at t2 are not larger than expected due to preexisting disparities at t1. However, the results for the lockdown period indicate that social and ethnic disparities after the lockdown (t3) are larger than expected due to pre-lockdown disparities (t2).

Supplementary Analyses

We performed a series of analyses to better understand the impact of different reading tests that were used as outcome variables. The results are provided in detail as supplement. For the analyses, we take advantage of the fact that a small subsample of $n = 141$ students (Subsample A) has completed the eighth LPA-test during the first 3 weeks of June and later also the ELFE II.

[2]Note: we applied the method to standardized path coefficients, although it was developed for comparing correlations and R^2s.

TABLE 2 | Results of SEM for research question 1.

	Section A—Ethnic background = Non-German language use				Section B—Ethnic background = migration background			
	Pre-lockdown	Lockdown	Difference		Pre-lockdown	Lockdown	Difference	
	β (SE)	β (SE)	q	95%-CI	β (SE)	β (SE)	q	95%-CI
Reading t-1[a]	0.703*** (0.052)	0.574*** (0.040)			0.700*** (0.049)	0.584*** (0.042)		
Ethnic background	0.028 (0.063)	−0.274*** (0.064)	−0.309	(−0.387, −0.215)	0.007 (0.041)	−0.098 (0.064)	0.105	(−0.193, −0.017)
SES	0.051 (0.072)	0.122* (0.055)	0.072	(−0.018, 0.160)	0.045 (0.077)	0.189** (0.066)	0.146	(0.056, 0.231)
R^2	0.506	0.514			0.505	0.450		
Model Fit								
χ^2(df)	40.667 (15)[b]	47.344 (16)			41.165 (15)[b]	44.842 (16)		
CFI	0.957	0.968			0.956	0.970		
TLI	0.922	0.947			0.921	0.949		
RMSEA	0.065	0.069			0.066	0.067		
90% CI RMSEA	(0.041, 0.090)	(0.047, 0.093)			(0.042, 0.090)	(0.044, 0.090)		
SRMR	0.042	0.039			0.041	0.039		

[a]*For the pre-lockdown period we control for reading at t1 and for the lockdown period for reading at t2.*

[b]*As indicated by the modification index we estimated a covariance between the LPA-word reading subtest errors across time. This seems reasonable as the LPA word reading may require somewhat different skills and strategies than sentence and text reading (Pritchard et al., 2018).*

*p < 0.05, **p < 0.01, ***p < 0.001.

Thus, both tests were administered after the lockdown. We investigated whether the results for the lockdown period (**Table 2**) could be confirmed using the LPA test as outcome in subsample A. We found no significant effect of the family background variables. This might be a power issue due to the reduced sample size. However, also the βs are smaller (SES: $\beta = 0.079$, $p > 0.05$; Language use: $\beta = -0.071$, $p > 0.05$). Thus, at a first glance, these results contradict the conclusion that disparities have grown during the school closures.

Referring to van de Vijver (1998) typology of bias in cross-cultural research that has also been applied to studies linking different tests (e.g., Wagner et al., 2018), there are three explanations for the divergent results.

First, subsample A (i.e., students that completed both tests after the lockdown) might be different from the remaining sample (subsample B; sample bias; van de Vijver, 1998, p. 45). It is possible that, regardless of the reading test, family background effects are smaller or even not present in subsample A. We ran multigroup models to explore whether family background effects on the ELFE II differ between the subsamples A and B. However, we found no significant differences in the family background effects. SES and language use are significantly related to the ELFE II in both subsamples (see **Supplementary Table A2** in the supplement).

Second, the tests might be differentially associated with the family background variables due to instrument bias or administration bias (van de Vijver, 1998, p. 46). That is, although both tests refer to the same construct, stimulus features such as differential stimulus familiarity (instrument bias) and administration aspects such as differential linguistic requirements to understand the test instruction, time restrictions or mode effects (administration bias) might cause different associations with family background. To investigate this explanation, we compared the correlations of the family background variables with the LPA-test and the ELFE II, respectively, in subsample A. Results show that the correlations with SES do not differ significantly [$r_{SES,ELFE} = 0.297$, $p < 0.01$ vs. $r_{SES,LPA} = 0.235$, $p < 0.05$; 95%-CI for the correlation difference (−0.038, 0.156), $q = 0.067$]. However, language use and migration background are significantly stronger correlated with the ELFE ($r_{LU,ELFE} = -0.348$, $p < 0.001$; $r_{MB,ELFE} = -0.330$, $p < 0.001$) than with the LPA-test [$r_{LU,LPA} = -0.132$, $p > 0.05$; $r_{MB,LPA} = -0.068$, $p > 0.05$; 95%-CI_{LU} (−0.313, −0.120), $q_{LU} = -0.230$; 95%-CI_{MB} (−0.359, −0.165), $q_{MB} = -0.275$]. Thus, the effects of language use reported in **Table 2** might by subject to instrument and/or administration bias.

Third, family background might not only be differentially associated with the whole test, but also with the subtests (comparable to item bias, van de Vijver, 1998, p. 46) and thus, biasing the overall results. Most important, it turns out that especially the correlations of the family background variables with the sentence reading subtests differ between the LPA and the ELFE II with significantly stronger correlations for the ELFE II [$r_{SES,ELFE} = 0.283$, $p < 0.01$ vs. $r_{SES,LPA} = 0.115$, $p > 0.05$; 95%-CI (0.030, 0.304), $q = 0.175$; $r_{LU,ELFE} = -0.349$, $p < 0.01$ vs. $r_{LU,LPA} = -0.123$, $p > 0.05$; 95%-CI (−0.360, −0.090), $q = -0.241$; $r_{MB,ELFE} = -0.321$, $p < 0.001$ vs. $r_{MB,LPA} = -0.054$, $p > 0.05$; 95%-CI (−0.401, −0.130), $q = -0.279$]. The correlation differences for the text reading subtests with SES and language use are not significant and negligibly in size [$r_{SES,ELFE} = 0.357$, $p < 0.001$ vs. $r_{SES,LPA} = 0.311$, $p < 0.01$; 95%-CI (−0.082, 0.175), $q = 0.052$; $r_{LU,ELFE} = -0.294$, $p < 0.01$ vs. $r_{LU,LPA} = -0.222$, $p < 0.05$; 95%-CI (−0.204, 0.060), $q = -0.077$]. Similarly, there are no significant differences between word reading and SES and language use, respectively. However, word reading is in general less strongly correlated with the family background (for full results see supplement). Thus, these results indicate that family background is especially differentially associated with the sentence reading subtests, what might bias the overall results reported in **Table 2**. Therefore, we repeated the analyses (results reported in **Table 2**) using the LPA-subtests and the ELFE II-subtests as outcomes at t3 for subsample A (for full results see **Supplementary Table A2** in the supplement). For text reading, the effects of SES ($\beta_{SES,LPA} = 0.232$, $p < 0.05$; $\beta_{SES,ELFE} = 0.301$, $p < 0.01$) and language use (LPA: $\beta = -0.259$, $p < 0.05$;

ELFE II: $\beta = -0.318$, $p < 0.01$) are confirmed using both, the LPA and the ELFE II as outcome. There are no family background effects on word reading, neither for the LPA nor the ELFE II as outcome. In line with differential correlations reported above, there are significant effects of SES and language use on ELFE II sentence reading ($\beta_{SES} = 0.175$, $p < 0.05$; $\beta_{SES} = -0.294$, $p < 0.001$), but not on LPA sentence reading ($\beta_{SES} = 0.004$, $p > 0.05$; $\beta_{SES} = -0.057$, $p > 0.05$).

Overall, these results indicate that the use of different reading tests has somewhat affected the effects of the family background variables. However, the additional analyses at least confirm family background effects on the text reading subtest.

Research Question 2

Results regarding RQ2 are shown in **Figure 4**. Note that only significant coefficients for a, b and c'-paths are displayed. Detailed results are reported in **Supplementary Tables A3, A4** in the supplement. Note that in the case of two reported values separated by a slash, the first value refers to the results using language use as indicator of the ethnic background (Section A in **Supplementary Table A4**) and the second value refers to results for migration background (Section B in **Supplementary Table A4**). Fit indices indicate an acceptable to good fit (χ^2/df = 1.78–2.37, RMSEA = 0.044–0.058, CFI = 0.966–0.975; TLI = 0.942–0.964, SRMR = 0.032–0.047).

First, there is only scant support for the hypothesis that family background is associated with parental involvement in distance learning (a-paths). Specifically, high-SES parents more frequently reported that they established structures for distance learning (β = 0.186, $p < 0.05$) and high-SES parents also reported less intrusive involvement ($\beta = -0.170/-0.178$, $ps < 0.01$). Moreover, parents with a migration background reported higher levels of controlling involvement ($\beta = 0.168$, $p < 0.01$). Second, we hardly found any support for the hypothesis that parental involvement is associated with reading achievement at t3 (b-paths). Only one out of 14 analyses resulted in a significant effect of parental involvement on reading. Higher levels of autonomy supportive involvement were associated with better reading at t3 ($\beta = 0.118$, $p < 0.05$). After controlling for multiple testing (Bonferroni-Holm), even this association becomes insignificant. Third, because the lack of significant a-paths and b-paths direct effects of family background (c'-paths) remain largely statistically significant and hardly change in size (SES: βs = 0.108–0.120/0.178–0.188, $ps <$ 0.05–0.10/.01–0.05; LU: βs = −0.273 to −0.294, $ps < 0.001$) and thus, we did not find any significant indirect effects of family background on reading achievement.

Finally, sex of child was associated with controlling involvement and intrusive involvement. Parents were more involved in a controlling ($\beta = -0.208/-0.204$, $p < 0.001$) and intrusive ($\beta = -0.093/-0.089$, $p < 0.05$) way in distance learning of boys than that of girls. Moreover, learning time was positively associated with establishing structures (β = 0.084/0.097, $p < 0.10/0.05$) and positive interpersonal involvement ($\beta = 0.121/0.127$, $ps < 0.05$) and reading at t2 was negatively related to intrusive involvement ($\beta = -0.111/-0.115$, $ps < 0.05$).

DISCUSSION

The current study had two objectives. On the one hand, we wanted to examine whether social and ethnic disparities in reading widened during COVID-related school closures in spring 2020 (RQ1). On the other hand, if there were any increased social and ethnic disparities in reading achievement, we wanted to discover whether the increased disparities could be explained by ethnic- and socioeconomic differences in parental involvement in distance learning (RQ2). Notably, whereas various studies have directly focused on increased disparities (i.e., c-paths in a mediation framework; Engzell et al., 2021; Pier et al., 2021) and others have focused on the associations of family background variables with variables that might account for a growing achievement gap (i.e., a-paths; Andrew et al., 2020; Reimer et al., 2021), the current study is–to the best of our knowledge–the first that explicitly tests a full mediation model. To answer our research questions, we used data from an ongoing longitudinal study (started in 2018) on the use of learning progress assessment in primary schools (25 classes and 409 2nd graders).

First, comparing a pre-lockdown and a lockdown period of similar length, our results revealed effects of family background (SES and non-German language use at home) on post-lockdown reading achievement, even after controlling for pre-lockdown achievement. Social and ethnic reading disparities after the lockdown (June 2020) were larger than expected due to the social and ethnic differences that already existed before the lockdown (reading and family background were moderately correlated before the lockdown). In contrast, we found no family background effects on reading achievement during the pre-lockdown period. Thus, social and ethnic disparities have grown during the lockdown period, whereas disparities remained stable during the pre-lockdown period. Our results are in line with the growing research that highlights that COVID-19-related school closures have affected educationally disadvantaged students more strongly than their more advantaged peers, resulting in a widening achievement gap (Maldonado and De Witte, 2020; Engzell et al., 2021; Pier et al., 2021). Whereas these other studies took a between-subject perspective–i.e., comparing the same grade students of different years–we took a within-subject perspective, i.e., we compared family background effects during a pre-lockdown period with family background effects of a lockdown period within the same sample of 2nd graders. Thus, our conclusion about increased disparities assumes that family background effects are equally at work throughout the school year. Possibly, this assumption might not hold. However, some research suggests constant reading-SES-associations throughout a school year (e.g., Kieffer, 2012). Importantly, it must be noted that we used a different reading outcome measure before and after the lockdown. This is far from ideal but is due to the special circumstances surrounding the school closures. The use of different tests might bias results if family background generally accounts for a different amount of variance in LPA-tests and the ELFE-test. Although additional analyses based on a subsample of students who completed the ELFE and the LPA-test after the lockdown showed that LPA and ELFE score are highly correlated

(r = 0.843), we also found that family background is significantly stronger correlated with the sentence reading subtests of the ELFE than with respective subtest of the LPA-test. As this might bias the overall results, we performed separate analyses for subtests. For the text reading subtests family background effects (SES and language use) during the lockdown period are confirmed and appear robust against the use of different tests. In contrast, the different tests affect the results on the family background effects on sentence reading, i.e., background effects are upwardly biased when using the ELFE as outcome. These discrepancies must be investigated in the future. Moreover, using different tests has generally been argued to bias results of studies on summer loss by artificially increasing achievement gaps (von Hippel et al., 2018). However, whereas these studies focus on quantifying the achievement gap over time in a common metric, we used a lagged-score approach (i.e., regressing achievement on family background and achievement at t–1) that asks a somewhat different question, namely, are social and ethnic disparities at time t larger than expected due to existing disparities at t–1 (see also Dumont and Ready, 2020). Finally, as students in our sample are nested within classes and schools, we adjusted the standard errors for clustering and did not use a multilevel approach because we focused on an overall effect of family background (see also Dumont et al., 2012). However, it is well known that such an overall effect is an uninterpretable blend of within cluster and between cluster effects (Raudenbush and Bryk, 2002), thus, our results might conflate compositional and individual level effects. A recent study by Dumont and Ready (2020) found effects of mean school SES during summer holidays, but not during the school year. In this regard, it might be that schools with a higher share of disadvantaged students provided less qualitative distance instruction during school closures, thus, increasing between-school differences.

Second, we found no support for the hypothesis that increased disparities during school closures were associated with social and ethnic differences in parental involvement in distance learning. This agrees with the findings of Dumont et al. (2012), who also did not find support for the hypothesis that family background effects on achievement are mediated by parental homework involvement. However, we found some evidence that high SES-parents show more conducive (structuring involvement) and less detrimental (intrusive involvement) forms of involvement in distance learning. Similar results have been reported in various other studies on parental homework involvement (Dumont et al., 2012; Moroni et al., 2014) and recently also in a study on parental involvement during COVID-19-related distance learning (Sander et al., 2021). Moreover, we found that parents with migrant background reported higher levels of controlling involvement during school closures. This finding is in line with results of Moroni et al. (2014) but contradicts the results of Dumont et al. (2012) who found that students with migration background characterized their parents as less controlling. The inconsistent findings regarding the effects of migration background might be associated with different cultural backgrounds that have (inappropriately) been collapsed into a binary variable (migration background no/yes). Parenting goals and behaviors might differ between ethnic groups (see e.g., Bornstein, 2012) and even might differentially affect achievement (Pinquart and Kauser, 2018). The culture of origin as well as the culture of the receiving country may also interact in affecting parental involvement (Nauck et al., 2017). Thus, ethnic background effects on involvement may differ depending on the ethnic groups that make up the migrant population. However, in our study we did not assess the country of origin (amongst other to ensure anonymity). Therefore, our analysis options on ethnic background effects are limited. Nonetheless, this issue should be subject to future research.

In this context, as the parent questionnaire focusing on distance learning during school closures was kept very short to maximize response rates during challenging times, this research cannot address a variety of contextual factors (e.g., remote working of parents, parents working in food stores and thus, outside the home) that would also be relevant to involvement, and may be candidate mediators for the relationship between family background and parental involvement (e.g., perceived stress). For example, the hypothesized SES effect on involvement is–amongst others–based on a family stress perspective (Conger and Donnellan, 2007). It is argued that low SES parents experience more stress what in turn negatively affects the quality and quantity of their involvement. However, an Italian study by Spinelli et al. (2021) showed that low SES parents even experienced lockdown and home confinement as less stressful than socioeconomically more advantaged parents. Spinelli et al. (2021) argue that this may be because daily routines have been more disrupted in families with higher SES. In these families more supportive resources may have been available before the lockdown, making it harder to cope with the loss of these resources. Higher SES parents may also more often work in jobs allowing remote working during the lockdown, thus, increasing strain due to difficulties to reconcile work and childcare, what in turn affected parental involvement. In a similar vein, remote working may have limited parental time and energy to get involved in the distance learning of the children. To sum up, our study does not provide information on relevant context factors that have changed and evolved due to lockdown, school closures, and home confinement, and in turn affected parental involvement and child (academic) development. A more comprehensive (especially also qualitative) assessment of the complex ecological system (Bronfenbrenner, 1979) during school closures would have been desirable, but could not be implemented in this study.

Further, we did not find evidence that parental involvement in distance learning is associated with students' achievement. This result contradicts research indicating that structuring, autonomy supportive, and positively affective involvement is conducive, whereas controlling and negatively affective homework involvement is detrimental to children's academic achievement (Dumont et al., 2012; Dumont et al., 2014; Moroni et al., 2015; Silinskas and Kikas, 2019). Moreover, given the high importance attached to parental involvement for successful distance learning (Cottingham, 2020; Education Endowment Foundation, 2020)—especially for younger children as in our study–the non-significant effects are somewhat surprising. There are several

explanations for this finding. Amongst others, three constructs (controlling, intrusive, and autonomy supportive involvement) were measured using single items, thus results are likely biased by measurement error. Related to this, the measures–and especially the single item measures–do not sufficiently capture the conceptual width of the constructs. For example, controlling involvement may take various other manipulative forms such as love withdrawal and guilt induction (Pomerantz and Grolnick, 2017), that might affect achievement. Similarly, Grolnick et al. (2014) describe various aspects of structuring involvement (e.g., provision of rationales for rules) that have not been considered in our study. Moreover, we assessed parental involvement *via* parent reports. However, for various aspects of involvement, such as controlling or structuring involvement, it might be much more important how children perceive and interpret their parents' behavior, and not simply what parents do (Kakihara and Tilton-Weaver, 2009). Thus, most research showing effects of parental homework involvement on achievement use child reports on involvement (Dumont et al., 2012; Moroni et al., 2015; Silinskas and Kikas, 2019).

Finally, we studied parental involvement from an SDT-perspective (Grolnick et al., 1997) and thus, might have missed relevant aspects of involvement derived from other theoretical perspectives. For example, the quality and quantity of instruction provided by parents during school closures and process-focused (e.g., praising the effort for and not the result of learning) involvement (Pomerantz and Grolnick, 2017) might be more relevant for reading achievement. Parental instruction might directly affect reading achievement, whereas SDT-based involvement is argued to indirectly affect reading achievement *via* motivation. Thus, given the relatively short period of school closures, these mediation processes may not have had enough time to produce their effects. To test this assumption, future studies may include student motivation in our mediation model. To conclude, a broader assessment of parental involvement using well-developed and validated scales would have been beneficial. However, this was not possible because the parent questionnaire had to be kept short to maximize response rate in challenging times and most importantly, available homework involvement scales could not directly be applied to involvement during school closures, as involvement in distance learning comprises more than "classical" homework involvement. Similar to a broader assessment of contextual factors, a detailed qualitative assessment of what constitutes parent involvement in distance learning would have been valuable.

CONCLUSION

This study adds to the growing research showing that social and ethnic inequalities were growing during COVID-19-related school closures. Thus, education systems and its actors are faced with the challenge of how to counteract these increased disparities. Effective interventions for promoting the target groups are available and should be considered (Dietrichson et al., 2017). Finally, future research must identify relevant mediators that accounted for growing disparities. This is necessary to prevent the future growth of disparities as the pandemic is still not over, and further school closures cannot be ruled out.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because data is part of an ongoing study. Requests by qualified researchers to access the minimal set of variables used in the study should be directed to the corresponding author. Requests to access the datasets should be directed to CW, christoph.weber@ph-ooe.at.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

CW, CH, and DK designed the study. CW performed the data analyses and was major contributor in writing the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

We would like to thank the University of Education Upper Austria, the Private University of Education, Diocese of Linz and the Johannes Kepler University Linz for funding our research project entitled "Wir Wollen's Wissen!". Moreover, we thank the University of Education Upper Austria for funding the open access publication fee.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2021.737064/full#supplementary-material

REFERENCES

Andrew, A., Cattan, S., Costa Dias, M., Farquharson, C., Kraftman, L., Krutikova, S., et al. (2020). Inequalities in Children's Experiences of home Learning During the COVID-19 Lockdown in England. *Fiscal Stud.* 41 (3), 653–683. doi:10.1111/1475-5890.12240

Antony-Newman, M. (2019). Parental Involvement of Immigrant Parents: A Meta-Synthesis. *Educ. Rev.* 71 (3), 362–381. doi:10.1080/00131911.2017.1423278

Barger, M. M., Kim, E. M., Kuncel, N. R., and Pomerantz, E. M. (2019). The Relation between Parents' Involvement in Children's Schooling and Children's Adjustment: A Meta-Analysis. *Psychol. Bull.* 145 (9), 855–890. doi:10.1037/bul0000201

BIFIE (2019). in *Standardüberprüfung 2018. Mathematik, 4. Schulstufe* (Salzburg: BIFIE).

Bonal, X., and González, S. (2020). The Impact of Lockdown on the Learning gap: Family and School Divisions in Times of Crisis. *Int. Rev. Educ.* 66 (5-6), 635–655. doi:10.1007/s11159-020-09860-z

Bornstein, M. H. (2012). Cultural Approaches to Parenting. *Parenting* 12 (2-3), 212–221. doi:10.1080/15295192.2012.683359

Bradley, R. H., and Corwyn, R. F. (2002). Socioeconomic Status and Child Development. *Annu. Rev. Psychol.* 53, 371–399. doi:10.1146/annurev.psych.53.100901.135233

Bronfenbrenner, U. (1979). *The Ecology of Human Development: Experiments by Nature and Design*. Cambridge, MA: Harvard University Press.

Cheong, J., and MacKinnon, D. P. (2012). "Mediation/indirect Effects in Structural Equation Modeling," in *Handbook of Structural Equation Modeling*. Editor R. H. Hoyle (New York: Guilford Press), 417–435.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. 2nd Edition. Hillsdale, NY: Lawrence Erlbaum Associates.

Conger, R. D., and Donnellan, M. B. (2007). An Interactionist Perspective on the Socioeconomic Context of Human Development. *Annu. Rev. Psychol.* 58, 175–199. doi:10.1146/annurev.psych.58.110405.085551

Cottingham, B. W. (2020). *Improving Distance Education in the Early Grades*. Stanford: Policy Analysis for California Education.

Depping, D., Lücken, M., Musekamp, F., and Thonke, F. (2021). "Kompetenzstände Hamburger Schüler*innen vor und während der Corona-Pandemie," in *Schule während der Corona-Pandemie. Neue Ergebnisse und Überblick über ein dynamisches Forschungsfeld*. Editors D. Fickermann and B. Edelstein (Münster: Waxmann), 51–79. doi:10.31244/9783830993315.03

Diedenhofen, B., and Musch, J. (2015). Cocor: A Comprehensive Solution for the Statistical Comparison of Correlations. *PLoS One* 10 (3), e0121945. doi:10.1371/journal.pone.0121945

Dietrich, H., Patzina, A., and Lerche, A. (2021). Social Inequality in the Homeschooling Efforts of German High School Students during a School Closing Period. *Eur. Soc.* 23 (Suppl. 1), S348–S369. doi:10.1080/14616696.2020.1826556

Dietrichson, J., Bøg, M., Filges, T., and Klint Jørgensen, A.-M. (2017). Academic Interventions for Elementary and Middle School Students with Low Socioeconomic Status: A Systematic Review and Meta-Analysis. *Rev. Educ. Res.* 87 (2), 243–282. doi:10.3102/0034654316687036

Dumont, H., and Ready, D. D. (2020). Do school Reduce or Exacerbate Inequality? How the Associations between Student Achievement and Achievement Growth Influence Our Understanding of the Role of Schooling. *Am. Educ. Res. J.* 57 (2), 728–774. doi:10.3102/0002831219868182

Dumont, H., Trautwein, U., Lüdtke, O., Neumann, M., Niggli, A., and Schnyder, I. (2012). Does Parental Homework Involvement Mediate the Relationship between Family Background and Educational Outcomes? *Contemp. Educ. Psychol.* 37 (1), 55–69. doi:10.1016/j.cedpsych.2011.09.004

Dumont, H., Trautwein, U., Nagy, G., and Nagengast, B. (2014). Quality of Parental Homework Involvement: Predictors and Reciprocal Relations with Academic Functioning in the reading Domain. *J. Educ. Psychol.* 106 (1), 144–161. doi:10.1037/a0034100

Education Endowment Foundation (2020). *Impact of School Closures on the Attainment gap: Rapid Evidence Assessment*. London: Education Endowment Foundation.

Enders, C. K. (2010). *Applied Missing Data Analysis*. New York: Guilford Publications.

Engzell, P., Frey, A., and Verhagen, M. D. (2021). Learning Loss Due to School Closures during the COVID-19 Pandemic. *Proc. Natl. Acad. Sci. U. S. A.* 118 (17), e2022376118. doi:10.1073/pnas.2022376118

Finney, S. J., and DiStefano, C. (2006). "Nonnormal and Categorical Data in Structural Equation Modeling," in *Structural Equation Modeling: A Second Course (Quantitative Methods in Education and the Behavioral Sciences)*. Editors G. R. Hancock and R. O. Mueller (Greenwich: Information Age Publishing), 269–314.

Fleischmann, F., and de Haas, A. (2016). Explaining Parents' School Involvement: The Role of Ethnicity and Gender in the Netherlands. *J. Educ. Res.* 109 (5), 554–565. doi:10.1080/00220671.2014.994196

Förster, N., and Souvignier, E. (2014). Learning Progress Assessment and Goal Setting: Effects on reading Achievement, reading Motivation and reading Self-Concept. *Learn. Instr.* 32, 91–100. doi:10.1016/j.learninstruc.2014.02.002

Förster, N., Kawohl, E., and Souvignier, E. (2018). Short- and Long-Term Effects of Assessment-Based Differentiated reading Instruction in General Education on reading Fluency and reading Comprehension. *Learn. Instr.* 56, 98–109. doi:10.1016/j.learninstruc.2018.04.009

Ganzeboom, H. B. G. (2010). "A New International Socio-Economic Index [ISEI] of Occupational Status for the International Standard Classification of Occupation 2008 [ISCO-08]: Constructed with Data from the ISSP 2002-2007," in Annual Conference of International Social Survey Programme (Lisboa. Retrieved from http://www.harryganzeboom.nl/Pdf/2010%20-%20Ganzeboom-ISEI08-ISSP-Lisbon-(paper).pdf.

Grewenig, E., Lergetporer, P., Werner, K., Woessmann, L., and Zierow, L. (2020). COVID-19 and Educational Inequality: How School Closures Affect Low- and High-Achieving Students. CESifo Working Paper No. 8648. München: CESifo.

Grolnick, W. S., and Slowiaczek, M. L. (1994). Parents' Involvement in Children's Schooling: A Multidimensional Conceptualization and Motivational Model. *Child. Dev.* 65 (1), 237–252. doi:10.1111/j.1467-8624.1994.tb00747.x

Grolnick, W. S., Deci, E. L., and Ryan, R. M. (1997). "Internalization within the Family: The Self-Determination Theory Perspective," in *Parenting and Children's Internalization of Values: A Handbook of Contemporary Theory*. Editors J. E. Grusec and L. Kuczynski (New York: John Wiley & Sons), 135–161.

Grolnick, W. S., Raftery-Helmer, J. N., Marbell, K. N., Flamm, E. S., Cardemil, E. V., and Sanchez, M. (2014). Parental Provision of Structure: Implementation and Correlates in Three Domains. *Merrill-Palmer Q.* 60 (3), 355. doi:10.13110/merrpalmquar1982.60.3.0355

Grolnick, W. S., Raftery-Helmer, J. N., Flamm, E. S., Marbell, K. N., and Cardemil, E. V. (2015). Parental Provision of Academic Structure and the Transition to Middle School. *J. Res. Adolesc.* 25 (4), 668–684. doi:10.1111/jora.12161

Grolnick, W. S. (2003). *The Psychology of Parental Control: How Well-Meant Parenting Backfires*. New York: Psychology Press. Reprint.

Grolnick, W. S. (2009). The Role of Parents in Facilitating Autonomous Self-Regulation for Education. *Theor. Res. Educ.* 7 (2), 164–173. doi:10.1177/1477878509104321

Grolnick, W. S. (2016). "Parental Involvement and Children's Academic Motivation and Achievement," in *Building Autonomous Learners*. Editors W. C. Liu, J. C. K. Wang, and R. M. Ryan (Singapore: Springer Singapore), 169–183. doi:10.1007/978-981-287-630-0_9

Hammerstein, S., König, C., Dreisörner, T., and Frey, A. (2021). Effects of COVID-19-Related School Closures on Student Achievement—A Systematic Review. *Front. Psychol.* 12, 746289. doi:10.3389/fpsyg.2021.746289

Hayes, A. F., and Coutts, J. J. (2020). Use Omega rather Than Cronbach's Alpha for Estimating Reliability. *Commun. Methods Meas.* 14 (1), 1–24. doi:10.1080/19312458.2020.1718629

Helm, C., Huber, S., and Loisinger, T. (2021a). Was wissen wir über schulische Lehr-Lern-Prozesse im Distanzunterricht während der Corona-Pandemie? – Evidenz aus Deutschland, Österreich und der Schweiz. *Z. Erziehungswissenschaft : ZfE* 24 (2), 237–311. doi:10.1007/s11618-021-01000-z

Helm, C., Huber, S., and Postelbauer, A. (2021b). "Learning Losses and Educational Inequality Due to School Closures during the Covid-19 Pandemic in Spring 2020 an Overview of Current Findings," in *Schule und Schulpolitik während der Corona-Pandemie: Nichts gelernt* Editors D. Fickermann, B. Edelstein, J. Gerick, and K. Racherbäumer (Münster: Waxmann), 59–80. doi:10.31244/9783830994589.03

Hoover-Dempsey, K. V., Battiato, A. C., Walker, J. M. T., Reed, R. P., DeJong, J. M., and Jones, K. P. (2001). Parental Involvement in Homework. *Educ. Psychol.* 36 (3), 195–209. doi:10.1207/S15326985EP3603_5

Huang, F. L. (2018). Multilevel Modeling Myths. *Sch. Psychol. Q.* 33 (3), 492–499. doi:10.1037/spq0000272

Huber, S. G., and Helm, C. (2020). COVID-19 and Schooling: Evaluation, Assessment and Accountability in Times of Crises—Reacting Quickly to Explore Key Issues for Policy, Practice and Research with the School Barometer. *Educ. Assess. Eval. Account.* 32 (2), 237–270. doi:10.1007/s11092-020-09322-y

Jæger, M. M., and Blaabæk, E. H. (2020). Inequality in Learning Opportunities during Covid-19: Evidence from Library Takeout. *Res. Soc. Stratif. Mobility* 68, 100524. doi:10.1016/j.rssm.2020.100524

Kakihara, F., and Tilton-Weaver, L. (2009). Adolescents' Interpretations of Parental Control: Differentiated by Domain and Types of Control. *Child. Dev.* 80 (6), 1722–1738. doi:10.1111/j.1467-8624.2009.01364.x

Kieffer, M. J. (2012). Before and after Third Grade: Longitudinal Evidence for the Shifting Role of Socioeconomic Status in reading Growth. *Reading Writing* 25 (7), 1725–1746. doi:10.1007/s11145-011-9339-2

Kohn, M. L. (1959). Social Class and Parental Values. *Am. J. Sociol.* 64 (4), 337–351. doi:10.1086/222493

Kristjansson, A. L., and Sigfúsdóttir, I. D. (2009). The Role of Parental Support, Parental Monitoring, and Time Spent with Parents in Adolescent Academic Achievement in Iceland: A Structural Model of Gender Differences. *Scand. J. Educ. Res.* 53 (5), 481–496. doi:10.1080/00313830903180786

Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E., and Liu, J. (2020). Projecting the Potential Impact of COVID-19 School Closures on Academic Achievement. *Educ. Res.* 49 (8), 549–565. doi:10.3102/0013189X20965918

Lenhard, W., Lenhard, A., and Schneider, W. (2017). *ELFE II: A reading Comprehension Test for Grades 1 to 7*. Göttingen: Hogrefe.

Little, R. J. A. (1988). A Test of Missing Completely at Random for Multivariate Data with Missing Values. *J. Am. Stat. Assoc.* 83 (404), 1198–1202. doi:10.1080/01621459.1988.10478722

Lynn, R., and Mikk, J. (2009). Sex Differences in reading Achievement. *Trames* 13, 3–13. doi:10.3176/tr.2009.1.01

MacKinnon, D. P. (2008). *Introduction to Statistical Mediation Analysis*. New York, NY: Routledge. Multivariate applications series.

Maldonado, J., and De Witte, K. (2020). The Effect of School Closures on Standardised Student Test. *Br. Educ. Res.* Advance online publication. doi:10.1002/berj.3754

Moroni, S., Dumont, H., and Baeriswyl, F. (2014). Wer hat, dem wird gegeben? Über den Zusammenhang zwischen familiärem Hintergrund und elterlicher Hausaufgabenhilfe. *Beiträge Zur Lehrerinnen- Und Lehrerbildung* 32 (3), 458–474. doi:10.25656/01:13882

Moroni, S., Dumont, H., Trautwein, U., Niggli, A., and Baeriswyl, F. (2015). The Need to Distinguish between Quantity and Quality in Research on Parental Involvement: The Example of Parental Help with Homework. *J. Educ. Res.* 108 (5), 417–431. doi:10.1080/00220671.2014.901283

Muller, C. (1998). Gender Differences in Parental Involvement and Adolescents' Mathematics Achievement. *Sociol. Educ.* 71 (4), 336–356. doi:10.2307/2673174

Muthén, L. K., and Muthén, B. O. (1998-2017). *Mplus User's Guide*. Eighth edition. Los Angeles, CA: Muthén & Muthén.

Nauck, B., Schnoor, B., and Herold, V. (2017). Parental Investments and Socialization Practices in Native, Turkish, and Vietnamese Families in Germany. *Z. für Soziologie der Erziehung Sozial.* 37 (3), 270–289. doi:10.3262/ZSE1703270

Nusser, L. (2021). Learning at home during COVID-19 School Closures – How Do German Students with and without Special Educational Needs Manage? *Eur. J. Spec. Needs Educ.* 36 (1), 51–64. doi:10.1080/08856257.2021.1872845

Patall, E. A., Cooper, H., and Robinson, J. C. (2008). Parent Involvement in Homework: A Research Synthesis. *Rev. Educ. Res.* 78 (4), 1039–1101. doi:10.3102/0034654308325185

Pier, L., Hough, H. J., Christian, M., Bookman, N., Wilkenfeld, B., and Miller, R. (2021). *COVID-19 and the Educational Equity Crisis Evidence on Learning Loss from the CORE Data Collaborative*. Stanford: Policy Analysis for California Education.

Pinquart, M., and Kauser, R. (2018). Do the Associations of Parenting Styles with Behavior Problems and Academic Achievement Vary by Culture? Results from a Meta-Analysis. *Cult. Divers. Ethnic Minor. Psychol.* 24 (1), 75–100. doi:10.1037/cdp0000149

Pinquart, M. (2016). Associations of Parenting Styles and Dimensions with Academic Achievement in Children and Adolescents: A Meta-Analysis. *Educ. Psychol. Rev.* 28 (3), 475–493. doi:10.1007/s10648-015-9338-y

Pomerantz, E. M., and Grolnick, W. S. (2017). "The Role of Parenting in Children's Motivation and Competence: What Underlies Facilitative Parenting," in *Handbook of Competence and Motivation: Theory and Application*. Editors A. J. Elliot, C. S. Dweck, and D. S. Yeager (New York: Guilford Press), 566–585.

Pomerantz, E. M., Moorman, E. A., and Litwack, S. D. (2007). The How, Whom, and Why of Parents' Involvement in Children's Academic Lives: More Is Not Always Better. *Rev. Educ. Res.* 77 (3), 373–410. doi:10.3102/003465430305567

Pritchard, S. C., Coltheart, M., Marinus, E., and Castles, A. (2018). A Computational Model of the Self-Teaching Hypothesis Based on the Dual-Route Cascaded Model of Reading. *Cogn. Sci.* 42 (3), 722–770. doi:10.1111/cogs.12571

Proulx, K., Lenzi-Weisbecker, R., Hatch, R., Hackett, K., Omoeva, C., Cavallera, V., et al. (2021). Responsive Caregiving, Opportunities for Early Learning, and Children's Safety and Security during COVID-19: A Rapid Review. *medRxiv*. doi:10.1101/2021.02.10.21251507

Raudenbush, S. W., and Bryk, A. S. (2002). Hierarchical Linear Models: Applications and Data Analysis Methods. Thousand Oaks, CA: Sage Publications.

Reimer, D., Smith, E., Andersen, I. G., and Sortkær, B. (2021). What Happens when Schools Shut Down? Investigating Inequality in Students' reading Behavior during Covid-19 in Denmark. *Res. Soc. Stratif. Mobility* 71, 100568. doi:10.1016/j.rssm.2020.100568

Ribeiro, L. M., Cunha, R. S., Silva, M. C. A. e., Carvalho, M., and Vital, M. L. (2021). Parental Involvement during Pandemic Times: Challenges and Opportunities. *Educ. Sci.* 11 (6), 302. doi:10.3390/educsci11060302

Rioux, C., and Little, T. D. (2021). Missing Data Treatments in Intervention Studies: What Was, what Is, and what Should Be. *Int. J. Behav. Dev.* 45 (1), 51–58. doi:10.1177/0165025419880609

Salaschek, M., and Souvignier, E. (2013). Web-Based Progress Monitoring in First Grade Mathematics. *Frontline Learn. Res.* 1 (2), 53–69. doi:10.14786/flr.v1i2.51

Sander, A., Schäfer, L., and van Ophuysen, S. (2021). Prädiktoren von prozessbezogener und strukturierender elterlicher Unterstützung während des (Coronabedingten) Distanzunterrichts [Predictors of process-related and structuring parental support during distance learning due to Corona-pandemic]. *Z. Erziehungswissenschaft : ZfE* 24 (2), 419–442. doi:10.1007/s11618-021-01015-6

Schermelleh-Engel, K., Moosbrugger, H., and Müller, H. (2003). Evaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness-Of-Fit Measures. *Methods Psychol. Res. Online* 8 (2), 23–74.

Schult, J., Mahler, N., Fauth, B., and Lindner, M. A. (2021). Did Students Learn Less during the COVID-19 Pandemic? Reading and Mathematics Competencies before and after the First Pandemic Wave. *PsyArXiv*. doi:10.31234/osf.io/pqtgf

Silinskas, G., and Kikas, E. (2019). Parental Involvement in Math Homework: Links to Children's Performance and Motivation. *Scand. J. Educ. Res.* 63 (1), 17–37. doi:10.1080/00313831.2017.1324901

Silinskas, G., Leppänen, U., Aunola, K., Parrila, R., and Nurmi, J.-E. (2010). Predictors of Mothers' and Fathers' Teaching of reading and Mathematics during Kindergarten and Grade 1. *Learn. Instruct.* 20 (1), 61–71. doi:10.1016/j.learninstruc.2009.01.002

Silinskas, G., Kiuru, N., Aunola, K., Lerkkanen, M.-K., and Nurmi, J.-E. (2015). The Developmental Dynamics of Children's Academic Performance and Mothers' Homework-Related Affect and Practices. *Dev. Psychol.* 51 (4), 419–433. doi:10.1037/a0038908

Silk, J. S., Morris, A. S., Kanaya, T., and Steinberg, L. (2003). Psychological Control and Autonomy Granting: Opposite Ends of a Continuum or Distinct Constructs? *J. Res. Adolesc.* 13 (1), 113–128. doi:10.1111/1532-7795.1301004

Sirin, S. R. (2005). Socioeconomic Status and Academic Achievement: A Meta-Analytic Review of Research. *Rev. Educ. Res.* 75 (3), 417–453. doi:10.3102/00346543075003417

Souvignier, E., Förster, N., and Salaschek, M. (2014). "quop: Ein Ansatz internetbasierter Lern-verlaufsdiagnostik mit Testkonzepten für Lesen und Mathematik," in *Tests und Trends: N.F., Bd. 12. Lernverlaufsdiagnostik*. Editors M. Hasselhorn, W. Schneider, and U. Trautwein (Göttingen: Hogrefe), 239–256.

Souvignier, E., Förster, N., Hebbecker, K., and Schütze, B. (2021). "Using Digital Data to Support Teaching Practice: Quop: An Effective Web-Based Approach to Monitor Student Learning Progress in reading and Mathematics in Entire Classrooms," in *International Perspectives on School Settings, Education Policy and Digital Strategies*. Editors A. Wilmers and S. Jornitz (Opladen: Verlag Barbara Budrich), 283–298. doi:10.2307/j.ctv1gbrzf4.20

Spinelli, M., Lionetti, F., Setti, A., and Fasolo, M. (2021). Parenting Stress during the COVID-19 Outbreak: Socioeconomic and Environmental Risk Factors and Implications for Children Emotion Regulation. *Fam. process* 60 (2), 639–653. doi:10.1111/famp.12601

Tomasik, M. J., Helbling, L. A., and Moser, U. (2020). Educational Gains of In-Person vs. Distance Learning in Primary and Secondary Schools: A Natural experiment during the COVID-19 Pandemic School Closures in Switzerland. *Int. J. Psychol.* 56, 566–576. doi:10.1002/ijop.12728

van de Vijver, F. J. R. (1998). "Towards a Theory of Bias and Equivalence," in *ZUMA-nachrichten Spezial*. Editor J. Harkness (Mannheim: ZUMA) 3, 41–65.

Vandevelde, S., van Keer, H., Schellings, G., and van Hout-Wolters, B. (2015). Using Think-Aloud Protocol Analysis to Gain In-Depth Insights into Upper Primary School Children's Self-Regulated Learning. *Learn. Indiv. Diff.* 43, 11–30. doi:10.1016/j.lindif.2015.08.027

von Hippel, P. T., Workman, J., and Downey, D. B. (2018). Inequality in reading and Math Skills Forms Mainly before Kindergarten: A Replication, and Partial Correction, of "Are Schools the Great Equalizer?" *Sociol. Educ.* 91 (4), 323–357. doi:10.1177/0038040718801760

Wagner, H., Hahn, I., Schöps, K., Ihme, J. M., and Köller, O. (2018). Are the Tests Scores of the Programme for International Student Assessment (PISA) and the National Educational Panel Study (NEPS) Science Tests Comparable? an Assessment of Test Equivalence in German Schools. *Stud. Educ. Eval.* 59, 278–287. doi:10.1016/j.stueduc.2018.09.002

Weber, C., Kemethofer, D., and Helm, C. (2020). Wir Wollen's Wissen! - Wie es um die Kompetenzen unserer Schüler/-innen steht - Diagnostik und Fortschrittsmonitoring als Ausgangslage für Schul- und Unterrichtsentwicklung an Schulen in herausfordernder Lage. *Schulverwaltung Spez.* 22 (4), 75–76.

Weber, C., Helm, C., and Kemethofer, D. (2021). Corona-related School Closures in Primary Schools -- Findings from Austria. *Psychol. Erziehung und Unterricht* 68 (4), 287–291. doi:10.2378/peu2021.art24d

Zou, G. Y. (2007). Toward Using Confidence Intervals to Compare Correlations. *Psychol. Methods* 12 (4), 399–413. doi:10.1037/1082-989X.12.4.399

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 15 December 2021
doi: 10.3389/fpsyg.2021.734264

Understanding Mental Burden and Factors Associated With Study Worries Among Undergraduate Medical Students During the COVID-19 Pandemic

Jennifer Guse[1], Ines Heinen[1], Sonja Mohr[2] and Corinna Bergelt[1,3]*

[1] Department of Medical Psychology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [2] Dean's Office for Student Affairs, Faculty of Medicine, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [3] Department of Medical Psychology, University Medicine Greifswald, Greifswald, Germany

OPEN ACCESS

Edited by:
Kathrin Lockl, Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Chongying Wang, Nankai University, China
Jared Andrew Danielson, Iowa State University, United States
Suprakash Chaudhury, Hospital and Research Centre, India
György Bárdos, Eötvös Loránd University, Hungary

***Correspondence:**
Jennifer Guse
j.guse@uke.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *08 November 2021*
Published: *15 December 2021*

Citation:
Guse J, Heinen I, Mohr S and Bergelt C (2021) Understanding Mental Burden and Factors Associated With Study Worries Among Undergraduate Medical Students During the COVID-19 Pandemic. Front. Psychol. 12:734264. doi: 10.3389/fpsyg.2021.734264

The Coronavirus disease 2019 (COVID-19) pandemic is affecting many areas of life and has led to major changes in undergraduate medical education. Even before the COVID-19 pandemic, high mental burden of medical students has frequently been reported in the literature. Additional pandemic-specific stressors could exacerbate this situation. This study aimed to assess mental health outcomes among medical students during the first semester after the COVID-19 outbreak and perception of the students on how the learning environment has changed. In May 2020, we conducted a cross-sectional survey among undergraduate medical students at a large medical school in Germany. The survey included validated mental health instruments (Distress Thermometer, Patient Health Questionnaire 4) and self-developed items to examine the perception of the study situation during the COVID-19 pandemic. Open-ended questions were analyzed by conventional content analyses. The response rate was 59.2% (914/1,545). Overall, 61.9% of the students reported distress levels above the cutoff. Year 1 students reported significantly higher levels of distress, anxiety and depression than students during their second to fourth year of studies. 48.3% of the students indicated a decrease in their study motivation since the beginning of the COVID-19 pandemic with significant differences between study years. The binary logistic regression model showed that male gender, being in study year 2, higher distress scores and higher symptoms of depression were significantly associated with a higher likelihood for experiencing serious worries. In the open-ended questions on current concerns related to the impact of the COVID-19 pandemic on their studies, students most frequently reported concerns about missing relevant practical learning experience, difficulties with self-regulated learning and self motivation as well as study-related worries. Year 4 students reported significantly more worries about the lack of practical training than students from study years 1 to 3. Analysis of gender differences showed that female students reported more frequently diverse worries. In contrast, female students shared more frequently helpful strategies in all the categories compared

to male students. Our findings suggest that medical students experience significant levels of distress and mental burden during the COVID-19 pandemic and highlight the need for ongoing psychological and educational support for medical students during the COVID-19 pandemic and after.

Keywords: mental health, medical education, COVID-19, learning environment, undergraduate medical students

INTRODUCTION

Since December 2019, reports of an illness with a novel coronavirus disease 2019 (COVID-19) had been accumulating from the Wuhan region of China and infections had been multiplying at a rapid rate worldwide (Zhu et al., 2020), prompting the World Health Organization (2020a) to declare an international the COVID-19 pandemic. The COVID-19 pandemic has been affecting many areas of life. Due to the rapid increase in the number of COVID-19 infections, many governments around the world have imposed strict rules on domestic quarantine and social isolation.

On January 27, 2020, the German Federal Ministry of Health (2020) announced the first COVID-19 case had been detected in Germany. Since then, the epidemiological situation has deteriorated sharply. As of May 31, 2020, more than 180,000 people in Germany had already been infected with COVID-19, of which 8,500 cases (4.7% of all the confirmed cases) have been fatal (Robert-Koch-Institut, 2020). At that time, Hamburg was the third most affected German state in terms of population (cases/100,000 inhabitants) (Robert-Koch-Institut, 2020). Worldwide, there were nearly 6 million confirmed cases at that time, including 367,166 deaths, according to the World Health Organization (2020b). At this time, the COVID-19 pandemic was spreading most rapidly in North and South America. The United States and Brazil were affected the most, with more than 100,000 new infections within 7 days (May 25–31, 2020). Most new infections were measured in Germany from mid-March to around mid-April 2020 (Robert-Koch-Institut, 2020). The rapid increase in the number of infections noticeably restricted the everyday life of the population. Since mid-March 2020, the German government announced several restrictions with respect to public life to suppress the spread of COVID-19 by increasing social distancing, i.e., school, daycare, and nonessential shop closures, bans on public meetings (Steinmetz et al., 2020). Depending on the federal state in Germany, people were not allowed to meet more than one person from another household, and schools, daycare and nonessential shops were closed. Temporarily people were not allowed to leave their homes without a reason (Steinmetz et al., 2020). At universities, lectures and seminars have been held predominantly digitally to reduce interpersonal contact and protect patients, students, and faculty (HRK German Rectors' Conference, 2020). Consequently, the spread of the COVID-19 pandemic has caused major changes in undergraduate medical education, too (Whelan et al., 2020). Many medical schools disrupted their undergraduate medical education and transitioned most of their teaching to digital formats (Rose, 2020). In Germany, it was agreed in March 2020 that medical lectures were held predominantly in digital form until further notice (Deutsche Hochschulmedizin, 2020). In this context, the learning environment as well as the study and examination conditions for students changed significantly.

A recent conceptual framework proposed a learning environment that encompasses a psychosocial dimension with a personal, social, and organizational component in addition to a material dimension that includes physical and virtual spaces (Gruppen et al., 2019). According to Gruppen et al. (2019), these five core components overlap and interact with each other. The personal and social components strongly shape perceptions of the learning environment of the students. Furthermore, the personal component reflects the psychological characteristics of the learners, e.g., quality of life, moral distress, and worries about future endurance. The social component describes the quality of interactions between peers, students and faculty, and students and patients (Gruppen et al., 2019). These interactions of learners include, for example, cooperation and competition with peers, feedback by and communication with faculty, and responsibility for and acceptance by the patients. In light of the COVID-19 pandemic, the personal and social components, in particular, could be seriously compromised. Previous studies highlighted the impact of the learning environment on well-being of the medical students (Dyrbye et al., 2009, 2020). Learning environments that are perceived as unsupportive and less nurturing are typically associated with decreased mental health among medical students (Dyrbye et al., 2009; Schwenk et al., 2010; Wasson et al., 2016). An international study has explored the impact of favorable perceptions of the learning environment (LE) on self-reported quality of life, burnout, and empathy of the undergraduate students at three different medical schools (Tackett et al., 2017). In total, 62% of the sample reported more favorable than unfavorable LE perceptions, which were positively correlated with better quality of life, lower emotional exhaustion, and less depersonalization in adjusted models. The domain "community of peers" as one factor of the applied instrument was the only factor that was independently associated with better quality of life scores, less emotional exhaustion, and less depersonalization (Tackett et al., 2017). A recent systematic review explored the association between learning environment interventions and improved mental health among undergraduate medical students (Wasson et al., 2016). The study group identified 28 of 4,207 published articles including more than 8,000 participants that met the inclusion criteria of their review. The results indicated that pass/fail grading systems (compared to grading systems with three or more intervals), formal mentoring/advisor programs, mental health and wellness programs were associated with improved emotional well-being among medical students.

Even before the COVID-19 pandemic, high mental burden of medical students had frequently been reported in the literature (Dyrbye et al., 2006; Hope and Henderson, 2014; Heinen et al., 2017). Additional pandemic-specific stressors could exacerbate this situation. In a study conducted in March 2020, 25% of the college students at a medical school in China reported anxiety related to COVID-19 (Cao et al., 2020). Previous research had reported the negative impact of past pandemics (Hawryluck et al., 2004) and the COVID-19 pandemic (Wang et al., 2020) on the general population and on specific groups, e.g., medical students (Elmer et al., 2020) and health professionals (Lai et al., 2020). Health professionals may be particularly affected (Bao et al., 2020) because of additional stressors on top of the general pandemic-specific ones (Inter-Agency Standing Committee (IASC), 2020). A number of recent studies have shown that mental burden during the COVID-19 pandemic was highest among women and young adults (Elmer et al., 2020; Pieh et al., 2020; Dale et al., 2021). For example, an Austrian study investigated mental health in the Austrian population during a strict lockdown in December 2020/January 2021 and found a prevalence of 26% for moderate depression, 23% for moderate anxiety, and 18% for moderate insomnia (Dale et al., 2021). For all the measures, women reported a higher mental burden than men. Likewise, the youngest age group (18–24 years) reported statistically significant more mental health symptoms in comparison to the oldest age group (65+ years) (Dale et al., 2021).

This study aimed to assess mental health outcomes among medical students during COVID-19 and perception of the students with respect to how learning environment has changed in a large sample of undergraduate medical students in Germany. It was conducted with the purpose of better understanding their levels of distress, anxiety, and depression as well as their perception of the learning environment during the first semester after the COVID-19 outbreak. This study is exploratory in nature. We investigated demographic and mental health factors associated with serious worries about the study situation during the COVID-19 pandemic and addressed the following two research questions: (1) Do female and male students differ with regard to mental burden and study worries during the COVID-19 pandemic? and (2) Do students in different years of study differ in terms of psychological distress and study worries during the COVID-19 pandemic? Based on recent studies (Elmer et al., 2020; Pieh et al., 2020; Dale et al., 2021), it is expected that female students might be higher burdened in contrast to male students, and students in the first study years might be higher burdened than students in year 2–4 as age increases with study year.

MATERIALS AND METHODS

Study Design

We conducted a cross-sectional online survey at the University Medical Center Hamburg-Eppendorf to measure mental health and perception of the learning situation of the medical students during and after the initial phase of the COVID-19 pandemic. The anonymous survey started 6 weeks after the summer term started on May 28, 2020 and ended on June 7, 2020.

Participants

All medical students (n = 1,545) enrolled in the integrated medical degree program (iMED) at the Medical Faculty of the University of Hamburg (Rheingans et al., 2019) in the summer semester 2020 were invited to participate in the online survey. Students were asked to complete an anonymous questionnaire linked to the voluntary curriculum evaluation conducted by the Dean's Office at regular intervals throughout the year. A few days in advance, students were informed by email about the study objectives, voluntary participation, and privacy policies. Out of 1,545 students, 887 students completed the questionnaire in full, of which 63.4% were women. Respondents were spread across study years 1 to 4 of the undergraduate medical curriculum (n = 307, 192, 210, and 178 for years 1–4, respectively). Most of the students were between 21 and 25 years old. Details are shown in **Table 1**.

Outcomes/Measures

We used the ultra-brief version of established measures of mental health that were validated in German and that have been used in previous studies (Heinen et al., 2017) to increase comparability. Longer versions of the instruments were used in recent studies during the COVID-19 pandemic in representative samples (Lai et al., 2020; Dale et al., 2021) and among students (Elmer et al., 2020). Additionally, we developed tailored items to assess perceptions of the students.

Distress

We used the German version of the Distress Thermometer (DT). The DT is a reliable and efficient single-item screening instrument with a scale from 0 to 10 developed by the National Comprehensive Cancer Network (Mehnert et al., 2006). Higher scores indicate higher distress. Internationally, a cutoff score of 5 and higher is established as a signal that a person is distressed and needs support.

Depression and Anxiety

We examined depression and anxiety with the German version of the four-item Patient Health Questionnaire-4 (PHQ-4). The ultra-brief screening instrument consists of a two-item depression scale (PHQ-2) and a two-item anxiety scale [Generalized Anxiety Disorder-2 (GAD-2)] and measures the amount of depression and anxiety symptoms the individual has felt during the past 2 weeks (Kroenke et al., 2009). The PHQ-4 total score is an overall measure of symptom burden using the following categories: 0–2 (normal), 3–5 (mild), 6–8 (moderate), and 9–12 (severe). It is a reliable screening instrument with good psychometric properties among students (Khubchandani et al., 2016).

Perception of Study Situation During Coronavirus Disease 2019 Pandemic

To measure direct changes in the study motivation and perceptions of the educational situation in the context of digital teaching, we employed two self-developed items: (1) "Has your study motivation changed since the start of the COVID-19 pandemic?" with three options to answer (increased, unchanged,

TABLE 1 | Sample characteristics (n = 887).

	Whole sample		Study year			
			Year 1 (n = 307)	Year 2 (n = 192)	Year 3 (n = 210)	Year 4 (n = 178)
	n	%	%	%	%	%
Sex						
Female	562	63.4	59.9	64.6	61.4	59.9
Male	325	36.6	40.1	35.4	38.6	40.1
Age						
≤ 20 years	199	22.4	44.6	28.6	3.3	44.6
21–25 years	461	52.0	31.9	50.0	69.5	31.9
≥ 26 years	227	25.6	23.5	21.4	27.1	23.5

n: frequencies.

and decreased) and (2) "Has your assessment of your study situation (e.g., teaching and learning conditions, scheduling, graduation opportunities, etc.) changed in the context of the COVID-19 pandemic?" with three answer options (No, I am as worried or unworried as before; Yes, I am somewhat worried; and Yes, I am seriously worried). Furthermore, students were asked for free-text answers to the questions "What comes to mind first when thinking about your current study situation?" and "What comes to mind as particularly helpful in your current situation?".

Statistical Analysis

Quantitative Data

The primary analysis involved descriptive statistics (numbers, percentages, means, and SDs) for demographic data and for estimating the magnitude of distress, the degree of symptoms of anxiety and depression, the prevalence of serious worries with respect to the current educational situation and the perception of the current educational situation of the students. Group comparisons were carried out using the chi-squared test for categorical variables and the t-test or ANOVA for differences of means. A two-tailed $p < 0.05$ was considered as statistically significant. Descriptive analyses were conducted to examine the magnitude of distress (DT), depression and anxiety (PHQ-4). The results of the entire sample were compared with the German norm population (Löwe et al., 2010; n = 5,030, mean age = 48 years, 54% women) and with PHQ-4 data of a German medical student sample (n = 321, mean age = 22 years, 60% women) from a previous study at the same faculty (Heinen et al., 2017) with the one-sample t-test. The binary logistic regression model was conducted to identify associations of the independent variables with serious worries (dichotomous) with respect to the study situation during the COVID-19 pandemic. Therefore, the sample was divided into two groups according to reported worries of the students (not or somewhat worried vs. seriously worried). We used forward and backward stepwise procedures to confirm that the results were stable and generalizable, independent of the model approach used. The independent variables included: sex, age (in groups), year in medical school, distress, anxiety, and depression. Nonsignificant variables were excluded stepwise via forward elimination and dropped at the level of $p < 0.05$. To avoid multicollinearity, we analyzed variance inflation factors (VIFs) scores (Midi et al., 2013). All the quantitative analyses were carried out using IBM SPSS software version 27 (SPSS software, IBM Corporation, New York, United States).

Qualitative Data

To analyze the qualitative data obtained by the open-ended questions, we conducted conventional content analyses with inductive categorization (Hsieh and Shannon, 2005). Two researchers (IH and JG) independently identified key concepts and created coding labels for recurring themes. Next, both the independently sorted codes into categories were reviewed by all the authors. Final definitions for categories and codes were developed by consensus and examples of each category were selected for illustration and translated into English. All the qualitative analyses were carried out using MAXQDA 2020 (VERBI Software, 2019).

After inductive categorization, responses of the students for each category were dichotomized (mentioned vs. not mentioned) to increase data transparency and to support our interpretation (Monrouxe and Rees, 2020). When students indicated more than one category per response, all responses were categorized. Group comparisons were conducted using the chi-squared test.

Ethical Considerations

The local ethics board of the Center for Psychosocial Medicine at the University Medical Center Hamburg-Eppendorf approved this study (LPEK-0161).

RESULTS

Quantitative Data

The response rate was 59.2% (914/1,545). Responses of 27 students had to be excluded due to missing data in age or gender. Thus, the final sample included 887 students for analyses (63.4% females). The majority was aged 21 to 25 years. The demographic characteristics of the final sample are shown in **Table 1**.

Results showed that 61.9% of the students reported distress levels above the recommended cutoff score. The level of distress (as measured by the DT) as well as anxiety and depression (as

TABLE 2 | Number of students above and below the cutoffs and mean scores for distress, depression and anxiety, perception of the study situation during the COVID-19 pandemic, and changes of study motivation for the total sample and by study year.

		Total	Study year				
		(*n* = 887)	Year 1 (*n* = 307)	Year 2 (*n* = 192)	Year 3 (*n* = 210)	Year 4 (*n* = 178)	Statistic
DT score	< 4	338 (38.1)	52 (16.9)	95 (49.5)	108 (51.4)	83 (46.6)	χ^2 (3) = 90.14,
n (%)	≥ 5	549 (61.9)	255 (83.1)	97 (50.5)	102 (48.6)	95 (53.4)	***p* < 0.001**
PHQ-2 score	< 3	704 (79.4)	220 (71.7)	153 (79.7)	189 (90.0)	142 (79.8)	χ^2 (3) = 25.66,
n (%)	≥ 3	183 (20.6)	87 (28.3)	39 (20.3)	21 (10.0)	36 (20.2)	***p* < 0.001**
GAD-2 score	< 3	723 (81.5)	219 (71.3)	165 (85.9)	189 (90.0)	150 (84.3)	χ^2 (3) = 34.53,
n (%)	≥ 3	164 (18.5)	88 (28.7)	27 (14.1)	21 (10.0)	28 (15.7)	***p* < 0.001**
DT score							Welch's *F*(3, 453.03) = 47.76,
M (SD)		5.17 (2.53)	6.46 (2.31)	4.48 (2.26)	4.41 (2.50)	4.58 (2.35)	***p* < 0.001**,
PHQ-4 score		3.13 (2.46)	3.95 (2.57)	2.81. (2.29)	2.40 (2.02)	2.93 (2.53)	Welch's *F*(3, 457.94) = 20.54,
M (SD)							***p* < 0.001**
Worries about study situation							χ^2(6, *N* = 855) = 22.23,
Not worried	*n* (%)	293 (34.3)	115 (39.8)	45 (23.7)	82 (40.8)	51 (29.1)	***p* = 0.001**
Somewhat worried	*n* (%)	458 (53.6)	149 (51.6)	114 (60.0)	96 (47.8)	99 (56.6)	
Seriously worried	*n* (%)	104 (12.2)	25 (8.7)	31 (16.3)	23 (11.4)	25 (14.3)	
Changes of study motivation							χ^2 (6, *N* = 855) = 25.57,
Increased	*n* (%)	116 (13.1)	41 (13.4)	17 (8.9)	36 (17.1)	22 (12.4)	***p* < 0.001**
Unchanged	*n* (%)	343 (38.7)	140 (45.6)	57 (29.7)	71 (33.8)	75 (42.1)	
Decreased	*n* (%)	428 (48.3)	126 (41.0)	118 (61.5)	103 (49.0)	81 (45.5)	

DT, Distress Thermometer (range 0–10); n, frequencies; χ^2, chi-squared; p, p-value; PHQ-2, Patient Health Questionnaire-2 (range 0–6); GAD-2, Generalized Anxiety Disorder-2 (range 0–6); M, mean; PHQ-4, Patient Health Questionnaire-4 (range 0–12); COVID-19, coronavirus disease 2019.
Bold font indicates statistical significance.

measured with the PHQ-4) differed statistically significant for the different study years. Year 1 students reported the highest mean scores (**Table 2**).

Compared to a German norm population (Löwe et al., 2010; PHQ-4: $M = 1.76$; $SD = 2.06$), the medical students in this study reported significantly higher levels of anxiety and depression (PHQ-4: $M = 3.13$, $SD = 2.46$, $p < 0.001$) and in comparison to the group of medical students from a prior study at the same medical school (Heinen et al., 2017; $M = 2.65$, $SD = 2.20$, $p < 0.001$). Details are shown in **Table 3**.

Analysis of gender differences showed that relatively more male students reported depression levels (PHQ-2) above the established cutoff than female students [male: 24.3% vs. female: 18.5%; χ^2 (1, $n = 887$) = 4.23, $p = 0.04$]. Nevertheless, data revealed no further significant differences between male and female students with respect to the self-reported level of DT and overall anxiety and depression (PHQ-4).

Overall, 48.3% of medical students reported a decrease in their study motivation since the beginning of the COVID-19 pandemic with significant differences between study years ($p < 0.001$). Relatively, the proportion of students reporting a decreased motivation was highest among year 2 students (**Table 2**). A significantly higher proportion of male students (54.2%) suffered from a decreased study motivation than female students [44.8%, χ^2 (2, $n = 887$) = 9.36, $p = 0.01$].

The majority of students was somewhat worried about the impact of the COVID-19 pandemic on their study situation, 34.3% reported to be as worried as before and 12.2% reported to be seriously worried (**Table 2**). Again, relatively more male students were burdened with serious worries than female students [15.7 vs. 9.4%, χ^2 (1, $n = 887$) = 7.80, $p = 0.005$].

The binary logistic regression model indicated that sex, study year, distress sum score, and severity of symptoms of depression (PHQ-2 sum score) were significant predictors of serious worries with respect to the current study situation during the COVID-19 pandemic (**Table 4**). The other two predictors – age in categories and severity of symptoms of anxiety (GAD-2) – were not significant. Results showed that male students were significantly more likely to experience serious worries with respect to the current study situation during the COVID-19 pandemic compared to females. Students in study year 2 were significantly more likely to experience serious worries with respect to the current study situation during the COVID-19 pandemic compared to all other students. In addition, higher distress was associated with a higher likelihood for reporting serious worries with respect to the current study situation during the COVID-19 pandemic. A one-point increase in the distress scale is associated with an increase of serious worries of 38.1%. Furthermore, more severe symptoms of depression (PHQ-2) were associated with a higher likelihood for reporting serious worries with respect to the current study situation during the COVID-19 pandemic. A one-point increase in the PHQ-2 scale was associated with an increase of serious worries of 35.6% (**Table 4**).

Qualitative Data

A total of 456 students (51.4% of all the participants, among them 309 females, 67.8%) provided optional free-text answers with

TABLE 3 | Mean scores for depression and anxiety among medical students during the COVID-19 pandemic in May 2020 for the total sample in comparison to the German norm population (Löwe et al., 2010) and medical students at the same medical school in 2014 (Heinen et al., 2017).

		Medical students 2020 during the COVID-pandemic	**German norm population (Löwe et al., 2010)**	**p**	**d**
		***n* = 887**	***n* = 5,030**		
PHQ-4 score	M (SD)	3.13 (2.46)	1.76 (2.06)	**< 0.001**	0.645
PHQ-2 score	M (SD)	1.70 (1.35)	0.94 (1.20)	**< 0.001**	0.621
GAD-2 score	M (SD)	1.43 (1.43)	0.82 (1.10)	**< 0.001**	0.528
		Medical students 2020 during the COVID-pandemic	**Medical students 2014 (Heinen et al., 2017)**	**p**	**d**
		***n* = 887**	***n* = 321**		
PHQ-4 score	M (SD)	3.13 (2.46)	2.65 (2.20)	**< 0.001**	0.201
PHQ-2 score	M (SD)	1.70 (1.35)	1.26 (1.12)	**< 0.001**	0.340
GAD-2 score	M (SD)	1.43 (1.43)	1.40 (1.36)	0.587	0.021

PHQ-4, Patient Health Questionnaire-4 (range 0–12); M, mean; n, frequencies; p, p-value; d, effect size Cohen's d; PHQ-2, Patient Health Questionnaire-2 (range 0–6); GAD-2, Generalized Anxiety Disorder-2 (range 0–6).
According to Cohen's (1988) guidelines, we considered d = 0.2 to be a small effect, d = 0.5 as a medium effect, and d = 0.8 as a large effect.
Bold font indicates statistical significance.

respect to the question: "What comes to mind first when thinking about your current study situation?" We identified 10 categories in a multistage inductive process. Students most frequently reported concerns about missing relevant practical learning experience, difficulties with self-regulated learning and self-motivation due to the new learning environment, study-related worries, and uncertainty. Year 4 students reported significantly more worries about the lack of practical training than students from study years 1 to 3. We identified other recurring themes with respect to study-related concerns during the initial phase of the COVID-19 pandemic. The results according to the study year are shown in **Table 5**.

Furthermore, students were asked what they experienced as particularly helpful during the COVID-19 pandemic. Overall, 400 students (45.1% of all the participants, among them 289 female students, 72.6%) provided optional free-text responses. We extracted four major themes: The two most frequent aspects that were mentioned as helpful were flexibility due to digital courses and contact with family and friends. Analysis showed no significant differences of the responses between students from different study years (**Table 6**).

Analysis of gender differences showed that perceptions of the female students were different from perceptions of the male students in four of ten identified themes with respect to current occupation and all the themes with respect to helpful strategies (**Table 7**). Female students reported more frequently diverse worries and more frequently concerns with respect to postponed examinations. At the same time, female students mentioned more frequently helpful strategies with all topics than male students.

TABLE 4 | The binary logistic regression model on the association of sex, study year, distress, and depression with serious worries in medical students during the COVID-19 pandemic.

	OR	**CI**	***p***	f^2
Sex				
Male	Reference		n.a.	0.205
Female	1.886	1.208 – 2.947	**0.005**	
Study year				
Year 1	3.170	1.638– 6.133	**0.001**	
Year 2	Reference		n.a	
Year 3	4.140	2.123–8.073	**<0.001**	
Year 4	5.315	2.790–10.126	**<0.001**	
Distress (DT)	1.381	1.223–1.559	**<0.001**	
Depression symptoms (PHQ-2)	1.356	1.148 – 1.600	**<0.001**	

OR, odds ratio; p, p-value; f^2, effect size Cohen's f^2.
According to Cohen's (1988) guidelines, we considered f^2 = 0.02 to be a small effect, f^2 = 0.15 as a medium effect, and f^2 = 0.35 as a large effect.
Bold font indicates statistical significance.

DISCUSSION

In this study, we investigated mental health outcomes among medical students during the initial phase of the COVID-19 pandemic and perceptions of the students on how the learning environment had changed in a large sample of undergraduate medical students in Germany. Overall, our findings suggest that medical students experienced significant levels of distress and mental burden during the COVID-19 pandemic.

A previous study conducted at the same medical school with the same measures served as a valid context to frame our findings (Heinen et al., 2017). Comparing our results to the findings of Heinen et al. (2017), the substantial decline in all mental health measures could be attributed to the impact of the COVID-19 pandemic. Consistent with earlier findings of other studies, we found significantly higher levels of anxiety and depression among medical students compared to the German norm population (Löwe et al., 2010; Stormon et al., 2019). First year students reported the highest levels of mental burden according to the DT and PHQ-4. Previous studies found that people in their early 20s—the most common age group in students—are particularly

TABLE 5 | Categories, examples, and quantified responses for the question "What comes to mind first when thinking about your current study situation?" for the total sample and by study year.

"What comes to mind first when thinking about your current study situation?"		**Total**	**Year 1**	**Year 2**	**Year 3**	**Year 4**			
Category and subcategory	**Example**	**(*n* = 887)**	**(*n* = 307)**	**(*n* = 192)**	**(*n* = 210)**	**(*n* = 78)**	X^2	**df**	***p***
		***n* (%) mentioned**	***n* (%) mentioned**	***n* (%) mentioned**	***n* (%) mentioned**	***n* (%) mentioned**			
Lack of practical training, i.e., bedside teaching, laboratory sessions • Concerns to miss out on relevant practical learning experience • Impedes deeper understanding and application of knowledge	"I think that I am missing out on important learning content. Bedside teaching and contact with patients and proper exchange with lecturers cannot be replaced by textbook and PowerPoint presentations. I am worried that I will miss this knowledge both as a future doctor and in the exam." "The lack of contact with patients. Through clinical practical application, newly learned clinical pictures could be better understood and learned in greater depth."	128 (14.4)	27 (8.8)	32 (16.7)	35 (16.7)	34 (19.1)	12.67	3	**0.005**
Difficulties with self-regulated learning and self-motivation • Self-motivation • Difficulties with self-regulated learning	"I find it increasingly difficult to motivate myself for the monotonous work at home alone at the laptop and my satisfaction with the "work done" is very low." "The fact that I have done absolutely nothing for university yet and the first module is already over."	125 (14.1)	40 (13.0)	25 (13.0)	30 (14.3)	30 (16.9)	1.60	3	0.660
Study-related worries and uncertainty • Study-related uncertainty • Worries regarding clinical internship year	"Uncertainty of the further course of studies and exam participation." "I realize that I am losing interest in my studies. In addition, I am worried about the extent to which I will have to bear professional losses when it comes to STEX [Second Part of the Medical Examination] and PJ [final clinical year]."	121 (13.6)	39 (12.7)	28 (14.6)	26 (12.4)	28 (15.7)	1.32	3	0.725
Lack of interaction with faculty and peers • Learner-to-faculty (i.e., feedback, clarity of expectations) • Peer-to-peer (i.e., cooperation, support)	"There is a lack of feedback, which is particularly important in bedside teaching. There, you first learn how to apply the theory in a meaningful way in everyday clinical practice, and gaps in knowledge/understanding are quickly noticed and can be eliminated directly or afterward. At the moment, I don't know which associations are actually important in the clinic, and how individual findings are evaluated in the interaction (case studies/bedside teaching help a lot here)." "No contact with fellow students. The interactive exchange between the students is missing. Even to hear that one or the other has a problem there, or just "quickly" explains something."	72 (8.1)	26 (8.5)	20 (10.4)	16 (7.6)	10 (5.6)	2.97	3	0.396

(Continued)

TABLE 5 | (Continued)

"What comes to mind first when thinking about your current study situation?"		**Total**	**Year 1**	**Year 2**	**Year 3**	**Year 4**			
Category and subcategory	**Example**	**(*n* = 887)**	**(*n* = 307)**	**(*n* = 192)**	**(*n* = 210)**	**(*n* = 78)**	**X^2**	**df**	***p***
		***n* (%) mentioned**	***n* (%) mentioned**	***n* (%) mentioned**	***n* (%) mentioned**	***n* (%) mentioned**			
Worries regarding financing, health, uncertainty and distress	"I belong to the risk group and wonder how to do the multiple choice exam without taking a risk."	55 (6.2)	17 (5.5)	16 (8.3)	11 (5.2)	11 (6.2)	2.07	3	0.558
Social isolation	"The lack of personal contact, even in private, and related to this, (especially at the beginning of the pandemic) not really knowing what to do with yourself."	52 (5.9)	19 (6.2)	13 (6.8)	14 (6.7)	6 (3.4)	2.60	3	0.458
Postponed exams and clerkships	"It also threw me off track that ENF [Examination Normal Function, for details see Rheingans et al. (2019)] was canceled, which I had been working toward for months with quite a lot of pressure to perform. Then, to be slowed down so shortly before the finish line threw me off track for a few weeks after the cancelation of ENF. I would have liked some support from the dean's office. To be honest, the thought of having to take this exam again in the summer makes my stomach hurt."	51 (5.7)	3 (1.0)	33 (17.2)	5 (2.9)	9 (5.1)	62.65	3	**< 0.001**
Changed learning environment	"I found it increasingly difficult to study in this module, as I spend most of my time in my dorm, which is not necessarily quiet //Normally I study in the library or seminar rooms, this was unfortunately not possible now."	45 (5.1)	16 (5.2)	10 (5.2)	9 (4.3)	10 (5.6)	0.40	3	0.940
Dissatisfaction with organization, communication and nurturance by faculty	"Overall little or very late info from the dean's office; it would also have been reassuring if there had at least been an email saying "we know there's problem X, we're on it." would have come."	45 (5.1)	6 (2.0)	16 (8.3)	8 (3.8)	15 (8.4)	15.29	3	**0.002**
Other	"At the moment, I am most burdened by having to do justice to my various tasks in life. I already have 3 children and through Covid-19 both the care and my social network broke away overnight. Full-time studies, home-schooling, kindergarten child, meal planning/cooking are many tasks that can't be done in 24 h..."	68 (7.7)	18 (5.9)	15 (7.8)	19 (9.0)	16 (9.0)	2.42	3	0.490

n, frequencies; X^2, chi-squared; p, p-value.
Bold font indicates statistical significance.

TABLE 6 | Categories, examples, and quantified responses for the question "What comes to mind as particularly helpful in your current situation?" for the total sample and by study year.

What comes to mind as particularly helpful in your current situation?		Total	Year 1	Year 2	Year 3	Year 4	X^2	df	*p*
Category and subcategory	**Example**	(*n* = 887)	(*n* = 307)	(*n* = 192)	(*n* = 210)	(*n* = 178)			
		n (%) mentioned	*n* (%) mentioned	*n* (%) mentioned	*n* (%) mentioned	*n* (%) mentioned			
Flexibility due to digital courses • Self-directed learning • Individualized learning	"You can decide for yourself where and when to study, work or go to sports." "The possibility to organize yourself. And, for example, to save lectures and then listen to them again."	211 (23.8)	64 (20.8)	58 (30.2)	44 (21.0)	45 (25.3)	6.98	3	0.073
Contact with friends and family	"As much social interaction as possible, spending time with family, creating a regular daily routine…"	151 (17.0)	44 (14.3)	37 (19.3)	37 (17.6)	33 (18.5)	2.60	3	0.457
Balance through sports, leisure and nature-based activities	"Especially helpful for me is currently sports activities and activities in nature."	82 (9.2)	22 (7.2)	20 (10.4)	25 (11.9)	15 (8.4)	3.80	3	0.283
Other	"To make a schedule. It would also be helpful to create groups where you can meet via Skype to work and discuss at the same time. But I personally have not done that."	64 (7.2)	15 (4.9)	11 (5.7)	22 (10.5)	16 (9.0)	7.29	3	0.063

n, frequencies; X^2, chi squared; p, p-value.

burdened during the COVID-19 pandemic (Brooks et al., 2020; Pieh et al., 2020; Qiu et al., 2020; Dale et al., 2021).

In contrast to other studies during the COVID-19 pandemic (Lai et al., 2020; Park et al., 2020; Pieh et al., 2020; Qiu et al., 2020) and a general tendency in psychiatry research (Riecher-Rössler, 2017), we found that male students reported more frequently higher levels of depressive symptoms according to the PHQ-2 than female students. Additionally, male students were at higher risk for experiencing serious worries with respect to the study situation during the COVID-19 pandemic than females. Our qualitative data may serve as a valid context to frame these novel findings. Overall, the qualitative data indicated that worries about the lack of practical training, difficulties with self-regulated learning, study-related uncertainty, and the changed learning environment increased as the semester progressed. In this study, female students stated more frequently worries with respect to their undergraduate courses, health, financing, and general uncertainty as expected by the literature.

At first sight, it seems to be a contradiction in this study that depression was higher among males and serious worries were reported more often by male than by female students. On the other hand, with regard to qualitative data, females expressed more worries than males. It should be taken into account that completing open-ended response options require a greater amount of time and mental effort than most close-ended questions (Dillman, 2007). Thus, only 51.4 and 45.1% of all the respondents completed the two items with open-ended response options. Furthermore, the proportion of women who completed the two items with open-ended response options was higher in both the items (67.8 and 72.6%) compared to the proportion of women in the entire survey (63.4%).

Interestingly, females mentioned helpful strategies during the COVID-19 pandemic more often than male students. This might indicate the use of more efficient coping strategies during the initial phase of the COVID-19 pandemic compared to male students. Recent research showed that female students often relied on denser social networks even during the social distancing phase (Elmer et al., 2020). This strategy could have buffered the negative effects in terms of a decline in mental health among female students.

The decrease in study motivation was highest in year 2 students. These findings complement earlier empirical research indicating that undergraduate students adopted a different learning approach and a sharp decrease in intrinsic motives with the entry to clinical training (Wickramasinghe and Samarasekera, 2011; Lee et al., 2020). The curriculum structure of iMED allows the intermediate examination after the third semester. Thus, the amount of practical training increases sharply from the 4th semester, which corresponds to the second half of year 2 (Rheingans et al., 2019). The construction of the curriculum with more practical training after the 3rd semester could account for the high decrease of study motivation among 2nd year students in this study. Further, in previous research, it was discussed that motivation of male and female students differs with higher autonomous motivation among female students and higher controlled motivation among male students when compared with the opposite sex (Kusurkar et al., 2013).

TABLE 7 | Quantified responses for the open-ended questions by sex.

What comes to mind first when thinking about your current study situation?	**Male students**	**Female students**	X^2	**df**	***p***
	***n* = 325**	***n* = 562**			
Category	***n* (%) mentioned**	***n* (%) mentioned**			
Lack of practical training, i.e., bedside teaching, laboratory sessions	40 (12.3)	88 (15.7)	1.87	1	0.171
Difficulties with self-regulated learning and self-motivation	52 (16.0)	73 (13.0)	1.54	1	0.214
Study-related worries and uncertainty	34 (10.5)	87 (15.5)	4.40	1	**0.036**
Lack of interaction with faculty and peers	26 (8.0)	46 (8.2)	0.009	1	0.923
Worries regarding financing, health, uncertainty and distress	12 (3.7)	43 (7.7)	5.55	1	**0.018**
Changed learning environment	18 (5.5)	27 (4.8)	0.23	1	0.631
Social isolation	16 (4.9)	36 (6.4)	0.82	1	0.365
Postponed exams and clerkships	8 (2.5)	43 (7.7)	10.23	1	**0.001**
Dissatisfaction with organization, communication and nurturance by faculty	18 (5.5)	27 (4.8)	0.23	1	0.631
Other	15 (4.6)	53 (9.4)	6.75	1	**0.009**
What comes to mind as particularly helpful in your current situation?	**Male students**	**Female students**	X^2	**df**	***p***
	***n* = 325**	***n* = 562**			
Category	***n* (%) mentioned**	***n* (%) mentioned**			
Flexibility due to digital courses	60 (18.5)	151 (26.9)	8.027	1	**0.005**
Contact with friends and family	37 (11.4)	114 (20.3)	11.55	1	**0.001**
Balance through sports, leisure and nature-based activities	16 (4.9)	66 (11.7)	11.42	1	**0.001**
Other	16 (4.9)	48 (8.5)	4.03	1	**0.045**

n, frequencies; X^2, chi-squared; p, p-value.
Bold font indicates statistical significance.

Interestingly, our qualitative results mapped several scales of the Medical School Learning Environment Survey: among others, but not limited to "flexibility," "student–student interaction," "meaningful learning experience," and "nurturance" (Rusticus et al., 2014). In line with recent studies, perception of the changed situation of the students included both negative and positive aspects (Elmer et al., 2020; Mohr et al., 2021). In this study, the flexibility due to digital teaching with few real-time courses is particularly noteworthy.

Limitations

This study has some limitations that should be noted. Representativeness is limited due to data collection at a single institution. The observational cross-sectional design of this study does not allow causal statements. With 59%, the response rate may be considered as high; nevertheless, there might be a self-selection bias and particular student groups might be underrepresented. Additionally, our data included only self-reported measures. It is known that people can be biased when reporting on their own experience (Devaux and Sassi, 2016). A particular strength of this study is the consideration of quantitative and qualitative data (Frambach et al., 2013). We used well-established and valid instruments (quantitative data). With respect to the qualitative data, the conventional content analysis approach can be used when existing theories or literature is limited (Hsieh and Shannon, 2005) and offers in-depth exploration of mental health and perception of the students of their study situation during the COVID-19 pandemic. The information comes directly from the participants without predefined categories. Quantification of qualitative data can also facilitate the process of meaning discovery through pattern recognition by identifying consistencies and inconsistencies in the data, especially when analyzing large qualitative data sets (Monrouxe and Rees, 2020).

CONCLUSION

The COVID-19 pandemic and its accompanying burdens and restrictions with regard to daily, occupational, and student life constitutes an unprecedented global challenge. Thus, academia and other sectors of public life cannot resort to existing concepts on how to support students in the COVID-19 pandemic circumstances. However, there is an existing body of prepandemic research on the effectiveness of interventions such as mental health programs, curricular restructuring, and mentoring programs that are associated with improved mental health among medical students (Wasson et al., 2016). In the recent statements with respect to the situation of students during the current COVID-19 pandemic, medical education researchers proposed a framework to manage student–athlete mental health during the COVID-19 pandemic including "goal setting/motivation" and "support system/social network" as potential positive influencers (Grubic et al., 2021). These aspects could be addressed among others

by mentoring and mental health programs and might be valuable medical education learning environment interventions to reduce the negative impact of the COVID-19 pandemic on students. Existing interventions should be redesigned and transitioned to digital formats to provide psychological and educational support to students during the COVID-19 pandemic, as they progress through medical school. Longitudinal research is required to monitor the mental health of medical students during the COVID-19 pandemic and after.

DATA AVAILABILITY STATEMENT

Underlying datasets of the data presented in this article are not available because, ethical approval was not obtained by the ethics board to make data sharing possible outside of the listed research team.

ETHICS STATEMENT

The local Ethics Board of the Center for Psychosocial Medicine at the University Medical Center Hamburg-Eppendorf approved the study (LPEK-0161). The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JG designed the study, contributed to the analysis and interpretation of quantitative and qualitative data, wrote the first draft of the manuscript, and critically revised the manuscript during the internal revision process. IH contributed to the analysis and interpretation of the quantitative and qualitative data, involved in drafting the article, and critically revised the manuscript during the internal revision process. SM contributed to the acquisition and interpretation of the quantitative data, involved in drafting the article, and critically revised the manuscript during the internal revision process. CB designed the study, analyzed the quantitative data, contributed to the interpretation of the quantitative and qualitative data, and critically revised the manuscript during the internal revision process. All the authors gave their approval for the final version of the manuscript.

ACKNOWLEDGMENTS

We thank all the students who participated in this study and the evaluation team of the faculty who administered the online survey.

REFERENCES

Bao, Y., Sun, Y., Meng, S., Shi, J., and Lu, L. (2020). 2019-nCoV epidemic: address mental health care to empower society. *Lancet* 395, e37–e38. doi: 10.1016/S0140-6736(20)30309-3

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 395, 912–920. doi: 10.1016/S0140-6736(20)30460-8

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., et al. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* 287:112934. doi: 10.1016/j.psychres.2020.112934

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale, NJ: Erlbaum.

Dale, R., Budimir, S., Probst, T., Stippl, P., and Pieh, C. (2021). Mental HEalth during the COVID-19 lockdown over the christmas period in Austria and the effects of sociodemographic and lifestyle factors. *Int. J. Environ. Res. Public Health* 18:7. doi: 10.3390/ijerph18073679

Deutsche Hochschulmedizin (2020). *Empfehlungen II der Deutschen Hochschulmedizin zum Studium der Humanmedizin und Zahnmedizin während der aktuellen COVID-19-Pandemie, 18.03.2020*. Available online at: https://www.uniklinika.de/fileadmin/user_upload/Covid-19-Empfehlungen_DHM_zum_Medizinstudium_2020-03-18.pdf (accessed June 8, 2020).

Devaux, M., and Sassi, F. (2016). Social disparities in hazardous alcohol use: self-report bias may lead to incorrect estimates. *Eur. J. Public Health* 26, 129–134. doi: 10.1093/eurpub/ckv190

Dillman, D. A. (2007). *Mail and Internet Surveys: The Tailored Design Method*, 2nd Edn. New York, NY: John Wiley & Sons, Inc.

Dyrbye, L. N., Lipscomb, W., and Thibault, G. (2020). Redesigning the learning environment to promote learner well-being and professional development. *Acad. Med.* 95, 674–678. doi: 10.1097/ACM.0000000000003094

Dyrbye, L. N., Thomas, M. R., Harper, W., Massie, F. S. Jr., Power, D. V., Eacker, A., et al. (2009). The learning environment and medical student burnout: a multicentre study. *Med. Educ.* 43, 274–282. doi: 10.1111/j.1365-2923.2008.03282.x

Dyrbye, L. N., Thomas, M. R., and Shanafelt, T. D. (2006). Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Acad. Med.* 81, 354–373. doi: 10.1097/00001888-200604000-00009

Elmer, T., Mepham, K., and Stadtfeld, C. (2020). Students under lockdown: comparisons of students' social networks and mental health before and during the COVID-19 crisis in Switzerland. *PLoS One* 15:e0236337. doi: 10.1371/journal.pone.0236337

Federal Ministry of Health (2020). *Chronik zum Coronavirus SARS-CoV-2*. Available online at: https://www.bundesgesundheitsministerium.de/coronavirus/chronik-coronavirus.html (accessed June 8, 2020).

Frambach, J. M., van der Vleuten, C. P., and Durning, S. J. (2013). AM last page. Quality criteria in qualitative and quantitative research. *Acad. Med.* 88:552. doi: 10.1097/ACM.0b013e31828abf7f

Grubic, N., Jain, S., Mihajlovic, V., Thornton, J. S., and Johri, A. M. (2021). Competing against COVID-19: have we forgotten about student-athletes' mental health? *Br. J. Sports Med.* 55, 950–951. doi: 10.1136/bjsports-2021-104218

Gruppen, L. D., Irby, D. M., Durning, S. J., and Maggio, L. A. (2019). Conceptualizing learning environments in the health professions. *Acad. Med.* 94, 969–974. doi: 10.1097/acm.0000000000002702

Hawryluck, L., Gold, W. L., Robinson, S., Pogorski, S., Galea, S., and Styra, R. (2004). SARS control and psychological effects of quarantine, Toronto, Canada. *Emerg. Infect. Dis.* 10, 1206–1212. doi: 10.3201/eid1007.030703

Heinen, I., Bullinger, M., and Kocalevent, R. D. (2017). Perceived stress in first year medical students - associations with personal resources and emotional distress. *BMC Med. Educ.* 17:4. doi: 10.1186/s12909-016-0841-8

Hope, V., and Henderson, M. (2014). Medical student depression, anxiety and distress outside North America: a systematic review. *Med. Educ.* 48, 963–979. doi: 10.1111/medu.12512

HRK German Rectors' Conference (2020). *Effects of the COVID-19 Pandemic on German Universities – Latest Information and News*. Available online at: https://www.hrk.de/activities/the-covid-19-pandemic-and-the-german-universities/ (accessed July 29, 2020).

Hsieh, H. F., and Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qual. Health Res.* 15, 1277–1288. doi: 10.1177/1049732305276687

Inter-Agency Standing Committee (IASC) (2020). *IASC Guidance on Operational considerations for Multisectoral Mental Health and Psychosocial Support Programmes During the COVID-19 Pandemic*. Avilable online at: https://interagencystandingcommittee.org/iasc-reference-group-mental-health-and-psychosocial-support-emergency-settings/iasc-guidance-operational-considerations-multisectoral-mental-health-and-psychosocial-support (accessed June 8, 2021).

Khubchandani, J., Brey, R., Kotecki, J., Kleinfelder, J., and Anderson, J. (2016). The psychometric properties of PHQ-4 depression and anxiety screening scale among college students. *Arch. Psychiatr. Nurs.* 30, 457–462. doi: 10.1016/j.apnu.2016.01.014

Kroenke, K., Spitzer, R. L., Williams, J. B., and Löwe, B. (2009). An ultra-brief screening scale for anxiety and depression: the PHQ-4. *Psychosomatics* 50, 613–621. doi: 10.1176/appi.psy.50.6.613

Kusurkar, R. A., Ten Cate, T. J., Vos, C. M., Westers, P., and Croiset, G. (2013). How motivation affects academic performance: a structural equation modelling analysis. *Adv. Health Sci. Educ. Theory Pract.* 18, 57–69. doi: 10.1007/s10459-012-9354-3

Lai, J., Ma, S., Wang, Y., Cai, Z., Hu, J., Wei, N., et al. (2020). Factors associated with mental health outcomes among health care workers exposed to Coronavirus disease 2019. *JAMA Netw. Open* 3:e203976. doi: 10.1001/jamanetworkopen.2020.3976

Lee, J., Jin, R., Kim, Y., and Choi, H. (2020). Most surface learning in the third year: dental student learning approaches and implications for curriculum and assessment. *J. Dent. Educ.* 84, 464–472. doi: 10.1002/jdd.12043

Löwe, B., Wahl, I., Rose, M., Spitzer, C., Glaesmer, H., Wingenfeld, K., et al. (2010). A 4-item measure of depression and anxiety: validation and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. *J. Affect. Disord* 122, 86–95. doi: 10.1016/j.jad.2009.06.019

Mehnert, A., Müller, D., Lehmann, C., and Koch, U. (2006). Die deutsche version des NCCN distress-thermometers. *Z. Klin. Psychol. Psychiatr. Psychother.* 54, 213–223. doi: 10.1024/1661-4747.54.3.213

Midi, H., Sarkar, S., and Rana, S. (2013). Collinearity diagnostics of binary logistic regression model. *J. Interdiscip. Math.* 13, 253–267. doi: 10.1080/09720502.2010.10700699

Mohr, S., Küfe, B., Rheingans, A., and Guse, J. (2021). Attitude towards and adoption of the novel learning environment among undergraduate medical students during COVID-19. *Front. Educ.* 6:714526. doi: 10.3389/feduc.2021.714526

Monrouxe, L. V., and Rees, C. E. (2020). When I say . . . quantification in qualitative research. *Med. Educ.* 54, 186–187. doi: 10.1111/medu.14010

Park, C. L., Russell, B. S., Fendrich, M., Finkelstein-Fox, L., Hutchison, M., and Becker, J. (2020). Americans' COVID-19 stress, coping, and adherence to CDC guidelines. *J. Gen. Intern. Med.* 35, 2296–2303. doi: 10.1007/s11606-020-05898-9

Pieh, C., Budimir, S., and Probst, T. (2020). The effect of age, gender, income, work, and physical activity on mental health during coronavirus disease (COVID-19) lockdown in Austria (vol 136, 110186, 2020). *J. Psychosom. Res.* 139:110278. doi: 10.1016/j.jpsychores.2020.110186

Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., and Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen. Psychiatr.* 33:e100213. doi: 10.1136/gpsych-2020-100213

Rheingans, A., Soulos, A., Mohr, S., Meyer, J., and Guse, A. H. (2019). The Hamburg integrated medical degree program iMED. *GMS J. Med. Educ.* 36, Doc52. doi: 10.3205/zma001260

Riecher-Rössler, A. (2017). Sex and gender differences in mental disorders. *Lancet Psychiatry* 4, 8–9. doi: 10.1016/s2215-0366(16)30348-0

Robert-Koch-Institut (2020). *Mai 2020: Archiv der Situationsberichte des Robert Koch-Instituts zu COVID-19*. Available online at: https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Situationsberichte/Archiv_Mai.html (accessed May 31, 2021).

Rose, S. (2020). Medical student education in the time of COVID-19. *JAMA* 323, 2131–2132. doi: 10.1001/jama.2020.5227

Rusticus, S., Worthington, A., Wilson, D., and Joughin, K. (2014). The medical school learning environment survey: an examination of its factor structure and relationship to student performance and satisfaction. *Learn. Environ. Res.* 17, 423–435. doi: 10.1007/s10984-014-9167-9

Schwenk, T. L., Davis, L., and Wimsatt, L. A. (2010). Depression, stigma, and suicidal ideation in medical students. *JAMA* 304, 1181–1190. doi: 10.1001/jama.2010.1300

Steinmetz, H., Batzdorfer, V., and Bosnjak, M. (2020). *The ZPID Lockdown Measures Dataset for Germany*. Available online at: http://dx.doi.org/10.23668/psycharchives.4485 (accessed June 8, 2021).

Stormon, N., Ford, P. J., Kisely, S., Bartle, E., and Eley, D. S. (2019). Depression, anxiety and stress in a cohort of Australian dentistry students. *Eur. J. Dent. Educ.* 23, 507–514. doi: 10.1111/eje.12459

Tackett, S., Wright, S., Lubin, R., Li, J., and Pan, H. (2017). International study of medical school learning environments and their relationship with student well-being and empathy. *Med. Educ.* 51, 280–289. doi: 10.1111/medu.13120

VERBI Software (2019). *MAXQDA 2020 [Computer Software]*. Berlin: VERBI Software. Available online at: *maxqda.com*.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., et al. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 Coronavirus disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* 17:1729. doi: 10.3390/ijerph17051729

Wasson, L. T., Cusmano, A., Meli, L., Louh, I., Falzon, L., Hampsey, M., et al. (2016). Association between learning environment interventions and medical student well-being: a systematic review. *JAMA* 316, 2237–2252. doi: 10.1001/jama.2016.17573

Whelan, A., Prescott, J., Young, G., and Catanese, V. M. (2020). *Guidance on Medical Students' Clinical Participation: Effective Immediately. Association of American Academic Colleges*. Available online at: https://lcme.org/wp-content/uploads/filebase/March-17-2020-Guidance-on-Mediical-Students-Clinical-Participation.pdf (accessed June 8, 2020).

Wickramasinghe, D. P., and Samarasekera, D. N. (2011). Factors influencing the approaches to studying of preclinical and clinical students and postgraduate trainees. *BMC Med. Educ.* 11:22. doi: 10.1186/1472-6920-11-22

World Health Organization (2020a). *Detail*. Available online at: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020 (accessed January 11, 2021).

World Health Organization (2020b). *Situation Reports. World Health Organization*. Available online at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/ (accessed May 31, 2021).

Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J., et al. (2020). A novel Coronavirus from patients with Pneumonia in China, 2019. *N. Engl. J. Med.* 382, 727–733. doi: 10.1056/NEJMoa2001017

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 11 January 2022
doi: 10.3389/fpsyg.2021.750605

Carrying the Burden Into the Pandemic – Effects of Social Disparities on Elementary Students' Parents' Perception of Supporting Abilities and Emotional Stress During the COVID-19 Lockdown

Markus Vogelbacher and Manja Attig*

Competencies, Personality, Learning Environments, Leibniz Institute for Educational Trajectories, Bamberg, Germany

OPEN ACCESS

Edited by:
Karin Sørlie Street, Western Norway University of Applied Sciences, Norway

Reviewed by:
Teresa Pozo-Rico, University of Alicante, Spain
Alexandra N. Langmeyer, Deutsches Jugendinstitut, Germany

***Correspondence:**
Markus Vogelbacher
markus.vogelbacher@lifbi.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 July 2021*
Accepted: *02 December 2021*
Published: *11 January 2022*

Citation:
Vogelbacher M and Attig M (2022) Carrying the Burden Into the Pandemic – Effects of Social Disparities on Elementary Students' Parents' Perception of Supporting Abilities and Emotional Stress During the COVID-19 Lockdown. Front. Psychol. 12:750605. doi: 10.3389/fpsyg.2021.750605

The COVID-19 pandemic has posed many challenges, especially for families. Both the public and the scientific community are currently discussing the extent to which school closings have worsened existing social differences, especially with regard to children's academic and socio-emotional development. At the same time, parents have had to manage childcare and home schooling alongside their jobs and personal burdens posed by the pandemic. Parents' possibilities for meeting these cognitive and emotional challenges might also depend on the different conditions in families. For this reason, the present paper investigates the structural and process characteristics of the family as well as children's and parents' psychological characteristics that predict how parents assess their ability to support their child's learning during homeschooling as well as parents' perceived emotional stress caused by school closure. The study analyses data of the Newborn Cohort Study of the German National Educational Panel Study. The two dependent variables (self-assessment of abilities, perceived stress) were measured during the COVID-19 pandemic after the first school closure in Germany, at a time when the children of this cohort were attending second grade. Besides a number of control variables (including the child's struggle with home schooling), families' structural characteristics [socioeconomic status (SES), education], process characteristics (home learning environment, HLE), parents' psychological characteristics (preceding psychological stress), and the child's psychological characteristics (self-regulation, school-related independence) from earlier waves were included as predictors. The results of structural equation models show that perceived stress was associated with structural factors and the preceding psychological stress of parents. Parents with higher preceding stress reported higher perceived stress. Interestingly, higher-educated parents also reported more stress than lower educated parents during the pandemic. The effect was the other way around for SES –

parents with lower SES reported more stress than parents with higher SES. The self-reported abilities to support the learning of the child seemed to be mainly predicted by the parent's education as well as preceding psychological stress. To sum up, the results identify important aspects that determine how parents handle the challenges of the school closures. Especially, socially disadvantaged families carry their burden into the pandemic.

Keywords: parental stress, parental support, COVID-19 pandemic, social disparities, parents of second graders

INTRODUCTION

In spring 2020, the COVID-19 pandemic swept around the world, bringing about many changes in the daily lives of people. To limit the spreading of the pandemic, many countries decided to send their inhabitants into a lockdown, leading to drastic changes that affected family, personal and work life. The lockdowns often prescribed closures of schools and other childcare facilities, presenting challenges to families. Already in the first wave of the pandemic, schools were closed in Germany. Hence, schoolchildren had to be taught at home from March 13, 2020 until the first schools re-opened in May. During this time, all institutional and non-institutional childcare offers were closed (for an overview regarding the situation in Germany, see Helm et al., 2021). From May or June, depending on the federal state, until the start of the summer breaks, the primary schools were not back to regular schooling, but implemented various measures to reduce social contacts in schools, e.g., changing classes with fewer students in the schools. Consequently, homeschooling remained a part of the families' lives until the start of the holidays at the end of June to the end of July.

As a result, parents had to deal with multiple challenges such as homeschooling (providing technical and learning support), the reorganization of childcare and their own dynamic working situation. In addition, they were confronted with social isolation and changes in their personal lives. Furthermore, this uncertain pandemic situation affecting many life domains caused emotional strain which people had to deal with (see e.g., Cheng et al., 2021).

Depending on the school age of their children, parents were faced with different challenges. Whereas older students were more able to learn on their own and deal with the technical aspects of home schooling and distance learning, younger students needed more support with learning at home. Further, the parents of younger students also had to deal with childcare in addition to supporting and monitoring the learning of their children. Before the lockdown, around half of the elementary school students in Germany attended additional childcare facilities and all-day schools (Autorengruppe Bildungsberichterstattung, 2020). These childcare facilities were closed during the pandemic at the expense of parents. In addition, elementary school students are less experienced in working with digital media than older students (see Schmid et al., 2017).

To sum up, parents were confronted with considerable challenges. They needed time and ability to offer school-related help and handle the mental strain posed by the lockdown situation. How parents dealt with the challenges of the pandemic and school closures, depended on the family situation, their personal resources, and the process characteristics of the HLE (Prime et al., 2020). Hence, parents experienced the pandemic in very different conditions. In addition, parents' ability to provide support to their children and their own wellbeing or stress can be assumed to be interdependent (Kohl et al., 2000; Yeung et al., 2002; Baranov et al., 2020).

During the course of the pandemic, discussions in the public and academic community shifted toward the negative academic and socio-emotional consequences on children due to the absence of professional teaching in an institutional setting and the loss of social contacts (Loades et al., 2020; Kaffenberger, 2021). These consequences were suspected to vary strongly as a result of social inequality, with the public and researchers aware of the danger that existing inequalities would be exacerbated by the pandemic (Eickelmann and Drossel, 2020; Huebener et al., 2020; Wößmann et al., 2020). In a similar vein, differences in the availability and use of technological resources in families were also likely to deepen social inequalities (Sari et al., 2021).

The discussion of the problematic cognitive and socio-emotional effects of school closures mainly focused on children (Loades et al., 2020; Kaffenberger, 2021). The challenges posed on parents by school closures, on the other hand, were often brought up in the context of the operational compatibility of homeschooling, the frequently changing working situations, and lack of childcare offers (Möhring et al., 2020; Müller et al., 2020).

As parents' emotional and cognitive ability to deal with the challenges of home learning is a most important determinant of the consequences of school closures on children (see e.g., Spinelli et al., 2020), it seems worthwhile to investigate the conditions affecting their emotional and cognitive potential to face the pandemic. Identifying these conditions is not only of academic interest, but a requirement in offering appropriate practical support to families challenged by the school closures. Hence, the aim of the present paper is to investigate the emotional as well as the cognitive dealing of parents of elementary students as these parents had to manage childcare and support the learning of their children. As the conditions differed between families already before the pandemic (e.g., Hart and Risley, 1995; Bradbury et al., 2015), a longitudinal view was needed to take pre-existing differences into account. To do so, the present paper analyzed longitudinal data. As social inequalities are assumed to have

increased, one main aim of the present paper was to analyze whether preceding social differences influenced how parents dealt with the challenges of the pandemic, focusing on their emotional stress and their ability to support the learning of their child at home.

THEORETICAL AND EMPIRICAL BACKGROUND

The Role of Parental Support and Parental Stress in the Homeschooling Situation

Recent empirical research on children's dealing with homeschooling showed that some children have troubles adjusting to the unfamiliar situation of learning at home (e.g., structuring their day, their tasks and to motivate themselves to learn) without professional guidance (Champeaux et al., 2020; Davis et al., 2020; Huber et al., 2020). Unlike regular school days, parents in homeschooling have a much bigger responsibility for ensuring that their children learn the subject matter (Greenhow et al., 2021). This applies especially for parents of younger school children. Supporting children requires parents to have both the ability to understand the school material and the didactic skills to convey it. Furthermore, parental self-efficacy in teaching is found to be a predictor of parent-child conflict (de Jong et al., 2021). Consequently, we assume that parental support of learning is a focal point of children not losing touch with the learning content and a crucial predictor of their educational trajectories during the pandemic. In addition to the aspect of practical support with subject matter, the emotional support of the parents can be considered as an important determinant of children's academic success in home learning (see, e.g., Mayo and Siraj, 2015). Emotional support, parental warmth and affective involvement are requirements of children's cognitive and socioemotional development and depend on parents' mental wellbeing (Conger et al., 1992; Wu et al., 2019), which comes under pressure in the pandemic (Spinelli et al., 2020). Even before the pandemic, qualitative research in U.S. families, who decided voluntarily to teach their children at home, described the integration of the teacher role in parent's everyday life as emotionally challenging up to causing emotional burnout (Lois, 2006). Thus, we consider parents' perceived stress as a determinant for the ability to face the challenges of homeschooling and provide emotional support to the child.

Conceptual Framework on Risks to Families' Wellbeing in the COVID-19 Pandemic

Already in the first lockdown of the pandemic, Prime et al. (2020) proposed a conceptual framework representing how the pandemic would potentially influence different parts of the family – the children, parents, and the family as a whole. Similar to bioecological models of development (e.g., Bronfenbrenner and Morris, 2006), the framework assumes that children are influenced by both distal factors and proximal processes in the pandemic. As central determinant of the family processes during the pandemic, the framework focuses on a cascading effect, starting from an unexpected increase of daily stressors directly connected to the pandemic, like financial insecurity and social distancing. These stressors exert a detrimental influence to the mental well-being of caregivers, which in turn shows harmful effects on the parent–child-interaction, the marital relationship and the family system as a whole. Further, the framework also suggests that pre-existing vulnerabilities (e.g., economic hardship, mental health) may influence how parents cope with the situation of the pandemic. The pandemic is assumed to have a bigger impact on families with a lower socioeconomic background (Prime et al., 2020).

Family Stress Model and Family Investment Model

In a similar but more specific direction, parental emotional strain and the ability to offer school-related help to the child are crucial factors in two of the most prominent theoretical models that explain the links between the socioeconomic background of the family and disparate academic and socio-emotional developmental outcomes of the child: the Family Stress Model (FSM; Conger et al., 1992) and the Family Investment Model (FIM; Conger and Donnellan, 2007):

According to the FSM (Conger et al., 1992), socioeconomic disparities in the academic and socio-emotional development of children are mediated by parental emotional strain. The model assumes that strain is caused by economic scarcity and negative economic events which lead to parent's depressive symptoms, an increase in marital conflicts, and in turn detrimental parenting behaviors, which influence children's cognitive and socio-emotional development adversely. Abidin's (1992) Parenting Stress Model focuses on parenting stress and extends the FSM by adding the crucial role of child characteristics which also can explain or influence parenting stress. Accordingly, children's social skills and problem behavior predict parental mental strain (Abidin, 1995).

The FIM (Conger and Dogan, 2007; Conger and Donnellan, 2007) describes another pathway for the effect of families' social background on children's health and cognitive and socio-emotional development. Rooted in economic theory (Mayer, 1997), the FIM deals with the ability of the family to invest financial, social and human capital (e.g., involvement in the academic education of the child) in the development of the child. This ability depends on the allocation of resources in the family. While parents with a lower socioeconomic status (SES) need to invest most of their resources meeting immediate needs (e.g., housing, food, clothing), parents with a higher SES possess excess resources which allow them to invest more in their child's development. According to Conger and Donnellan (2007), there are several mediators of the effects of financial, social, and human capital on child outcomes: standard of living; residence in a more or less protected and fostering environment; the provision of learning materials and the parent's stimulation and support of learning, both directly and through external training. The latter is more specifically related to the parent's

involvement in the academic education of the child. Hence, parent's ability to help his or her child with schoolwork can be seen as one aspect of parental investment (Simons et al., 2016) and has been found to be a strong predictor of children's academic outcomes (Liu and Leighton, 2021). Kohl et al. (2000) suggest disentangling the SES into its components (income, occupation, parental education) when investigating its effects on parental involvement in children's learning. Consequently, they solely examine the structural influence of parent's education, for which they find significant fostering effects on parental involvement at home (but there are also studies pointing out the crucial role of the material family background in predicting the parental home involvement, see, e.g., Green et al., 2007).

Yeung et al. (2002) suggested that the potential pathways of structural effects on child outcomes should not be investigated in isolation. They propose a two-way model according to which emotional distress impairs parental engagement in stimulating learning activities, on the one hand, and previous parental investment in the HLE influences perceived mental strain, on the other. Yeung et al. (2002) only found empirical evidence for the beneficial effect of previous parental investment on parental stress. With data from a 16-year longitudinal study, Wu et al. (2019) reported mothers' depression to decrease the provision of emotional and material learning support to their child. They also found low maternal support in middle childhood to predict higher levels of maternal depression later on. In addition, based on an intervention study on depressed mothers, Baranov et al. (2020) reported decreasing maternal depression to have long-term beneficial effects on parental investment as well. Taking a multi-dimensional approach on parental investment in children's education, Kohl et al. (2000) differentiated parental involvement in school activities, exerting stimulating activities with the child and parent-teacher contact. They investigated risk factors for these dimensions of involvement and found, among other things, maternal depression to exert adverse effects on nearly all dimensions. This points to a potential reciprocal effect between the parent's ability to provide support and his or her perceived stress, suggesting that an integrated analysis of the predicting factors for both parental outcomes is required.

To sum up, the theoretical models introduced above propose different (pre-existing) aspects that may influence how families and parents cope with the challenges of the pandemic and, in turn, influence how the child copes and develops. Following the models (Conger et al., 1992; Conger and Donnellan, 2007), it seems worthwhile, on the one hand, to investigate the influence of structural social differences on how parents dealt with the pandemic. On the other hand, potential mediators such as individual psychological and family process aspects (e.g., home learning environment/stimulating activities; Kluczniok et al., 2013) should be taken into account in the analysis of social differences.

Family Stress and Family Investment During the Pandemic

In regard to both models, the FSM and the FIM (Conger et al., 1992; Conger and Donnellan, 2007), the COVID-19-pandemic can be conceptualized as an additional challenge to all families with children. However, the expected burden seems higher for disadvantaged families.

In the FSM, the COVID-19-pandemic and therefore the school closure can be modeled as a collective stressor (Zinn and Bayer, 2021), which presents a challenge to all parents. It could be assumed that the disparities in the available resources of families and the mental health of parents prior to the pandemic, however, result in parents perceiving the challenges accompanying the lockdown differently, leaving disadvantaged families mentally more worn out. For example, Zinn and Bayer (2021) found that lower-educated parents and single parents report a higher amount of stress during the pandemic. On top of that, parents with lower SES had a higher risk of being affected by short-time work measures or of losing their jobs during the pandemic and had fewer possibilities of working from home (Kleinert et al., 2020). Such negative economic events as well as the lack of health protection and possibility to supervise one's child's learning can function as additional stressors, further increasing the mental strain of parents (Calvano et al., 2021).

Recent empirical studies have investigated the predictors of parental experience of emotional demands such as stress, anxiety, and parent-child interaction in the context of the COVID-19 pandemic and found an influence of factors directly related to the pandemic situation (e.g., Brown et al., 2020; Davis et al., 2020; Cheng et al., 2021; Racine et al., 2021). For example, Brown et al. (2020) investigated the impact of the COVID-19 pandemic on parental perceived stress. They showed that – besides a higher number of COVID-19 related stressor – high anxiety and depressive symptoms were associated with the perceived stress of the parents. Further, Brown et al. (2020) used children's problems with learning in homeschooling as an aspect of the cumulative scale of COVID-19 related stressors, which was associated with higher levels of perceived parental stress. Davis et al. (2020) examined the effects of homeschooling on parents' mental health and corroborated the promoting role of children's struggling with homeschooling in parents' anxiety and depressive symptoms. Cheng et al. (2021) reported that the necessity to care for their children during the lockdown led to an increase in mental health problems among working parents. In addition, the support provided to parents, for example, in the form of childcare, had a significant negative effect on depressive symptoms (Racine et al., 2021) and perceived stress (Brown et al., 2020) both of which decreased as support increased. This also holds true for the perceived support provided by schools (Porsch and Porsch, 2020). Furthermore, besides the impact of disruptive economic events, such as loss of income or employment (Cheng et al., 2021; Racine et al., 2021), the parent's mental framing of the situation also had an effect: acceptance and perceived control of the situation were associated with lower perceived stress (Brown et al., 2020; Chung et al., 2020).

In addition to factors directly associated with the pandemic, the personal and structural conditions of parents and families prior to lockdown had an effect on the (perceived) stress during school closings (e.g., Brown et al., 2020). Based on self-reports, some cross-sectional studies (Brown et al., 2020; Chartier et al., 2021) found associations between perceived stress during

the pandemic and depressive symptoms and levels of stress reported prior to the pandemic. Longitudinal data backing up this correlation are scarce (for longitudinal results on mental health, see Cheng et al., 2021; for longitudinal results with history of mental illness as predictor, see Racine et al., 2021). Moreover, demographic and structural factors impacted the perceived emotional stress during the pandemic. For example, Brown et al. (2020) found disparities in COVID-19-related stressors, such as parental mood and stress, among different ethnic groups, with members of minorities showing higher levels of stressors. Further, research has shown that women as well as younger parents and lower-educated parents experienced significantly higher levels of peritraumatic stress during the lockdown than men, older parents and higher-educated parents (Chartier et al., 2021). Going in a similar direction, Porsch and Porsch (2020) found stronger experiences of stress in female parents and in families with a higher numbers of school-aged children, but their results regarding the education of the parents were not in line with those in other studies. They reported that higher-educated parents experienced higher levels of stress. However, as they did not have any information on the preceding levels of stress and the previous family situation, a causal interpretation of this finding seems questionable. Porsch and Porsch (2020) also identified a negative association between the parental self-efficacy in supporting the child with school subject matter and the experience of stress and anxiety.

In the FIM (Conger and Dogan, 2007; Conger and Donnellan, 2007), parents' obligations to accompany their child with his or her everyday learning and to carry out parts of school teaching themselves represent an investment need, which only higher-SES parents can fully meet. To provide adequate support to a child in a homeschooling situation, parents, relatives, and friends have to be able to understand and explain schoolwork, in addition to finding time to be involved in the child's learning. If this ability to provide support is low, extra training and support for the child can be provided by external trainers, but this is commonly subject to payment of a fee.

Bol (2020) investigated parental ability to support their child with schoolwork during the lockdown using data from the Dutch LISS panel study. He found that parents' subjective assessment of their ability to help their children with schoolwork was more positive for parents with higher educational degrees than parents with lower educational degrees. Furthermore, parental ability to support their child was identified as a crucial predictor for actual parental support. Socially privileged parents were already shown to have a higher ability to support their child before the COVID-19 pandemic and school closures (e.g., Anger and Plünnecke, 2020). These findings do not relate to the quantitative aspect of support. Whereas no social differences were found in the time spent supporting a child with homework (Lee and Bowen, 2006; Luplow and Smidt, 2019), effects were found for the quality of assistance (Dumont, 2012; O'Sullivan et al., 2014). Besides parental ability to provide help, the availability of material learning resources for homeschooling in a family (e.g., computers, tablets, wireless internet access) was associated with actual learning support (Bol, 2020; Sari et al., 2021). The availability of the necessary technological infrastructure for remote learning, for its part, depended on the economic resources of a family (Greenhow et al., 2021).

The previous empirical findings (e.g., Bol, 2020; Brown et al., 2020) support the assumption that different social and personal aspects play an important role in how parents deal with the pandemic. The conceptual framework (Prime et al., 2020), representing the impact of the pandemic on children, parents, and families, already proposed that not only aspects during the pandemic play a role, but also pre-existing vulnerabilities. Hence, the present paper aimed to investigate if pre-existing structural, process, and psychological characteristics of parents and children influence how parents deal emotionally and how they managed to support their child's learning during the pandemic.

PRESENT STUDY

The present paper examines how parents of second-graders experienced the time during the first school closures in the COVID-19 pandemic in Germany, focusing on two aspects. The first aspect is the parent's perception of their ability to support their child with home learning during the lockdown. The second aspect is the emotional stress experienced by parents during school closure. The aim of the paper is to determine which preceding structural and processual aspects of the family as well as psychological characteristics of the responding parent and the child helped parents to handle the challenge of navigating their own work, homeschooling, and childcare all at once. To answer the research questions, the present paper used longitudinal data collected in the Newborn Cohort Study of the National Educational Panel Study (NEPS). These data allow an analysis of how different aspects of family life before the pandemic help parents to handle the cognitive and emotional challenges during the school closure caused by the pandemic.

The following preceding aspects of family's and personal characteristics were assumed to impact parents' ability to provide support to their child as well as parents' emotional stress during the lockdown as a result of the pandemic.

(1) Structural characteristics of the families, such as SES and education. Based on the predictions of the FSM (Conger et al., 1992), parents with a lower SES report more emotional stress than parents from a higher socioeconomic background. According to the FIM (Conger and Dogan, 2007; Conger and Donnellan, 2007) and current empirical research in the context of the COVID-19 pandemic (Bol, 2020), parents with lower levels of education assess themselves as less able to support the child with schoolwork.
(2) Process characteristics of the family, such as the home learning environment (HLE). We assumed that parents who were able and used to offering their child a stimulating HLE already before the pandemic, were better prepared for the extra investment in learning support and emotional challenges during school closure. We expected parents who reported a more stimulating learning environment before the pandemic to report that they were more able to provide support and have fewer emotional difficulties during the

pandemic. Furthermore, we expected the HLE to function as a mediator of the structural effects on the outcomes during the pandemic.

(3) Psychological characteristics of the parent (focusing on the main caregiver), such as psychological stress. We expected parents with a higher level of psychological stress in the years before the pandemic to experience more problems in dealing emotionally with the pandemic as well as having more difficulties supporting their child's learning.

(4) Psychological characteristics of the child, such as self-regulation as well as school-related independence. We expected parents of children with a higher level of self-regulation as well as school-related independence to report fewer difficulties during the pandemic, both emotional strain and difficulties in supporting the child.

MATERIALS AND METHODS

Sample

The present paper used data from the Newborn Cohort Study of the NEPS (Blossfeld and Roßbach, 2019). This cohort study has a representatively drawn sample of around 3,500 infants born between February and June 2012 and their mothers (Weinert et al., 2016). Each year, the mother or another responding parent (since wave 2) take part in a computer-assisted parent interview. Further, in each wave the competencies of the children are assessed. Hence, the Newborn Cohort Study has both data from the years before the pandemic (waves 1–8) and data which collected during the pandemic (wave 9). Further, in wave 9 – in addition to the regular assessment – a short questionnaire regarding the COVID-19 pandemic was integrated into the survey in addition to the regular assessment. The present paper analyzes data from the cohort study waves 7–9 for children aged from 6 years (Kindergarten) to 8 years (Grade 2). The data from wave 9 were collected from June to August 2020, after schools started to reopen. In total, 1,848 families took part in the survey. For the present paper we included data from 1,812 families who responded in wave 9 and for whom data from waves 7 and 8 were available (regardless of responding parent). In that sample, we treated values from waves 8 or 9 as missing if the responding person changed in the corresponding waves.

We applied a weighting procedure to account for a sample bias toward higher-educated parents and misbalances in other sample characteristics to increase representativeness of the results (for details, see also section "Analytic strategy"). In wave 9, the mother was the responding parent in 98% of the families; the mean age of 39 years (weighted; 40 years unweighted)[1]. The responding parent had approximately 13.73 years of education (SD = 2.32; unweighted: mean = 15.43, SD = 2.29), and around 22% (weighted; 16% unweighted) of the responding parents had a migration background (born outside of Germany). Around 55% (weighted; 50% unweighted) of the participating children were female in wave 9.

[1] Due to questions about the pregnancy and breastfeeding, the mother was aimed to be the respondent in the first wave. After that, a change of respondent was possible only in few exceptions. This explains why in the most cases the mother is still the respondent in the Newborn Cohort of the NEPS.

Research Instruments

Dependent Variables

Self-Assessment of Supporting Abilities

In the COVID-19 questionnaire in wave 9, the responding parents were asked to assess their own ability to support their child's learning at home at this time during school closure in terms of learning content: "How do you assess your ability to support your child with content during the school closure to help your child learn at home at this time?". They could respond using a 4-point-scale from "completely sufficient" to "completely insufficient" (the scale was reversed for all analyses).

Perceived Stress

The second dependent variable was the perceived stress of the responding parent. The parents were asked to answer the following statement on a 5-point-scale, ranging from "does not apply at all" to "does completely apply": "I was very stressed by the school closure and the demands of homeschooling."

Predictors

Structural Aspects

As structural aspects the following two variables were considered:

The first variable was the years spent in education by the responding parent (as a function of CASMIN; König et al., 1988).

Second, the highest International Socioeconomic Index of Occupational Status (ISEI-08, Ganzeboom et al., 1992) of both parents was included (HISEI). The ISEI hierarchizes the occupational status of a person's last occupation according to the average earning and education of individuals with the respective occupation. The HISEI was utilized as an indicator of the SES of the family.

Process Aspect

The following process aspect was used as indicator of parental investment in the child's education:

Facet of the HLE. Based on the FIM, we included joint stimulating activities to cover former facets of the HLE. Joint activities were assessed in wave 8 (first grade) using four items (Melhuish et al., 2008). For example, the parents were asked how often they (or someone else in the household) read or tell stories to the child (see **Supplementary Table 1** for all items as well as the indices of the measurement model). The responses on the 8-point-likert scale ranged from several times a day to never (the scale was reversed for all analyses). Although the internal consistence (Cronbach's alpha) was questionable (0.62), in confirmatory factor analysis (CFA) the measurement model showed an acceptable fit (for the utilized cutoff criteria and detailed information see section "Analytic strategy").

Psychological Characteristics of the Parents

Psychological Stress. Psychological stress was measured in wave 7, last year before the children started school. The psychological stress measure included five items. First, the parents were asked to specify how often they had felt depressed or sad in the last 4 weeks using a 5-point Likert scale with responses ranging from

"never" to "always" (adaption of SF-12 from SOEP-Study; Ware et al., 2002; Goebel et al., 2019). Second, aspects of parenting strain were includes, such as if the parents suffered from being restricted to role as mother/father. Here, the 4-point Likert scale ranged from "completely disagree" to "completely agree" (adaption from SOEP-Study; Goebel et al., 2019; for negative items the scale was reversed for all analyses). Cronbach's alpha was 0.68; the measurement model again showed an acceptable fit. No data were collected on psychological stress in wave 8. Hence, psychological stress and the structural aspects were measured at the same time point.

Psychological Characteristics of the Child

School-related independence of the child. As an important characteristic of child, the school-related independence of the child was used (adaption of FEESS from BiKS-Study; Rauer and Schuck, 2003; von Maurice et al., 2007). In wave 8, parents rated items such as "the child does most of his/her homework on his/her own" using a 4-point Likert scale ranging from "does not apply at all" to "does completely apply" (the scale was reversed for negative items for all analyses). Overall, the construct was measured using three items; Cronbach's alpha was 0.67. Results of CFA were uninformative for the measurement model due to the low number of indicators and resulting zero degrees of freedom (West et al., 2012).

Self-Regulation. Self-regulation of the child was measured in wave 7 using three items. To this end, parents rated aspects such as whether the child calms down relatively quickly if it doesn't get what he or she wants, using a 4-point Likert scale ranging from "does not apply" to "does apply" (the scale was reversed for negative items for all analyses; German version of the California-Child-Q-Sort, adaption from BiKS-Study; Göttert and Asendorpf, 1989; von Maurice et al., 2007). Cronbach's alpha was 0.68. As with school-related independence of the child, the number of indicators of the measurement model was too low to obtain meaningful model fit indicators in CFA.

Control and Additional Variables

To take demographic factors and the contextual frame of parental experiences during the pandemic into account, we included a number of control variables. First, the sex and age of the responding parent as well as the sex of the child were included. Further, to control for different household settings, we collected information about the number of children under 14 years in the household in waves 8 and 9.

The extent to which a child struggled with homeschooling was assumed to be a crucial covariate of the outcomes. If it is also a mediator of structural, processual, and personal effects on the outcomes, could not be tested in the present study. As data on the child's struggles with homeschooling were collected at the same time point as the parent's report on their ability to provide support with homeschooling and deal with stress, we can only look at the association between these factors and cannot claim a specific directionality of the effects. Due to missing information about employment status during the lockdown (for relevance, see Porsch and Porsch, 2020) for the whole sample, we considered the employment situation of the responding parent before lockdown at wave 9. We also considered the childcare situation during lockdown and the perceived control of the respondent over his or her live during the pandemic.

In addition to the structural predictors discussed above, another structural aspect of the family that was found to correlate with COVID-19- related stressors such as parental stress and bad health, is being part of a minority (Brown et al., 2020). As the investigated minorities (e.g., African and Latin Americans) were also socioeconomically disadvantaged, we assumed the main effect to be attributed to these structural inequalities. Therefore, belonging to a minority was not the focus of our research. Nevertheless, we included migration background in additional analyses to check for independent effects of being part of a minority (the results of the models with weighted and unweighted data can be found in the **Supplementary Figures 2**, **3**). Migration background was operationalized as the respondent being born outside of Germany.

Analytic Strategy

Already in wave 7, the Starting Cohort 1 of the NEPS showed a severe bias toward higher-educated respondents (approximately 47% of responding parents hold an academic degree) due to a higher rate of attrition among lower-educated parents in the panel. To limit bias and increase representativeness, we applied a weighting procedure (see Würbach et al., 2021) to account for disproportionalities between our sample in wave 9 and the micro-census quota (Lüttinger and Riede, 1997). The sample was adjusted to comply with the current micro-census quota in terms of education (ISCED; UNESCO Institute for Statistics, 2012), country and year of birth of the parent, federal state, size of the place of residence and employment. After an iterative weighting procedure, each case received an individual weighting factor. In this paper, sample characteristics are presented for both the unweighted and weighted data. Statistical analyses were conducted with the weighted and the unweighted data set. The results of the analysis with weighted data are presented in the paper; results of the analysis with unweighted data are presented in the **Supplementary Material**.

For the evaluating of the measurement models of the latent variables we performed CFA and utilized the cutoff criteria proposed in Hu and Bentler (1999; CFI $\geq$ 0.95, TLI $\geq$ 0.95, RMSEA $\leq$ 0.06) to identify acceptable model fit (the model fit indicators of all measurement models can be found in the **Supplementary Table 1**). We applied structural equation modeling (SEM) to investigate the effect of the structural aspects of the family measured at wave 7 on parental self-assessed ability to support the child and the perceived stress of the parent during the pandemic in wave 9. The process characteristics of the family and psychological characteristics of the responding parent and the child measured in wave 8 (HLE, school-related independence of the child), were modeled as mediators of the structural effects on parental outcomes. The process and psychological characteristics assessed in wave 7 were treated as independent variables (psychological stress of the parent, self-regulation of the child). As control variables, we considered the parent's sex and age, the child's sex, number of children under 14 years in the household, employment situation of the

responding parent before lockdown, childcare situation during lockdown, the perceived control of the responding parents, and the child's struggles with homeschooling. The analytic model is shown in **Figure 1**.

Further, we covaried the residuals of the two dependent variables, as there could be a reciprocal effect not explained by the common predictors and controls. Due to a lack of clear expectations regarding the directionality of influences because the measurement was carried out at the same time point, we covaried the residuals of the child's struggles with homeschooling with the residuals of both dependent variables. Similar to for the dependent variables, we predicted the child's struggles with homeschooling with the preceding structural, processual, and personal factors in order to take into account possible pathways of moderation.

For all analyses, we modeled predictors as latent variables where possible (except years of education and SES of the family). All controls were included as manifest variables.

Structural equation modeling were calculated using Stata 15.1. Missing values were treated with Full Information Maximum Likelihood Estimation (FIML). Postestimation procedures for SEM such as CFI, TLI, and RMSEA are inappropriate for survey estimation results using weighted data, as there is no sample likelihood value (StataCorp, 2021, p. 113). Hence, to obtain model fit indicators, we run our main model again with non-weighted data.

RESULTS

Descriptive Analyses

Table 1 shows the descriptive characteristics of the analyzed variables. Constructs measured with multiple indicators were represented by a mean index (find all indicators in the **Supplementary Material 1**). The mean values of self-assessed supporting abilities and perceived stress in wave 9 show a high self-efficacy expectation in parents with regard to their ability to support their child. However, perceived stress was also situated in the upper area of the scale.

Table 2 presents the correlations between the manifest predictors and outcomes and the mean indices of the multiple indicator constructs. Interestingly, the two dependent variables, self-assessed supporting abilities and perceived stress, showed no significant correlation (r_s = –0.03, $p > 0.10$). Both structural characteristics correlated with the ability of the responding parent to provide support. That means that parents with a higher education and socioeconomic background evaluated their abilities to support their child's learning during the school closures higher than parents with lower education and socioeconomic background. Of other assumed predictors, only psychological stress and the previously assessed self-regulation of the child showed an association with the supporting abilities (the child's previous self-regulation surprisingly showed a negative association). Perceived stress correlated with the SES of the family as well as three of the other predictors. The strongest association was with previous psychological stress. Only joint activities, as a facet of a stimulating HLE prior to the pandemic, did not correlate with the perceived stress of the respondent. All correlations including control variables can be found in the **Supplementary Table 2**.

Structural Equation Modeling of Dealing With the Pandemic

The main model, considered as a more complex model than a CFA (Weiber and Mühlhaus, 2010; West et al., 2012), demonstrated an acceptable fit with the unweighted data[2] [Chi^2 (248) = 643.76, CFI = 0.93, TLI = 0.91, RMSEA = 0.03]. All estimates of the structural model (performed with weighted and unweighted data) are presented in the **Supplementary Table 3**. Due to the bias in the sample in favor of higher-educated parents, the effects of the model calculated with unweighted data should be interpreted with caution.

Figure 2 shows all significant standardized estimates of the main model based on the weighted data (for the model with unweighted data see **Supplementary Figure 1**). We found a significant effect of the respondent's education on his or her ability to provide support (0.31); hence better-educated parents evaluated their ability to support the learning of their child higher than lower-educated parents. On the other hand, the second structural characteristic, the SES of the family, showed no effect. Most of the process and psychological characteristics did not predict self-assessed supporting abilities. Only the preceding psychological stress of the respondent showed a negative effect (–0.21); hence respondents who reported more psychological stress before the pandemic evaluated their ability to provide support during the pandemic lower than respondents with lower psychological stress prior to the pandemic. Further, a residual covariance of –0.26 was found with the child's struggles to deal with the school closure. In other words, parents reported a lower ability to provide support if their child struggled more with the situation, even after controlling for structural, processual, and psychological determinants and control variables. Further, none of the other control variables – namely age and sex of the respondent, sex of the child, number of children under 14 in the household, employment before lockdown, childcare situation and perceived control – showed a significant association with ability to support. No significant association was found between supporting abilities and perceived stress. Altogether, the considered constructs explained 21% of the variation of the respondent's ability to provide support.

The second dependent variable – perceived stress – was predicted negatively by the SES of the family (–0.23) and positively by the years of education (0.15). Thus, in families with a higher SES, the responding parent perceived lower stress. On the other hand, better-educated respondents reported more perceived stress during the pandemic than lower-educated parents. In line with our assumptions, respondents reporting more psychological stress before the pandemic also reported more stress during the pandemic (0.29). Further, the perceived

[2]Due to technical reasons, the common model fit indicators could not be calculated with the weighted data (StataCorp, 2021, p. 113). For that, we included at least the model fit of the estimation with unweighted data.

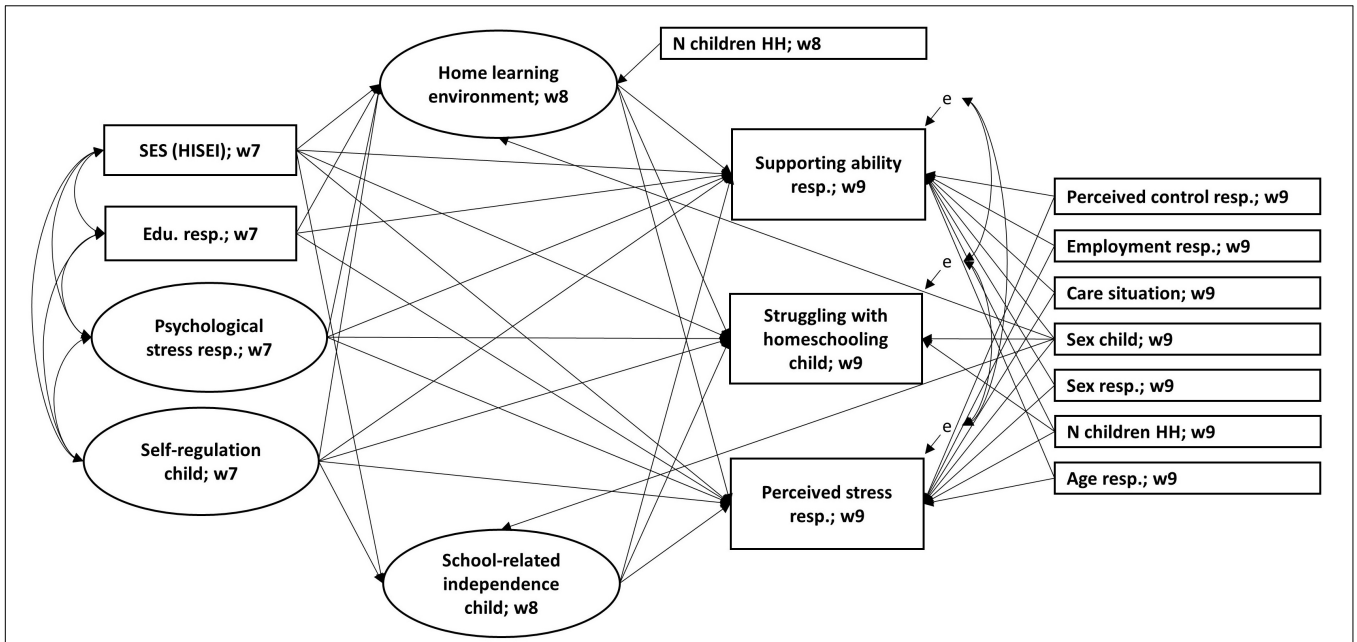

FIGURE 1 | Analytic model. All assumed and estimated paths are shown.

TABLE 1 | Descriptive statistics.

	N	Minimum	Maximum	*M*	*SD*
Dependent variables					
Self-assessed supporting abilities; w9	1,739	1	4	3.65	0.61
Perceived stress; w9	1,743	1	5	3.42	1.33
Structural aspects					
Education of respondent, years (CASMIN); w7	1,717	9	18	13.73	2.32
SES (highest ISEI of family); w7	1,810	14	89	55.38	19.81
Process aspect					
Home learning environment (mean of indicators); w8	1,708	1	7.75	4.78	1.23
Characteristics of the parent					
Frequency feeling depressed; w7	1,725	1	5	2.24	0.98
Parenting strain (mean of indicators); w7	1,725	1	3.5	1.60	0.46
Characteristics of the child					
Self-regulation (mean of indicators); w7	1,637	1	4	2.95	0.64
School-related independence (mean of indicators); w8	1,658	1	4	3.21	0.59
Control variables					
Child struggling with homeschooling; w9	1,742	1	5	2.01	1.02
Number of children under 14 years in household; w9	1,746	1	7	2.01	1.03
Number of children under 14 years in household; w8	1,707	1	7	2.01	0.97
Perceived control (1 = high, 5 = low); w9	1,745	1	5	3.48	1.22
Age respondent (years); w9	1,773	26	57	39.15	5.62
Sex respondent (1 = male); w9	1,748	1	2	1.98	0.13
Sex child (1 = male); w9	1,804	1	2	1.55	0.50
Care situation during lockdown (0 = only others caring; 1 = me and others caring); w9	1,748	0	1	0.84	0.36
Employment before lockdown (0 = not or spare-time employed; 1 = part- or fulltime employed); w9	1,746	0	1	0.83	0.38

Indicators collected in wave 7 (w7), wave 8 (w8), and wave 9 (w9). Mean and SD estimated with weighted data.

stress of the respondent not explained by the predictors and controls (residuals) covaried with the residuals of the child struggling during the pandemic (0.17). Consequently, parents, who reported more perceived stress also described their child as struggling more with the pandemic situation. Again, no significant associations between the other control variables and

TABLE 2 | Correlations (Spearman rho).

	2	3	4	5	6	7	8
1 Supporting abilities (w9)	−0.03	0.31***	0.21***	0.04	−0.11***	−0.06*	0.01
2 Perceived stress (w9)	1	0.05+	−0.13***	−0.03	0.20***	−0.06*	−0.16***
3 Education (w7)		1	0.53***	0.04	0	−0.10***	0.15***
4 SES (w7)			1	0.06*	0.08**	−0.19***	0.22***
5 HLE (w8)[1]				1	−0.11***	−0.02	−0.06*
6 Psychological stress (w7)[2]					1	−0.22***	−0.09**
7 Self-regulation (w7)[1]						1	0.15***
8 School-related independence (w8)[1]							1

*SES, socioeconomic status, highest ISEI of family; HLE, home learning environment; w7, wave 7; w8, wave 8; w9, wave 9. [1]Mean of indicators. [2]Mean of standardized indicators. Correlations estimated with weighted data. +p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.*

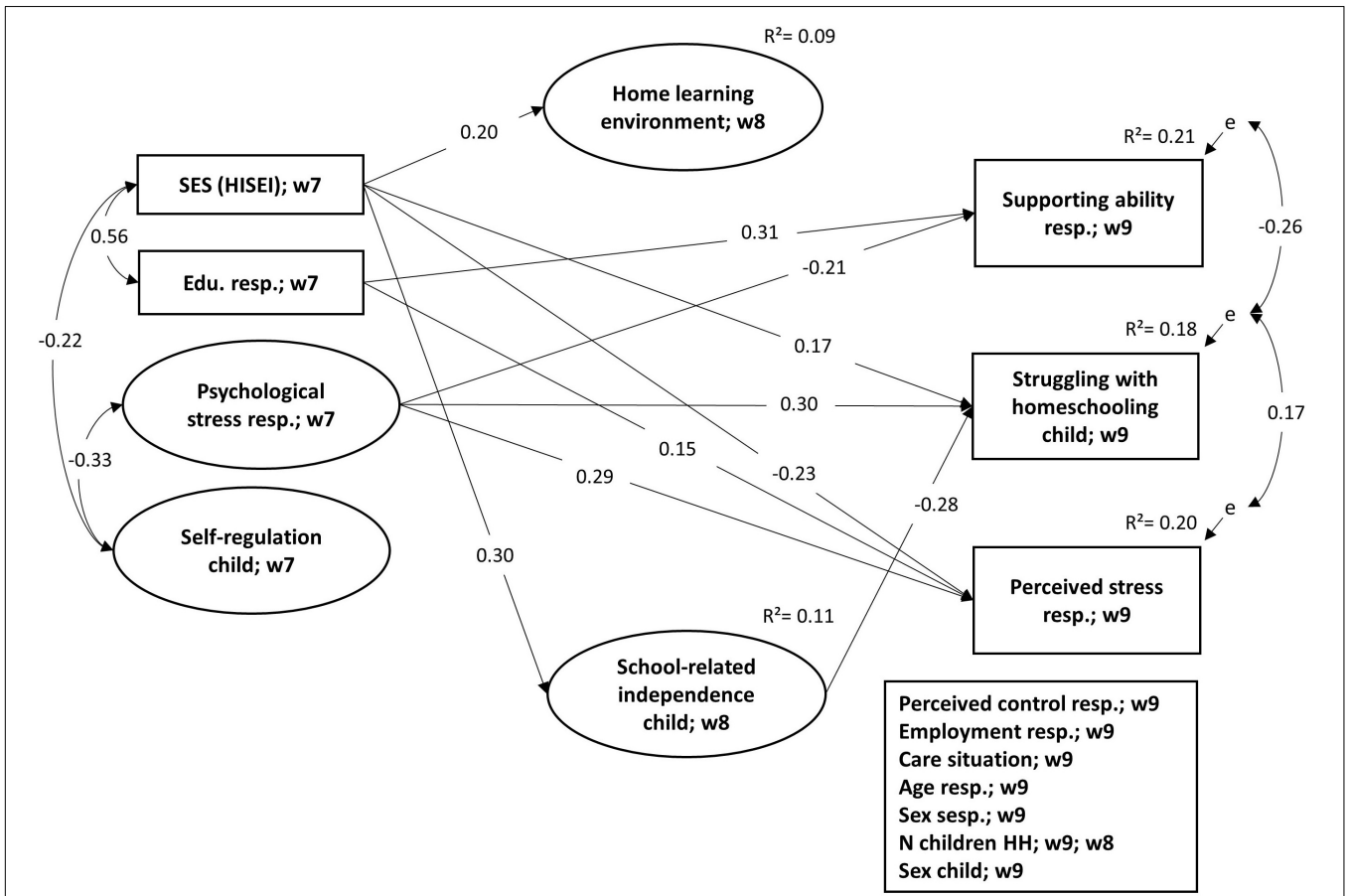

FIGURE 2 | Results of the structural equation model for self-assessed supporting ability and perceived stress during the school closure (algorithm mlmv). Only the significant standardized coefficients are presented ($p < 0.05$). SES, socioeconomic status, highest ISEI of the family. Edu. resp., education of the respondent in years. w, wave. Estimated with weighted data. Measurement models of latent variables in the **Supplementary Table 1**. Model fit of estimation with unweighted data: N = 1,812; Chi^2 (248) = 643.76, CFI = 0.93, TLI = 0.91, RMSEA = 0.03.

perceived stress were found. Taken together, the considered predictors explained 20% of the variance of perceived stress.

Further, the SES of the family also predicted the child's struggles (0.17), facets of the HLE (0.20), and school-related independence (0.30). Besides the remarkable weaker positive effect of the family's SES, the child's struggles during the pandemic were also predicted by the parent's previous psychological stress (0.30) and school-related independence of the child (–0.28). Thus, school-related independence mediated a negative effect of the family's SES on the child struggling during the lockdown (indirect effect: –0.08). The other control variables showed no significant association to the child struggling. Overall, 18% of the variance of the child's struggles with the homeschooling situation was explained by the considered variables. In addition, 9% of the

variance in home learning environment facets (here, a significant effect of child sex was found in favor for the girls) as well as 11% of school-related independence were explained by the independent variables and controls.

DISCUSSION

The COVID-19 pandemic has posed many challenges, especially for families. Already early in the pandemic, the public and scientific community started voicing concerns about the consequences of the pandemic on children and their development. However, parents have also been affected by the pandemic, which in turn influences their children (Conger et al., 1992; Bronfenbrenner and Morris, 2006; Conger and Donnellan, 2007; Kluczniok et al., 2013; Prime et al., 2020). The conceptual framework representing how the pandemic may affect children, parents, and families assumes not only a mutual influence between children and parents, but also a role of pre-existing vulnerabilities in how parents and children cope with the pandemic (Prime et al., 2020). Against this background, the present paper investigates the effects of the structural, processual, and psychological characteristics of parents and children on how parents of elementary students dealt in the pandemic longitudinally.

Based on the FSM (Conger et al., 1992) and the FIM (Conger and Donnellan, 2007), we expected the socioeconomic background of families and the education of the main caregiver to predict the responding parent's perceived stress and self-assessed ability to support his or her child during school closure in spring 2020. In line with the theoretical models, we further assumed that previous parental psychological stress, the child's psychological characteristics, and previous parental investment in stimulating activities would have an effect on perceived stress and the parent's ability to provide support.

The Role of Structural Characteristics in Handling the Challenges of the School Closures During the Pandemic

For our first research question, which addressed the role of structural characteristics, we hypothesized that SES would predict perceived stress and that the responding parent's education would predict his or her ability to provide support. The results of the structural equation model confirmed a significant negative effect of SES on parents' perceived stress during the pandemic. This is in line with the theoretical models and implies unobserved mediating effects playing into this finding in the form of economically determined living conditions (e.g., overcrowding – especially in homeschooling situations-, problems making ends meet and having to cut back on necessary expenses; see, e.g., Simons et al., 2016). As the NEPS does not provide such information, further research is needed to investigate the effects of living conditions and possible mediating effects. We did not find an effect of the family's SES on the responding parent's self-assessed ability to support the child. Surprisingly, the family's SES increased the extent to which the child struggled with homeschooling significantly, which in turn was associated with both parental outcomes in the pandemic. This finding is hard to classify. Higher expectations toward the child's academic performance and behavior as well as stronger monitoring of the child's learning in higher SES families (see, e.g., Stull, 2013; Guo et al., 2018) can be discussed as potential explanations. Nonetheless, a negative indirect path from family's SES on the child's struggles with homeschooling was also identified, mediated by the child's school-related independence. As data on the child's struggles were collected at the same time point as the parental outcomes, a mediation of the SES effects on parental perceived stress and ability to provide support by the child's struggles with homeschooling can only be taken into consideration. Due to the pandemic, there was another lockdown in winter 2021 in Germany. Hence, possible mediating effects can be verified by further research with a longitudinal view on the pandemic.

Furthermore, and contrary to our hypothesis, the responding parent's education was found to have a weaker yet also significant positive effect on perceived stress. This finding is surprising, but has also been reported in other studies (see Porsch and Porsch, 2020). In contrast, Zinn and Bayer (2021) reported the effect the other way around but did not control for SES of the family. It is important to keep in mind that this effect was only found when we controlled for the SES of the family in the SEM. In the bivariate correlations, the association between the parent's education and perceived stress did not reach significance. A possible explanation could be that higher-educated parents have a higher personal expectation to deal with the pandemic situation, leading to increased stress (Parker and Mills, 1996; Smith et al., 2021).

Based on empirical evidence (Bol, 2020; Sari et al., 2021), we expected the education of the responding parent to be the strongest structural predictor of self-assessed ability to provide support. The results of the structural equation model confirmed this expectation. Better-educated parents reported a higher ability to support the learning of their child than lower-educated parents. As already discussed by Zinn and Bayer (2021), the reason could be that higher-educated parents are in general more familiar with the educational system.

The Role of the Home Learning Environment in Handling the Challenges of the School Closures During the Pandemic

Based on the FIM (Conger and Donnellan, 2007), our second research question focused on the role of investment in the HLE prior to the pandemic as a predictor of the ability to provide support during the lockdown. Contrary to our hypothesis, we found no effects of the HLE, which was measured as the frequency of carrying out stimulating activities with the child one year prior to the lockdown, on the self-assessed ability to provide support during the first wave of the pandemic. A possible explanation for the lack of association are the differences in content between the operationalization of these two kinds of parental investment in the child's education. This result can give a hint that facets of parental investment other than stimulating activities played a role during the first school closure (e.g., information about and

involvement with schools' learning support and material). It's up to further research to set a clearer focus on different facets of the HLE and their role for dealing with the challenges caused by the pandemic.

Consequently, our expectation that the HLE would partially mediate the structural effects of parent's education and socioeconomic background on the ability to provide support has to be rejected. Nevertheless, we identified a positive significant effect of the family's SES on the HLE. It is not surprising that families with a higher SES report more frequent stimulating activities, as social differences in aspects of the HLE have often been found (Lehrl et al., 2012; Hayes and Berthelsen, 2020) and are already evident in the first years of life (Attig and Weinert, 2020).

The Role of Psychological Stress in Handling the Challenges of the School Closures During the Pandemic

Our third research question investigated whether a parent's psychological stress prior to the pandemic acts as a predictor of perceived stress during school closure. We found a clear positive effect of psychological stress measured 2 years before the pandemic on perceived stress during school closure. This finding replicates a number of previous empirical studies investigating the antecedents of parental mental health during the pandemic with cross-sectional data (Brown et al., 2020; Davis et al., 2020; Chartier et al., 2021). Hence, the present findings clearly confirm the association between previous psychological stress and perceived stress during the pandemic longitudinally (for roughly similar longitudinal findings, see Racine et al., 2021).

Beyond that, a significant effect of previous psychological stress on ability to provide support during the pandemic was detected. This kind of crossover influence is not formalized in the Family Stress or the FIM. For the FSM it could be argued that supporting the child is parent–child interaction and therefore is expected to be directly and indirectly influenced by parents' stress (Conger et al., 1992). The self-assessed supporting ability as a self-efficacy belief, however, is rather a possible predictor of actual interaction. Nevertheless, the association between parental stress and self-reported ability to support is identified in empirical studies (e.g., Kohl et al., 2000; Baranov et al., 2020). In a cross-sectional study conducted in Germany, Porsch and Porsch (2020) found that parental self-efficacy beliefs on their ability to provide support with the child's schoolwork during the pandemic was a negative predictor of parental mental stress. As they had only data from the time of the pandemic, a causal interpretation of these results was not possible. Our longitudinal data point to previous mental stress rather being a predictor of self-assessed ability to provide support, than the other way round. Further research is required to confirm this finding.

Another possible pathway of the effects of previous psychological stress on both parental outcomes is the noticeable increasing effect of psychological stress on the child's struggles with the homeschooling situation, which is associated with perceived stress and the ability to provide support during the pandemic. However the question arises as to whether this effect is due to a biased evaluation of the child's behavior by mentally strained parents (see, e.g., Najman et al., 2001).

Based on the theoretical models (Conger et al., 1992) and empirical evidences (Brown et al., 2020; Chartier et al., 2021), it can be assumed that previous psychological stress is a mediating factor of the structural effects on the perceived stress during the lockdown. However, as previous psychological stress was measured on the same occasion as the structural background factors, no mediation could be tested. Furthermore, the covariance between SES as well as the responding parent's education and psychological stress did not attain significance; therefore, the data did not support any further plausible assumptions of a mediation.

The Role of Characteristics of the Child in Parents' Handling of the Challenges of the School Closures During the Pandemic

Our last question focused on whether the characteristics of the child predicted parental handling of the challenges of school closure. In accordance with Abidin's (1992) Parenting Stress Model, we expected the child's social skills and problematic behavior to predict parental outcomes in the pandemic. The child's self-regulation and school-related independence both showed no significant influence on parents' self-assessed ability to support the child with schoolwork or perceived stress during school closure. Nevertheless, the child's previous school-related independence decreased the extent to which the child struggled with the homeschooling situation, which in turn was associated with both parental outcomes. A possible mediating effect can be discussed.

To sum up, the present study utilizes pre-pandemic measurements of families' structural and process characteristics and the psychological characteristics of the parents and the child to explain the perception of parental challenges during the COVID-19 pandemic. It thus provides a longitudinal perspective on the antecedents of parents' ability to handle these challenges. In addition, it includes the central mediators from two different prominent models explaining the mechanisms of the impact of structural background on child development (Conger et al., 1992; Conger and Donnellan, 2007), thus providing a benefit by focusing on several pathways of mediation. Furthermore, the study offers opportunities to investigate interdependencies between parental investment and parental stress – in terms of both cross-sectional and longitudinal associations. Adding to previous research, the results of the present paper show that pre-existing social differences as well as pre-existing psychological stress influence how parents deal with the pandemic. Nevertheless, further research is needed to analyze how these factors influence child development, particularly with regard to the still ongoing pandemic accompanied with the challenges for families.

As the Newborn Cohort Study of the NEPS collected further data on the COVID-19 pandemic in wave 10 after the second school closure in winter 2020/2021, future research can use the potential of longitudinal modeling to investigate the development

of parental perception of challenges during the pandemic as well as its predictors and moderators. The cognitive and socio-emotional outcomes of the child could be included in future studies. This might potentially provide empirical backup for the theoretical assumptions that parental investment and stress in the pandemic predict the child's development and mediate structural effects of the family (Conger et al., 1992; Conger and Donnellan, 2007). In addition, information is available on the schools' support of home learning which could be included in future research.

Strength and Limitations

Utilizing data of the Newborn Cohort of the NEPS, this study contributes to research on the challenges posed on parents of second-graders by the COVID-19 pandemic by using longitudinal data from a large scale survey. Drawing on the benefits of structural equation modeling, the present study investigates how parents dealt with the cognitive and emotional challenges of the pandemic in a joint model. Further, as the NEPS provides longitudinal data, not only information assessed during the pandemic was considered, but also data from the years before the pandemic. This enabled us to analyze the impact of pre-existing social differences in the families as well as the process characteristics of the family and psychological characteristics of parent and child. Another strength of this study is the use of weighting procedures in the main model before interpreting the effects, which limited bias and increased representativeness of results obtained with the present sample under study. Further, we applied FIML to deal with missing values which are inevitable in longitudinal data.

However, the present study is not without limitations. First of all, our dependent constructs were operationalized by only one variable each. This means that our items only represent a narrow aspect of the respective constructs under investigation. Measurements with one variable are more vulnerable to measurement errors as well as to unknown biases in meaning and interpretation than measurements with more variables. Furthermore, single item indicators suffer from a low sensitivity. This means that a single item provides fewer points of discrimination than multiple items (Nunnally, 1978; McIver and Carmines, 1981). Hence, with regard to that, our results must be interpreted with caution. For example, it could be assumed that the missing association between preceding investments in the HLE and the ability to support during the pandemic is a consequence of this reduction of facets of the construct. Unfortunately, for economic reasons, the amount of survey time was limited, so only a few questions could be added to assess how parents were dealing with the pandemic.

In addition, even if the study follows a longitudinal perspective, we did not utilize strictly longitudinal methods. As the constructs were measured using different operationalizations over different waves, we could not apply repeated measurement methods and report mean level differences and trajectories.

A third limitation was the fact that the mother was the respondent of the survey in most cases. Hence, the sample contains only limited information about how fathers dealt with the situation. As already mentioned, in the first wave, the mothers were asked to be the respondent, and in most cases the mothers remained the respondent. Consequently, this sample does not allow research on sex differences in dealing with the pandemic, but that was not the focus of our paper. Nevertheless, the present study loses variation due to this specific sample, and the results should be interpreted with caution. Future research should take into account differences due to the sex of the respondent.

CONCLUSION

Taking family processes as well as personal and child characteristics into account, the present paper analyzed social differences in how parents of second-graders dealt with the challenges of the pandemic. To this end, it focused on two aspects, namely parents' perceived stress and their ability to support the learning of their child. As our analyses are based on longitudinal data, our results shed some light on the directionality of effects between structural, processual and psychological family conditions and parents' experience of the homeschooling situation. Besides the corroboration of results pointing out the crucial role of family's SES, our study shows some surprising results. Though the association between parental stress and parents' ability to provide support was found before (e.g., Kohl et al., 2000; Baranov et al., 2020; Porsch and Porsch, 2020), the relationship was not examined in the context of the COVID-19 pandemic or it was assumed that supporting ability influences mental stress (Porsch and Porsch, 2020). Our results showed that the preceding psychological stress of the parents predicted the supporting abilities during the school closures. Furthermore, parental education could not be confirmed as a protective factor against mental stress once the occupational status was controlled for, but on the contrary, higher education seems to increase parental perceived stress. This holds theoretical as well as practical implications.

For research on families' experiences in the COVID-19 pandemic, this suggests to regard parental stress as a predictor when investigating parental support of children's learning, even when following explanatory models not explicitly considering the role of mental health. Secondly, taking different aspects of SES into account can be recommended. Different facets of SES, like the occupation determining the family's material resources and education representing the cultural aspect, could be shown to have differential effects on the same outcomes in the pandemic.

Addressing the practical provision of support for families challenged in the pandemic, this draws attention on the mental health status of families. Family support after the school closures should not only focus on catching up on children's learning gaps in socially disadvantaged families. Providers should also take into account the potential emotional problems of parents and in the family system as a whole that could have arisen in the pandemic

and may in turn influence the child's learning. For example, providers of support and educators could encourage and help building social support networks between struggling families and connect them with community support resources like childcare offers or counseling.

DATA AVAILABILITY STATEMENT

This article analyzed the data from the National Educational Panel Study in Germany. The anonymized data are available for the scientific community at: https://www.neps-data.de.

ETHICS STATEMENT

The NEPS study is conducted under the supervision of the German Federal Commissioner for Data Protection and Freedom of Information (BfDI) and in coordination with the German Standing Conference of the Ministers of Education and Cultural Affairs (KMK) and—in the case of surveys at schools—the Educational Ministries of the respective Federal States. All data collection procedures, instruments, and documents were checked by the data protection unit of the Leibniz Institute for Educational Trajectories (LIfBi). The necessary steps are taken to protect participants' confidentiality according to the national and international regulations of data security. Participation in the NEPS study is voluntary and based on the informed consent of participants. This consent to participate in the NEPS study can be revoked at any time. All parents of the Newborn Cohort of the NEPS give their agreement for participation and answering questions during the assessments as well as written consent for participating in the video-taped measures to each measurement point.

AUTHOR CONTRIBUTIONS

MV and MA contributed to the conception and the design of the manuscript. MV performed the statistical analysis. Both authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

This manuscript uses data from the National Educational Panel Study (NEPS): Starting Cohort Newborns, Scientific-Use-Files Version 8.0.1, *doi: 10.5157/NEPS:SC1:8.0.1* and the yet unpublished data packet B128_C3. From 2008 to 2013, NEPS data was collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network. We would like to thank all families who participated in the NEPS.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.750605/full#supplementary-material

REFERENCES

Abidin, R. R. (1992). The determinants of parenting behavior. *J. Clin. Child Psychol.* 21, 407–412. doi: 10.1207/s15374424jccp2104_12

Abidin, R. R. (1995). *Parenting Stress Index: manual*, 3rd Edn. Odessa, FL: Psychological Assessment Ressources.

Anger, C., and Plünnecke, A. (2020). *Homeschooling und Bildungsgerechtigkeit. IW-Kurzbericht, No. 44*. Köln: Institut der deutschen Wirtschaft (IW).

Attig, M., and Weinert, S. (2020). What Impacts Early Language Skills? Effects of Social Disparities and Different Process Characteristics of the Home Learning Environment in the First 2 Years. *Front. Psychol.* 11:557751. doi: 10.3389/fpsyg.2020.557751

Autorengruppe Bildungsberichterstattung (2020). *Bildung in Deutschland 2020 : ein indikatorengestützter Bericht mit einer Analyse zu Bildung in einer digitalisierten Welt*. Bielefeld: wbv Media.

Baranov, V., Bhalotra, S., Biroli, P., and Maselko, J. (2020). Maternal depression, women's empowerment, and parental investment: evidence from a randomized controlled trial. *Am. Econ. Rev.* 110, 824–859. doi: 10.1257/aer.20180511

Blossfeld, H.-P., and Roßbach, H.-G. (2019). *Education as a Lifelong Process. The German National Educational Panel Study (NEPS)*, 2nd Edn. Wiesbaden: VS Verlag für Sozialwissenschaften, doi: 10.1007/978-3-658-23162-0

Bol, T. (2020). Inequality in homeschooling during the Corona crisis in the Netherlands. First results from the LISS Panel *SocArXiv* [Preprint]. doi: 10.31235/osf.io/hf32q.

Bradbury, B., Corak, M., Waldfogel, J., and Washbrook, E. (2015). *Too Many Children Left Behind: the Us Achievement Gap In Comparative Perspective*. New York: Russell Sage Foundation.

Bronfenbrenner, U., and Morris, P. A. (2006). "The bioecological model of human development," in *Handbook of Child Psychology. Theoretical models of human development*, ed. R. M. Lerner (Hoboken, NJ: John Wiley & Sons), 793–828. doi: 10.1002/9780470147658.chpsy0114

Brown, S. M., Doom, J. R., Lechuga-Peña, S., Watamura, S. E., and Koppels, T. (2020). Stress and parenting during the global COVID-19 pandemic. *Child Abuse Negl.* 110:104699. doi: 10.1016/j.chiabu.2020.104699

Calvano, C., Engelke, L., Di Bella, J., Kindermann, J., Renneberg, B., and Winter, S. M. (2021). Families in the COVID-19 pandemic: parental stress, parent mental health and the occurrence of adverse childhood experiences—results of a representative survey in Germany. *Eur. Child Adolesc. Psychiatry* [Epub Online ahead of print] doi: 10.1007/s00787-021-01739-0

Champeaux, H., Mangiavacchi, L., Marchetta, F., and Piccoli, L. (2020). Learning at home: distance learning solutions and child development during the COVID-19 lockdown. *IZA Discussion Papers* 13819, 1–29.

Chartier, S., Delhalle, M., Baiverlin, A., and Blavier, A. (2021). Parental peritraumatic distress and feelings of parental competence in relation to COVID-19 lockdown measures: what is the impact on children's peritraumatic distress? *Eur. J. Trauma Dissociation* 5:100191. doi: 10.1016/j.ejtd.2020.100191

Cheng, Z., Mendolia, S., Paloyo, A. R., Savage, D. A., and Tani, M. (2021). Working parents, financial insecurity, and childcare: mental health in the time of COVID-19 in the UK. *Rev. Econ. Househ.* 19, 123–144. doi: 10.1007/s11150-020-09538-3

Chung, G., Lanier, P., and Wong, P. Y. J. (2020). Mediating effects of parental stress on harsh parenting and parent-child relationship during coronavirus (COVID-19) pandemic in Singapore. *J. Fam. Violence* [Epub Online ahead of print] doi: 10.1007/s10896-020-00200-1

Conger, R. D., Conger, K. J., Elder, G. H. Jr., Lorenz, F. O., Simons, R. L., and Whitbeck, L. B. (1992). A family process model of economic hardship and adjustment of early adolescent boys. *Child Dev.* 63, 526–541. doi: 10.1111/j.1467-8624.1992.tb01644.x

Conger, R. D., and Dogan, S. J. (2007). "Social class and socialization in families," in *Handbook Of Socialization Theory And Research*, eds J. Grusec and P. Hastings (New York: Guilford), 433–460.

Conger, R. D., and Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annu. Rev. Psychol.* 58, 175–99. doi: 10.1146/annurev.psych.58.110405.085551

Davis, C. R., Grooms, J., Ortega, A., Rubalcaba, J. A. A., and Vargas, E. (2020). Distance Learning and Parental Mental Health During COVID-19. *Educ. Res.* 10:0013189X2097880. doi: 10.3102/0013189X20978806

de Jong, P. F., Schreurs, B. G., and Zee, M. (2021). Parent–Child Conflict During Homeschooling in Times of the COVID-19 Pandemic: a key Role for Mothers' Self-Efficacy in Teaching. *PsyArXiv* [Preprint] doi: 10.31234/osf.io/feuj9.

Dumont, H. (2012). *Elterliche Hausaufgabenhilfe unter dem Blickwinkel sozialer Disparitäten: eine Untersuchung pädagogisch-psychologischer Prozesse*. Ph.D. thesis. Tübingen: Universität Tübingen

Eickelmann, B., and Drossel, K. (2020). *Schule auf Distanz*. Berlin & Düsseldorf: Vodafone Stiftung Deutschland gGmbH.

Ganzeboom, H. B., De Graaf, P. M., and Treiman, D. J. (1992). A standard international socio-economic index of occupational status. *Soc. Sci. Res*. 21, 1–56. doi: 10.1016/0049-089X(92)90017-B

Goebel, J., Grabka, M. M., Liebig, S., Kroh, M., Richter, D., Schröder, C., et al. (2019). The German Socio-Economic Panel Study (SOEP). *Jahrb. Natl. Okon. Stat.* 239, 345–360. doi: 10.1515/jbnst-2018-0022

Göttert, R., and Asendorpf, J. B. (1989). Eine deutsche Version des California-Child-Q-Sort: kurzform. *Z. Entwicklungspsychol. Padagog. Psychol.* 21, 70–82.

Green, C. L., Walker, J. M., Hoover-Dempsey, K. V., and Sandler, H. M. (2007). Parents' motivations for involvement in children's education: an empirical test of a theoretical model of parental involvement. *J. Educ. Psychol.* 99, 532–544. doi: 10.1037/0022-0663.99.3.532

Greenhow, C., Lewin, C., and Staudt Willet, K. B. (2021). The educational response to Covid-19 across two countries: a critical examination of initial digital pedagogy adoption. *Technol. Pedagogy Educ.* 30, 7–25. doi: 10.1080/1475939X.2020.1866654

Guo, X., Lv, B., Zhou, H., Liu, C., Liu, J., Jiang, K., et al. (2018). Gender Differences in How Family Income and Parental Education Relate to Reading Achievement in China: the Mediating Role of Parental Expectation and Parental Involvement. *Front. Psychol.* 9:783. doi: 10.3389/fpsyg.2018.00783

Hart, B., and Risley, T. R. (1995). *Meaningful Differences In The Everyday Experience Of Young American Children*. Baltimore, MD: Paul H. Brookes Publishing.

Hayes, N., and Berthelsen, D. C. (2020). Longitudinal profiles of shared book reading in early childhood and children's academic achievement in Year 3 of school. *Sch. Eff. Sch. Improv.* 31, 31–49. doi: 10.1080/09243453.2019.1618347

Helm, C., Huber, S., and Loisinger, T. (2021). Was wissen wir über schulische Lehr-Lern-Prozesse im Distanzunterricht während der Corona-Pandemie? – Evidenz aus Deutschland, Österreich und der Schweiz. *Z. Erziehwiss.* 24, 237–311. doi: 10.1007/s11618-021-01000-z

Hu, L., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Modeling* 6, 1–55. doi: 10.1080/10705519909540118

Huber, S. G., Günther, P. S., Schneider, N., Helm, C., Schwander, M., Schneider, J. A., et al. (2020). *COVID-19 und aktuelle Herausforderungen in Schule und Bildung [COVID-19 and the current challenges in education]*. Münster, Germany: Waxmann.

Huebener, M., Spieß, C. K., and Zinn, S. (2020). SchuülerInnen in Corona-Zeiten: teils deutliche Unterschiede im Zugang zu Lernmaterial nach Schultypen undtraägern. *DIW Wochenbericht* 87, 865–875.

Kaffenberger, M. (2021). Modelling the long-run learning impact of the Covid-19 learning shock: actions to (more than) mitigate loss. *Int. J. Educ. Dev.* 81:102326. doi: 10.1016/j.ijedudev.2020.102326

Kleinert, C., Bächmann, A.-C., and Zoch, G. (2020). *Schützt Bildung vor Erwerbsrisiken in der Corona-Krise? Analysen auf Basis der NEPS-Startkohorten 2, 4, 5 und 6*. Bamberg: Leibniz Institute for Educational Trajectories, doi: 10.5157/NEPS:WP89:1.0

Kluczniok, K., Lehrl, S., Kuger, S., and Roßbach, H.-G. (2013). Quality of the home learning environment during preschool age – Domains and contextual conditions. *Eur. Early Child. Educ. Res. J.* 21, 420–438. doi: 10.1080/1350293X.2013.814356

Kohl, G. O., Lengua, L. J., and McMahon, R. J. (2000). Parent involvement in school conceptualizing multiple dimensions and their relations with family and demographic risk factors. *J. Sch. Psychol.* 38, 501–523. doi: 10.1016/S0022-4405(00)00050-9

König, W., Lüttinger, P., and Müller, W. (1988). *A Comparative Analysis of the Development and Structure of Educational Systems. Methodological Foundations and the Construction of a Comparative Educational Scale. CASMIN Working Paper No.12*. Mannheim: Universität Mannheim.

Lee, J. S., and Bowen, N. K. (2006). Parent involvement, cultural capital, and the achievement gap among elementary school children. *Am. Educ. Res. J.* 43, 193–218. doi: 10.3102/00028312043002193

Lehrl, S., Ebert, S., Roßbach, H.-G., and Weinert, S. (2012). Die Bedeutung der familiären Lernumwelt für Vorläufer schriftsprachlicher Kompetenzen im Vorschulalter. *J. Fam. Res.* 24, 115–133. doi: 10.20377/jfr-181

Liu, Y., and Leighton, J. P. (2021). Parental Self-Efficacy in Helping Children Succeed in School Favors Math Achievement. *Front. Educ.* 6:657722. doi: 10.3389/feduc.2021.657722

Loades, M. E., Chatburn, E., Higson-Sweeney, N., Reynolds, S., Shafran, R., Brigden, A., et al. (2020). Rapid systematic review: the impact of social isolation and loneliness on the mental health of children and adolescents in the context of COVID-19. *J. Am. Acad. Child Adolesc. Psychiatry* 59, 1218–1239. doi: 10.1016/j.jaac.2020.05.009

Lois, J. (2006). Role strain, emotion management, and burnout: homeschooling mothers' adjustment to the teacher role. *Symb. Interact.* 29, 507–529. doi: 10.1525/si.2006.29.4.507

Luplow, N., and Smidt, W. (2019). Bedeutung von elterlicher Unterstützung im häuslichen Kontext für den Schulerfolg am Ende der Grundschule. *Z. Erziehwiss.* 22, 153–180. doi: 10.1007/s11618-018-0827-x

Lüttinger, P., and Riede, T. (1997). Der Mikrozensus: amtliche Daten für die Sozialforschung. *ZUMA Nachrichten* 21, 19–43.

Mayer, S. E. (1997). *What money can't buy: family income and children's life chances*. Cambridge, MA: Harvard University Press.

Mayo, A., and Siraj, I. (2015). Parenting practices and children's academic success in low-SES families. *Oxf. Rev. Educ.* 41, 47–63. doi: 10.1080/03054985.2014.995160

McIver, J., and Carmines, E. G. (1981). *Unidimensional scaling (Vol. 24)*. Thousand Oaks: Sage.

Melhuish, E., Phan, M. B., Sylva, K., Sammons, P., Siraj-Blatchford, I., and Taggart, B. (2008). Effects of the home learning environment and preschool center experience upon literacy and numeracy development in early primary school. *J. Soc. Issues* 64, 95–114. doi: 10.1111/j.1540-4560.2008.00550.x

Möhring, K., Naumann, E., Reifenscheid, M., Blom, A. G., Wenz, A., Rettig, T., et al. (2020). *Die Mannheimer Corona-Studie: schwerpunktbericht zu Erwerbstätigkeit und Kinderbetreuung*. Mannheim: Universität Mannheim.

Müller, K. U., Samtleben, C., Schmieder, J., and Wrohlich, K. (2020). Corona-Krise erschwert Vereinbarkeit von Beruf und Familie vor allem für Mütter: erwerbstätige Eltern sollten entlastet werden. *DIW Wochenbericht* 87, 331–340.

Najman, J. M., Williams, G. M., Nikles, J., Spence, S., Bor, W., O'Callaghan, M., et al. (2001). Bias influencing maternal reports of child behaviour and emotional state. *Soc. Psychiatry Psychiatr. Epidemiol.* 36, 186–194. doi: 10.1007/s001270170062

Nunnally, J. C. (1978). *Psychometric theory*. New York: McGraw-Hill.

O'Sullivan, R. H., Chen, Y. C., and Fish, M. C. (2014). Parental Mathematics Homework Involvement of Low-Income Families with Middle School Students. *Sch. Comm. J.* 24, 165–188.

Parker, W. D., and Mills, C. J. (1996). The incidence of perfectionism in gifted students. *Gift. Child Q.* 40, 194–199. doi: 10.1177/001698629604000404

Porsch, R., and Porsch, T. (2020). "Fernunterricht als Ausnahmesituation. Befunde einer bundesweiten Befragung von Eltern mit Kindern in der Grundschule," in *Langsam vermisse ich die Schule . "Schule während und nach der Corona-Pandemie*, eds D. Fickermann and B. Edelstein (Münster; New York: Waxmann), 61–78. doi: 10.31244/9783830992318.03

Prime, H., Wade, M., and Browne, D. T. (2020). Risk and Resilience in Family Well Being During the COVID-19 Pandemic. *Am. Psychol.* 75, 631–643. doi: 10.1037/amp0000660

Racine, N., Hetherington, E., McArthur, B. A., McDonald, S., Edwards, S., Tough, S., et al. (2021). Maternal depressive and anxiety symptoms before and during the COVID-19 pandemic in Canada: a longitudinal analysis. *Lancet Psychiatry* 8, 405–415. doi: 10.1016/S2215-0366(21)00074-2

Rauer, W., and Schuck, K. D. (2003). *FEESS 3-4: fragebogen zur Erfassung emotionaler und sozialer Schulerfahrungen von Grundschulkindern dritter und vierter Klassen*. Göttingen: Beltz.

Sari, E., Bittmann, F., and Homuth, C. (2021). Explaining Inequalities of Homeschooling in Germany during the first COVID-19 Lockdown. *SocArXiv* [Preprint]. doi: 10.31235/osf.io/vsdq4

Schmid, U., Goertz, L., and Behrens, J. (2017). *Monitor Digitale Bildung. Die Schulen im digitalen Zeitalter*. Gütersloh: Bertelsmann Stiftung.

Simons, L. G., Wickrama, K. A. S., Lee, T. K., Landers-Potts, M., Cutrona, C., and Conger, R. D. (2016). Testing family stress and family investment explanations for conduct problems among African American adolescents. *J. Marriage Fam.* 78, 498–515. doi: 10.1111/jomf.12278

Smith, M. M., Sherry, S. B., Ray, C., Hewitt, P. L., and Flett, G. L. (2021). Is perfectionism a vulnerability factor for depressive symptoms, a complication of depressive symptoms, or both? A meta-analytic test of 67 longitudinal studies. *Clin. Psychol. Rev.* 84:101982. doi: 10.1016/j.cpr.2021.101982

Spinelli, M., Lionetti, F., Pastore, M., and Fasolo, M. (2020). Parents' stress and children's psychological problems in families facing the COVID-19 outbreak in Italy. *Front. Psychol.* 11:1713. doi: 10.3389/fpsyg.2020.01713

StataCorp (2021). *Stata: release 17. Statistical Software*. College Station, TX: StataCorp LLC.

Stull, J. C. (2013). Family socioeconomic status, parent expectations, and a child's achievement. *Res. Educ.* 90, 53–67. doi: 10.7227/rie.90.1.4

UNESCO Institute for Statistics (2012). *International Standard Classification of Education: ISCED 2011*. Available Online at: http://dx.doi.org/10.15220/978-92-9189-123-8-en (accessed July 26, 2021)

von Maurice, J., Artelt, C., Blossfeld, H.-P., Faust, G., Roßbach, H.-G., and Weinert, S. (2007). *Bildungsprozesse, Kompetenzentwicklung und Formation von Selektionsentscheidungen im Vor- und Grundschulalter: überblick über die Erhebungen in den Längsschnitten BiKS-3-8 und BiKS-8-12 in den ersten beiden Projektjahren*. Available Online at: http://psydok.psycharchives.de/jspui/bitstream/20.500.11780/440/1/online_version.pdf (accessed July 26, 2021).

Ware, J. E., Kosinski, M., Turner-Bowker, D. M., and Gandek, B. (2002). *How to score Version 2 of the SF-12§Health Survey (with a supplement documenting version 1)*. Lincoln, RI: Qualitymetric Incorporated.

Weiber, R., and Mühlhaus, D. (2010). *Strukturgleichungsmodellierung: eine anwendungsorientierte Einführung in die Kausalanalyse mit Hilfe von AMOS, SmartPLS und SPSS*. Berlin, Heidelberg: Springer.

Weinert, S., Linberg, A., Attig, M., Freund, J.-D., and Linberg, T. (2016). Analyzing early child development, influential conditions, and future impacts: prospects of a German newborn cohort study. *Int. J. Child Care Educ. Policy* 10, 1–20. doi: 10.1186/s40723-016-0022-6

West, S. G., Taylor, A. B., and Wu, W. (2012). "Model fit and model selection in structural equation modeling," in *Handbook Of Structural Equation Modeling*, ed. R. H. Hoyle (New York, NY: Guilford Press), 209–231.

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Werner, K., and Zierow, L. (2020). Bildung in der Coronakrise: wie haben die Schulkinder die Zeit der Schulschließungen verbracht, und welche Bildungsmaßnahmen befürworten die Deutschen? *ifo Schnelldienst* 73, 25–39.

Wu, V., East, P., Delker, E., Blanco, E., Caballero, G., Delva, J., et al. (2019). Associations among mothers' depression, emotional and learning-material support to their child, and children's cognitive functioning: a 16-year longitudinal study. *Child Dev.* 90, 1952–1968. doi: 10.1111/cdev.13071

Würbach, A., Landrock, U., Schnapp, T., Ziesmer, J., and Bergrab, M. (2021). *NEPS Technical Report for Weighting – the Additional Corona Survey of the National Educational Panel Study (NEPS Survey Paper No. 89)*. Bamberg: Leibniz Institute for Educational Trajectories, National Educational Panel Study, doi: 10.5157/NEPS:SP89:1.0

Yeung, W. J., Linver, M. R., and Brooks–Gunn, J. (2002). How money matters for young children's development: parental investment and family processes. *Child Dev.* 73, 1861–1879. doi: 10.1111/1467-8624.t01-1-00511

Zinn, S., and Bayer, M. (2021). Subjektive Belastung der Eltern durch die Beschulung ihrer Kinder zu Hause zu Zeiten des Corona-bedingten Lockdowns im Frühjahr 2020. *Z. Erziehwiss.* 24, 339–365. doi: 10.1007/s11618-021-01012-9

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 13 January 2022
doi: 10.3389/fpsyg.2021.733867

The Structure of Social Networks and Its Link to Higher Education Students' Socio-Emotional Loneliness During COVID-19

Manuel D. S. Hopp[1], Marion Händel[1], Svenja Bedenlier[2], Michaela Glaeser-Zikuda[2], Rudolf Kammerl[2], Bärbel Kopp[2] and Albert Ziegler[1]*

[1] Department of Psychology, University of Erlangen Nuremberg, Erlangen, Germany, [2] Department of Education, University of Erlangen Nuremberg, Erlangen, Germany

OPEN ACCESS

Edited by:
Karin Sørlie Street, Western Norway University of Applied Sciences, Norway

Reviewed by:
Marc Sarazin, University of Edinburgh, United Kingdom
Joni Tzuchen Tang, National Taiwan University of Science and Technology, Taiwan
Julia Eberle, Ludwig Maximilian University of Munich, Germany

***Correspondence:**
Manuel D. S. Hopp
manuel.hopp@fau.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *13 December 2021*
Published: *13 January 2022*

Citation:
Hopp MDS, Händel M, Bedenlier S, Glaeser-Zikuda M, Kammerl R, Kopp B and Ziegler A (2022) The Structure of Social Networks and Its Link to Higher Education Students' Socio-Emotional Loneliness During COVID-19. Front. Psychol. 12:733867. doi: 10.3389/fpsyg.2021.733867

Lonely students typically underperform academically. According to several studies, the COVID-19 pandemic is an important risk factor for increases in loneliness, as the contact restrictions and the switch to mainly online classes potentially burden the students. The previously familiar academic environment (campus), as well as the exchange with peers and lecturers on site, were no longer made available. In our cross-sectional study, we examine factors that could potentially counteract the development of higher education student loneliness during the COVID-19 pandemic from a social network perspective. During the semester, N = 283 students from across all institutional faculties of a German comprehensive university took part in an online survey. We surveyed their social and emotional experiences of loneliness, their self-reported digital information-sharing behavior, and their current egocentric networks. Here, we distinguished between close online contacts (i.e., mainly online exchanges) and close offline contacts (i.e., mainly in-person face-to-face exchanges). In addition, we derived the interconnectedness (i.e., the densities of the egocentric networks) and heterogeneity (operationalized with the entropy) of students' contacts. To obtain the latter, we used a novel two-step method combining t-distributed stochastic neighbor embedding (t-SNE) and cluster analysis. We explored the associations of the aforementioned predictors (i.e., information-sharing behavior, number of online and offline contacts, as well as interconnectedness and heterogeneity of the close contacts network) on social and emotional loneliness separately using two hierarchical multiple linear regression models. Our results suggest that social loneliness is strongly related to digital information-sharing behavior and the network structure of close contacts. In particular, high information-sharing behavior, high number of close contacts (whether offline or online), a highly interconnected network, and a homogeneous structure of close contacts were associated with low social loneliness. Emotional loneliness, on the other hand, was mainly related to network homogeneity, in the sense that students

with homogeneous close contacts networks experienced low emotional loneliness. Overall, our study highlights the central role of students' close social network on feelings of loneliness in the context of COVID-19 restrictions. Limitations and implications are discussed.

Keywords: COVID-19 pandemic, loneliness, social network, interconnectedness, network density, network homogeneity, network heterogeneity, digital information-sharing behavior

INTRODUCTION

In early 2020, the new COVID-19 brought drastic transformations to the lives of many people around the world. Many nations enacted far-reaching COVID-19 measures, such as masking mandates and restricting in-person face-to-face contacts. The resulting school and university closures affected over 1.5 billion students and adolescents, according to UNESCO (2021). Higher education institutions across many countries switched to online distance education at short notice. This so-called emergency remote teaching (Hodges et al., 2020) had a profound impact on teaching. The learning spaces transformed from shared seminar rooms and library space to the personal confines of the home. In-person teaching was replaced by asynchronous and synchronous online courses. This change from offline teaching to online teaching posed new challenges for the digital skills of the students. Online tools had to be operated; reliable webcam and microphone communication had to be established; and online information exchange with other peers had to be ensured. Students who could not meet these requirements could fail to catch up. Not only was teaching restricted, so, too, were regular in-person meetings with other students and friends. The COVID-19 restrictions greatly limited the opportunities to meet others in-person not only on campus and in seminars, but also in the context of students' private lives. In many countries, contact with more than one person outside the household was prohibited. This led to an increased feeling of loneliness (Liu et al., 2021)—especially when the exchange with close contacts (i.e., the people with whom they discuss sensitive topics) was no longer possible in-person (Russell et al., 2012).

The aim of the study is to explore possible factors influencing students' feelings of loneliness in a German sample. We hypothesize that an aspect of digital skills, i.e., the ability to easily exchange information with peers called "information-sharing behavior," have a lowering effect on the perception of loneliness. Furthermore, we focus on the close social network of the students (i.e., the people with whom they discuss sensitive topics) and investigate the connections between their structures and students' perceptions of loneliness. For the first network-related question, we examine whether the way in which students communicate with their close contacts has a varying impact on their sense of loneliness. Here we distinguish between the number of contacts with whom communication took place mainly online and the number of contacts with whom communication took place mainly offline, i.e., in-person. The second network-related question concerns the connectivity structure of the network, namely, whether greater interconnectivity in the close social network is helpful to students' sense of loneliness. The last question addresses the diversity of the network, i.e., whether it is more helpful to have many close contacts of a similar type or whether a high degree of diversity is more helpful. Here, we implicitly consider the mechanisms of social network formation (i.e., selection and influence effects).

THEORETICAL BACKGROUND

COVID-19 Pandemic Restrictions and the Feeling of Loneliness

Worldwide the COVID-19 pandemic had a far-reaching impact on higher education teaching. In 165 countries, schools and universities were closed (UNESCO, 2020), and a sudden switch from mainly offline teaching to a special form of online teaching occurred. Due to its differences from conventional online teaching, the term *emergency remote teaching* was coined (Hodges et al., 2020). For the more than 1.5 billion affected students and adolescents, this meant a blatant rift in their social environment. Alongside the extracurricular contact restrictions, students lost many opportunities to meet and interact with peers and other close contacts outside of their own households. For example, in many countries, contact with more than one person outside the household was prohibited. As a result, many contacts were eliminated, and increasing feelings of loneliness had to be confronted (Bu et al., 2020; Liu et al., 2021).

Loneliness has harmful effects on academic achievement. In particular, evidence suggests that feelings of loneliness can have a negative impact on grades (Neto et al., 2015; Rosenstreich and Margalit, 2015) and are associated with an increased attrition rate (Rotenberg and Morrison, 1993; Alkan, 2014). Loneliness can affect academic grades through multiple impact pathways. For one, studies show that loneliness leads to a decrease in self-efficacy (Fry and Debats, 2002; Al Khatib, 2012), which itself affects the academic performance (Honicke and Broadbent, 2016). Loneliness can also lead to so-called learning burnout (Lin and Huang, 2012), where the students experience emotional exhaustion and negative attitudes toward their learning and university activities (Schaufeli et al., 2002).

The increased dropout rate of lone students (i.e., student attrition), is described by Tinto's (1993) student integration model. His concept implies that student attrition is associated with the student's perceived (person-environment) fit to the university environment, i.e., feeling lonely represents a suboptimal fit. Rotenberg and Morrison (1993) repeatedly measured the loneliness of freshman students on two consecutive fall semesters and were able to show that loneliness predicted attrition, even after controlling for poor grade point average.

This finding is supported by additional research indicating that positive social relationships make a substantial contribution to explaining students' academic satisfaction, which is a key indicator of student attrition (Bernholt et al., 2018). Overall, literature suggests that there is a connection (albeit moderate; Rotenberg and Morrison, 1993) between experience of loneliness and academic performance.

Loneliness as a Multidimensional Construct

Loneliness is understood as the subjectively perceived discrepancy between desired and actual social relationships (Weiss, 1973). According to Weiss' topology, loneliness is a multidimensional construct. It is characterized by two aspects: social loneliness and emotional loneliness. *Social loneliness* refers to the number of relationships that is less than the desired number. For example, people who have recently moved (e.g., to a new city or university) are likely to experience this form of loneliness (Russell et al., 1984). *Emotional loneliness*, on the other hand, refers to situations in which the absence of closeness and intimate relationships is lamented. For example, people who have recently been widowed or had a romantic relationship broken off often experience this form of loneliness (Russell et al., 1984). This proposed two-dimensional nature of loneliness means that someone can feel lonely even though they have many friends (i.e., low social but high emotional loneliness; Weiss, 1973). The involuntary constraints of the COVID-19 pandemic led to a reduction of the (close) social network, which in turn had a direct impact on the emotional as well as the social sense of loneliness of both young and old adults (Killgore et al., 2020; Liu et al., 2021).

Factors Related to Loneliness During COVID-19 Restrictions

Digital Information-Sharing Behavior and the Close Social Network

During the COVID-19 pandemic, the importance of digital skills was twofold. First, the newly introduced emergency remote teaching placed demands on students' digital skills. Students were required to use online tools and to exchange information efficiently with fellow students and lecturers so as to avoid falling behind the lecture—what Hong and Kim (2018) call information-sharing behavior.

Second, the pandemic restrictions posed new challenges to communication with friends and fellow students, whose presence plays an important aspect in feelings of loneliness (Russell et al., 2012). Due to the loss of in-person meetings, it was now essential for higher education students to be able to efficiently exchange information with close contacts via common (digital) communication tools (i.e., telephone, video chat, messenger) to avoid losing touch. The ability to exchange information is therefore an essential building block for remote teaching, as well as for maintaining one's online social network.

The widespread adoption of the internet in many people's daily lives created new ways of communicating with their contacts (e.g., via chat, voice, or video chat). This raises the question of whether online communication can even serve as a substitute for in-person face-to-face contact and if, to which extent has it an impact on feelings of loneliness?

Some researchers argued that online communication could have a negative impact on people's well-being because it displaces time that could be spent with friends in-person (e.g., Kraut et al., 1998). Other researchers reasoned that online communication could increase the quality of relationships with friends and therefore one's own well-being (e.g., Valkenburg and Peter, 2007b). While there is evidence for both hypotheses (e.g., Kraut et al., 2002), it seems to be of great importance with whom, rather than whether, people communicate online (for a concise literature review, see Valkenburg and Peter, 2007a). If the exchange takes place, for example, with friends and other close contacts (i.e., "strong ties" according to Granovetter, 1973), positive effects on relationship quality as well as on feelings of loneliness were shown, especially with new communication methods, such as video chat (Shaw and Gant, 2002; Manago et al., 2020; Nakagomi et al., 2020). This association does not tend to occur in the case of online exchanges with casual acquaintances (i.e., "weak ties"; Valkenburg and Peter, 2007b).

The preceding findings are strengthened by further loneliness research, since a central decisive factor for the perception of loneliness is the immediate social network (i.e., a person's close contacts) and the social support that it provides (Nicpon et al., 2006). Lonely individuals have a lower number of close contacts (Shin, 2007) and are less likely to interact with them than non-lonely individuals and thus, may experience lower levels of social support (Russell, 1982). Jackson et al. (2000) showed a direct link between social support and loneliness among college students. Low levels of social support during the semester predicted feelings of loneliness at the end of the semester. This also applies in the online context, where a lower perceived social support is associated with a lower number of online contacts (Nabi et al., 2013; Dai et al., 2021), all of which can affect the feeling of loneliness (Moody, 2001).

Overall, previous research indicates that, in the context of COVID-19 restrictions, individuals who are more capable of communicating seamlessly online with their existing close circle might be better protected from feelings of loneliness (Valkenburg and Peter, 2007b; Kralj Novak et al., 2015; Kluck et al., 2021). This effect is further enhanced by a higher number of close contacts, which could also translate to online exchange (Shin, 2007; Nabi et al., 2013; Dai et al., 2021).

Interconnectivity of Close Contacts

Along with the number of social relationships, the interconnectedness of the circle of contacts is an important factor in the individual's sense of loneliness (Stokes and Levin, 1986; Bell, 1991; Kovacs et al., 2021). As described above, the circle of family and close friends might be particularly protective against feelings of loneliness. This close network, also sometimes referred to as bonding capital, is characterized by a relatively high degree of interconnectivity (Salehi et al., 2019). In network research, interconnectedness is expressed in terms of network density which indicates the ratio between existing links in the present network and the theoretical maximum

number of links (i.e., everyone is connected to everyone else). An early cross-sectional study by Stokes (1985) supports that a high interconnectivity (i.e., high density) of an individual's close contacts can be an important correlate of low feelings of loneliness. In Stoke's case, interconnectivity turned out to be even more relevant than the number of close contacts. However, the favorable link between interconnectivity and feelings of loneliness does not appear to be unconditional. Other research suggests that loneliness may spread through social networks, much like a viral infectious disease (Cacioppo et al., 2009); therefore, the "contagiousness" of loneliness should be taken into account, particularly in longitudinal study designs. However, as shown by Stokes (1985), a loneliness-reducing effect of interconnectivity dominates in cross-sectional designs.

Diversity of Close Contacts

A further aspect that can contribute to an individual's feeling of loneliness is the homogeneity or diversity of the network actors. Here we refer to homogeneous networks if the network actors are very similar to each other (e.g., in terms of behavior or attitudes), and to heterogeneous networks if they are very dissimilar to each other. Homogeneous networks are often a result of mainly two processes: selection and influence (Snijders, 2001).

Selection means that contacts outside the family circle are selected according to one's own preferences, i.e., new contacts who have similar characteristics to oneself are favored. This process is based on homophily (McPherson et al., 2001), which can be expressed with the phrase "birds of a feather flock together." Selection processes are observed in the offline school context (Burk et al., 2008; Steglich et al., 2010; Hopp et al., 2019), in university (Mayer and Puller, 2008; Smirnov and Thurner, 2017), as well as in online contexts (e.g., in online social networks; Mayer and Puller, 2008; as well as in online mentoring; Hopp et al., 2020). Choosing new contacts selectively can lead to homogeneous individual networks (Mayer and Puller, 2008; and clusters in the global network; Cacioppo et al., 2009; Hofstra et al., 2017). Additional to selection, influence processes occur between people in the same network and can increase homogeneity of the network. Here, behaviors (e.g., smoking) or attitudes (e.g., confidence) can spread between the actors in the network. Influence processes have been identified in many contexts—offline and online (e.g., Mercken et al., 2010; Caravita et al., 2014; Hopp et al., 2020). Moreover, there is evidence that loneliness can also spread through influence processes—especially through close friends (Cacioppo et al., 2009).

Research to date indicates a desirable role of homogeneous close contacts networks in terms of low feelings of loneliness, although studies so far have been rather limited. Homogeneous networks often consist of close contacts, such as family and close friends, whereas in heterogeneous networks, links between the actors tend to be rather weak (Coffé and Geys, 2007). Especially family and close friends play a major role in the feeling of loneliness (Weiss, 1973). Some studies on bonding capital (i.e., the network consisting of close contacts) underline a protective effect of homogeneity on feelings of loneliness (Simons et al., 2020; Thomas et al., 2020). Few studies have explicitly investigated the homogeneity of the network based on different types of actors. Van Baarsen et al. (1999) examined different types of relationships (e.g., parent, child, friend, etc.) and could demonstrate this protective association in a sample of Dutch elderly. Ashida and Heaney (2008) showed that in older adults, more homogeneous networks in terms of the network members' demographic characteristics could improve social support and therefore people experience less feelings of loneliness (Russell, 1982). However, contradicting research in older subpopulations indicates that homogeneous network connections might increase the risk of loneliness, due to the reduced resilience that homogeneous networks might be associated with (Robustelli et al., 2017; Liebke, 2019).

Nevertheless, due to the unusual situation of COVID-19 constraints, homogeneous networks (indicating high social support) may be predominantly related to perceptions of low loneliness (evidence of limited comparability, Benkel et al., 2009).

The Current Study

The COVID-19 pandemic and the resulting restrictions on face-to-face interactions present a novel research opportunity to explore associations between one's social network and one's sense of loneliness. We investigate to what extent digital information-sharing behavior and the structure of close contact networks help to mitigate feelings of loneliness in higher education students. Here, we examine a sample of German students who were exposed to the above-mentioned COVID-19 restrictions during the study period.

Digital information-sharing behavior should make it easier to deal with contact restrictions; that is, students demonstrate the ability to communicate and interact via online tools. Therefore, our first hypothesis is:

> ***Hypothesis 1***. In the given context of COVID-19 restrictions, digital information-sharing behavior is associated with lower feelings of loneliness, both in terms of social loneliness (H1a) and emotional loneliness (H1b).

The immediate social network (i.e., close contacts) is a central factor that plays a decisive role in the perception of loneliness (Nicpon et al., 2006). We consider three structural measures, i.e., number of close contacts, interconnectivity of the social network, and homogeneity of the social network members. We distinguish between offline and online contacts to examine how the number of online contacts affects students' feelings of loneliness. Therefore, we investigate the following hypothesis:

> ***Hypothesis 2.*** In the given context of COVID-19 restrictions, a higher number of online contacts are associated with lower levels of loneliness, both in terms of social loneliness (H2a) and emotional loneliness (H2b).

Beyond the number of contacts, the interconnectivity of the contacts is also likely to contribute to a supportive network and could thus be associated with a low sense of loneliness.

> ***Hypothesis 3.*** In the given context of COVID-19 restrictions, higher interconnectivity of all close contacts is associated with lower social (H3a) and lower emotional (H3b) loneliness.

Finally, we argued that homogeneous networks are linked with low feelings of loneliness. Therefore, we investigate the fourth hypothesis:

> ***Hypothesis 4.*** In the given context of COVID-19 restrictions, higher homogeneity of contact types is associated with lower social (H4a) and lower emotional (H4b) loneliness.

MATERIALS AND METHODS

Sample

In total, the raw data set consisted of 363 students enrolled at the University of Erlangen-Nuremberg, Germany. The performed data cleaning (see section "Plan of Analysis") resulted in 283 listwise complete cases (78.0%). Comparison between the two samples (100 and 78.0%) led to no significant differences (t-tests, all $|t| < 0.78$, all $p > 0.44$) regarding all variables depicted in **Table 1**.

Participants were members of the following university faculties: 34.1% faculty of humanities, social sciences, and theology, 18.6% faculty of business, economics, and law, 17.6% faculty of engineering, 16.1% faculty of medicine, and 13.6% faculty of sciences. The participants were between 18 and 59 years old (M_{age} = 23.5 years), and were predominantly female (i.e., 72%). On average, students were in the middle of their fourth semester ($M_{semester}$ = 4.54). For more details (see **Table 1**).

Procedure

The data collection was conducted during the summer semester in 2020 at the University of Erlangen-Nuremberg in Germany as an online survey with one measurement. At that time, Germany was subject to the restrictions described in the introductory section, such as lockdown orders, and higher education teaching was mainly online. All enrolled students were notified about the questionnaire via email from an official university channel. They were informed that the online survey will take approximately 12 min and that it is about students' personal social network and that the results might help to better understand the changes in student life due to (the COVID-19) contact restrictions. The questionnaire was implemented in the German language using the online survey system Unipark Questback EFS (unipark.com). After answering demographic questions and the batteries regarding loneliness and digital information-sharing behavior, participants were asked to name up to eight close contacts with whom they had "discussed matters important" to them in the last 4 weeks. Here, the participants were instructed not to use names that would allow conclusions to be drawn about the contacts named. Then the students had to answer for each given contact the following items. For distinguishing "offline" from "online" contacts, they had to provide the main channel of communication during the past 4 weeks. For deriving the students' contacts' heterogeneity, students provided the contacts' initiation of exchange, gender, residence, relationship to student, social attraction, and media skill, see **Supplementary Appendix** for more details. To determine the interconnectivity between the subjects' contacts, we presented participants with an upper triangular matrix (based on the previously mentioned close contacts) in which we indicated to them, step-by-step, that they could mark which contacts knew each other by checking boxes. After 2 weeks, students were reminded again to complete the questionnaire. Subsequently, the questionnaire data were extracted and subjected to further data processing. In accordance with the institutional commissioner for data protection, participants' privacy was protected; all data has been anonymized; and participating students were not disadvantaged due to non-participation. Informed consent of the participants was obtained by virtue of survey completion.

TABLE 1 | Descriptives (n = 283).

	M	*SD*	Median	Mad	Min	Max	Skew	Kurtosis
Age	23.48	5.06	22.00	2.97	18.00	59.00	3.30	15.27
Gender*	1.72	0.46	2.00	0.00	1.00	2.00	−0.89	−0.90
Semester	4.54	2.74	4.00	2.97	1.00	15.00	0.99	0.85
Social loneliness	2.39	1.03	2.20	1.19	1.00	5.40	0.57	−0.37
Emotional loneliness	3.06	1.01	3.00	0.99	1.00	6.00	0.15	−0.34
Offline contacts	2.72	1.57	3.00	1.48	0.00	8.00	0.49	−0.07
Partner	0.54	0.50	1.00	0.00	0.00	1.00	−0.15	−1.99
Inf.-sharing beh.	5.29	0.85	5.50	0.74	1.75	6.00	−1.52	2.57
Online contacts	2.64	1.74	3.00	1.48	0.00	8.00	0.62	0.21
Interconnectedness	0.68	0.29	0.70	0.40	0.00	1.00	−0.58	−0.54
Heterogeneity	1.13	0.41	1.15	0.34	0.00	1.91	−0.80	0.55

*Mad, median of absolute deviation. Partner refers to current significant other. Both interconnectedness and heterogeneity refer to all contacts, regardless of online or offline. *Gender coding: 1 = "male," 2 = "female." Inf.-sharing beh. stands for information-sharing behavior.*

Measures

Social and Emotional Loneliness

To assess social and emotional loneliness, the Loneliness Scale developed by Jong Gierveld and colleagues was used (Jong Gierveld and Kamphuls, 1985; de Jong Gierveld and Van Tilburg, 1999). The total 11 item scale consists of separate social (5 items) and emotional (6 items) loneliness subscales, and is demonstrated to be valid and reliable measurement instruments for these phenomena (van Baarsen et al., 2001; Dykstra and Jong Gierveld, 2004). They were measured using a six-point Likert scale with 1 = "not at all true" to 6 = "completely true," and were recoded, if necessary. A high scale value indicates high-perceived loneliness.

Social Loneliness

The social loneliness subscale (e.g., "there are enough people I feel close to," recoded) showed good internal consistency indicated by Cronbach's $\alpha = 0.88$. The subscale showed a good one-dimensionality, indicated by McDonald's $\omega_h = 0.84$, which gives the proportion of variance in scale scores accounted for by a general factor (McDonald, 1999). A high ω total value of McDonald's $\omega_t = 0.91$ indicated a reliable multidimensional composite (Watkins, 2017).

Emotional Loneliness

The emotional loneliness subscale (e.g., "I miss having people around") showed acceptable internal consistency indicated by Cronbach's $\alpha = 0.78$. The subscale showed an acceptable one-dimensionality, indicated by McDonald's $\omega_h = 0.66$ (McDonald, 1999). Again, a high ω total value of McDonald's $\omega_t = 0.89$ indicated a reliable multidimensional composite (Watkins, 2017).

Information-Sharing Behavior

We used the "Information-Sharing Behavior" subscale of the measurement tool "Readiness for Academic Engagement Scale" (Hong and Kim, 2018). The subscale consisted of four items (e.g., "I can interact with classmates using real-time communication tools, for example, video conferencing tools or messengers") and used a six-point Likert scale with 1 = "not at all true" to 6 = "completely true." The subscale showed good internal consistency indicated by Cronbach's $\alpha = 0.83$. The McDonald's hierarchical ω indicated good one-dimensionality with $\omega_h = 0.79$ (McDonald, 1999). A high McDonald's total ω value of $\omega_t = 0.87$ indicated a reliable multidimensional composite (Watkins, 2017).

The Online Exchange With the Social Network of Close Contacts

Participants were asked to name up to eight close contacts with whom they had "discussed matters important" to them, which is based on Marsden's(1987) name generator. For each contact mentioned, they were also asked to indicate whether the exchange occurred predominately online (e.g., video chat, instant messenger) or predominately offline (i.e., in-person face-to-face). Thus, a student could have up to eight close contacts with varying numbers of online and offline contacts (e.g., two offline and six online contacts, or one offline and three online contacts).

Interconnectivity of Close Contacts

Interconnectivity describes the extent to which a student's contacts know each other. The interconnectivity was operationalized with the network measure density, which represents the ratio of observed connections to the maximum possible connections. It is calculated with the formula $(2 \times d)/(N \times (N-1))$, where N is the number of all contacts in the network and d the observed connections between the contacts. The value ranges from 0 (i.e., no one knows each other) to 1 (i.e., all the contacts know each other). For example, if a student has three contacts, and two contacts know each other, then the interconnectivity is 1/3 (because one of three possible connections is realized).

Heterogeneity of Close Contacts

As the measure of network heterogeneity, we chose the Shannon entropy (also called Shannon index; Jost, 2006) of the close contact types of each student. The Shannon entropy is a widely used, reliable measurement of homogeneity or heterogeneity (Jost, 2006; Masisi et al., 2008)[1]. For calculating the entropy, we derived the types of close contacts using a two-step procedure. Here, we collected additional variables for each contact (e.g., closeness to person and residence) and applied a combination of t-distributed stochastic neighbor embedding (t-SNE; i.e., step 1) and cluster analysis (i.e., step 2) to derive 12 types. A detailed description of the used variables and process of analysis can be found in **Supplementary Appendix**.

For each participant, the Shannon entropy is defined as the negative of the sum of the probability of each close contact type multiplied by the logarithm of the probability of each close contact type. A high entropy value reflects high heterogeneity, and a low entropy value reflects low heterogeneity (i.e., high homogeneity). The numerical value of entropy is determined by two properties, by the number of types and their probability distribution. The entropy increases with the number of types and with an equal distribution of these types. If the number of types is given (e.g., the eight close contacts consist of two types "type A" and "type B"), the Shannon entropy reaches its maximum when all types are occupied with equal frequency (e.g., four contacts are "type A" and four contacts are "type B")—regardless of the order of the types. We found twelve different types of close contacts; thus, entropy theoretically could take values between zero and $\log(12) = 2.5$. However, since only a maximum of eight contacts could be named, the entropy was limited to $\log(8) = 2.1$.

Plan of Analysis

Data Preparation

The data were available as an SPSS file and were prepared for the following steps using SPSS v26 (IBM Corp, 2019): Definition of missing values, recoding of negatively worded items, and calculation of scales. Subsequently, further processing of the data took place in R v4.0.4 (R Core Team, 2020). The data set was examined for duplicates, and individuals who had more than 90% missing values in the dependent or independent variables were removed ($n = 13$, 3.6%). In addition, $n = 67$ (18.5%) cases showed missing values in the dependent or independent variables and were excluded from further analysis. Subsequently, we calculated the variables: offline and online contacts, interconnectedness, and heterogeneity, as reported in section "Measures."

Data Analytic Strategy

We began our data analysis by examining the descriptive statistics and the bivariate Pearson correlation to provide a first impression of the structure of the variables of interest. This was followed by our main analysis consisting of hierarchical regressions with social and emotional loneliness as criteria. The control variables were age, gender, and the presence of a partner (derived from the variable "relationship to student" of the indicated close contacts). We built the hierarchical regression on a base model with the independent variables gender, age, offline contacts, partner, and the corresponding loneliness subscale as the dependent variable.

First, to test hypotheses H1a and H1b, i.e., the beneficial relationship of information-sharing behavior on social and emotional loneliness, we added the variable information-sharing behavior as an independent variable to these baseline models. Second, for testing hypotheses H2a and H2b, i.e., the association between higher number of online contacts and lower social and emotional loneliness, we added the variable online contacts,

[1]Other measures such as the Blau index (also known as Gibbs-Martin index or Gini-Simpson index) represent a similar reliable measurement of heterogeneity (Jost, 2006) and showed no major changes in our results.

as an independent variable to the previous models. Third, to test hypotheses H3a and H3b, i.e., the beneficial link of higher interconnectedness of the student's close contacts and feelings of social and emotional loneliness, we added interconnectedness as an independent variable to the previous models. Fourth, heterogeneity of the close contacts was added to the models as an independent variable to address hypotheses H4a and H4b (i.e., the correlation of lower heterogeneity with lower social and emotional loneliness). Finally, to explore the relative contributions of the predictors to the variance decomposition of the final models, a relative importance analysis was performed using the proportional marginal variance decomposition as proposed by Feldman (2005). Confidence intervals were determined via bootstrapping with n = 10,000 bootstrap runs. For the regressions, two-sided hypothesis tests were used, each with an alpha level of $\alpha = 0.05$.

For the mentioned analyses, we utilized R (v4.0.4; R Core Team, 2020), as well as the following packages: for general descriptives *psych v2.1.3* (Revelle, 2020), for graphics *ggplot2 v3.3.3* and *scatterplot3d v0.3-41* (Ligges and Mächler, 2003; Wickham, 2016), for cluster analysis *factoextra v1.0.7* (Kassambara and Mundt, 2020), for t-SNE analysis *Rtsne v0.15* (Krijthe, 2015), for calculating Shannon entropy *vegan v2.5-7* (Oksanen et al., 2020), and for relative importance analysis *relaimpo* v2.2-5 (Grömping, 2006).

RESULTS

Descriptives and Correlations

The descriptives of the participants included in the analysis can be found in **Table 1**. Students had—on average—an equal number of offline and online contacts, $t(558.01) = 0.63$, $p = 0.53$. Fifty-eight students (i.e., 20%) reported the maximum of eight possible close contacts. Every second student (i.e., 54%) reported having communicated with their significant other (i.e., partner). The value of mean interconnectedness (i.e., a density value of 0.68) indicates that approximately two-thirds of all possible acquaintance connections between the students' contacts were present, which is considered as high (Giannella and Fischer, 2016). Additional results can be found in **Table 1**.

The correlation analysis, see **Table 2**, showed—as expected—a high correlation between emotional and social loneliness. Social loneliness correlated higher with the number of contacts (online as well as offline) and digital information-sharing behavior than did emotional loneliness. The number of close contacts (i.e., sum of offline and online contacts) correlated moderately with social loneliness, $r(281) = -0.36$, $p < 0.001$, and weakly with emotional loneliness, $r(281) = -0.12$, $p = 0.047$.

Social Loneliness

Regression Results

To assess the associations between social loneliness and the assumed independent variables, a hierarchical linear regression was conducted. All results can be found in **Table 3**. All resulting linear regression models showed good fit, indicated by normally distributed residual variances and no signs of heteroscedasticity. The variance inflation factors (O'Brien, 2007), and the condition numbers (Kim, 2019) of all models indicated no collinearity between the predictors.

Starting from a base model, we added the appropriate predictors for each hypothesis. The base model including gender, age, offline contacts and presence of partner showed a fit of adjusted $R^2 = 0.042$, $F_{(4,\ 278)} = 4.07$, $p = 0.003$; see **Table 3** for more details. While a higher number of offline contacts was associated with decreased social loneliness ($\beta = -0.18$, $p = 0.002$), the presence of a partner showed no significant effect. While age was not related to loneliness, female participants showed higher levels of loneliness on average, $\beta = -0.12$, $p = 0.049$.

By adding information-sharing behavior as a predictor, the model fit improved significantly by $\Delta R^2 = 0.037$, $p = 0.009$, as displayed in **Table 3**. The significant regression coefficient indicated a relationship between increased information-sharing behavior and decreased social loneliness ($\beta = -0.20$, $p < 0.001$). Thus, we accept Hypothesis 1a.

The number of online contacts increased the model fit significantly by $\Delta R^2 = 0.067$, $p < 0.001$ and showed a significant negative association with social loneliness ($\beta = -0.29$, $p < 0.001$), as displayed in **Table 3**, indicating that having more online contacts is associated with less social loneliness. Thus, we accept Hypothesis 2a.

TABLE 2 | Pearson's correlation coefficients of all variables of interest (n = 283).

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Gender		–0.11	**–0.13**	0.01	0.03	**0.15**	–0.06	0.11	**0.15**	0.07
2. Age			–0.02	**–0.14**	–0.01	**0.13**	0.06	0.12	–0.02	0.10
3. Social loneliness				**0.56**	**–0.19**	–0.09	**–0.19**	**–0.20**	–0.08	–0.07
4. Emotional loneliness			**0.57**		–0.05	–0.07	**–0.12**	–0.08	–0.03	0.07
5. Offline contacts			**–0.19**	–0.06		0.11	0.01	**–0.38**	0.01	**0.32**
6. Partner			–0.07	–0.05	0.11		**0.27**	–0.05	**0.25**	0.10
7. Inf.-sharing beh.			**–0.20**	–0.11	0.02	**0.28**		**0.12**	–0.05	–0.02
8. Online contacts			**–0.19**	–0.06	**–0.39**	–0.09	**0.12**		**–0.29**	**0.21**
9. Interconnectedness			–0.06	–0.03	<0.01	**0.23**	–0.04	**–0.32**		0.11
10. Heterogeneity			–0.06	0.09	**0.32**	0.08	–0.02	**0.19**	0.10	

The upper triangular matrix represents Pearson's bivariate correlation coefficients; the lower triangular matrix shows partial bivariate correlation coefficients controlled for age and gender. Correlation coefficients with $p < 0.05$ are marked bold. No alpha error cumulation correction was applied. Inf.-sharing beh. stands for information-sharing behavior.

TABLE 3 | Regression results for social loneliness as the criterion.

Predictor	Base model	Model 1	Model 2	Model 3	Model 4
Gender	−0.12*	−0.14*	−0.09	−0.06	−0.05
Age	−0.02	−0.02	0.02	0.02	0.01
Offline contacts	−0.18**	−0.19**	−0.30**	−0.33**	−0.41**
Partner	−0.05	0.01	−0.02	0.02	0.02
Inf.-sharing beh.		−0.20**	−0.16**	−0.17**	−0.15**
Online contacts			−0.29**	−0.36**	−0.44**
Interconnectedness				−0.18**	−0.22**
Heterogeneity					0.17**
R^2	0.055	0.092	0.159	0.186	0.208
ΔR^2	0.055**	0.037**	0.067**	0.027**	0.021**

*Standardized regression coefficients. A more detailed table is depicted in **Supplementary Appendix**. *Indicates p < 0.05. ** indicates p < 0.01. Inf.-sharing beh. stands for information-sharing behavior.*

By adding the interconnectedness of the students' contacts, the model fit significantly increased by $\Delta R^2 = 0.027$, $p = 0.003$. The significant negative regression weight indicated that an increase of interconnectedness was associated with lower social loneliness ($\beta = -0.18$, $p = 0.001$). For more details (see **Table 3**). Thus, we accept Hypothesis 3a.

In the final step of the hierarchical regression, the added heterogeneity predictor significantly increased the model by $\Delta R^2 = 0.021$, $p = 0.007$, thus resulting in a final model fit of adjusted $R^2 = 0.18$. As expected, a lower heterogeneity (i.e., higher homogeneity) was significantly associated with lower social loneliness ($\beta = 0.17$, $p = 0.003$, see **Table 3**). This final model indicates that having many contacts of a predominately few types or not uniformly distributed types is associated with low social loneliness. Thus, we accept Hypothesis 4a.

Relative Importance Analysis of the Final Model

To assess the various contributions to explained variance, we conducted a relative importance analysis of the final step of the linear regression model. The results can be found in **Table 4**. The final model explained $R^2 = 0.21$ of total variance regarding social loneliness as the criterion, of which age and gender explained $R^2 = 0.02$. Of the remaining $R^2 = 0.19$ variance, digital information-sharing behavior explained 14.8% (i.e., $R^2 = 0.03$ of total variance). Both offline and online contacts were the most relevant contributors to the explained variance; together they resulted in approximately two thirds of R^2 (i.e., 64.8%, or $R^2 = 0.12$ of total variance, respectively). Offline and online contacts did not differ in their amount of explained variance, indicating that the communication channel with close contacts shows no differences regarding the association with social loneliness. The two predictors—interconnectedness and heterogeneity—contributed 12.3% (i.e., $R^2 = 0.02$) and 8% (i.e., $R^2 = 0.02$) respectively, to R^2.

TABLE 4 | Relative importance analysis results.

Predictors	Absolute variance explained	Proportion of variance explained	Lower 95% CI	Upper 95% CI	Significant differences
Offline contacts	0.06	32.25	18.08	46.94	a, c
Partner	<0.01	0.15	0.00	7.96	a, b
Inf.-sharing beh.	0.03	14.84	1.83	36.09	
Online contacts	0.06	32.43	17.15	48.22	b, d
Interconnectedness	0.02	12.32	3.26	25.10	
Heterogeneity	0.02	8.00	1.03	16.43	c, d

Explained variances of included predictors for social loneliness as the criterion. $R^2 = 0.21$, of which 0.02 is explained by gender and age. Significant differences ($p < 0.05$) in explained variance are marked with the same letter (e.g., the proportions of variance explained of offline contacts and partner differ significantly, indicated by the same letter "a"). The confidence intervals (CI) might be inflated (Grömping, 2006). Inf.-sharing beh. stands for information-sharing behavior.

TABLE 5 | Regression results using emotional loneliness as the criterion.

Predictor	Base model	Model 1	Model 2	Model 3	Model 4
Gender	0.00	−0.01	0.01	0.02	0.03
Age	−0.14*	−0.14*	−0.13*	−0.12*	−0.13*
Offline contacts	−0.05	−0.05	−0.08	−0.09	−0.19**
Partner	−0.05	−0.02	−0.02	−0.01	−0.01
Inf.-sharing beh.		−0.11	−0.10	−0.10	−0.08
Online contacts			−0.08	−0.11	−0.20**
Interconnectedness				−0.06	−0.11
Heterogeneity					0.20**
R^2	0.026	0.037	0.043	0.046	0.074
ΔR^2	0.026*	0.011	0.006	0.003	0.028**

*Standardized regression coefficients. A more detailed table can be found in **Supplementary Appendix**. * Indicates p < 0.05. ** indicates p < 0.01. Inf.-sharing beh. stands for information-sharing behavior.*

Emotional Loneliness

Regression Results

To assess the associations between emotional loneliness and the predictors, a hierarchical linear regression analysis was conducted. All results can be found in **Table 5**. All resulting linear regression models showed good fit, indicated by normally distributed residual variances and no signs of heteroscedasticity. The variance inflation factors (O'Brien, 2007), and the condition numbers (Kim, 2019) of all models indicated no collinearity between the predictors.

Starting from a baseline model, we added the appropriate predictors for each hypothesis. The baseline model, including gender, age, offline contacts, and presence of partner, showed a fit of adjusted $R^2 = 0.01$. Neither a higher number of offline contacts nor the presence of a partner showed any significant effect on emotional loneliness. Solely higher age was associated with lower loneliness experience ($\beta = -0.14$, $p = 0.023$).

No significant association between digital information-sharing behavior and emotional loneliness was found ($\beta = -0.11$, $p = 0.078$). For more details (see **Table 5**). Thus, we reject Hypothesis 1b.

No significant association between the number of online contacts and emotional loneliness was found ($\beta = -0.05$, $p = 0.101$), thus we rejected Hypothesis 2b.

No significant association between the interconnectedness of the students' contacts and emotional loneliness was found ($\beta = -0.06$, $p = 0.164$), thus we rejected Hypothesis 3b.

TABLE 6 | Relative importance analysis results.

Predictors	Absolute variance explained	Proportion of variance explained in %	Lower 95% CI	Upper 95% CI	Significant differences
Offline contacts	0.01	21.43	3.26	47.26	
Partner	<0.01	0.47	0.01	33.82	
Inf.-sharing beh.	0.01	18.88	0.05	54.82	
Online contacts	0.01	21.10	2.61	46.03	
Interconnectedness	0.01	11.95	0.14	32.73	
Heterogeneity	0.01	26.17	4.45	53.71	

Explained variances of included predictors for emotional loneliness as the criterion. R^2 = 0.07, of which 0.02 is explained by gender and age. Significant differences ($p < 0.05$) in explained variance are marked with the same letter (i.e., there are no significant differences). The confidence intervals (CI) might be inflated (Grömping, 2006). Inf.-sharing beh. stands for information-sharing behavior.

By adding heterogeneity of the students' contacts, the model fit increased by $\Delta R^2 = 0.028$, thus resulting in a final model fit of adjusted $R^2 = 0.05$. A significant positive association between the heterogeneity of students' contacts and emotional loneliness was found ($\beta = 0.20$, $p = 0.002$), as displayed in **Table 5**, indicating homogenous networks are associated with lower emotional loneliness. By adding heterogeneity, the two predictors offline and online contacts turned significant which is addressed in more detail in the discussion. Thus, we accept Hypothesis 4b.

Relative Importance Analysis of the Final Model

To assess the various contributions to explained variance, we conducted a relative importance analysis of the final step of the linear regression model. The results can be found in **Table 6**. The final model explained $R^2 = 0.07$ of total variance regarding emotional loneliness as the criterion, of which age and gender explained $R^2 = 0.02$ of the remaining $R^2 = 0.05$ variance, digital information-sharing behavior explained 18.9% (i.e., $R^2 = 0.01$ of total variance). Both offline and online contacts were the large contributors to the explained variance, added together they resulted in approximately 42.5% of R^2 (i.e., $R^2 = 0.02$ of total variance). They did not differ in their amount of explained variance. Interconnectedness contributed 12.0% to R^2. Heterogeneity made up approximately one quarter of R^2 (i.e., 26.2% or $R^2 = 0.01$ of total variance).

DISCUSSION

In this study, we investigated higher education students' perceptions of loneliness in a German sample. The COVID-19 contact restrictions and the rapid move to emergency remote teaching in higher education resulted in a loss of in-person contact. In this context, we examined how digital information-sharing behavior and the structure of students' close network (i.e., number of close contacts with whom they communicated predominately online or offline, interconnectivity of close contacts, and heterogeneity of close contacts) were related to students' feelings of loneliness. Here, we examined social and emotional loneliness separately. We performed hierarchical linear regressions and examined the predictive strength of the predictors via relative importance analyses.

In summary, our findings indicate that social loneliness is strongly related to digital information-sharing behavior and the network structure of close contacts. In particular, high information-sharing behavior, many close contacts (regardless of whether offline or online), a highly interconnected network, and a homogeneous structure of close contacts were associated with low social loneliness. Emotional loneliness, on the other hand, was mainly linked with network homogeneity, in the sense that students with homogeneous networks showed low emotional loneliness.

Regarding our first hypothesis, we looked at the relationships between information-sharing behavior and social and emotional loneliness. Information-sharing behavior showed a favorable relationship with social loneliness: Students with higher information-sharing behavior showed lower social loneliness perceptions. We could not find a significant association between information-sharing behavior and emotional loneliness. Several possible explanations exist for this connection. The imposed COVID-19 restriction led to two relevant changes in students' lives. First, there was a switch to emergency remote teaching, and second, face-to-face contact was reduced. Emergency remote teaching posed stressful challenges for many students and instructors (Clabaugh et al., 2021). Digital information-sharing behavior facilitated the use of the new focus on remote teaching (Bergdahl et al., 2020). Students who were able to cope well with the new virtual learning environment therefore experienced less stress, which enables them to experience less feelings of loneliness (Yarcheski et al., 2011; Händel et al., 2020). Information-sharing behavior also seemed to be helpful outside the higher education learning context. Our correlation analysis results imply that higher digital information-sharing behavior facilitates staying in touch with a higher number of close contacts, and thus might be linked with decreased feelings of social loneliness (as suggested by Hypothesis 2). The non-significant association between information-sharing behavior and emotional loneliness may be explained by the nature of the Covid-19 restriction in Germany. Although personal contacts were severely restricted at the height of the restrictions, it was still possible to meet another person from another household in addition to people from one's own household. Therefore, participants were able to meet their most important social contact, usually their own partner or best friend, resulting in little or no need to shift communication to online communication. Further—preferably longitudinal—research should explore this question in more detail.

In our second hypothesis, we tested the relationship between close contacts with whom mainly online communication took place and social as well as emotional loneliness. In the case of social loneliness, we found a relationship in accordance with the assumptions, i.e., the more online contacts, the less lonely. In the case of emotional loneliness, this relationship only emerged in the final model, considering all subsequent effects. As other research suggests (Subrahmanyam and Greenfield, 2008; Reich et al., 2012), we assume that due to involuntary contact

termination by the COVID-19 restrictions, communication with offline contacts was inevitably shifted to online communication. In line with our results, this means that in the case of social loneliness, which according to the definition is mainly related to the number of close contacts, online communication could—possibly only temporarily—act as a substitute for the lack of in-person, face-to-face exchange. However, the desire for intimacy is not associated with many close friends, resulting in weaker associations with emotional loneliness (Russell et al., 1984). This is also supported by our relative importance analysis where the absolute proportion of variance of close contacts (no matter whether offline or online) was lower for emotional loneliness than it was for social loneliness. This result suggests that it is not the number of close contacts that is decisive, but rather, as mentioned for example by Weiss (1973), the quality of certain few contacts is significant toward (not) developing feelings of emotional loneliness.

Our third hypothesis tested whether higher levels of close contact interconnectedness were associated with lower levels of loneliness. Our results indicate that increased interconnectivity was associated with lower social, but not emotional, loneliness. Interconnectedness can derive from an evolutionary mechanism of social networks, namely triadic closure (Schaefer et al., 2010; Bianconi et al., 2014), i.e., if a person has two close friends, the two friends will almost inevitably get to know each other over time (e.g., through shared activities, or a shared social environment). Over time, this leads to an interconnected close contacts network. For many social networks, a high level of interconnectivity indicates functioning social support, since the network consists of people who know each other and thus originating from the same social environment (Jones and Moore, 1989; Ashida and Heaney, 2008). Both interconnectedness and social support have been shown to have favorable impacts on feelings of loneliness (Jones and Moore, 1989; Bell, 1991; Ashida and Heaney, 2008). The unobserved effect of interconnectedness on emotional loneliness in our study could probably be due to the assumption that emotional loneliness is mainly related to significant others (e.g., life partners, Russell et al., 1984). Significant others usually account for only a small proportion of the close social network (Dunbar, 1998; Zhou et al., 2005) and therefore, they exert relatively little impact on interconnectivity (i.e., the measure of network density).

In our fourth hypothesis, we considered the relationship between heterogeneity of the students' close contacts and feelings of loneliness; we hypothesized that higher homogeneity would be associated with lower feelings of social and emotional loneliness. To derive the heterogeneity, we applied the Shannon entropy of the close contact types, which we obtained by using a combination of t-distributed stochastic neighbor embedding and cluster analysis. The final hierarchical linear regression model demonstrated that higher contact homogeneity was associated with lower social and emotional loneliness. High homogeneity is often associated with networks of trusted people, who provide social support that might allow students to better cope with new challenges (Salehi et al., 2019; Simons et al., 2020). Shannon entropy as a measure of heterogeneity allows two conclusions about the structure of these social support networks. A high degree of homogeneity (i.e., low heterogeneity) can indicate (1) a low number of types or (2) a non-uniform distribution of the present contact types in the social support network. In other words, the support network structure consists either of a few contact types (e.g., four persons of "type 1" and four persons of "type 2") or of several types that are non-uniformly distributed (i.e., some types are disproportionately frequent, e.g., six persons of "type 1," one person of "type 2," and one person of "type 3"). It is possible to determine which of the two possibilities applies by considering the other two predictors relating to the number of close contacts of the multiple regression (i.e., number of offline and online contacts). Because the number of online and offline contacts is correlated with the number of types ($r \approx 0.6$), the additional explained variance of the loneliness measures due to heterogeneity in our hierarchical model can be attributed to the two structural possibilities by examining the regression weights of online and offline contacts *before* and *after* adding heterogeneity to the model.

In the case of social loneliness, both predictors online and offline contacts were already significantly associated with social loneliness before the inclusion of our heterogeneity measure. We assume that the additional explained variance after adding heterogeneity to our model consequently indicates homogeneity due to a low number of types than a non-uniform distribution of types. However, the latter possibility (i.e., non-uniformly distributed types) cannot be completely excluded due to the increased regression weights of online and offline contacts after adding heterogeneity to the model. Either way, according to our results, social support networks associated with low social loneliness are characterized by many contacts with a low effective number of types (either few types, or individual types are heavily overrepresented).

In the case of emotional loneliness, probably only one structural property of these social support networks applies: the non-uniformity of types, i.e., an overrepresentation of individual types. By adding the predictor heterogeneity, the originally non-significant predictors online and offline contacts turned significant, indicating shared variance between heterogeneity and the predictors. Since the number of types is correlated with the number of online and offline contacts, the remaining residual effect of heterogeneity mainly describes the distribution of types. Consequently, in the case of emotional loneliness, an overrepresentation of a few individual types (i.e., the types are non-uniformly distributed, as seen in social support networks, Coffé and Geys, 2007) is associated with lower feelings of loneliness.

Overall, regarding social loneliness, we interpret our network related observations as follows: we conclude that close contact networks formed according to principles of selection, influence and linkage formation and thus, consisting of many individuals of mainly a few types, are associated with lower feelings of social loneliness. In the case of emotional loneliness, we assume that a different explanatory possibility applies—mainly specific types (e.g., significant others) of the close contacts network might be associated with lower emotional loneliness.

Therefore, the absolute number of close contacts might be less important in this context, but rather a prioritization of these special types.

Limitations, Future Research, and Implications

We would like to address some limitations of our study and simultaneously put the interpretation of the results in context. First, since the present study consists of a cross-sectional analysis, these results only represent correlational associations. However, a comparison of longitudinal results with cross-sectional results in similar research contexts indicates that they may well be very comparable (Newall et al., 2009). Nevertheless, further research should shed more light on the dynamic nature of the interactions found. For example, longitudinal analyses could additionally consider network development and explore the interplay between selection, influence, and feelings of loneliness. Can contagion processes regarding feelings of loneliness be demonstrated again, as indicated by Cacioppo et al. (2009)? What is the temporal pattern of our observed correlational effects?

Second, we would like to address our sample. It showed a gender bias and mainly was situated in one state and one university; therefore, there might be limited generalizability to populations outside those represented by our sample. Regarding the gender bias, a comparison with the validation analysis of the utilized loneliness scales suggests that our results might be representative (Jong Gierveld and Van Tilburg, 2010). In addition, our results indicate that age is related to emotional loneliness, and younger adults report higher emotional loneliness than older adults do. This is consistent with previous research (Yang and Victor, 2011; Ang, 2016; Nyqvist et al., 2016) and may support the generalizability of our sample. In addition, we cannot rule out the possibility of an overlap of egocentric networks (e.g., through shared circles of friends or living in the same apartment) that would violate the necessary statistical independence for linear regression. However, we expect a negligible influence on our analyses since students attended different faculties and a large proportion of students lived with their parents rather than at the university during the COVID-19 restrictions. Two other points worth mentioning are the relatively small sample size and the convenience sample. Both aspects could explain why we did not find a significant correlation between the presence of a partner and (emotional) loneliness. Overall, we note that while our sample is likely to have limited representativeness, it nevertheless provides an interesting initial insight into students' feelings of loneliness during a pandemic period when only people from a maximum of two different households were allowed to meet. Still, there is a need to repeat our analyses with a larger, randomized sample to obtain more reliable statistical results.

Third, in our study, we wanted to advance a networks heterogeneity measure one step further by employing Shannon entropy. There are two reasons why we would like to emphasize that our study may have limited comparability with previous research in terms of heterogeneity. First, our method of measuring heterogeneity, and second, the context in which previous research has viewed heterogeneity and loneliness. First, to our knowledge, our study is the first to use the heterogeneity measure entropy in students' close networks. Other studies often employ the so-called social network index, which counts only the number of social types (e.g., spouse, parents, friends, etc.) with which an individual interacts (Robustelli et al., 2017; Liebke, 2019). However, when measuring heterogeneity or homogeneity, respectively, both the distribution of types and a sophisticated type classification method should be used (Jost, 2006). We addressed this shortcoming through a more sophisticated type assignment and the use of Shannon entropy. It is often used in ecology, information theory, and thermodynamics (Jost, 2006; Masisi et al., 2008); we encourage its use in a psychological research context as well. Second, the context of our study is in part, very distinct from that of earlier research. Our data reflected only a rather short-term impact of the COVID-19 restrictions on students' feelings of loneliness. Most students were aware—or at least hoped—that these restrictions were only a temporary solution. Furthermore, it should be noted that a considerable part of public and private life was affected by the COVID-19 measures and therefore, it is likely that each close contact in the network experienced impacts on their loneliness. Indeed, previous loneliness research had been conducted in a different context, and with different populations. Populations heretofore studied in loneliness research were often challenged by a lack of social support in their individual social networks (e.g., elderly, Fry and Debats, 2002; as well as populations with mental health challenges, such as, borderline personality disorder, Liebke, 2019), where heterogeneity proves beneficial to lower feelings of loneliness due to its link to resilience (Elmqvist et al., 2003). Considering the aforementioned points (i.e., our method of measuring heterogeneity and our distinctive study context), our results on the heterogeneity of close contacts networks have limited comparability with previous research. Moreover, although the entropy measure represents an advance over previous heterogeneity measures in network research, we encourage future research to compare other indicators of heterogeneity or homogeneity in individual network environments, or even explore ensemble statistics of multiple classifiers (Masisi et al., 2008).

Fourth, the relatively low effect sizes for emotional loneliness could also be associated with the acceptable but rather low omega hierarchical. A value of $\omega_h = 0.66$ indicates a rather poor unidimensional construct, which might affect our results. This could also be a reason why the presence of a partner showed only a non-significant value in the regression analysis. Additional, research findings that a partner is less predictive of emotional loneliness in young adults than in older adults may play a role here (Green et al., 2001). In addition, a relatively high number of students (i.e., 20%) reported the maximum possible number of close contacts (i.e., eight), indicating a ceiling effect. While this had no discernible impact on our results, we recommend that, if the scope of the study allows it, future research should provide twelve or more fields for recording close contacts to better account for the skewed distribution. Moreover, the observed results for

emotional loneliness open up another possible interpretation: there may be an unrecognized positive relationship between the number of contacts and emotional loneliness after all (i.e., increased close contacts and decreased emotional loneliness, see Hypothesis 2b). The effect of the number of close contacts could be masked by its association with the number of types and thus with heterogeneity in model 3 (**Table 5**) in the following ways: A higher number of close contacts is correlated with a higher number of types present and thus with higher heterogeneity, which is negatively related to loneliness, thus negating the "positive" effect of the number of contacts. Future research should investigate this possible relationship in more detail.

From our results, first indications for practical implications can be derived—albeit to a limited extent due to the limitations mentioned above. In order to strengthen the positive influence of information-sharing behavior, universities should rely on easy-to-use communication software and offer trainings on their optimal use for lecturers as well as students. In this way, not only the quality of online teaching might increase but the hurdle for students to communicate with their peers is also kept low. Our research revealed a strong association of students' close social network, which consisted largely of peers (see **Supplementary Appendix**), with feelings of loneliness. Other research reinforces this connection through highlighting the importance of perceived peer support on feelings of loneliness (e.g., Kaufmann and Vallade, 2020; Laslo-Roth et al., 2020). Here the lecturer plays a central role in facilitating these beneficial effects (Kaufmann and Vallade, 2020). In online teaching, the lecturer should try to promote interactions between students and their peers (e.g., through group work in breakout rooms), to provide opportunities for the development of online peer support relationships (Kaufmann and Vallade, 2020). It should be noted that such a supportive environment is more likely to be created by synchronous teaching methods (e.g., via video chat platform) and therefore the exclusive use of pre-recorded material should be avoided. Moreover, our results imply that interventions for loneliness (outside the context of higher education) should not only take into account the individual but also the individual's network. Here, the focus could lie on connecting and expanding the close network (ongoing research projects are already being conducted, e.g., Band et al., 2019).

CONCLUSION

The present study provides valuable information about how students' close contacts network structures and digital information-sharing behavior are linked to their experience of loneliness in the context of the COVID-19 pandemic. This study distinguished between social (related to the number of contacts) and emotional (related to intimate contacts) loneliness and showed different associations with the investigated predictors. Overall, social loneliness was more strongly associated with the network structure of close contacts than was emotional loneliness. A higher number of close contacts, high interconnectivity and strong homogeneity of those networks were associated with lower feelings of loneliness—more with social than with emotional loneliness—regardless of whether the communication between the student and their close contacts took place primarily online or offline. We concluded that homogeneous network structures, which are an indicator of social support networks, were linked with lower feelings of loneliness. In addition, digital information-sharing behavior, which might have facilitated transfer from offline to online communication, was found to help students cope with feelings of social loneliness. This study demonstrates that a functioning close social network and suitable usage of digital tools are important to cope with new social and educational environments that will continue to play a decisive role in students' lives, even after COVID-19.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

MDSH, AZ, and MH developed the research idea and developed the questionnaire. MDSH and MH processed the data. MDSH performed the statistical analysis and wrote the manuscript. All authors provided feedback, participated in revising the manuscript, reviewed, and approved the final manuscript.

ACKNOWLEDGMENTS

We thank the university for supporting our study, the student assistants who helped us conduct the study, including Fabian Kratzer who entered the questionnaire online. Furthermore, we thank Miguelina Nuñez for her thorough English language editing and Skylor Zhitian Zhang for her proofreading and fruitful discussions. Finally, we would like to express our gratitude to our reviewers who improved the quality of our manuscript with their constructive feedback.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.733867/full#supplementary-material

REFERENCES

Al Khatib, S. A. (2012). Exploring the Relationship among Loneliness, Self-esteem, Self-efficacy and Gender in United Arab Emirates College Students. *Eur. J. Psychol.* 8:1. doi: 10.5964/ejop.v8i1.301

Alkan, N. (2014). Humor, Loneliness and Acceptance: predictors of University Drop-out Intentions. *Procedia Soc. Behav. Sci.* 152, 1079–1086. doi: 10.1016/j.sbspro.2014.09.278

Ang, C.-S. (2016). Types of Social Connectedness and Loneliness: the Joint Moderating Effects of Age and Gender. *Appl. Res. Qual. Life* 11, 1173–1187. doi: 10.1007/s11482-015-9428-5

Ashida, S., and Heaney, C. A. (2008). Differential Associations of Social Support and Social Connectedness With Structural Features of Social Networks and the Health Status of Older Adults. *J. Aging Health* 20, 872–893. doi: 10.1177/0898264308324626

Band, R., Ewings, S., Cheetham-Blake, T., Ellis, J., Breheny, K., Vassilev, I., et al. (2019). Study protocol for 'The Project About Loneliness and Social networks (PALS)': a pragmatic, randomised trial comparing a facilitated social network intervention (Genie) with a wait-list control for lonely and socially isolated people. *BMJ Open* 9:e028718. doi: 10.1136/bmjopen-2018-028718

Bell, R. A. (1991). Gender, Friendship Network Density, and Loneliness. *J. Soc. Behav. Pers.* 6, 45–56.

Benkel, I., Wijk, H., and Molander, U. (2009). Family and friends provide most social support for the bereaved. *Palliat. Med.* 23, 141–149. doi: 10.1177/0269216308098798

Bergdahl, N., Nouri, J., and Fors, U. (2020). Disengagement, engagement and digital skills in technology-enhanced learning. *Educ. Inf. Technol.* 25, 957–983. doi: 10.1007/s10639-019-09998-w

Bernholt, A., Hagenauer, G., Lohbeck, A., Gläser-Zikuda, Michaela Wolf, N., Moschner, B., et al. (2018). Bedingungsfaktoren der Studienzufriedenheit von Lehramtsstudierenden. *J. Educ. Res. Online* 10, 22–49.

Bianconi, G., Darst, R. K., Iacovacci, J., and Fortunato, S. (2014). Triadic closure as a basic generating mechanism of communities in complex networks. *Phys. Rev.* 90:042806. doi: 10.1103/PhysRevE.90.042806

Bu, F., Steptoe, A., and Fancourt, D. (2020). Who is lonely in lockdown? Cross-cohort analyses of predictors of loneliness before and during the COVID-19 pandemic. *Public Health* 186, 31–34. doi: 10.1016/j.puhe.2020.06.036

Burk, W. J., Kerr, M., and Stattin, H. (2008). The co-evolution of early adolescent friendship networks, school involvement, and delinquent behaviors. *Rev. Française Sociol.* 49:499. doi: 10.3917/rfs.493.0499

Cacioppo, J. T., Fowler, J. H., and Christakis, N. A. (2009). Alone in the crowd: the structure and spread of loneliness in a large social network. *J. Pers. Soc. Psychol.* 97, 977–991. doi: 10.1037/a0016076

Caravita, S. C. S., Sijtsema, J. J., Rambaran, J. A., and Gini, G. (2014). Peer influences on moral disengagement in late childhood and early adolescence. *J. Youth Adolesc.* 43, 193–207. doi: 10.1007/s10964-013-9953-1

Clabaugh, A., Duque, J. F., and Fields, L. J. (2021). Academic Stress and Emotional Well-Being in United States College Students Following Onset of the COVID-19 Pandemic. *Front. Psychol.* 12:628787. doi: 10.3389/fpsyg.2021.628787

Coffé, H., and Geys, B. (2007). Toward an Empirical Characterization of Bridging and Bonding Social Capital. *Nonprofit Volunt. Sect. Q.* 36, 121–139. doi: 10.1177/0899764006293181

Dai, P., Wang, N., Kong, L., Dong, X., and Tian, L. (2021). A large number of online friends and a high frequency of social interaction compensate for each Other's shortage in regard to perceived social support. *Curr. Psychol.* 6, 1–10. doi: 10.1007/s12144-021-01458-4

de Jong Gierveld, J., and Van Tilburg, T. (1999). *Manual of the Loneliness Scale*. Amsterdam: Departement of Social Research Methodology, Vrije Universiteit.

Dunbar, R. I. M. (1998). The social brain hypothesis. *Evol. Anthropol.* 6, 178–190. doi: 10.1002/(SICI)1520-650519986:5<178::AID-EVAN5<3.0.CO;2-8

Dykstra, P. A., and Jong Gierveld, J. D. (2004). Gender and Marital-History Differences in Emotional and Social Loneliness among Dutch Older Adults. *Can. J. Aging* 23, 141–155. doi: 10.1353/cja.2004.0018

Elmqvist, T., Folke, C., Nystrom, M., Peterson, G., Bengtsson, J., Walker, B., et al. (2003). Response Diversity, Ecosystem Change, and Resilience. *Front. Ecol. Environ.* 1:488. doi: 10.2307/3868116

Feldman, B. E. (2005). *Relative Importance and Value*. doi: 10.2139/ssrn.2255827 Available online at: https://ssrn.com/abstract=2255827 (accessed June 20, 2021).

Fry, P. S., and Debats, D. L. (2002). Self-Efficacy Beliefs as Predictors of Loneliness and Psychological Distress in Older Adults. *Int. J. Aging Hum. Dev.* 55, 233–269. doi: 10.2190/KBVP-L2TE-2ERY-BH26

Giannella, E., and Fischer, C. S. (2016). An inductive typology of egocentric networks. *Soc. Netw.* 47, 15–23. doi: 10.1016/j.socnet.2016.02.003

Granovetter, M. S. (1973). The Strength of Weak Ties. *Am. J. Sociol.* 78, 1360–1380. doi: 10.1086/225469

Green, L. R., Richardson, D. S., Lago, T., and Schatten-Jones, E. C. (2001). Network Correlates of Social and Emotional Loneliness in Young and Older Adults. *Personal. Soc. Psychol. Bull.* 27, 281–288. doi: 10.1177/0146167201273002

Grömping, U. (2006). Relative Importance for Linear Regression in R: the Package relaimpo. *J. Stat. Softw.* 17, 1–27. doi: 10.18637/jss.v017.i01

Händel, M., Stephan, M., Gläser-Zikuda, M., Kopp, B., Bedenlier, S., and Ziegler, A. (2020). *Digital Readiness and its Effects on Higher Education Students' Socio-Emotional Perceptions in the Context of the COVID-19 Pandemic*. United Kingdom: Taylor & Francis. 1–13. doi: 10.1080/15391523.2020.1846147

Hodges, C., Moore, S., Lockee, B., Trust, T., and Bond, A. (2020). *The Difference Between Emergency Remote Teaching and Online Learning*. Available online at: https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning (accessed June 16, 2021).

Hofstra, B., Corten, R., van Tubergen, F., and Ellison, N. B. (2017). Sources of Segregation in Social Networks: a Novel Approach Using Facebook. *Am. Sociol. Rev.* 82, 625–656. doi: 10.1177/0003122417705656

Hong, A. J., and Kim, H. J. (2018). College Students' Digital Readiness for Academic Engagement (DRAE) Scale: scale Development and Validation. *Asia-Pacific Educ. Res.* 27, 303–312. doi: 10.1007/s40299-018-0387-0

Honicke, T., and Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: a systematic review. *Educ. Res. Rev.* 17, 63–84. doi: 10.1016/j.edurev.2015.11.002

Hopp, M. D. S., Stoeger, H., and Ziegler, A. (2020). The Supporting Role of Mentees' Peers in Online Mentoring: a Longitudinal Social Network Analysis of Peer Influence. *Front. Psychol.* 11:1929. doi: 10.3389/fpsyg.2020.01929

Hopp, M. D. S., Zhang, Z. S., Hinch, L., O'Reilly, C., and Ziegler, A. (2019). Creative, Thus Connected: the Power of Sociometric Creativity on Friendship Formation in Gifted Adolescents—A Longitudinal Network Analysis of Gifted Students. *New Dir. Child Adolesc. Dev.* 2019, 47–73. doi: 10.1002/cad.20324

IBM Corp (2019). *IBM SPSS Statistics for Windows, Version 26.0*. Armonk, NY: IBM Corp.

Jackson, T., Soderlind, A., and Weiss, K. E. (2000). Personality traits and quality of relationships as predictors of future loneliness among American college students. *Soc. Behav. Pers. Int. J.* 28, 463–470. doi: 10.2224/sbp.2000.28.5.463

Jones, W. H., and Moore, T. L. (1989). "Loneliness and Social Support" in *Loneliness, Theory, Research and Applications*. eds M. Hojat and R. Crandall (United States: SAGE Publications, Inc). 145–156.

Jong Gierveld, J. D., and Kamphuls, F. (1985). The Development of a Rasch-Type Loneliness Scale. *Appl. Psychol. Meas.* 9, 289–299. doi: 10.1177/014662168500900307

Jong Gierveld, D., and Van Tilburg, T. (2010). The De Jong Gierveld short scales for emotional and social loneliness: tested on data from 7 countries in the UN generations and gender surveys. *Eur. J. Ageing* 7, 121–130. doi: 10.1007/s10433-010-0144-6

Jost, L. (2006). Entropy and diversity. *Oikos* 113, 363–375. doi: 10.1111/j.2006.0030-1299.14714.x

Kassambara, A., and Mundt, F. (2020). *Factoextra: extract and Visualize the Results of Multivariate Data Analyses*. Available online at: https://cran.r-project.org/package=factoextra (accessed June 20, 2021).

Kaufmann, R., and Vallade, J. I. (2020). *Exploring Connections in the Online Learning Environment: student Perceptions of Rapport, Climate, and Loneliness*. United Kingdom: Taylor and Francis. 1–15. doi: 10.1080/10494820.2020.1749670

Killgore, W. D. S., Cloonan, S. A., Taylor, E. C., and Dailey, N. S. (2020). Loneliness: a signature mental health concern in the era of COVID-19. *Psychiatry Res.* 290:113117. doi: 10.1016/j.psychres.2020.113117

Kim, J. H. (2019). Multicollinearity and misleading statistical results. *Korean J. Anesthesiol.* 72, 558–569. doi: 10.4097/kja.19087

Kluck, J. P., Stoyanova, F., and Krämer, N. C. (2021). Putting the social back into physical distancing: the role of digital connections in a pandemic crisis. *Int. J. Psychol.* 56, 594–606. doi: 10.1002/ijop.12746

Kovacs, B., Caplan, N., Grob, S., and King, M. (2021). *Social Networks and Loneliness During the COVID-19 Pandemic*. United States: Sage Publication. doi: 10.1177/2378023120985254

Kralj Novak, P., Smailović, J., Sluban, B., and Mozetič, I. (2015). Sentiment of Emojis. *PLoS One* 10:e0144296. doi: 10.1371/journal.pone.0144296

Kraut, R., Kiesler, S., Boneva, B., Cummings, J., Helgeson, V., and Crawford, A. (2002). Internet Paradox Revisited. *J. Soc. Issues* 58, 49–74. doi: 10.1111/1540-4560.00248

Kraut, R., Patterson, M., Lundmark, V., Kiesler, S., Mukophadhyay, T., and Scherlis, W. (1998). Internet paradox: a social technology that reduces social involvement and psychological well-being? *Am. Psychol.* 53, 1017–1031. doi: 10.1037/0003-066X.53.9.1017

Krijthe, J. H. (2015). *Rtsne: T-Distributed Stochastic Neighbor Embedding using Barnes-Hut Implementation*. Available online at: https://github.com/jkrijthe/Rtsne (accessed December 21, 2021).

Laslo-Roth, R., Bareket-Bojmel, L., and Margalit, M. (2020). *Loneliness Experience During Distance Learning Among College Students With ADHD: the Mediating Role of Perceived Support and Hope*. United Kingdom: Taylor & Francis. 1–15. doi: 10.1080/08856257.2020.1862339

Liebke, L. (2019). Alterations in Interpersonal Relations in Borderline Personality Disorder: loneliness, Rejection, and Belonging. Available online at: http://www.ub.uni-heidelberg.de/archiv/25987 (accessed June 25, 2021).

Ligges, U., and Mächler, M. (2003). Scatterplot3d - An R Package for Visualizing Multivariate Data. *J. Stat. Softw.* 8, 1–20. doi: 10.18637/jss.v008.i11

Lin, S.-H., and Huang, Y.-C. (2012). Investigating the relationships between loneliness and learning burnout. *Act. Learn. High. Educ.* 13, 231–243. doi: 10.1177/1469787412452983

Liu, S., Heinzel, S., Haucke, M. N., and Heinz, A. (2021). Increased Psychological Distress, Loneliness, and Unemployment in the Spread of COVID-19 over 6 Months in Germany. *Medicina* 57:53. doi: 10.3390/medicina57010053

Manago, A. M., Brown, G., Lawley, K. A., and Anderson, G. (2020). Adolescents' daily face-to-face and computer-mediated communication: associations with autonomy and closeness to parents and friends. *Dev. Psychol.* 56, 153–164. doi: 10.1037/dev0000851

Marsden, P. V. (1987). Core Discussion Networks of Americans. *Am. Sociol. Rev.* 52:122. doi: 10.2307/2095397

Masisi, L., Nelwamondo, V., and Marwala, T. (2008). "The use of entropy to measure structural diversity" in *2008 IEEE International Conference on Computational Cybernetics* (United States: IEEE). 41–45. doi: 10.1109/ICCCYB.2008.4721376

Mayer, A., and Puller, S. L. (2008). The old boy (and girl) network: social network formation on university campuses. *J. Public Econ.* 92, 329–347. doi: 10.1016/j.jpubeco.2007.09.001

McDonald, R. P. (1999). *Test Theory: a Unified Treatment*. London: Psychology Press.

McPherson, M., Smith-Lovin, L., and Cook, J. M. (2001). Birds of a Feather: homophily in Social Networks. *Annu. Rev. Sociol.* 27, 415–444. doi: 10.1146/annurev.soc.27.1.415

Mercken, L., Snijders, T. A. B., Steglich, C., Vartiainen, E., and de Vries, H. (2010). Dynamics of adolescent friendship networks and smoking behavior. *Soc. Netw.* 32, 72–81. doi: 10.1016/j.socnet.2009.02.005

Moody, E. J. (2001). Internet Use and Its Relationship to Loneliness. *CyberPsychol. Behav.* 4, 393–401. doi: 10.1089/109493101300210303

Nabi, R. L., Prestin, A., and So, J. (2013). Facebook Friends with (Health) Benefits? Exploring Social Network Site Use and Perceptions of Social Support, Stress, and Well-Being. *Cyberpsychology, Behav. Soc. Netw.* 16, 721–727. doi: 10.1089/cyber.2012.0521

Nakagomi, A., Shiba, K., Kondo, K., and Kawachi, I. (2020). Can Online Communication Prevent Depression Among Older People? A Longitudinal Analysis. *J. Appl. Gerontol.* 41, 167–175. doi: 10.1177/0733464820982147

Neto, R., Golz, N., and Polega, M. (2015). Social Media Use, Loneliness, and Academic Achievement: a Correlational Study with Urban High School Students. *J. Res. Educ.* 25, 28–37.

Newall, N. E., Chipperfield, J. G., Clifton, R. A., Perry, R. P., Swift, A. U., and Ruthig, J. C. (2009). Causal beliefs, social participation, and loneliness among older adults: a longitudinal study. *J. Soc. Pers. Relat.* 26, 273–290. doi: 10.1177/0265407509106718

Nicpon, M. F., Huser, L., Blanks, E. H., Sollenberger, S., Befort, C., and Kurpius, S. E. R. (2006). The Relationship of Loneliness and Social Support with College Freshmen's Academic Performance and Persistence. *J. Coll. Student Retent. Res. Theory Pract.* 8, 345–358. doi: 10.2190/A465-356M-7652-783R

Nyqvist, F., Victor, C. R., Forsman, A. K., and Cattan, M. (2016). The association between social capital and loneliness in different age groups: a population-based study in Western Finland. *BMC Public Health* 16:542. doi: 10.1186/s12889-016-3248-x

O'Brien, R. M. (2007). A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Qual. Quant.* 41, 673–690. doi: 10.1007/s11135-006-9018-6

Oksanen, J., Blanchet, F. G., Friendly, M., Kindt, R., Legendre, P., McGlin, D., et al. (2020). *vegan: Community Ecology Package*. Available online at: https://cran.r-project.org/package=vegan (accessed June 20, 2021).

R Core Team (2020). *R: a Language and Environment for Statistical Computing Reference Index*. Vienna. Available online at: http://www.r-project.org/index.html. doi: 10.1109/ICIN.2011.6081064 (accessed June 2, 2021).

Reich, S. M., Subrahmanyam, K., and Espinoza, G. (2012). Friending, IMing, and hanging out face-to-face: overlap in adolescents' online and offline social networks. *Dev. Psychol.* 48, 356–368. doi: 10.1037/a0026980

Revelle, W. (2020). *psych: Procedures for Psychological, Psychometric, and Personality Research*. Available online at: https://cran.r-project.org/package=psych (accessed January 26, 2021).

Robustelli, B. L., Newberry, R. E., Whisman, M. A., and Mittal, V. A. (2017). Social relationships in young adults at ultra high risk for psychosis. *Psychiatry Res.* 247, 345–351. doi: 10.1016/j.psychres.2016.12.008

Rosenstreich, E., and Margalit, M. (2015). Loneliness, Mindfulness, and Academic Achievements: a Moderation Effect among First-Year College Students. *Open Psychol. J.* 8, 138–145. doi: 10.2174/1874350101508010138

Rotenberg, K. J., and Morrison, J. (1993). Loneliness and College Achievement: do Loneliness Scale Scores Predict College Drop-Out? *Psychol. Rep.* 73, 1283–1288. doi: 10.2466/pr0.1993.73.3f.1283

Russell, D. W. (1982). "The Measurement of Loneliness" in *Loneliness: a Sourcebook of Current Theory, Research and Therapy*, eds L. Peplau and D. Perlman (United States: Wiley). 81–104.

Russell, D. W., Cutrona, C. E., McRae, C., and Gomez, M. (2012). Is Loneliness the Same as Being Alone? *J. Psychol.* 146, 7–22. doi: 10.1080/00223980.2011.589414

Russell, D. W., Cutrona, C. E., Rose, J., and Yurko, K. (1984). Social and emotional loneliness: an examination of Weiss's typology of loneliness. *J. Pers. Soc. Psychol.* 46, 1313–1321. doi: 10.1037/0022-3514.46.6.1313

Salehi, A., Ehrlich, C., Kendall, E., and Sav, A. (2019). Bonding and bridging social capital in the recovery of severe mental illness: a synthesis of qualitative research. *J. Ment. Heal.* 28, 331–339. doi: 10.1080/09638237.2018.1466033

Schaefer, D. R., Light, J. M., Fabes, R. A., Hanish, L. D., and Martin, C. L. (2010). Fundamental principles of network formation among preschool children. *Soc. Netw.* 32, 61–71. doi: 10.1016/j.socnet.2009.04.003

Schaufeli, W. B., Martínez, I. M., Pinto, A. M., Salanova, M., and Bakker, A. B. (2002). Burnout and Engagement in University Students. *J. Cross. Cult. Psychol.* 33, 464–481. doi: 10.1177/0022022102033005003

Shaw, L. H., and Gant, L. M. (2002). In Defense of the Internet: the Relationship between Internet Communication and Depression, Loneliness, Self-Esteem, and Perceived Social Support. *Cyber Psychol. Behav.* 5, 157–171. doi: 10.1089/109493102753770552

Shin, Y. (2007). Peer Relationships, Social Behaviours, Academic Performance and Loneliness in Korean Primary School Children. *Sch. Psychol. Int.* 28, 220–236. doi: 10.1177/0143034307078103

Simons, M., Lataster, J., Reijnders, J., Peeters, S., Janssens, M., and Jacobs, N. (2020). Bonding personal social capital as an ingredient for positive aging and mental well-being. A study among a sample of Dutch elderly. *Aging Ment. Health* 24, 2034–2042. doi: 10.1080/13607863.2019.1650887

Smirnov, I., and Thurner, S. (2017). Formation of homophily in academic performance: students change their friends rather than performance. *PLoS One* 12:e0183473. doi: 10.1371/journal.pone.0183473

Snijders, T. A. B. (2001). The Statistical Evaluation of Social Network Dynamics. *Sociol. Methodol.* 31, 361–395. doi: 10.1111/0081-1750.00099

Steglich, C., Snijders, T. A. B., and Pearson, M. (2010). Dynamic Networks And Behavior: separating Selection From Influence. *Sociol. Methodol.* 40, 329–393. doi: 10.1111/j.1467-9531.2010.01225.x

Stokes, J. P. (1985). The relation of social network and individual difference variables to loneliness. *J. Pers. Soc. Psychol.* 48, 981–990. doi: 10.1037/0022-3514.48.4.981

Stokes, J. P., and Levin, I. (1986). Gender differences in predicting loneliness from social network characteristics. *J. Pers. Soc. Psychol.* 51, 1069–1074. doi: 10.1037/0022-3514.51.5.1069

Subrahmanyam, K., and Greenfield, P. (2008). Online Communication and Adolescent Relationships. *Futur. Child.* 18, 119–146. doi: 10.1353/foc.0.0006

Thomas, L., Orme, E., and Kerrigan, F. (2020). Student Loneliness: the Role of Social Media Through Life Transitions. *Comput. Educ.* 146:103754. doi: 10.1016/j.compedu.2019.103754

Tinto, V. (1993). *Leaving College: Rethinking the Causes and Cures of Student Attrition*, 2nd editio Edn. Chicago: University of Chicago Press.

UNESCO (2020). *UNESCO Rallies International Organizations, Civil Society and Private Sector Partners in a Broad Coalition to Ensure LearningNeverStops*. Available online at: https://en.unesco.org/news/unesco-rallies-international-organizations-civil-society-and-private-sector-partners-broad (accessed September 27, 2021).

UNESCO (2021). *Global Education Coalition*. Available online at: https://en.unesco.org/covid19/educationresponse/globalcoalition (accessed September 27, 2021).

Valkenburg, P. M., and Peter, J. (2007a). Online Communication and Adolescent Well-Being: testing the Stimulation Versus the Displacement Hypothesis. *J. Comput. Commun.* 12, 1169–1182. doi: 10.1111/j.1083-6101.2007.00368.x

Valkenburg, P. M., and Peter, J. (2007b). Preadolescents' and adolescents' online communication and their closeness to friends. *Dev. Psychol.* 43, 267–277. doi: 10.1037/0012-1649.43.2.267

Van Baarsen, B., Smit, J. H., Snijders, T. A. B., and Knipscheer, K. P. M. (1999). Do personal conditions and circumstances surrounding partner loss explain loneliness in newly bereaved older adults? *Ageing Soc.* 19, 441–469. doi: 10.1017/S0144686X9900745X

van Baarsen, B., Snijders, T. A. B., Smit, J. H., and van Duijn, M. A. J. (2001). Lonely but Not Alone: emotional Isolation and Social Isolation as Two Distinct Dimensions of Loneliness in Older People. *Educ. Psychol. Meas.* 61, 119–135. doi: 10.1177/00131640121971103

Watkins, M. W. (2017). The reliability of multidimensional neuropsychological measures: from alpha to omega. *Clin. Neuropsychol.* 31, 1113–1126. doi: 10.1080/13854046.2017.1317364

Weiss, R. S. (1973). *Loneliness: the Experience of Emotional and Social Isolation*. Cambridge: MIT Press.

Wickham, H. (2016). *ggplot2 Elegant Graphics for Data Analysis*. Available online at: https://ggplot2.tidyverse.org (accessed October 18, 2020).

Yang, K., and Victor, C. (2011). Age and loneliness in 25 European nations. *Ageing Soc.* 31, 1368–1388. doi: 10.1017/S0144686X1000139X

Yarcheski, A., Mahon, N. E., and Yarcheski, T. J. (2011). Stress, Hope, and Loneliness in Young Adolescents. *Psychol. Rep.* 108, 919–922. doi: 10.2466/02.07.09.PR0.108.3.919-922

Zhou, W.-X., Sornette, D., Hill, R. A., and Dunbar, R. I. M. (2005). Discrete hierarchical organization of social group sizes. *Proc. R. Soc. B Biol. Sci.* 272, 439–444. doi: 10.1098/rspb.2004.2970

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 25 January 2022
doi: 10.3389/fpsyg.2021.733683

Educational Concerns, Health Concerns and Mental Health During Early COVID-19 School Closures: The Role of Perceived Support by Teachers, Family, and Friends

*Lena Dändliker[1], Isabel Brünecke[2], Paola Citterio[1], Fabienne Lochmatter[1], Marlis Buchmann[1] and Jeanine Grütter[1,3]**

[1] Jacobs Center for Productive Youth Development, University of Zurich, Zurich, Switzerland, [2] Department of Psychology, University of Konstanz, Konstanz, Germany, [3] Empirical Education Research, University of Konstanz, Konstanz, Germany

OPEN ACCESS

Edited by:
Karin Gehrer, Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Yvonne Hendrika Maria Van Den Berg, Radboud University Nijmegen, Netherlands
Maximilian Pfost, University of Bamberg, Germany

***Correspondence:**
Jeanine Grütter
jeanine.gruetter@uni-konstanz.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *23 December 2021*
Published: *25 January 2022*

Citation:
Dändliker L, Brünecke I, Citterio P, Lochmatter F, Buchmann M and Grütter J (2022) Educational Concerns, Health Concerns and Mental Health During Early COVID-19 School Closures: The Role of Perceived Support by Teachers, Family, and Friends. Front. Psychol. 12:733683. doi: 10.3389/fpsyg.2021.733683

This study investigated whether school closures and health-related uncertainties in the early phases of the COVID-19 pandemic posed risk factors for adolescents' mental health and whether perceived social support by parents, teachers, and friends functioned as protective factors. In particular, we argued that perceived social support would buffer negative associations between educational and health concerns and mental health. Based on a person-centered approach, we first examined resilience profiles. These profiles reflect configurations regarding the levels of these risk and protective factors and levels of mental health. Second, we analyzed whether these risk and protective factors predicted adolescents' mental health differently by using a variable-centered approach. The sample consisted of 1'562 adolescents (*M*age = 16.18, *SD* = 1.48, range = 14-20 years; 72% females) in lower and higher secondary education from three regions: German-speaking part of Switzerland, *N* = 486; Italian-speaking part of Switzerland, *N* = 760; and Northern Italy *N* = 316. Results from the person-centered approach revealed three latent profiles characterized by low (19%), average (47%), or high resilience (34%). Lower resilience was associated with higher educational concerns, lower perceived social support, and lower mental health, while high resilience was characterized by lower concerns, higher support, and higher mental health. Importantly, educational concerns varied more between profiles than health concerns, and perceived teacher and family support varied more than perceived friend support. Corroborating these findings, the variable-centered approach (i.e., a path analysis) revealed that educational concerns were a stronger predictor than health concerns and pointed to a higher relative importance of perceived family support for adolescents' mental health relative to perceived teacher and friend support. Taken together, the findings suggest that adolescents' educational concerns and perceived family support, respectively, were stronger risk and protective factors for their mental health during school closures related to the COVID-19 pandemic. Finally, adolescents

from regions being more exposed to the COVID-19 pandemic, namely, Italian-speaking part of Switzerland and Northern Italy, were more likely classified in the low or the average rather than in the high resilience profile compared to students from the region with lower exposure, that is, the German-speaking part of Switzerland.

Keywords: educational concerns, perceived friend support, perceived family support, perceived teacher support, mental health, latent profiles, COVID-19 school closures, health concerns

INTRODUCTION

In early 2020, the spread of the coronavirus SARS-CoV-2 led severely affected countries like Switzerland and Italy to take protective and containment measures, such as school closures and the conversion from in-school to distance learning. Due to these changes, adolescents faced new challenges in their educational environment, such as increased demand for self-centered learning, insecurities about their future and fear of grade retention, in particular (Klootwijk et al., 2021). At the same time, face-to-face support from teachers was restricted in certain schools. Teacher support was particularly limited during the lockdown, as many teachers had to adjust to their new roles, including the application of new teaching technologies (Beteille et al., 2020; Korzycka et al., 2021). In addition to these educational concerns, adolescents encountered uncertainties about the virus and fear about infection (Brooks et al., 2020). This occurred at a time when they were not able to interact in person with their friends, who could be an important source of support in times of crisis; hence, restricted social support may have exacerbated psychosocial and internalizing problems (Bernasco et al., 2021). Evidence shows that such pandemic-related stressors have been negatively associated with adolescents' mental health (Guessoum et al., 2020; Shanahan et al., 2020).

While potential risks for adolescents' mental health during the crisis have been documented (e.g., Shanahan et al., 2020), little is known about the relative role of educational and health-related risk factors, reflecting individual stressors for adolescents. More research is also needed to better understand how adolescents perceived different sources of social support and how these sources were related to their mental health during pandemic-related school closures. While the positive role of perceived social support from teachers, families and friends for adolescents' mental health has been well documented in general (Armstrong et al., 2005; Pinkerton and Dolan, 2007; Suldo et al., 2009; Traylor et al., 2016), first evidence points to its significant role during the COVID-19 pandemic (Ellis et al., 2020; Bernasco et al., 2021; Klootwijk et al., 2021; Ye et al., 2021). The current research aimed to build on these first insights by studying the relative role of these support systems during school closures in early phases of the pandemic. Due to the new situation, the relative role of particular social support systems may have changed, as support from face-to-face interactions with teachers and friends were less likely, while family interaction patterns have been more frequent at the same time (Ellis et al., 2020; Fegert et al., 2020; Prime et al., 2020). Therefore, perceived family support may have gained in significance for adolescents' mental health, among other things, also in their supporting role regarding distance learning (Garrote et al., 2021).

Based on a resilience framework, the current study investigated adolescents' mental health during school closures at the onset of the COVID-19 pandemic taken as an indicator for adolescents' healthy functioning during times of crisis. Even though a universal definition of resilience has been questioned (Pooley and Cohen, 2010; Southwick et al., 2014; Valiente et al., 2021), the literature agrees that two components must be present: First, the individual must encounter adversity or a high-risk situation and second, there must be a process of successful adaptation (e.g., Schilling, 2008). The result of this adaptation is often reflected in high well-being and is facilitated by a person's resources, also called protective factors (Buchanan, 2014).

In the current study, we specifically focused on the role of adversities related to uncertainties regarding adolescents' education and health as risk factors for adolescents' mental health. Whereas adolescents were confronted with such objective stressors in the form of COVID-19-related school closures, we assumed that adolescents would react with subjective perceived stress, reflected in higher educational and health concerns. Regarding protective factors for adolescents' mental health, we investigated the relative role of perceived social support by teachers, family, and friends. We first analyzed whether there were different groups of adolescents who could be described by different levels of risk (i.e., higher perceived stress reflected in higher educational and health concerns) and protective factors (i.e., perceived social support) associated with either lower or higher levels of mental health. These resilience profiles were examined within a person-centered approach. In addition, we used a variable-centered approach to investigate the relative associations of these risk and protective factors with adolescents' mental health. Hereby, we first predicted adolescents' mental health with the risk and protective variables; second, we investigated whether perceived social support by teachers, family, and friends buffered negative associations of educational and health concerns with adolescents' mental health. The stress-buffering hypothesis proposes that perceived social support serves as a protective factor against negative effects of stress from negative life events on mental health (Cassel, 1976). High perceived social support may have been particularly important during school closures in early stages of the COVID-19 pandemic.

Lastly, we aimed to understand to what extent the exposure to the virus and related restrictions might have affected adolescents' resilience with pandemic-related educational and health concerns by comparing adolescents from three different

regions (i.e., German-speaking part of Switzerland, Italian-speaking part of Switzerland and Northern Italy).

Adolescents' Educational and Health Concerns During the Pandemic

The onset of the measures to contain the spread of the pandemic dramatically changed adolescents' everyday lives and was associated with lower mental health (Jones et al., 2021; Stefaniak et al., 2021), such as increasing levels of depressive symptoms and loneliness (Grey et al., 2020). Particularly, young people seem to be at risk in such situations, as they react more strongly to surrounding stressors (El-Zoghby et al., 2020; Stefaniak et al., 2021) and are more vulnerable to traumatic and stressful events (Zhang et al., 2014). Stress may be either characterized as an external event, typically measured with negative life events believed to be stressful, and hence objective (Holmes and Rahe, 1967; Derogatis and Coons, 1993; Christensen et al., 2019) or it may be described as an individual perception central to the impact of a given stressor and hence subjective (Lazarus and Folkman, 1984; Christensen et al., 2019). The current study focused on subjective perceptions of stress, reflected in adolescents' educational and health concerns, with higher concerns reflecting higher levels of perceived stress. We expected that these were two particularly salient concerns during early phases of the pandemic, when objective stressors such as lockdowns and school closures changed adolescents' routines (de Miranda et al., 2020; Lee, 2020), and when relatively little was known about the new virus, potentially exacerbating fear of being infected (Fegert et al., 2020) and general concerns about the pandemic (Ellis et al., 2020).

Educational Concerns Associated With Pandemic-Related School Closures

Studies conducted prior to the pandemic suggest that adolescents experience stress due to increasing educational demands and concerns for their educational performance (Huan et al., 2008; Rickwood et al., 2016; Pascoe et al., 2020). Such educational concerns are associated with several undesirable outcomes. Among those are negative affect (Arsenio and Loria, 2014), negative general mood (Arsenio and Loria, 2014), lower self-esteem, higher anxiety and depression (Nguyen et al., 2019), and decreasing educational engagement (Reschly et al., 2008). Adolescents' educational concerns have been investigated as symptoms of school burnout, which is defined by cynicism, exhaustion at school, and a sense of inadequacy at school (Bask and Salmela-Aro, 2013). Recent work shows that school burnout is associated with lower mental health (Nazar et al., 2020; Özhan and Yüksel, 2021) and lower educational achievement (Madigan and Curran, 2021).

Educational concerns may have been particularly salient during school closures associated with the COVID-19 pandemic. First, adolescents were deprived of routine habits associated with going to school, such as clear daily structures and regular interactions with peers and teachers and faced uncertainty and about future educational achievements (de Miranda et al., 2020; Golberstein et al., 2020; Hoffman and Miller, 2020; Wang et al., 2020; van Loon et al., 2021). Moreover, recent evidence pointed to increased worries about being behind and getting delayed in school (van Loon et al., 2021). Such educational concerns can increase loneliness, particularly when coupled with reduced social interactions (Loades et al., 2020; Wang et al., 2020). In addition, schools converted classroom teaching to distance learning, creating new challenges for both, teachers and students (Bond, 2020). The new educational setting required, for example, technology knowledge on the part of the teacher and technology acceptance on the part of the student (Bond, 2020), whereas such additional demands on new skills may have been overwhelming for certain students.

Taken together, school closures during the pandemic confronted students with new challenges. For certain adolescents, these sudden changes in the educational setting and educational demands might have exceeded their resources (Wang et al., 2020), increasing their educational concerns. Based on previous work (Wang et al., 2020; van Loon et al., 2021), we thus assumed that heightened educational concerns reflected a risk factor for adolescents' mental health.

In addition to educational concerns, adolescents encountered health concerns. In March 2020, with the number of cases dramatically increasing, the development of the pandemic situation was still unknown. How infectious the virus was and how long the measures to contain the virus would continue were uncertain, potentially engendering pandemic-related health concerns.

Health Concerns Associated With the COVID-19 Pandemic

A recent systematic review pointed to a decline of adolescents' mental health because of COVID-19-related health concerns (Meherali et al., 2021). For example, among Canadian adolescents, almost every other adolescent was "very concerned" about the pandemic, expressing high degrees of loneliness and depression (Ellis et al., 2020). Moreover, intolerance of uncertainty during the COVID-19 situation was directly and indirectly associated with negative emotions and higher risk perception among Chinese adolescents (Li et al., 2021). Relatedly, evidence suggests that the pandemic can increase the risk of post-traumatic stress symptoms (de Miranda et al., 2020; Guessoum et al., 2020; Liang et al., 2020) as well as anxiety and depressive symptoms (Duan et al., 2020; Fegert et al., 2020; Meherali et al., 2021). A German study comparing data before and during the pandemic, showed that the quality of life has decreased for adolescents, with the pandemic leading to higher levels of fear and mental disorders and lower mental health (Ravens-Sieberer et al., 2021). During the COVID-19 situation, adolescents might have also displayed other behavioral problems such as concentration problems, irritability, and reduced physical activity (Jiao et al., 2020), both potentially being related to adolescents' health concerns during the lockdown. Based on this prior work, we assumed that health concerns would negatively relate to adolescent's mental health.

While uncertainties related to school closures and health concerns were conceptualized as risk factors for adolescents' mental health, social support by teachers, family, and

friends was assumed to be an important protective factor for their mental health.

Perceived Social Support

The current study focused on the role of perceived social support, consisting of an individual's perception of how much support they feel they receive (Eagle et al., 2019; Qi et al., 2020). During adolescence, social support assumes a significant role for coping with developmental tasks associated with physical, emotional, and social changes (Pinkerton and Dolan, 2007). Evidence confirms that social support has a positive effect on social relationships and promotes feelings of being safe and cared for (Andrews et al., 2002). Furthermore, it has been found to alleviate anxiety, depression, and loneliness, with more perceived social support leading to better mental health (Grey et al., 2020). Evidence documents that high levels of perceived social support promote mental health at all points in life (Barker, 2007; Pinkerton and Dolan, 2007; Jakobsen et al., 2021). Thereby, the literature proposes that the more social support - received or perceived - a person has, the more they feel in control and the better they are able to cope with difficult situations, in particular (Szkody et al., 2020).

Based on these assumptions and relying on pre-pandemic and general literature about social support as well as based on recent literature examining social support during the pandemic (e.g., Ellis et al., 2020; Szkody et al., 2020; Campione-Barr et al., 2021; Bernasco et al., 2021; Ye et al., 2021), we expected that adolescents who perceived higher levels of social support during COVID-19 related school closures would report better mental health. Moreover, we investigated whether perceived social support buffered negative associations between educational and health concerns and mental health.

Social support has been found to be particularly helpful during stressful times, serving as a buffer by reducing negative effects of those events (Armstrong et al., 2005). Accordingly, the stress-buffering hypothesis proposes that perceived social support serves as a protective factor against negative effects of stress from negative life events on mental health (Cassel, 1976). Regarding the COVID-19 pandemic, recent literature found support for this hypothesis, whereby perceived social support (i.e., from friends, family, and someone close to the participant) buffered the negative association between worries about COVID-19 and psychological health (Szkody et al., 2020).

Importantly, previous studies show that different sources of social support may differentially relate to adolescents 'mental health. For example, Colarossi and Eccles (2003) showed on the one hand that self-esteem was significantly predicted by adolescents' perceived friend and teacher support but not by support of their mothers. On the other hand, perceived support from mothers had the largest effect for adolescents' level of depression. The authors argue that parental support may have cumulative effects over time on depression because of long-standing and relatively stable parent-child relationships. Extending this prior work, an important aim of this study was also to assess the relative role of different sources of social support for adolescents' mental health during the pandemic. During school closures, the intensity and nature of social interactions has changed considerably for many adolescents. Home-schooling and social distancing implied that adolescents spent a lot of time at home and less time with their friends and teachers at school. Under these uncommon circumstances, family support may have played a more decisive role for adolescents' mental health during school closures than perceived teacher and friend support.

Teacher Support

With a large portion of daily life spent at school, teachers play an important role in adolescents' life. The literature conceptualizes teacher support as teachers being sensitive to their students' needs (Hamre and Pianta, 2007). Especially when paired with consistency (i.e., stable and predictable support), teacher support helps making students feel secure and giving them the confidence to be more active in school, socially as well as academically (Curby et al., 2013). Teacher support thus seems to have the potential of promoting adolescents' social and educational development. Research has shown that teacher support is indeed linked with the use of self-regulatory strategies (Wang and Holcombe, 2010) and more prosocial behavior (Farmer et al., 2011). Students perceive teachers to be particularly supportive when they feel an emotional bond and when teachers support a fair environment that recognizes and praises educational success (Suldo et al., 2009). The conceptualization of teacher support usually distinguishes two components: emotional support and instrumental support. The former entails that teachers show to students that they care about them and the latter consists of making sure students have everything they need to learn (Suldo et al., 2009).

The COVID-19 pandemic has led to substantial changes and challenges in how teachers provide their students with much-needed social interactions and emotional bonds during school closures (Ye et al., 2021). Teachers and students reported being overwhelmed with new teaching approaches and technologies (Beteille et al., 2020), likely to engender uncertainty about student-teacher relationships on both sides. Teacher support may not only have been an important source for students in dealing with the acquisition of new skills for remote learning, but also a source for dealing with uncertainty about the academic situation. Accordingly, a recent study by Moser et al. (2021) demonstrated that teachers expressed concerns about students' achievements. Moreover, students felt a lack of consultation (Korzycka et al., 2021) and decreased support from teachers (Lessard and Puhl, 2021).

In contrast, high support from teachers has shown to be beneficial for adolescents' engagement in remote learning during school closures (Bray et al., 2021). Similarly, a study from Garrote et al. (2021) showed that if teachers had high expectations on adolescents' remote learning performance, students performed better in general and had a more positive perception of distance learning. Thus, high perceived teacher support may have been an important resource during school closures for adolescents' mental health as well as serving as a buffer against subjective stressors. A recent study showed that a positive student-teacher relationship was associated with higher academic engagement as well as fewer mental health problems in times of online learning as schools were closed (Ye et al., 2021). In addition, these authors

also showed that positive student-teacher relationships buffered negative effects of cyberbullying and difficulties with COVID 19-related online learning on mental health.

Based on these first insights, we assumed that teachers who provided high support to students during school closures promoted students' well-being during the situation and helped to buffer potential negative associations for their mental health.

Family Support

In addition to teachers, family support is regarded as essential for adolescents' psychological adjustment (Anderson et al., 2007) and mental health (Anthony and Stone, 2010). Parents are seen as the closest source of help for adolescents in terms of reducing and coping with stressors and thus promoting well-being (Guessoum et al., 2020). For example, good parental communication (i.e., positive communication and the willingness to seek parental advice) and family dinners have positive effects on adolescents' psycho-social development, with adolescents displaying lower depression, more engagement in learning and less school problems, and more positive social behavior (Fulkerson et al., 2006). Therefore, more time spent with the family may help reduce the effect of stress on adolescents' mental health.

These findings suggest that adolescents' families may have been central sources of social support during the COVID-19 pandemic, particularly during school closures. Especially warm, supportive, and democratic parenting styles were found to have a positive effect on adolescents' mental health, as opposed to a more authoritarian style (Ye et al., 2021). Regarding school closures, parents' reactions to the pandemic have shown to have an effect on adolescents' adjustment to online learning, with less parental stress correlating with a more positive experience of adolescents' online learning during school closures (Garrote et al., 2021). Recent evidence with Dutch adolescents showed an increase in parental support with a simultaneous decrease of anxiety and depression during a 20-day period of at first online, and later on, mostly physical school days in times of the pandemic (Klootwijk et al., 2021). In addition, Ellis et al. (2020) documented that spending more time with the family (i.e., time spent with family activities during the past three weeks) was associated with higher mental health among Canadian adolescents.

In contrast, a recent study found that a sizeable proportion of adolescents (36% of the sample) spent less than 30 minutes per day with their family during the COVID-19 pandemic (Ellis et al., 2020). Other studies even reported an increase in domestic violence during the lock-down (Chandan et al., 2020; Imran et al., 2020; Lee, 2020) with an increase of conflict occurring between adolescents and their parents, leading to lower life satisfaction and, regarding conflicts with fathers in particular, more depressive symptoms (Magson et al., 2020). Such negative interactions at home are thought to negatively affect adolescents' mental health.

Based on these previous insights, we assumed that high perceived family support played a central role for adolescents' mental health during school closure. Moreover, based on the stress-buffering hypothesis, we assumed that perceived family support may have buffered negative consequences of adolescents' educational and health concerns for their mental health. This assumption was also based on previous insights of the positive role of parental support for adolescents' learning (Chohan and Khan, 2010; Shukla et al., 2015) and their important function of providing emotional security to their children (Fulkerson et al., 2006). In line with this, recent literature pointed out that high family support served as a buffer of loneliness as a reaction of how severe COVID-19 was perceived (Wang et al., 2021).

Friend Support

During adolescence, individuals spend less time at home and generally socialize more often with friends; thus, interactions with friends increase in importance for adolescents' psycho-social development (Rubin et al., 2006; Wang et al., 2011). Friend support, as one of the sources of social support, describes a variety of connections (e.g., emotional support or help-seeking) built with friends that have an influence on a person's functioning (Barker, 2007). Several studies documented the benefits of friend support by showing that it is positively associated with social competence, higher self-esteem, lower depression and lower stress levels (Wilburn and Smith, 2009), higher self-regulation (Patrick et al., 2007), and better psychosocial mental health (Vieno et al., 2007; Williams and Anthony, 2015; Traylor et al., 2016).

During school closures and social distancing rules in the COVID-19 pandemic, adolescents faced strong restrictions for personal meetings with their friends. Magson et al. (2020) found that not being able to see their friends as much was a great concern for many adolescents; feelings of social disconnection were associated with higher levels of symptoms of anxiety and depression and less life satisfaction (Magson et al., 2020). However, many adolescents met their friends online: Ellis et al. (2020) investigated how time spent with friends virtually was associated with adolescents' mental health during the COVID-19 pandemic and found that more time spent with friends online was linked to lower loneliness on the one hand, but at the same time associated with greater depression. Similarly, Bernasco et al. (2021) investigated whether time spent with friends either online or offline moderated the association between pre-COVID friend support and stress related to COVID. However, they didn't find such a moderating effect, whereas pre-COVID support from friends predicted having less COVID-related stress. In contrast, Campione-Barr et al. (2021), demonstrated that close relationships to best friends predicted adolescents' ability to adjust to pandemic-related concerns (i.e., by showing lower levels of anxiety, depressive symptoms, problem behavior) while controlling for their pre-pandemic adjustment.

These findings highlight the importance of perceived friend support during the COVID-19 pandemic, suggesting that lower perceived friend support may be associated with lower mental health, either directly, or as buffer for negative experiences.

In the current study, we assumed that the family may have become relatively more important for adolescents' mental health during the pandemic in comparison with friends and teachers. First insights regarding the relative role of different social support systems during the COVID-19 lockdown with an adult sample from Egypt show that the need of familial support and of caring for family members has increased during

times of isolation, whereby almost twice as many participants reported increased support from family members as compared to increased support from friends (El-Zoghby et al., 2020). Similarly, Ellis et al. (2020) showed that spending more time with the family, actively as well as virtually, was associated with fewer depression, whereas findings regarding time spent with friends virtually were mixed, with adolescents reporting lower loneliness but greater depression instead. In addition, Campione-Barr et al. (2021) illustrated that when adolescents encountered high COVID-related stress, they experienced greater problem behavior even when perceiving high positivity in their friendships, while positive relationships with parents predicted adolescents' adjustment (Campione-Barr et al., 2021).

Regional Differences

The sample of the current study included three different regions (i.e., German-speaking part of Switzerland, Italian-speaking part of Switzerland, and Northern Italy) in order to investigate possible regional differences in the level of exposure to the COVID-19 virus and the measures taken to contain its spread. In the literature, heterogeneous findings regarding possible regional differences associated with the pandemic were found. For example, no regional differences were found in the stress level and mental health in two different studies on Italian adolescents (Commodari and La Rosa, 2020; Nocentini et al., 2021). In contrast, two recent studies suggested that living in a high-risk and strongly affected area may influence mental health, with the prevalence of post-traumatic stress symptoms being higher for people living in such areas (Liu et al., 2020), and lower mental health of students living in more strongly affected regions in China (Wu et al., 2021). Moreover, living in a strongly affected area or an urban area were two factors associated with higher anxiety level and depression symptoms in Chinese adolescents (Duan et al., 2020). We thus explored whether there were regional differences in adolescents' pandemic-related educational and health concerns, which may have been more salient in regions with higher exposure to the virus and more restrictive measures.

The Current Study

Based on a resilience framework, the current work aimed to identify different profiles of adolescents' risk and protective factors being associated with mental health during the beginning of the COVID-19 pandemic, when schools were closed, strong restrictions on social interactions were imposed, and high levels of uncertainty pertained to negative consequences and the spread of the virus. In order to better understand the relative role of educational concerns and health concerns as risk factors and the relative role of perceived social support by teachers, family, and friends as protective factors for adolescents' mental health, we employed a person-centered approach to identify different groups of adolescents with either higher or lower resilience profiles.

Moreover, we investigated whether adolescents living in regions where different measures were imposed to contain the spread of the virus differed in their likelihood to belong to one of the resilience profiles, while accounting for socio-demographic differences. Lastly, in addition to the exploratory approach of identifying resilience profiles, we also used a variable-centered approach to examine the relative role of risk and protective factors for adolescents' mental health (i.e., current well-being and depressive mood) as well as a potential moderating, stress-buffering role of perceived social support for adolescents against subjective stress, reflected in their educational and health concerns.

Regarding mental health indicators, we included adolescents' current well-being during the lockdown as well as their depressive symptoms, with one aspect reflecting a more situational measure, capturing well-being during the pandemic, and depressive mood reflecting a general condition over a longer period of time. Adolescents with higher depressive mood may have had lower resources to deal with the challenges related to the pandemic. Accordingly, recent evidence identified pre-pandemic psychiatric disorders (Becker and Gregory, 2020; Guessoum et al., 2020; van Loon et al., 2021), pre-pandemic stress (van Loon et al., 2021), maladaptive coping skills (Guessoum et al., 2020; van Loon et al., 2021) or sleep problems (Becker and Gregory, 2020) as additional risk factors for low mental health during the COVID-19 pandemic.

Hypotheses Regarding Adolescents' Resilience Profiles

We assumed that the relative level of risk and protective factors as well as current well-being and depressive mood (i.e., mental health indicators) would generate qualitatively and quantitatively differences between different groups of adolescents, crystallizing in different resilience profiles. We did not expect a specific number of profiles. Regarding quantitative differences, we assumed that educational and health concerns were at lower levels in profiles reflecting high resilience (e.g., Wang et al., 2020; Ellis et al., 2020). Moreover, we assumed that high resilience profiles would be characterized by high levels of perceived social support (e.g., Chu et al., 2010; Fegert et al., 2020; Szkody et al., 2020; Ye et al., 2021) as well as high current well-being and lower levels of depressive mood (e.g., Loades et al., 2020). For profiles with low resilience, we expected high levels in both risk factors (i.e., educational and health concerns), low levels of perceived social support and low current well-being as well as higher depressive mood.

In addition to these quantitative differences, we also anticipated qualitative differences between the profiles. Here, we first explored whether there were qualitative differences between educational and health concerns within the profiles. Moreover, we expected the three components of perceived social support (i.e., perceived teacher, family and friend support) to differ in their relative importance in times of the lockdown (e.g., Ellis et al., 2020; Prime et al., 2020; Campione-Barr et al., 2021). Based on the hours spent at home during the lockdown, we expected perceived family support to vary the most between the resilience profiles among all three sources of social support.

Hypotheses Regarding Regional Differences

In addition to investigating adolescents' resilience profiles, an important aim was to explore whether different levels of exposure to the virus and according measures taken predicted

adolescents' resilience profiles. Therefore, adolescents from three regions differentially affected by COVID-19 at the onset of the pandemic were compared, namely, from the German-speaking part of Switzerland, the Italian-speaking part of Switzerland, and Northern Italy (i.e., Lombardy).

On March 16, 2021, with the quick spreading of the COVID-19 virus, Switzerland decided to close schools, shops, and restaurants, resulting in a significant decrease in daily incidence. At the End of March, as the situation became more critical, each Swiss region could individually decide whether to take extra measures. Compared to the German-speaking part, the Italian-speaking part of Switzerland adopted more severe restrictions, as COVID-19 hit this region more strongly. This region decided to prolong the closure of trading and production activities. The Federal Council decided to gradually reduce these measures by the end of April, with hospitals allowing non-urgent surgery to take place and with schools reopening for classroom teaching on May 11, 2020 (Bundesamt für Gesundheit, 2020; Forster, 2020).

Meanwhile, Northern Italy was the most affected area, especially at the onset of the pandemic. Seven Italian regions, including Lombardy, have decided to close their schools as of 24 February, while the Italian government has decided to close schools throughout Italy as of 5 Marchuntil September, offering home-schooling whenever possible and isolating some regions particularly at risk (Caffo et al., 2020; Ministero della Salute, 2021). While in Switzerland it was possible to leave the house and meet friends (up to 5 people) with necessary precautions such as the social distance, the restrictions in Italy were harder, and it was not possible to move freely between the regions or leave the house, if not for some necessity, such as grocery shopping. Comparing the three regions at the time of the survey (around mid-April), schools were closed in all three regions, with the Italian-speaking part of Switzerland and Italy having more cases than the German-speaking part of Switzerland. In addition, Italy had stricter restrictions concerning the possibility of leaving the house, not allowing inhabitants to go out beside for some exceptions (e.g., groceries), while Switzerland allowed gatherings of up to 5 people.

Considering the case numbers and measures taken, the exposure to the virus is arguably depended on the country and, more specifically, on the region. Therefore, we explored whether regions with higher exposure (i.e., Italian-speaking part of Switzerland and Northern Italy) were more likely to belong to profiles with higher risk factors, lower resources and lower mental health, as compared to areas with lower exposure (i.e., German-speaking part of Switzerland).

In these analyses, we controlled for grade, gender, socio-economic status [SES], and migration background, as previous evidence pointed to differences in mental health depending on these variables (de Miranda et al., 2020; Masonbrink and Hurley, 2020; Zhou et al., 2020; Nocentini et al., 2021; Ravens-Sieberer et al., 2021).

Hypotheses Regarding the Role of Risk and Protective Factors for Adolescents' Mental Health

We analyzed within a variable-centered approach whether educational and health concerns and perceived social support predicted adolescents' mental health, reflected in their current well-being and depressive mood. Similar to the hypotheses regarding the resilience profiles, we assumed negative associations between educational and health concerns with mental health and positive associations of all sources of perceived social support with adolescents' mental health (e.g., Grey et al., 2020; Bernasco et al., 2021; Bray et al., 2021; Jakobsen et al., 2021; van Loon et al., 2021; Ye et al., 2021). Regarding the relative role of educational and health concerns, we investigated whether these predictors differed in their association with both aspects of mental health. Regarding the relative role of social support, we specifically hypothesized that perceived family support would be more predictive of adolescents' mental health rather than perceived teacher and friend support (e.g., Ellis et al., 2020; Campione-Barr et al., 2021; Wang et al., 2021). Lastly, based on the stress-buffering hypothesis (Cassel, 1976; Szkody et al., 2020), we explored moderating relations of all three sources of social support between educational and health concerns and mental health.

METHODS

Participants and Design

Cross-sectional data was collected in two regions of Switzerland and in Northern Italy during three weeks in mid-April of 2020. Hence the data was collected in the beginning of the COVID-19 pandemic, when schools had been closed in all three regions as one of the measures to contain the spread of the virus.

This study was conducted in accordance with ethical standards of the APA and was approved by the Ethics Committee of the[blinded]. The analyses are based on the data from 1,562 students with an average age of 16.18 years (SD = 1.48, range = 14-20 years). Seventy-two percent of the participants specifying their gender reported identifying as female (28% as male). At the time of the survey, most of the participants were in grade nine (21%), ten (20%), or eleven (19%) and mostly attending high school (58%) or secondary school (26%). The rest of the sample were either in an apprenticeship (12%), in middle school (3%) or in a higher technical school (1%).

With 80%, the largest proportion of participants lived in Switzerland (49% in the Italian- and 31% in the German-speaking part of Switzerland) and 20% of the participants lived in Northern Italy. Furthermore, 27% of the participants indicated another nationality than or an additional nationality to the Swiss one (i.e., for the Swiss participants) or the Italian one (i.e., for the Italian participants). To assess participants' socio-economic status (SES), their housing situation was assessed. Seventy-five percent of the students stated that they lived in an owned house or apartment and 25% stated that they lived in rented accommodation. For details about the demographic information for the total sample as well as for the specific regions in which the survey was conducted, see **Supplementary Table 1** in the **Supplementary Material**.

The data was collected via an online survey (approx. 20 min). Schools received a link to the questionnaire and forwarded it to their students if they agreed to participate in the study. Before taking the survey, the participants were informed that their

participation was voluntary and that their data was anonymous. After completing the survey, participants received gift certificates.

Measures

The item correlations and respective reliability measures of the scales can be found in **Table 1**. **Supplementary Table 2** in the **Supplementary Material** contains a complete list of all items. All items were rated on a six-point-scale (0 = completely disagree, 5 = completely agree).

Educational Concerns

Educational concerns were measured with four items capturing adolescents' academic fears and worries from the school burnout questionnaire that focus on concerns regarding school and education (e.g., "I feel overwhelmed with school.", "I am afraid that I will have to repeat the school year"; adapted from Satow and Mittag, 1999; Salmela-Aro et al., 2009).

Health Concerns

Health concerns were operationalized with five items regarding concerns for the health of oneself or others related to COVID-19, adapted from measures developed in studies on previous pandemics (e.g., "I am concerned that my friends or family may become seriously ill because of Corona.", "I am worried that Corona continues to spread"; adapted from Han et al., 2014 and Wong and Tang, 2005). For the profiles, all scales were recoded, with higher scores representing lower levels of educational concerns and lower levels of health concerns, respectively.

Perceived Social Support by Teachers, Family, and Friends

Perceived social support was assessed using three previously validated scales, thereby examining three different components of emotional support for students: teachers, family, and friends. One of the three items regarding perceived teacher support was e.g., "My teachers always help me when I get stuck.", "My teachers notice when I have a problem." (see Ryzin et al., 2009; Gasser et al., 2018). The measures of perceived family support and perceived friend support also consisted of three items each. These two scales only differed with regard to the source of support (e.g., "I can always rely on my family." resp. "I can always rely on my friends.", "I can tell my family everything" resp. "I can tell my friends everything"; adapted from Procidano and Heller, 1983; Satow, 2012).

Mental Health

Two components were used to assess participants' mental health. The first scale was a measure of current well-being, focusing on the previous week. In particular, adolescents were asked how they were doing in quarantine and how their last week was. It consisted of five items (e.g., "I felt happy.", "I was full of energy."; Ravens-Sieberer et al., 2010). The second scale included three items regarding depressive mood reflecting a rather stable measure of mental health. In particular, adolescents reported whether they tended to be in certain states over a longer period of time (e.g., "I often feel sad or unhappy.", "I often feel lonely"; Wentzel et al., 1990). This scale was recoded to have higher scores representing higher mental health in both scales.

Regions and Socio-Demographic Variables

Regions. Regions were assessed as a factor variable, including two areas from Switzerland (i.e., German- and Italian-speaking parts), and one region in Northern Italy (i.e., Lombardy).

Socio-Demographic Variables (Control Variables). Adolescents reported their grade attending at the time of the survey. Given that data on age was limited to year of birth and that our central questions focused on educational concerns, grade was considered a more accurate control variable than age. Gender was coded as either female or male (1 = female, 0 = male). SES was conceptualized as a dummy variable reporting the housing situation of adolescents (1 = owned house, 0 = rented house). Migration background was operationalized as a dummy variable, whereby reporting another nationality than or indicating an additional nationality than the resident country were used as indicators of migration background (i.e., Swiss for the samples from the German- and Italian-speaking parts of Switzerland and Italian for the sample from Northern Italy).

Data Analytic Strategy

The current study was based on a combination of a person-centered approach, including latent profile analysis (LPA), and a variable-centered approach, including a path analysis (PA) and multinomial logit modeling (MLM).

The goal of the LPA was to find out whether different latent profiles emerged for different groups of adolescents. Such profiles reveal quantitative and qualitative differences in the specific variables between subpopulations of adolescents. To identify profiles, we used in total seven components (i.e., educational and health concerns, three different components of perceived social support and two different components of mental health). Thus, with regards to our research questions, the analyses helped to investigate whether the relations among the three main constructs were differently associated for certain groups of adolescents.

The LPA was executed with the *MPlusAutomation* package (Hallquist and Wiley, 2018), using R-Studio via *Mplus* (Muthén and Muthén, 2018). To select the optimal number of classes, we started with a solution of one class and subsequently increased the number of latent profiles, whereby we compared the Bayesian information criterion (BIC, with lower values indicating a better fit), the entropy value (i.e., the confidence with which individuals can be classified into a specific profile, ranging from 0-1, recommended > 0.8) and the Lo-Mendell-Rubin (LMR) test. The LMR test tests the hypothesis that K-classes are optimal compared to K-1 classes (Lo et al., 2001). In addition, we considered the interpretability of the different profiles, particularly how well the profiles differentiated between groups and whether they differed quantitatively (i.e., in their level) or also qualitatively (i.e., in their pattern). To facilitate model convergence, variances across profiles were freely estimated and covariance constrained to be unrelated to one another (i.e., constrained to 0). Moreover, in order to ease the interpretation of the profiles, the scales were mean-centered. We accounted for missing data by using full maximum-likelihood estimation (FIML) in *Mplus 8.6* (Muthén and Muthén, 2018).

TABLE 1 | Descriptive statistics of the components of the resilience profiles and the control variables (N = 1562).

	M (SD)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Educational concerns	2.35 (1.15)	0.76										
(2) Health concerns	3.63 (1.01)	0.10***	0.84									
(3) Perceived teacher support	3.06 (1.03)	−0.42***	0.05†	0.82								
(4) Perceived family support	3.62 (1.10)	−0.32***	0.15***	0.37***	0.86							
(5) Perceived friend support	3.70 (0.91)	−0.15***	0.10***	0.21***	0.21***	0.83						
(6) Current well-being	3.13 (0.82)	−0.51***	−0.07**	0.33***	0.40***	0.18***	0.74					
(7) Depressive mood*	2.58 (1.23)	−0.47***	−0.15***	0.23***	0.35***	0.06*	0.56***	0.78				
(8) Grade	10.19 (1.52)	0.23***	0.03	−0.29***	−0.15***	−0.05†	−0.23***	−0.18***	–			
(9) Gender	0.72 (0.45)	0.10***	0.22***	−0.11***	−0.05†	0.11***	−0.15***	−0.21***	0.16***	–		
(10) SES	0.75 (0.43)	0.00	0.04	−0.04	0.00	−0.01	0.04	−0.04	0.13***	0.04	–	
(11) Migration background	0.27 (0.44)	−0.04	−0.01	0.03	−0.02	−0.05†	0.00	0.03	−0.14***	−0.08**	−0.34***	–

*Means (M) and standard deviations (SD) are shown in the first column. Range of the scales of the 7 components: 0 (completely disagree) to 5 (completely agree); gender: 1 = female, 0 = male; SES: 1 = own house, 0 = rented house; Migration background: 1 = migration background, 0 = no migration background. The reliability of the scales is reported in the diagonal. * Depressive mood was recoded, with higher levels reflecting lower depressive mood.*
*†$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, two-tailed.*

Next, in order to understand whether educational and health concerns on the one hand and perceived social support on the other hand were associated with adolescents' mental health at a general level, we investigated the associations between the key variables within a path analysis (PA). Within this approach, we specified contrast between the relative predictive value (i.e., the regression parameters) of educational and health concerns, as well as between different sources of social support as additional parameters with the "model constraints" in MPLUS. Thus, we were able to answer the question whether educational and health concerns respective social support by teachers, family, and peers, differed in their relative association with mental health. Lastly, we investigated whether perceived social support moderated the association between educational and health concerns and mental health in order to test whether perceived social support buffered negative consequences of stress during the school closures associated with the COVID-19 pandemic.

Lastly, as we were interested in regional differences, we tested whether the profiles could be generalized for the different regions (as recommended by Morin et al., 2016). Thus, before we investigated whether adolescents from different regions had different probabilities of belonging to the profiles identified for the complete sample, we first investigated, whether we could replicate the profiles within the regional subsamples. As we were able to replicate the profiles for the three subsamples (see **Supplementary Material**), we computed a MLM, whereby we entered the region (i.e., German-speaking part of Switzerland, Italian-speaking part of Switzerland and Northern Italy) as predictor for profile membership. As we had a special interest in regional differences, we controlled for individual variables (i.e., grade, gender, SES and migration background).

RESULTS

Descriptive results are displayed in **Table 1**. The descriptive data shows that the mean of educational concerns, M = 2.35, SD = 1.15, was somewhat lower than the mean of health concerns, M = 3.63, SD = 1.01. Regarding social support the mean of perceived friend support, M = 3.70, SD = 0.91, was slightly higher than the mean of perceived family support, M = 3.62, SD = 1.10, whereas adolescents had relatively lower perceptions of teacher support, M = 3.06, SD = 1.03. Interestingly, health concerns were significantly positively correlated with perceived teacher support, r = 0.05, $p < 0.1$, with perceived family support, r = 0.15, $p < 0.001$, and with perceived friend support, r = 0.10, $p < 0.001$, which implies reporting higher health concerns was associated with perceiving higher support from teachers, families and friends. In contrast, educational concerns were as one would expect negatively correlated with all three sources of perceived social support (teachers, r = -0.42, $p < 0.001$, families, r = -0.32, $p < 0.001$, friends, r = -0.15, $p < 0.001$).

Latent Profile Analysis

When deciding about the number of profiles in a stepwise procedure, fit information revealed that a solution with two profiles fit the data well. In addition, a three-profile solution lead to a considerable improvement of the log likelihood and BIC value while the LMR test was significant (see **Table 2**). A four-profile model did not lead to a considerable higher improvement and also had a non-significant LMR test. When examining the profile plots (showing the mean-centered values for each variable within each profile) for the model with two respective three profiles, the two-profile model consisted of two predominantly quantitatively different profiles with low, respective high resilience (see **Supplementary Figure 1**) while the three-profile model also included a group with average resilience. In the two-profile solution 50% were identified being in the low resilience profile and 50% of the sample belonged to the high resilience profile. The three-profile solution (minimal class probability = 0.89, maximum class probability = 0.91) included three latent resilience profiles (see **Figure 1**): A low (19% of the sample), an average (47% of the sample) and a high (34% of the sample) resilience profile. Based on the fit values and the information from the profile plots, we decided that the three-profile model did the best job in explaining the heterogeneity

TABLE 2 | Fit information of the latent profile analysis.

No of classes	*Log Likelihood*	*BIC*	*Entropy*	*LMR p-value*
LPA				
1	−13297.63	26698.21	1	
2	−12637.35	25487.95	0.67	0.000
3	−12419.41	25162.38	0.64	0.012
4	−12284.77	25003.41	0.67	0.311

BIC = Bayesian information criterion; LMR = Lo-Mendell-Rubin Test; LPA = latent profile analysis.

in adolescents' resilience. Moreover, as one of our aims was to investigate regional differences, a three-profile solution was generalizable across subsamples. We estimated and plotted the profiles for the German- and the Italian-speaking part of Switzerland as well as Northern Italy separately. Results revealed that the three-profile solution showed similar patterns within each region as it did in the entire sample (see **Supplementary Figures 2, 3**, and **4** in the **Supplementary Material**).

The findings of the three-profile solution were in line with our hypothesis, assuming that there would be theoretically cohesive latent resilience profiles, with the three dimensions concerns, perceived social support, and mental health being correlated for each group at either a low, average or high level. Supporting our hypotheses, adolescents belonging to the low resilience profile were characterized by high levels of educational concerns, low levels of perceived social support (i.e., low perceived teacher support, low perceived family support, and low to average perceived friend support) and low mental health (i.e., low current well-being and high levels of depressive mood). Belonging to the average resilience profile implied perceiving average levels of all seven components. In contrast, adolescents who were in the high resilience profile perceived low levels of educational concerns, high levels of perceived social support (high perceived teacher and family support, average perceived friends support) and high levels of mental health.

Regarding perceived social support, the means of perceived family and teacher support were about one *SD* below the mean for the low resilience profile and about 0.5 *SD* above the mean for the high resilience profile. This suggests that those sources of support were perceived as particularly low among adolescents in the low resilience profile. Moreover, with regards to relative differences in perceived support between the profiles, perceived teacher and family support varied more between the resilience profiles than perceived friend support. These qualitative differences suggest that support by families and teachers may have been relatively strong determinants of adolescents' resilience profiles. While we expected this pattern for the family, we did not hypothesize that perceived teacher support and perceived friend support differed qualitatively from one another. In contrast, perceived friend support was relatively low in the low resilience profile

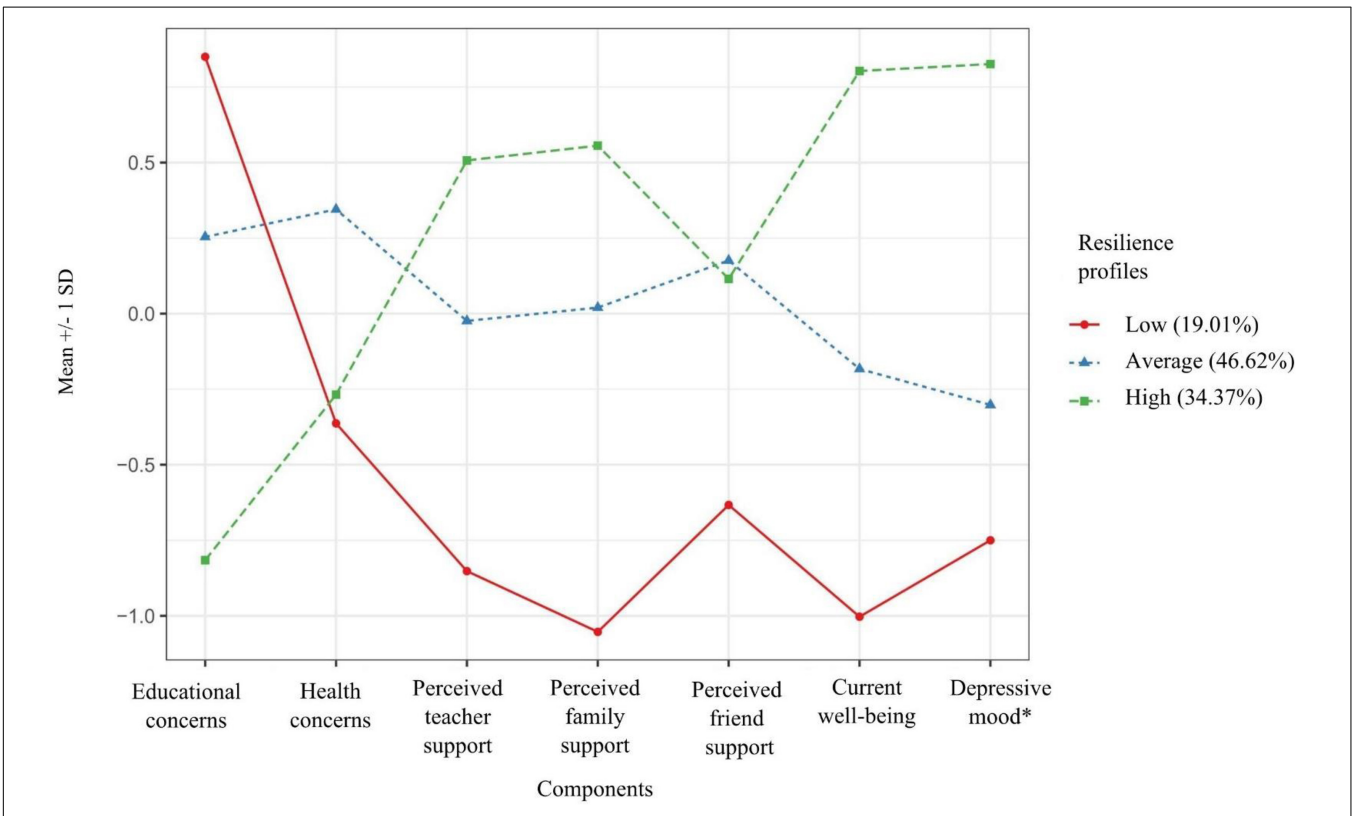

FIGURE 1 | Latent resilience profiles. Scales marked with an asterisk * were recoded so that higher values of depressive mood reflect lower depressive levels. All components were mean-centered.

compared to both the average and the high profile but did not differ between these two profiles. Hence, low perceived friend support correlated with lower mental health among adolescents in the low resilience profile.

Regarding health concerns, not all profiles differed in the expected way: for the low resilience profile, the level of health concerns was at a similar level as the high resilience profile. Thus, health concerns may have been less relevant than educational concerns for adolescents in the low resilience profile.

Path Analysis

With the path analysis, we aimed to shed light on how the key variables related to each other. While the latent profile analysis identified different associations between these variables for different groups of adolescents, the results of the path model applied to the whole sample. In other words, while the latent profile analysis identified different resilience profiles based on different combinations of risk and protective factors, the current analysis investigated the general associations between the two risk (i.e., educational and health concerns) and three protective factors (i.e., perceived teacher, family, and friend support) with adolescents' mental health.

In a first step, we entered the risk and protective factors as predictors of both mental health, indicators, while accounting for the correlation of the two mental health measures. We included additional contrasts between educational and health concerns as well as between all three sources of social support as additional model constraints in order to test whether the effects differed in magnitude. The results (see **Figure 2**) showed that educational and health concerns were both associated with lower mental health. Moreover, significant contrasts between the regression parameters revealed that health concerns were less predictive for both mental health predictors than educational concerns (current well-being: Δb = -0.45, SE = 0.03, $p < 0.001$; depressive mood: Δb = -0.52, SE = 0.03, $p < 0.001$). Perceived family support was significantly and positively related to current well-being and depressive mood (which was recoded, with higher value displaying lower depressive mood), while teacher and friend support were only significantly associated with current well-being, but not depressive mood (see **Figure 2**). In line with our

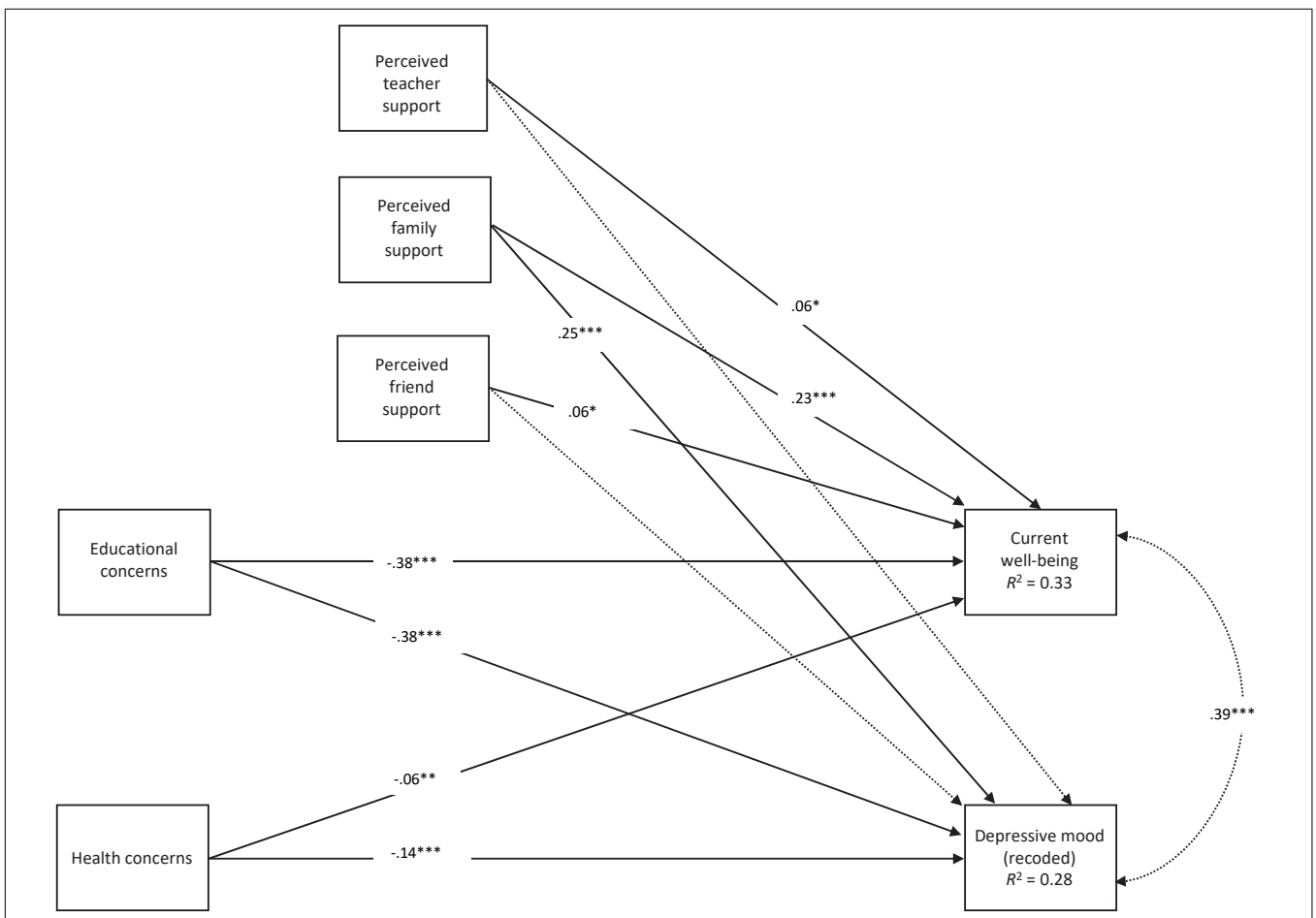

FIGURE 2 | Path analysis predicting adolescents' current well-being and depressive mood with the two risk (i.e., educational and health concerns) and three protective factors (i.e., perceived social support by teachers, family, and friends). Depressive mood was recoded, with higher values reflecting lower depressive mood. Standardized estimates are reported on the straight and curved arrows. The dashed arrows represent non-significant paths. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$, two-tailed.

hypothesis, perceived support by family was more predictive for both aspects of mental health than perceived teacher (current well-being: $\Delta b = 0.19$, $SE = 0.04$, $p < 0.001$; depressive mood: $\Delta b = 0.26$, $SE = 0.04$, $p < 0.001$) and perceived friend support (current well-being: $\Delta b = 0.19$, $SE = 0.04$, $p < 0.001$; depressive mood: $\Delta b = 0.28$, $SE = 0.04$, $p < 0.001$). There was no significant difference between the regression parameters of perceived support by teachers and by friends and the two aspects of mental health. Importantly, the results did not differ, when including control variables.

Next, in order to explore whether social support served as a stress-buffer for mental health, we included the interaction terms of educational and health concerns with all three sources of social support to the model. Thereby, the only significant interaction parameter related to the interaction of educational concerns and perceived teacher support on depressive mood ($\beta = 0.07$, $SE = 0.03$, $p = 0.02$). However, when adjusting for multiple comparisons, this effect was non-significant.

Lastly, we explored whether there were regional differences between the hypothesized associations. Thereby, a multi-group model with the region as grouping variable in which all predictive regression parameters were constrained to be equal did not fit the data better than a model in which these parameters were freely estimated $\Delta\chi^2$ (22) = 26.45. Hence, the associations between the main variables did not differ between the three regions.

Multinomial Logit Models

Our third aim of this study was to find out whether regional differences would predict adolescents' likelihood of being classified in one of the three identified profiles.

To investigate this question, we performed multinomial logit models. As the high resilience profile was chosen as a reference category, these models compared the likelihood of belonging to the low respective the average resilience profiles relative to the high resilience profile. Thereby, we first included individual control variables. The results revealed that adolescents from higher grades, $\beta = 0.48$, $SE = 0.06$, $p < 0.001$, females, $\beta = 0.53$, $SE = 0.20$, $p < 0.01$, students with lower SES, $\beta = -0.45$, $SE = 0.22$, $p < 0.05$ or having a migration background, $\beta = 0.39$, $SE = 0.21$, $p < 0.1$, were more likely to belong to the low resilience profile as compared to the high resilience profile relative to adolescents from lower grades, males, students with higher SES and having no migration background (see **Table 3**). This was also the case for the average resilience profile, except that the coefficients on SES and migration background were not significant.

In a second step, regions were added to the model, whereby significant regional differences emerged: Adolescents living in the Italian-speaking part of Switzerland, $\beta = 0.96$, $SE = 0.22$, $p < 0.001$, or in Northern Italy, $\beta = 2.05$, $SE = 0.32$, $p < 0.001$, were both more likely to belong to the low resilience profile as compared to the high resilience profile relative to adolescents from the German-speaking part of Switzerland. Moreover, students from the Italian-speaking part of Switzerland, $\beta = 0.71$, $SE = 0.15$, $p < 0.001$, and Northern Italy, $\beta = 1.83$, $SE = 0.25$, $p < 0.001$, versus the German-speaking part of Switzerland had a higher likelihood of being in the average resilience profile as compared to the high resilience profile. In terms of relative risk, adolescents from the Italian-speaking part of Switzerland were about three times more likely ($exp(\beta) = 2.61$) to belong to the low resilience profile and about two times more likely ($exp(\beta) = 2.03$) to belong to the average resilience profile as compared to the high resilience profile relative to German-speaking Swiss adolescents. Adolescents from Northern Italy were even at a higher risk, with having an around eight times higher likelihood ($exp(\beta) = 7.81$) of being in the low and approximately a six times higher risk ($exp(\beta) = 6.22$) of being in the average resilience profile relative to the high resilience profile when comparing with students from the German-speaking part of Switzerland. When changing the reference category in order to compare differences in terms of risk between the Italian-speaking part of Switzerland and Northern Italy, results revealed that adolescents living in Northern Italy were around three times more likely to belong to the low resilience profile, $\beta = 1.10$, $exp(\beta) = 2.99$, $SE = 0.29$, $p < 0.001$, or the average resilience profile, $\beta = 1.12$, $exp(\beta) = 3.07$, $SE = 0.25$, $p < 0.001$, compared to the high profile. These findings support our hypothesis, suggesting that a higher exposure in the Italian-speaking part of Switzerland and Northern Italy may have been associated with adolescents' risk of low resilience.

DISCUSSION

Based on a resilience framework, the current study investigated adolescents' mental health during the school closures in the beginning of the COVID-19 pandemic as an indicator for adolescents' healthy functioning during times of crisis. We specifically focused on the role of adolescents' uncertainties and concerns regarding their education as well as their own and others' health as risk factors for adolescents' mental health. Regarding protective factors for adolescents' mental health, we investigated the relative role of perceived social support by teachers, family, and friends. Based on a person-centered approach, we identified three different resilience profiles, characterized by qualitative and quantitative differences between educational and health concerns, perceived social support by teachers, family, and friends, and well-being and depressive mood. In addition, the findings from a variable-centered approach revealed that educational concerns were a stronger predictor for mental health than health concerns and pointed to a higher relative importance of perceived family support for adolescents' mental health relative to perceived teacher and friend support.

Lastly, the region in which adolescents lived significantly predicted the likelihood of belonging to one of the profiles: Students from regions being more exposed to the COVID-19 pandemic and related imposed measures (i.e., Italian-speaking part of Switzerland and Northern Italy) were more likely classified in the low or the average rather than in the high resilience profile as compared to students from regions with lower exposure (i.e., German-speaking part of Switzerland).

Adolescents' Resilience Profiles

The current study identified three resilience profiles, with 19% of the sample belonging to the low, 47% to the average, and 34% to

TABLE 3 | Results of the multinomial logit model on resilience profile classification.

	Step 1				Step 2			
	Low resilience		Average resilience		Low resilience		Average resilience	
	β *(SE)*	*exp(β)*	β *(SE)*	*exp(β)*	β *(SE)*	*exp(β)*	β *(SE)*	*exp(β)*
Grade	0.48 (0.06)***	1.62***	0.32 (0.05)***	1.37***	0.38 (0.06)***	1.46***	0.22 (0.05)***	1.25***
Gender	0.53 (0.20)**	1.69**	0.79 (0.15)***	2.20***	0.44 (0.21)*	1.55*	0.69 (0.16)***	1.99***
SES	−0.45 (0.22)*	0.64*	−0.19 (0.17)	0.83	−0.63 (0.22)**	0.53**	−35 (0.17)*	0.70*
Migration background	0.39 (0.21)†	1.47†	−0.03 (0.16)	0.97	0.51 (0.21)*	1.66*	0.09 (0.17)	1.10
Regional differences								
Italian-speaking part of Switzerland					0.96 (0.22)***	2.61***	0.71 (0.15)***	2.03***
Northern Italy					2.05 (0.32)***	7.81***	1.83 (0.25)***	6.22***
AIC	2280.12				2209.22			
BIC	2330.71				2280.04			

Reference category for the dependent variable = high resilience profile; reference category for regional differences = German-speaking part of Switzerland; gender: 1 = female, 0 = male; SES: 1 = own house, 0 = rented house; migration background: 1 = migration background, 0 = no migration background. The coefficients β are the logarithms of the ratio of the probability of choosing one outcome category over the probability of choosing the baseline category. Exp(β) is the exponentiation of the coefficients β, which can be interpreted as the relative risk or likelihood of belonging to the low or medium resilience profile relative to the high resilience profile when increasing the predictor variables by one unit or switching the category of the predictor.
†$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, *two-tailed.*

the high resilience profile. As expected, adolescents categorized in the high resilience profile expressed fewer uncertainties and stress regarding educational demands and high perceived support from teachers, parents, and friends. Also, they reported high levels of well-being and few depressive symptoms. However, compared to those belonging to the average or low resilience profile, adolescents who were part of the high resilience profile did not have fewer worries about others' health, such as concerns about their families and people around the globe.

These findings are in line with previous research highlighting that educational concerns, such as being worried of not understanding the subject matter, may pose a risk for adolescents' well-being (Xiang et al., 2019) and that increasing stress associated with new educational challenges during the pandemic predicted lower mental health (Lee, 2020; Stefaniak et al., 2021). Moreover, previous research emphasized the importance of social support for adolescents, especially in times of difficulty or crisis (Armstrong et al., 2005; Wang and Holcombe, 2010). Our findings align with this previous work suggesting that high perceived social support was a particularly valuable resource for adolescent during the school closures related to the COVID-19 pandemic, which highlights the importance of supportive relationship systems during uncertain and difficult times.

The current study also identified a group of adolescents with low resilience, which made up around one fifth of adolescents of the current sample. This group was characterized by high educational concerns, and thus, high uncertainty and stress regarding educational demands during the school closures, while health concerns were at an average level. Recent work demonstrated that adolescents suffered from school closures during the pandemic because their daily routine was highly influenced by changing circumstances regarding their relationships with friends and teachers, losing important anchors in their life (Lee, 2020). Adolescents belonging to the low resilience profile were also those with the relatively lowest perceived social support, which can be perceived as concerning, given that those adolescents would have needed the feeling of being safe and cared the most (Andrews et al., 2002). Future research may identify further risk factors of young people who are particularly vulnerable to educational concerns, as targeting those who are least able to cope with extraordinary situations causing stress would be essential. As the findings of this study were limited due to the cross-sectional design, future work should consider whether pre-existing worries related to school made adolescents more vulnerable during the pandemic-related school closures. For example, the study of Nazar et al. (2020) shows that school burnout was associated with negative mental health.

The Relative Importance of Educational and Health Concerns for Adolescents' Resilience

Qualitative differences in adolescents' resilience profiles emerged regarding the two components of concerns under consideration: educational and health concerns. Previous research showed negative effects on psychological outcomes of the fear of being infected or infecting others (e.g., Brooks et al., 2020). However, in the current study, health concerns of the low resilience profile were at a similar level in the average and the high resilience profile. Moreover, the results from the path analysis revealed that educational concerns were a stronger predictor for mental health than health concerns. Hence, findings suggest that health-related concerns about the pandemic could be factors that are less salient for adolescents as compared to sources of educational concerns.

Literature shows that adolescents already have to cope with a lot of educational stressors independent of a crisis, whereby

educational stress has generally been associated with the risk of school burnout and exhaustion at school (Bask and Salmela-Aro, 2013; Nazar et al., 2020; Özhan and Yüksel, 2021) being associated with lower academic achievement (Madigan and Curran, 2021). During the pandemic, adolescents had to deal with many uncertainties about their academic future, potentially increasing this risk for exhaustion. Accordingly, Wang et al. (2020) argued that the educational stress caused by the pandemic might have exceeded adolescents' resources. In addition, it is also possible that adolescents might have been overwhelmed with distance learning, as the new settings required adaptations and brought new challenges such as technology-based learning (Bond, 2020). Future research may address this topic and investigate whether distance learning with its new technologies may be a factor increasing students' workload and school burnout.

When considering the descriptive statistics adolescents reported higher health concerns than educational concerns. Hence, adolescents were not without worries about the spread and negative consequences of COVID-19 for others' health. Moreover, health concerns were indeed negatively related to adolescents' mental health in the path analysis. This finding is in line with previous studies concluding that adolescents' mental health (Meherali et al., 2021) or quality of life (Ravens-Sieberer et al., 2021) declined because of COVID-19-related health concerns.

Interestingly, the descriptive findings of the current study also suggest that having more health concerns was positively associated with higher perceived social support in all three sources. Since family interactions were particularly high during the lockdown, high perceived family support might have implied discussing concerns of COVID-19 and the lockdown more strongly within the family. Therefore, adolescents with higher support might have been more aware of risk factors regarding the pandemic resulting in more health concerns. In line with this, Peplak et al. (2021) found child-parent conversations about COVID-19 to be positively correlated with empathic concerns for those affected by COVID-19. Future research may further shed light on the associations between the type of family discussions about COVID-19 and adolescents' well-being.

The Relative Importance of Different Forms of Social Support for Adolescents' Resilience

The three components of perceived social support (i.e., perceived teacher, family, and friend support) had different configurations within the three resilience profiles. First, the profile analyses revealed that perceived teacher and family support differed more between each profile, while perceived friend support varied the least, but was still associated with adolescents' mental health. In addition, the results from the path analysis revealed that perceived family support had a significantly higher association with adolescents' mental health than teacher and friend support. Thereby, perceived family support was positively related to both, higher current well-being and lower depressive mood, while teacher and friend support was only significantly and positively associated with current well-being. Hence, for adolescents with higher depressive mood, teacher and friend support did not serve as a protective factor. Lastly, the path analysis only revealed direct effects of perceived social support on mental health. No effects were found with perceived social support as a potential buffer against the negative effects of educational and health concerns on mental health.

The current study included two measures of mental health, one capturing adolescents' well-being specifically during the time of school closure (i.e., situational measure) and one capturing their depressive mood reflecting a more stable measure, whereby adolescents reported whether they tended to be in certain states over a longer period of time. The idea was that adolescents with higher depressive mood may have had lower resources to deal with the challenges related to the pandemic (Becker and Gregory, 2020; Guessoum et al., 2020; van Loon et al., 2021). Thus, considering potential differences between adolescents' current well-being and depressive mood, teachers and friends may have helped adolescents to deal better with the current situation, but their perceived support was unrelated to adolescents' depressive symptomatic. In contrast, adolescents who perceived high family support were more likely to report higher well-being during the school closure and lower depressive mood. While the current study did not assess adolescents' mental health before the pandemic and thus, cannot make any claims regarding causal relations between support and adolescents' mental health due to its cross-sectional design, the findings still point to relative differences regarding the importance of the source of which support was received from.

One possible interpretation for the significant role of family support for adolescents' mental health could be that school closures may have led to a higher amount of time spent with the family. This more intense contact may have increased the need for and importance of family support (Prime et al., 2020). Accordingly, in times of the pandemic, higher parental support was found to be connected to lower anxiety and depression (Klootwijk et al., 2021) as well as lower stress and higher well-being (Guessoum et al., 2020). Pre-pandemic literature points out to direct effects of perceived family support on adolescents' current well-being and depressive mood. Thereby, Colarossi and Eccles (2003) highlight the importance of perceived mother support on adolescents' depression and found that effects were larger as compared to perceived friend and teacher support. The authors argue that family support may have cumulative effects over time as parent-child relationships are generally rather long-standing and relatively stable, having notable effects on depression (Garnefski and Diekstra, 1996; Colarossi and Eccles, 2003).

With regards to educational challenges, research showed that parents had to take on new unfamiliar roles in home schooling during the COVID-19 school closures, while being more responsible for the educational support of their children (e.g., Garrote et al., 2021). Regarding educational concerns in the current study, perceived family support was higher in the resilience profile of adolescents with lower educational concerns and vice versa. Moreover, at a general level, parental support correlated with lower educational concerns. However, in the path analysis, perceived family support did not moderate the

association between adolescents' educational nor health concerns and their mental health. Potentially, efforts by parents may not have been sufficient to alleviate the negative association between stress related to educational challenges and adolescents' mental health. For example, some parents reported being overwhelmed and having problems to motivate their children to study (Garbe et al., 2020). Garrote et al. (2021) found a negative association between stress in parents and their children's online learning experience. Taken together, parents did play a key role for adolescents' mental health; however, their role may have been more significant with regards to other functions, such as providing emotional security (Colarossi and Eccles, 2003) or providing a daily routine (Bülow et al., 2021; Liu et al., 2021).

In addition to parents, teachers had an important function to support adolescents in their distance learning during the COVID-19 pandemic. Teachers had to change teaching routines by shifting from face-to-face to online lessons. Therefore, students might have been more dependent on their teachers' support to guide them through the transition and help them learn in the changed school context. Recent research found high support from teachers and a positive student-teacher relationship to be associated with higher engagement in remote learning during school closures (Bray et al., 2021) as well as fewer mental health problems (Garrote et al., 2021; Ye et al., 2021). Our findings align with this prior work; however, only with regards to adolescents' current well-being. Moreover, while teacher support did correlate with lower levels of educational concerns, there was no significant moderation effect of teacher support regarding adolescents' mental health. Potentially, through online teaching, emotional support by teachers might have been more challenging to build up because, among other things, teachers had to deal with new teaching methods. In addition, studies have reported that especially adolescents with mental health issues and special educational needs suffered from school closures with the loss of a daily routine (Lee, 2020). Hence, teachers may have needed additional resources to support at-risk students during the pandemic.

When studying the resilience profiles and particularly the level of perceived support from friends, it was the lowest in the low resilience profile while in the average and the high resilience profile this component was at a similar level. Thus, adolescents being in the low resilience profile felt more isolated during the pandemic, meeting fewer or having fewer friends. It was also reported that this feeling of social disconnection related to higher levels of anxiety and depression as well as lower life satisfaction (Magson et al., 2020). The findings from the variable-centered approach revealed that friend support was positively associated with adolescents' current well-being, but not with their depressive mood. In line with these findings, Colarossi and Eccles (2003) showed that perceived friend support was only a significant predictor of adolescents' self-esteem but not of the level of depression. In addition, changes from in-person to online conversations may have been related to loneliness (Rumas et al., 2021). Ellis et al. (2020) suggest that more virtual contact with friends was related to lower loneliness, but also higher levels of depression in adolescents. The authors thereby argue that in group chats adolescents may encounter social aggression and even cyberbullying (Meter and Bauman, 2015; Ellis et al., 2020) which may lead to increasing interpersonal problems. Lastly, even with close friends, and especially in stressful times and dealing with uncertainties, conversations may not only positively, but also negatively affect adolescents' mental health, when involving excessive discussions of problems and increasingly focusing on negative emotions (Rose, 2002; Ellis et al., 2020). Research may thus shed more light on the specific factors in online conversations with friends that could protect adolescents' well-being.

Regional Differences in the Exposure to COVID-19 and Associated Restrictions

A further aim of this study was to identify whether adolescents' resilience profiles could be predicted by their exposure to the virus with regards to the measures executed and the case numbers. Given that the measures and case numbers varied substantially between regions (Bundesamt für Gesundheit, 2020; Ministero della Salute, 2021), we expected adolescents from the Italian-speaking part of Switzerland and Northern Italy to be more likely to belong to a lower than to a higher resilience profile as compared to the German-speaking part of Switzerland. As hypothesized, the results showed that students living in the German-speaking part of Switzerland were more likely to be in the high than in the average or low resilience profile as compared to those living in the Italian-speaking part of Switzerland or in Northern Italy. In the latter two regions, exposure to COVID-19 was higher, as indicated by the higher case numbers of infected people and more restrictive measures implemented at different points in time (Bundesamt für Gesundheit, 2020; Ministero della Salute, 2021). In Italy for example, the measures no longer allowed to leave the house and schools were closed earlier than in the German-speaking part of Switzerland (Bundesamt für Gesundheit, 2020; Caffo et al., 2020; Ministero della Salute, 2021). Also, while schools where still closed at the time this survey was conducted, the Swiss federal council had already announced their reopening which could have lowered adolescents' educational concerns. Thus, how adolescents evaluated the measures taken by the government may reveal more information about regarding their resilience in different regions. Thereby, future work would benefit from a longitudinal investigation of adolescents' development within different regions in order to shed more light on how different measures taken in different areas (e.g., school closures and their duration) predict adolescents' resilience during the pandemic.

Socio-Demographic Differences in Adolescents' Resilience

In addition to regional differences, gender, grade and migration background were significant predictors of adolescents' likelihood of being categorized into the resilience profiles. Specifically, female students, those in higher-grade levels, and students with a migration background were more likely to belong to the low or average resilience profiles than to the high resilience profile. These results are consistent with previous work, maintaining that during the COVID-19 pandemic females reported higher

health concerns and lower mental health (Liu et al., 2020; Wang et al., 2020; Zhou et al., 2020; Nocentini et al., 2021). Moreover, also in line with previous research, increasing age and migration background was associated with lower mental health (Chu et al., 2010; Klein et al., 2020; Zhou et al., 2020; Nocentini et al., 2021; Ravens-Sieberer et al., 2021) resulting in lower resilience. In many instances, parents with a migration background have high aspirations and high expectations for their children (Fuligni, 1997; Glick and White, 2004) but less resources to support them educationally compared to native-born parents (e.g., having a lower SES and being less educated themselves; OECD, 2006), which may have become more noticeable during the pandemic.

However, it must be noted that in the current study, migration background was included as a dichotomous variable, in which each person who had another nationality than or an additional nationality to the Swiss one (i.e., for the Swiss participants) or the Italian one (i.e., for the Italian participants) was considered to have a migration background. Therefore, no country- or nationality-specific statement is possible. It should also be noted with caution that the proportion of students who reported a migration background was very different between the three regions (see **Supplementary Table 1** in the **Supplementary Material**). Future research should include more differentiated and possibly also multiple measures of adolescents' SES and migration background in order to compare whether different measures would have an effect on the results.

Limitations

The current study is limited by the cross-sectional nature of the data. Importantly, we could not account for adolescents' pre-pandemic levels in the key variables and thus not investigate whether there were changes in adolescents' concerns, perceived social support or mental health. Prior evidence suggests, for example, that adolescents displaying mental health issues prior to the pandemic might have been more vulnerable to shifts in their routines (Meherali et al., 2021). In addition, pre-pandemic reported emotional distress was associated with emotional distress during the pandemic (Shanahan et al., 2020) and pre-pandemic stress influenced COVID-19 concerns and school concerns (van Loon et al., 2021). Hence, those adolescents experiencing higher stress and lower mental health before the pandemic may have been the most affected by COVID-19-related concerns. However, examining causal relations was not the aim of this cross-sectional study. Future research may need to disentangle whether lacking social support may have made adolescents with high levels of educational concerns more vulnerable for mental health issues or whether adolescents with already existing mental health issues may have perceived fewer social support, higher pressure, and uncertainty to cope with the additional educational uncertainties (Lee, 2020).

Similarly, adolescents' educational concerns may have been already high before the pandemic. Hence, while our study can shed light on the associations between educational and health concerns as risk, and social support as protective factors with adolescents' mental health, the findings are limited to adolescents' perceptions of these aspects during the school closures in the early phases of the pandemic and cannot speak for adaptation processes.

Moreover, different sample sizes and characteristics of the regions might have overrepresented a particular region within the full sample. In particular, the Italian-speaking part of Switzerland (i.e., Ticino) was the largest sub-sample with over 700 participants, followed by the German-speaking part of Switzerland and Northern Italy (i.e., Lombardy). The results might therefore be more representative for the situation in Ticino than for the one in the German-speaking part of Switzerland or in Lombardy. Still, the separate analyses of the regions all revealed similar patterns for the three-profile solution; however, it must be noted that the percentage of adolescents that were categorized into the relatively low, average, or high resilience profiles varied between regions, with the German-Speaking part of Switzerland having the highest percentage of adolescents in the low resilience profile (see **Supplementary Figures 2, 3**, and **4** in the **Supplementary Material**). Thus, future research needs to examine additional factors (i.e., resources and risk factors specific to adolescents in these regions), which can explain such regional differences.

CONCLUSION

The current study provided new insights regarding adolescents' concerns, perceived support, and mental health during the school closures in early phases of the COVID-19-pandemic. Findings revealed differences between three groups of adolescents, in which different associations between educational concerns, the level of social support by teachers, family, and friends, and their mental health were identified. About one fifth of the sample faced high uncertainty about their educational outcomes and did not feel supported by their environment, pointing to a particularly vulnerable group that may benefit from targeted interventions during school closures. In addition, adolescents being more exposed to COVID-19-related measures and case numbers (i.e., whether they lived in the German-speaking part of Switzerland, the Italian-speaking part of Switzerland or Northern Italy) were at a higher risk of showing rather low resilience. Importantly, our findings also point to a high protective role by adolescents' family environment during the pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the University of Zurich (Approval N. 20.4.2). Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

LD, IB, PC, FL, and JG conceptualized, prepared and realized the study together, including the recruitment of participating schools, data collection, organization, and analysis. LD and JG conducted the statistical analyses of the data and their visualization. IB, PC, LD, and FL provided feedback for the interpretation of the findings, drafted the manuscript, and revised it based on feedback regarding intellectual content from MB and JG. All authors contributed to the article and approved the submitted version.

FUNDING

The authors received a small grant by the Jacobs Center for Productive Youth Development.

ACKNOWLEDGMENTS

The authors would like to thank all schools and students who participated in the present study and thus provided valuable data. The authors also would like to express our gratitude to Sarah Bunz, Leonie Graf, and Eli Eggenberg for their great support during the conduction of the study and literature search.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.733683/full#supplementary-material

REFERENCES

Anderson, S. A., Sabatelli, R. M., and Kosutic, I. (2007). Families, Urban Neighborhood Youth Centers, and Peers as Contexts for Development. *Fam. Relat.* 56, 346–357. doi: 10.1111/j.1741-3729.2007.00464.x

Andrews, A., Ben-Arieh, A., Carlson, M., Damon, W., Dweck, C., Earls, F., et al. (2002). *Ecology of child well-being: Advancing the science and the science-practice link*. Arizona, ARI: Center for Child Well-Being.

Anthony, E. K., and Stone, S. I. (2010). Individual and contextual correlated of adolescent health and well-being. *Fam. Soc.* 91, 225–233. doi: 10.1606/1044-3894.3999

Armstrong, M., Birnie-Lefcovitch, S., and Ungar, M. (2005). Pathways Between Social Support, Family Well Being, Quality of Parenting, and Child Resilience: What We Know. *J. Child Fam. Stud.* 14, 269–281. doi: 10.1007/s10826-005-5054-4

Arsenio, W. F., and Loria, S. (2014). Coping with Negative Emotions: Connections with Adolescents' Academic Performance and Stress. *J. Genet. Psychol.* 175, 76–90. doi: 10.1080/00221325.2013.806293

Barker, G. (2007). Adolescents, social support and help-seeking behaviour. An international literature review and programme consultation with recommendations for action. *WHO Discuss. Pap. Adolesc.* 2007, 1–58.

Bask, M., and Salmela-Aro, K. (2013). Burned out to drop out: Exploring the relationship between school burnout and school dropout. *Eur. J. Psychol. Educat.* 28, 511–528. doi: 10.1007/s10212-012-0126-5

Becker, S. P., and Gregory, A. M. (2020). Editorial Perspective: Perils and promise for child and adolescent sleep and associated psychopathology during the COVID-19 pandemic. *J. Child Psychol. Psychiatry Allied Discipl.* 61, 757–759. doi: 10.1111/jcpp.13278

Bernasco, E. L., Nelemans, S. A., van der Graaff, J., and Branje, S. (2021). Friend Support and Internalizing Symptoms in Early Adolescence During COVID-19. *J. Res. Adolesc.* 31, 692–702. doi: 10.1111/jora.12662

Beteille, T., Ding, E., Molina, E., Pushparatnam, A., and Wilichowski, T. (2020). *Three Principles to Support Teacher Effectiveness During COVID-19*. Washington, D.C: World Bank.

Bond, M. (2020). Schools and emergency remote education during the COVID-19 pandemic: A living rapid systematic review. *Asian J. Distance Educat.* 15, 191–247.

Bray, A., Banks, J., Devitt, A., and Ní Chorcora, E. (2021). Connection before content: using multiple perspectives to examine student engagement during Covid-19 school closures in Ireland. *Irish Educat. Stud.* 2021, 1–11. doi: 10.1080/03323315.2021.1917444

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 395, 912–920. doi: 10.1016/S0140-6736(20)30460-8

Buchanan, A. (2014). Risk and protective factors in child development and the development of resilience. *Open J. Soc. Sci.* 2:244. doi: 10.4236/jss.2014.24025

Bülow, A., Keijsers, L., Boele, S., van Roekel, E., and Denissen, J. J. A. (2021). Parenting adolescents in times of a pandemic: Changes in relationship quality, autonomy support, and parental control? *PsyArXiv* [Preprint]. doi: 10.31234/osf.io/g8kpf

Bundesamt für Gesundheit (2020). *Coronavirus-Krankheit 2019 (COVID-19). Epidemiologische Zwischenbilanz zum neuen Coronavirus in der Schweiz und im Fürstentum Liechtenstein*. Bonn: Bundesamt für Gesundheit.

Caffo, E., Scandroglio, F., and Asta, L. (2020). Debate: COVID-19 and psychological well-being of children and adolescents in Italy. *Child Adolesc. Mental Health* 25, 167–168. doi: 10.1111/camh.12405

Campione-Barr, N., Rote, W., Killoren, S. E., and Rose, A. J. (2021). Adolescent Adjustment During COVID-19: The Role of Close Relationships and COVID-19-related Stress. *J. Res. Adolesc.* 31, 608–622. doi: 10.1111/jora.12647

Cassel, J. (1976). The contribution of the social environment to host resistance: the Fourth Wade Hampton Frost Lecture. *Am. J. Epidemiol.* 104, 107–123. doi: 10.1093/oxfordjournals.aje.a112281

Chandan, J. S., Taylor, J., Bradbury-Jones, C., Nirantharakumar, K., Kane, E., and Bandyopadhyay, S. (2020). COVID-19: a public health approach to manage domestic violence is needed. *Lancet Public Health* 5:e309.

Chohan, B. I., and Khan, R. M. (2010). Impact of Parental Support on the Academic Performance and Self Concept of the Student. *J. Res. Reflect. Educat.* 4, 14–26.

Christensen, D. S., Dich, N., Flensborg-Madsen, T., Garde, E., Hansen, ÅM., and Mortensen, E. L. (2019). Objective and subjective stress, personality, and allostatic load. *Brain Behav.* 9:e01386. doi: 10.1002/brb3.1386

Chu, P. S., Saucier, D. A., and Hafner, E. (2010). Meta-Analysis of the Relationships Between Social Support and Well-Being in Children and Adolescents. *J. Soc. Clin. Psychol.* 29, 624–645. doi: 10.1521/jscp.2010.29.6.624

Colarossi, L. G., and Eccles, J. S. (2003). Differential effects of support providers on adolescents' mental health. *Soc. Work Res.* 27, 19–30. doi: 10.1093/swr/27.1.19

Commodari, E., and La Rosa, V. L. (2020). Adolescents in quarantine during COVID-19 pandemic in Italy: Perceived health risk, beliefs, psychological experiences and expectations for the future. *Front. Psychol.* 11:2480. doi: 10.3389/fpsyg.2020.559951

Curby, T. W., Brock, L. L., and Hamre, B. K. (2013). Teachers' Emotional Support Consistency Predicts Children's Achievement Gains and Social Skills. *Early Educat. Dev.* 24, 292–309. doi: 10.1080/10409289.2012.665760

de Miranda, D. M., da Silva Athanasio, B., de Sena Oliveira, A. C., and Silva, A. C. S. (2020). How is COVID-19 pandemic impacting mental health of children and adolescents? *Int. J. Disaster Risk Reduct.* 2020:101845. doi: 10.1016/j.ijdrr.2020.101845

Derogatis, L. R., and Coons, H. L. (1993). "Self-report measures of stress," in *Handbook of stress: Theoretical and clinical aspects*, eds L. Goldberger and S. Breznitz (Mumbai: Free Press), 200–233.

Duan, L., Shao, X., Wang, Y., Huang, Y., Miao, J., Yang, X., et al. (2020). An investigation of mental health status of children and adolescents in china during the outbreak of COVID-19. *J. Affect. Disord.* 275, 112–118. doi: 10.1016/j.jad.2020.06.029

Eagle, D. E., Hybels, C. F., and Proeschold-Bell, R. J. (2019). Perceived social support, received social support, and depression among clergy. *J. Soc. Pers. Relationsh.* 36, 2055–2073. doi: 10.1177/0265407518776134

Ellis, W. E., Dumas, T. M., and Forbes, L. M. (2020). Physically isolated but socially connected: Psychological adjustment and stress among adolescents during the initial COVID-19 crisis. *Canad. J. Behav. Sci.* 52, 177–187.

El-Zoghby, S. M., Soltan, E. M., and Salama, H. M. (2020). Impact of the COVID-19 Pandemic on Mental Health and Social Support among Adult Egyptians. *J. Commun. Health* 45, 689–695. doi: 10.1007/s10900-020-00853-5

Farmer, T. W., McAuliffe Lines, M., and Hamm, J. V. (2011). Revealing the invisible hand: The role of teachers in children's peer experiences. *J. Appl. Dev. Psychol.* 32, 247–256. doi: 10.1016/j.appdev.2011.04.006

Fegert, M. J., Vitiello, B., Plener, P. L., and Clemens, V. (2020). Challenges and burden of the Coronavirus 2019 (COVID-19) pandemic for child and adolescent mental health: a narrative review to highlight clinical and research needs in the acute phase and the long return to normality. *Child Adolesc. Psychiatry Mental Health* 14, 1–11. doi: 10.1186/s13034-020-00329-3

Forster, C. (2020). *Ein Kinder-Infektiologe erklärt, was Eltern vor dem Schulstart wissen sollten*. Zürich: Neue Zürcher Zeitung.

Fuligni, A. J. (1997). The academic achievement of adolescents from immigrant families: The role of family background, attitudes, and behavior. *Child Dev.* 68, 351–363. doi: 10.1111/j.1467-8624.1997.tb01944.x

Fulkerson, J. A., Story, M., Mellin, A., Leffert, N., Neumark-Sztainer, D., and French, S. A. (2006). Family dinner meal frequency and adolescent development: Relationships with developmental assets and high-risk behaviors. *J. Adolesc. Health* 39, 337–345.

Garbe, A., Ogurlu, U., Logan, N., and Cook, P. (2020). COVID-19 and remote learning: Experiences of parents with children during the pandemic. *Am. J. Qualitat. Res.* 4, 45–65. doi: 10.29333/ajqr/8471

Garnefski, N., and Diekstra, R. F. (1996). Perceived social support from family, school, and peers: Relationship with emotional and behavioral problems among adolescents. *J. Am. Acad. Child Adolesc. Psychiatry* 35, 1657–1664. doi: 10.1097/00004583-199612000-00018

Garrote, A., Niederbacher, E., Hofmann, J., Rösti, I., and Neuenschwander, M. P. (2021). Teacher Expectations and Parental Stress During Emergency Distance Learning and Their Relationship to Students' Perception. *Front. Psychol.* 12:712447. doi: 10.3389/fpsyg.2021.712447

Gasser, L., Grütter, J., Buholzer, A., and Wettstein, A. (2018). Emotionally supportive classroom interactions and students' perception of their teachers as just and caring. *J. Learn. Instruct.* 54, 82–92. doi: 10.1016/j.learninstruc.2017.08.003

Glick, J. E., and White, M. J. (2004). Post-secondary school participation of immigrant and native youth: The role of familial resources and educational expectations. *Soc. Sci. Res.* 33, 272–299. doi: 10.1016/j.ssresearch.2003.06.001

Golberstein, E., Wen, H., and Miller, B. F. (2020). Coronavirus disease 2019 (COVID-19) and mental health for children and adolescents. *JAMA Pediatrics* 174, 819–820. doi: 10.1001/jamapediatrics.2020.1456

Grey, I., Arora, T., Thomas, J., Saneh, A., Tohme, P., and Abi-Habib, R. (2020). The role of perceived social support on depression and sleep during the COVID-19 pandemic. *Psychiatry Res.* 293:113452. doi: 10.1016/j.psychres.2020.113452

Guessoum, S. B., Lachal, J., Radjack, R., Carretier, E., Minassian, S., Benoit, L., et al. (2020). Adolescent psychiatric disorders during the COVID-19 pandemic and lockdown. *Psychiatry Res.* 291:113264. doi: 10.1016/j.psychres.2020.113264

Hallquist, M. N., and Wiley, J. F. (2018). MplusAutomation: an R package for facilitating large-scale latent variable analyses in M plus. *Struct. Equat. Model. Multidiscipl. J.* 25, 621–638. doi: 10.1080/10705511.2017.1402334

Hamre, B. K., and Pianta, R. (2007). "Learning opportunities in preschool and early elementary classrooms," in *School readiness and the transition to school*, eds R. C. Pianta, M. J. Cox, and K. Snow (Oxford: Brookes), 49–84.

Han, G., Zhang, J., Chu, K., and Shen, G. (2014). Self–other differences in H1N1 flu risk perception in a global context: A comparative study between the United States and China. *Health Commun.* 29, 109–123. doi: 10.1080/10410236.2012.723267

Hoffman, J. A., and Miller, E. A. (2020). Addressing the consequences of school closure due to COVID-19 on children's physical and mental well-being. *World Med. Health Policy* 12, 300–310. doi: 10.1002/wmh3.365

Holmes, T. H., and Rahe, R. H. (1967). The social readjustment rating scale. *J. Psychosom. Res.* 11, 213–218.

Huan, V. S., See, Y. L., Ang, R. P., and Har, C. W. (2008). The impact of adolescent concerns on their academic stress. *Educat. Rev.* 60, 169–178. doi: 10.1080/00131910801934045

Imran, N., Zeshan, M., and Pervaiz, Z. (2020). Mental health considerations for children & adolescents in COVID-19 Pandemic. *Pak. J. Med. Sci.* 36:2759. doi: 10.12669/pjms.36.COVID19-S4.2759

Jakobsen, A. L., Hansen, C. D., and Andersen, J. H. (2021). The association between perceived social support in adolescence and positive mental health outcomes in early adulthood: a prospective cohort study. *Scand. J. Public Health* 2021:1403494821993718. doi: 10.1177/1403494821993718

Jiao, W. Y., Wang, L. N., Liu, J., Fang, S. F., Jiao, F. Y., Pettoello-Mantovani, M., et al. (2020). Behavioral and emotional disorders in children during the COVID-19 epidemic. *J. Pediatrics* 221, 264–266. doi: 10.1016/j.jpeds.2020.03.013

Jones, E. A., Mitra, A. K., and Bhuiyan, A. R. (2021). Impact of COVID-19 on mental health in adolescents: a systematic review. *Int. J. Environ. Res. Public Health* 18:2470. doi: 10.3390/ijerph18052470

Klein, E. M., Müller, K. W., Wölfling, K., Dreier, M., Ernst, M., and Beutel, M. E. (2020). The relationship between acculturation and mental health of 1st generation immigrant youth in a representative school survey: Does gender matter? *Child Adolesc. Psychiatry Mental Health* 14:6. doi: 10.1186/s13034-020-00334-6

Klootwijk, C. L., Koele, I. J., van Hoorn, J., Güroğlu, B., and van Duijvenvoorde, A. C. (2021). Parental Support and Positive Mood Buffer Adolescents' Academic Motivation During the COVID-19 Pandemic. *J. Res. Adolesc.* 31, 780–795. doi: 10.1111/jora.12660

Korzycka, M., Bójko, M., Radiukiewicz, K., Dzielska, A., Nałęcz, H., Kleszczewska, D., et al. (2021). Demographic analysis of difficulties related to remote education in Poland from the perspective of adolescents during the COVID-19 pandemic. *Ann. Agricult. Environ. Med.* 28, 149–157. doi: 10.26444/aaem/133100

Lazarus, R. S., and Folkman, S. (1984). *Stress, appraisal, and coping*. Berlin: Springer publishing company.

Lee, J. (2020). Mental health effects of school closures during COVID-19. *Lancet Child Adolesc. Health* 4:421. doi: 10.1016/S2352-4642(20)30109-7

Lessard, L. M., and Puhl, R. M. (2021). Adolescent academic worries amid COVID-19 and perspectives on pandemic-related changes in teacher and peer relations. *School Psychol.* 36, 285–292. doi: 10.1037/spq0000443

Li, Q., Luo, R., Zhang, X., Meng, G., Dai, B., and Liu, X. (2021). Intolerance of covid-19-related uncertainty and negative emotions among chinese adolescents: A moderated mediation model of risk perception, social exclusion and perceived efficacy. *Int. J. Environ. Res. Public Health* 18:2864. doi: 10.3390/ijerph18062864

Liang, L., Ren, H., Cao, R., Hu, Y., Qin, Z., Li, C., et al. (2020). The Effect of COVID-19 on Youth Mental Health. *Psychiatric Quart.* 91, 841–852. doi: 10.1007/s11126-020-09744-3

Liu, J., Zhou, T., Yuan, M., Ren, H., Bian, X., and Coplan, R. J. (2021). Daily routines, parent–child conflict, and psychological maladjustment among Chinese children and adolescents during the COVID-19 pandemic. *J. Fam. Psychol.* [Preprint]. doi: 10.1037/fam0000914

Liu, N., Zhang, F., Wei, C., Jia, Y., Shang, Z., Sun, L., et al. (2020). Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: Gender differences matter. *Psychiatry Res.* 287:112921. doi: 10.1016/j.psychres.2020.112921

Lo, Y., Mendell, N. R., and Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika* 88, 767–778. doi: 10.1093/biomet/88.3.767

Loades, M. E., Chatburn, E., Higson-Sweeney, N., Reynolds, S., Shafran, R., Brigden, A., et al. (2020). Rapid systematic review: the impact of social isolation and loneliness on the mental health of children and adolescents in the Context of COVID-19. *J. Am. Acad. Child Adolesc. Psychiatry* 8567, 30337–30333. doi: 10.1016/j.jaac.2020.05.009

Madigan, D. J., and Curran, T. (2021). Does burnout affect academic achievement? A meta-analysis of over 100,000 students. *Educat. Psychol. Rev.* 2021, 1–19. doi: 10.1007/s10648-020-09533-1

Magson, N. R., Freeman, J. Y. A., Rapee, R. M., Richardson, C. E., Oar, E. L., and Fardouly, J. (2020). Risk and Protective Factors for Prospective Changes in Adolescent Mental Health during the COVID-19 Pandemic. *J. Youth Adolesc.* 50, 44–57. doi: 10.1007/s10964-020-01332-9

Masonbrink, A. R., and Hurley, E. (2020). Advocating for children during the COVID-19 school closures. *Pediatrics* 146:1440. doi: 10.1542/peds.2020-1440

Meherali, S., Punjani, N., Louie-Poon, S., Abdul Rahim, K., Das, J. K., Salam, R. A., et al. (2021). Mental health of children and adolescents amidst CoViD-19 and past pandemics: a rapid systematic review. *Int.J. Environ. Res. Public Health* 18:3432. doi: 10.3390/ijerph18073432

Meter, D. J., and Bauman, S. (2015). When sharing is a bad idea: The effects of online social network engagement and sharing passwords with friends on cyberbullying involvement. *Cyberpsychol. Behav. Soc. Network.* 18, 437–442. doi: 10.089/cyber.2015.0081

Ministero della Salute (2021). *Covid-19 - Situazione in Italia*. Roma: Ministero della Salute.

Morin, A. J., Meyer, J. P., Creusier, J., and Biétry, F. (2016). Multiple-group analysis of similarity in latent profile solutions. *Organiz. Res. Methods* 19, 231–254. doi: 10.1177/1094428115621148

Moser, K. M., Wei, T., and Brenner, D. (2021). Remote teaching during COVID-19: Implications from a national survey of language educators. *System* 97:102431. doi: 10.1016/j.system.2020.102431

Muthén, K. L., and Muthén, B. O. (2018). *Mplus user's guide*, 8th Edn. Los angeles CA: Muthén & Muthén.

Nazar, N., Österman, K., and Björkqvist, K. (2020). School burnout and its psychological concomitants among students from three school types in Pakistan. *Euras. J. Med. Investigat.* 4, 187–194. doi: 10.14744/ejmi.2020.99149

Nguyen, D. T., Wright, E. P., Dedding, C., Pham, T. T., and Bunders, J. (2019). Low self-esteem and its association with anxiety, depression, and suicidal ideation in Vietnamese secondary school students: a cross-sectional study. *Front. Psychiatry* 10:698. doi: 10.3389/fpsyt.2019.00698

Nocentini, A., Palladino, B. E., and Menesini, E. (2021). Adolescents' Stress Reactions in Response to COVID-19 Pandemic at the Peak of the Outbreak in Italy. *Clin. Psychol. Sci.* 2021:216770262199576. doi: 10.1177/2167702621995761

OECD (2006). *Where Immigrant Students Succeed: A Comparative Review of Performance and Engagement in PISA 2003*. Paris: OECD Publishing, doi: 10.1787/9789264023611-en

Özhan, M. B., and Yüksel, G. (2021). The Effect of School Burnout on Academic Achievement and Well-Being in High School Students: A Holistic Model Proposal. *Int. J. Contemp. Educat. Res.* 8, 145–162. doi: 10.33200/ijcer.824488

Pascoe, M. C., Hetrick, S. E., and Parker, A. G. (2020). The impact of stress on students in secondary school and higher education. *Int. J. Adolesc. Youth* 25, 104–112. doi: 10.1080/02673843.2019.1596823

Patrick, H., Ryan, A. M., and Kaplan, A. (2007). Early adolescents' perceptions of the classroom social environment, motivational beliefs, and engagement. *J. Educat. Psychol.* 99, 83–98. doi: 10.1037/0022-0663.99.1.83

Peplak, J., Klemfuss, J. Z., and Yates, T. M. (2021). Parent-Adolescent Conversations About COVID-19 Influence Adolescents' Empathic Concern and Adherence to Health Protective Behaviors. *J. Adolesc. Health* [Preprint]. doi: 10.1016/j.jadohealth.2021.08.013

Pinkerton, J., and Dolan, P. (2007). Family support, social capital, resilience and adolescent coping. *Child Fam. Soc. Work* 12, 219–228. doi: 10.1111/j.1365-2206.2007.00497.x

Pooley, J. A., and Cohen, L. (2010). Resilience: A definition in context. *Austral. Commun. Psychol.* 22, 30–37.

Prime, H., Wade, M., and Browne, D. T. (2020). Risk and resilience in family well-being during the COVID-19 pandemic. *Am. Psychol.* 75, 631–643. doi: 10.1037/amp0000660

Procidano, M. E., and Heller, K. (1983). Measures of perceived social support from friends and from family: Three validation studies. *Am. J. Commun. Psychol.* 11, 1–24. doi: 10.1007/BF00898416

Qi, M., Zhou, S.-J., Guo, Z.-C., Zhang, L.-G., Min, H.-J., Li, X.-M., et al. (2020). The Effect of Social Support on Mental Health in Chinese Adolescents During the Outbreak of COVID-19. *J. Adolesc. Health* 67, 514–518. doi: 10.1016/j.jadohealth.2020.07.001

Ravens-Sieberer, U., Erhart, M., Rajmil, L., Herdman, M., Auquier, P., Bruil, J., et al. (2010). Reliability, construct and criterion validity of the KIDSCREEN-10 score: A short measure for children and adolescents' well-being and health-related quality of life. *Qual. Life Res.* 19, 1487–1500. doi: 10.1007/s11136-010-9706-5

Ravens-Sieberer, U., Kaman, A., Erhart, M., Devine, J., Schlack, R., and Otto, C. (2021). Impact of the COVID-19 pandemic on quality of life and mental health in children and adolescents in Germany. *Eur. Child Adolesc. Psychiatry* 2021, 1–11. doi: 10.1007/s00787-021-01726-5

Reschly, A. L., Huebner, E. S., Appleton, J. J., and Antaramian, S. (2008). Engagement as flourishing: The contribution of positive emotions and coping to adolescents' engagement at school and with learning. *Psychol. Schools* 45, 419–431. doi: 10.1002/pits.20306

Rickwood, D., Telford, N., O'Sullivan, S., Crisp, D., and Magyar, R. (2016). *National tertiary student wellbeing survey 2016*. London: National Union of Students.

Rose, A. J. (2002). Co–rumination in the friendships of girls and boys. *Child Dev.* 73, 1830–1843. doi: 10.1111/1467-8624.00509

Rubin, K. H., Bukowski, W. M., and Parker, J. G. (2006). "Peer Interactions, Relationships, and Groups," in *Handbook of child psychology: Social, emotional, and personality development*, eds N. Eisenberg, W. Damon, and R. M. Lerner (Hoboken, NJ: John Wiley & Sons, Inc), 571–645.

Rumas, R., Shamblaw, A. L., Jagtap, S., and Best, M. W. (2021). Predictors and consequences of loneliness during the COVID-19 pandemic. *Psychiatry Res.* 300:113934. doi: 10.1016/j.psychres.2021.113934

Ryzin, M. J., Gravely, A. A., and Roseth, C. J. (2009). Autonomy, belongingness, and engagement in school as contributors to adolescent psychological well-being. *J. Youth Adolesc.* 38, 1–12. doi: 10.1007/s10964-007-9257-4

Salmela-Aro, K., Kiuru, N., Leskinen, E., and Nurmi, J.-E. (2009). School Burnout Inventory (SBI): Reliability and validity. *Eur. J. Psychol. Assess.* 25, 48–57. doi: 10.1027/1015-5759.25.1.48

Satow, L. (2012). *Stress- und Coping-Inventar (SCI): Vollständige Test- und Skalendokumentation*. Markdorf: Dr. Satow.

Satow, L., and Mittag, W. (1999). "Selbstwirksamkeitserwartung im Umgang mit sozialen Anforderungen (WIRKSOZ)," in *Skalen zur Erfassung von Lehrer- und Schülermerkmalen: Dokumentation der psychometrischen Verfahren im Rahmen der Wissenschaftlichen Begleitung des Modellversuchs Selbstwirksame Schulen*, eds R. Schwarzer and M. Jerusalem (Berlin: Freie Universität), 17–18.

Schilling, T. A. (2008). An examination of resilience processes in context: The case of Tasha. *Urban Rev.* 40, 296–316. doi: 10.1007/s11256-007-0080-8

Shanahan, L., Steinhoff, A., Bechtiger, L., Murray, A. L., Nivette, A., Hepp, U., et al. (2020). Emotional distress in young adults during the COVID-19 pandemic: Evidence of risk and resilience from a longitudinal cohort study. *Psychol. Med.* 2020, 1–10. doi: 10.1017/S003329172000241X

Shukla, S. Y., Tombari, A. K., Toland, M. D., and Danner, F. W. (2015). Parental Support for Learning and High School Students' Academic Motivation and Persistence in Mathematics. *J. Educ. Dev. Psychol.* 5:v5n144.

Southwick, S. M., Bonanno, G. A., Masten, A. S., Panter-Brick, C., and Yehuda, R. (2014). Resilience definitions, theory, and challenges: interdisciplinary perspectives. *Eur. J. Psychotraumatol.* 5:25338. doi: 10.3402/ejpt.v5.25338

Stefaniak, A. R., Blaxton, J. M., and Bergeman, C. S. (2021). Age Differences in Types and Perceptions of Daily Stress. *Int. J. Aging Hum. Dev.* doi: 10.1177/00914150211001588 [Prepeint].

Suldo, S. M., Friedrich, A. A., White, T., Farmer, J., Minch, D., and Michalowski, J. (2009). Teacher Support and Adolescents' Subjective Well-Being: A Mixed-Methods Investigation. *School Psychol. Rev.* 38:20. doi: 10.1080/02796015.2009.12087850

Szkody, E., Stearns, M., Stanhope, L., and McKinney, C. (2020). Stress-Buffering Role of Social Support during COVID-19. *Fam. Process Instit.* 2020:12618. doi: 10.1111/famp.12618

Traylor, A., Williams, J., Kenney, J., and Hopson, L. (2016). Relationships between Adolescent Well-Being and Friend Support and Behavior. *Children Schools* 38, 179–186. doi: 10.1093/cs/cdw021

Valiente, C., Vázquez, C., Contreras, A., Peinado, V., and Trucharte, A. (2021). A symptom-based definition of resilience in times of pandemics: patterns of psychological responses over time and their predictors. *Eur. J. Psychotraumatol.* 12:1871555. doi: 10.1080/20008198.2020.1871555

van Loon, A. W., Creemers, H. E., Vogelaar, S., Miers, A. C., Saab, N., Westenberg, P. M., et al. (2021). Prepandemic Risk Factors of COVID-19-Related Concerns in Adolescents During the COVID-19 Pandemic. *J. Res. Adolesc.* 31, 531–545. doi: 10.1111/jora.12651

Vieno, A., Santinello, M., Pastore, M., and Perkins, D. D. (2007). Social support, sense of community in school, and self-efficacy as resources during early adolescence: An integrative model. *Am. J. Commun. Psychol.* 39, 177–190. doi: 10.1007/s10464-007-9095-2

Wang, G., Zhang, Y., Zhao, J., Zhang, J., and Jiang, F. (2020). Mitigate the effects of home confinement on children during the COVID-19 outbreak. *Lancet* 395, 945–947. doi: 10.1016/S0140-6736(20)30547-X

Wang, M.-T., and Holcombe, R. (2010). Adolescents' Perceptions of School Environment, Engagement, and Academic Achievement in Middle School. *Am. Educat. Res. J.* 47, 633–662. doi: 10.3102/0002831209361209

Wang, M.-T., Dishion, T. J., Stormshak, E. A., and Willett, J. B. (2011). Trajectories of family management practices and early adolescent behavior. *Dev. Psychol.* 47, 1324–1341. doi: 10.1037/a0024026

Wang, Y., Ariyo, T., Liu, H., and Ma, C. (2021). Does psychosocial support buffer the effect of COVID-19 related stressors on mental health among Chinese during quarantine? *Curr. Psychol.* 2021, 1–11.

Wentzel, K. R., Weinberger, D., Ford, M. E., and Feldman, S. S. (1990). Academic achievement in preadolescence: The role of motivational, affective, and self-regulatory processes. *J. Appl. Dev. Psychol.* 11, 179–193. doi: 10.1016/0193-3973(90)90004-4

Wilburn, V. R., and Smith, D. E. (2009). Relationships Among Selected Demographic Variables and Adolescent Psychosocial Well-Being. *Fam. Consumer Sci. Res. J.* 38, 63–75. doi: 10.1111/j.1552-3934.2009.00006.x

Williams, L., and Anthony, E. K. (2015). A model of positive family and peer relationships on adolescent functioning. *J. Child Fam. Stud.* 24, 658–667. doi: 10.1007/s10826-013-9876-1

Wong, C. Y., and Tang, C. S. K. (2005). Practice of habitual and volitional health behaviors to prevent severe acute respiratory syndrome among Chinese adolescents in Hong Kong. *J. Adolesc. Health* 36, 193–200. doi: 10.1016/j.jadohealth.2004.02.024

Wu, X., Tao, S., Zhang, Y., Li, S., Ma, L., Yu, Y., et al. (2021). Geographic distribution of mental health problems among Chinese college students during the COVID-19 pandemic: nationwide, web-based survey study. *J. Med. Internet Res.* 23:e23126. doi: 10.2196/23126

Xiang, Z., Tan, S., Kang, Q., Zhang, B., and Zhu, L. (2019). Longitudinal effects of examination stress on psychological well-being and a possible mediating role of self-esteem in Chinese high school students. *J. Happ. Stud.* 20, 283–305. doi: 10.1007/s10902-017-9948-9

Ye, Y., Wang, C., Zhu, Q., He, M., Havawala, M., Bai, X., et al. (2021). Parenting and Teacher–Student Relationship as Protective Factors for Chinese Adolescent Adjustment During COVID-19. *School Psychol. Rev.* 2021, 1–19. doi: 10.1080/2372966X.2021.1897478

Zhang, W., Liu, H., Jiang, X., Wu, D., and Tian, Y. (2014). A longitudinal study of posttraumatic stress disorder symptoms and its relationship with coping skill and locus of control in adolescents after an earthquake in China. *PLoS One* 9:e88263. doi: 10.1371/journal.pone.0088263

Zhou, S. J., Zhang, L. G., Wang, L. L., Guo, Z. C., Wang, J. Q., Chen, J. C., et al. (2020). Prevalence and socio-demographic correlates of psychological health problems in Chinese adolescents during the outbreak of COVID-19. *Eur. Child Adolesc. Psychiatry* 29, 749–758. doi: 10.1007/s00787-020-01541-4

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 25 January 2022
doi: 10.3389/fpsyg.2021.702323

The Role of Relatedness in the Motivation and Vitality of University Students in Online Classes During Social Distancing

Vanda Capon-Sieber[1], Carmen Köhler[2], Ayşenur Alp Christ[1], Jana Helbling[1] and Anna-Katharina Praetorius[1]*

[1] Faculty of Arts and Social Sciences, Institute of Education, University of Zurich, Zurich, Switzerland, [2] Leibniz Institute for Research and Information in Education (DIPF), Frankfurt, Germany

As part of the social distancing measures for preventing the spread of COVID-19, many university courses were moved online. There is an assumption that online teaching limits opportunities for fostering interpersonal relationships and students' satisfaction of the basic need for relatedness – reflected by experiencing meaningful interpersonal connections and belonging – which are considered important prerequisites for student motivation and vitality. In educational settings, an important factor affecting students' relatedness satisfaction is the teachers' behavior. Although research suggests that relatedness satisfaction may be impaired in online education settings, to date no study has assessed how university lecturers' relatedness support might be associated with student relatedness satisfaction and therefore, student motivation and vitality. This study tested this mediating relationship using data collected during the early days of the COVID-19 pandemic. The study also investigated whether the relations were moderated by a high affiliation motive which reflects a dispositional wish for positive and warm relationships. The possible importance of the communication channel selected by the lecturers (video chat yes/no) and the format of a class (lecture/seminar) were also investigated. In a sample of $N = 337$ students, we tested our hypotheses using structural equation model (SEM). Results confirmed mediation, but not moderation. The use of video chat (video call) seems to facilitate the provision of relatedness support but our data did not show that the format of a class was associated with relatedness. Our findings indicate that both teaching behavior and the technical format used to deliver lectures play important roles in student experiences with online classes. The results are discussed in light of other research conducted during the pandemic.

Keywords: relatedness need satisfaction, relatedness support, affiliation motive, online teaching, COVID-19, motivation, communication channel, vitality

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Jesús-Nicasio García-Sánchez, Universidad de León, Spain
Sarah Jelbert, University of Bristol, United Kingdom

****Correspondence:***
Vanda Capon-Sieber
vanda.sieber@ife.uzh.ch

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *29 April 2021*
Accepted: *15 December 2021*
Published: *25 January 2022*

Citation:
Capon-Sieber V, Köhler C, Alp Christ A, Helbling J and Praetorius A-K (2022) The Role of Relatedness in the Motivation and Vitality of University Students in Online Classes During Social Distancing. Front. Psychol. 12:702323. doi: 10.3389/fpsyg.2021.702323

INTRODUCTION

The COVID-19 pandemic led to the adoption of social distancing measures in many countries and educational institutions were faced with the challenge of teaching their students remotely. In higher education, this resulted in most traditional in-person lessons moving exclusively online, raising questions about how student motivation could best be fostered in that environment. Adding to

the difficulties of motivating students in online interactions were the reduced social interactions and increased feelings of social isolation triggered by the pandemic, affecting general well-being negatively (Banerjee and Rai, 2020; Elmer et al., 2020). It is therefore important to investigate the extent to which online classes foster relatedness, a key aspect of teaching quality that has been shown to affect both motivation and vitality (e.g., Standage et al., 2005; Klieme et al., 2009; Taylor and Lonsdale, 2010; Kunter and Trautwein, 2013; Praetorius et al., 2018). Despite the emphasis on the importance of relatedness need support and satisfaction in the educational psychology literature, before the pandemic there were few studies investigating its role in online classes at university level. Examining the extent to which the need for relatedness is supported and satisfied in online education is also valuable beyond the context of the pandemic because it is often argued that despite technical advancements such as video conferencing, online lessons cannot compensate for the complex nature of face-to-face interactions (e.g., Manwaring et al., 2017). This study also looks at the impact of technical facilities (communication channels) and organizational factors (type of class) to better understand students' experience of relatedness in online classes. Following calls in the discipline to consider individual student characteristics when examining teaching quality (see the opportunity-use model, Helmke, 2017), this study also examines whether differences in the need for relatedness between individuals affect student outcomes in this specific situation.

In the following sections, we first describe the role of relatedness as an important aspect related to students' intrinsic motivation and their vitality experienced during class. Here vitality is defined as a positive feeling of being alive and energetic, an important aspect of eudaimonic well-being (Ryan and Frederick, 1997; Nix et al., 1999; Niemiec, 2014). Eudaimonic well-being refers to the realization of one's inherent potential as a human being and is considered a positive subjective state that is the result of striving for self-actualization (Waterman, 2008). We then illustrate why it is important to focus on individual differences in the need for relatedness when trying to understand the effects of relatedness on student outcomes. Finally, we review studies focusing on the role of relatedness and social interaction in online teaching, looking at technical (use of communication channel) and organizational (lecture vs. seminar) preconditions.

THEORETICAL BACKGROUND

The Role of Student Relatedness

Social interactions with teachers and peers are seen as important prerequisites for learning in education research (Vygotsky, 1978). Self-determination theory is an important framework that systematically addresses the role of how these social interactions affect students (SDT; Deci and Ryan, 1985; Ryan and Deci, 2000, 2017). SDT argues that people benefit from the satisfaction of three innate basic needs, which are presumed to be essential for the optimal functioning of humans and a precondition for health, motivation, and vitality. Those basic psychological needs comprise the need for competence, the need for autonomy, and the need for relatedness. The need for *competence* is defined as the desire for effectiveness and mastery through the interaction with one's environment, for example, while mastering challenging tasks (Ryan and Deci, 2002). The need for *autonomy* is defined as the need to experience volition, choice, and personal freedom (Vansteenkiste et al., 2010). The third need, the need for *relatedness*, refers to building a sense of community with others that comes with the experience of close and warm relationships characterized by mutual care and concern (Baumeister and Leary, 1995; Deci and Ryan, 2002). The three basic needs are assumed to be innate, and therefore universal regardless of one's cultural context or gender (Vansteenkiste et al., 2010).

Self-determination theory highlights social environments as facilitators for the satisfaction of the basic needs. In the educational context, teacher behaviors supporting students' basic needs were often associated with enhanced student motivation, vitality, and performance (e.g., Black and Deci, 2000; Niemiec and Ryan, 2009; Taylor and Lonsdale, 2010; Mouratidis et al., 2013; Stroet et al., 2013; Vergara-Torres et al., 2020). Prior to the pandemic, the examination of the interplay between need support, basic need satisfaction, motivation, and vitality among university students in online learning environments was not, however, a popular subject for investigation (for exceptions see for example Chen and Jang, 2010; Hsu et al., 2019; Wang et al., 2019). In the studies that were conducted, teacher support was usually subsumed in the term "autonomy supportive climate," often assessed using the learning climate questionnaire (Williams and Deci, 1996) which considers behaviors such as promoting the volition of one's counterpart by answering questions, and providing choices and options (Williams et al., 1996; Mageau and Vallerand, 2003; Reeve and Jang, 2006; Deci and Ryan, 2008; Vansteenkiste et al., 2010). Besides the emphasis on behaviors fostering autonomy, the construct "autonomy supportive climate" also involves teacher behaviors that support the experience of relatedness in students, such as behaving respectfully toward students. Given the importance of social interaction and the feeling of connectedness for learning (see also Vygotsky, 1978), researchers have become increasingly interested in teacher behaviors that specifically focus on supporting the need for relatedness in education and started exploring it as a separated construct from autonomy support (e.g., Furrer and Skinner, 2003; Standage et al., 2005; Sparks et al., 2015). For example, in a recent study, Sparks et al. (2016) found that physical education teachers' relatedness supportive behavior affected students' intrinsic motivation, and this relation was mediated by the satisfaction of students' need for relatedness. Moreover, the relation between relatedness support and relatedness need satisfaction was shown to be stronger than the relation between an autonomy supportive climate as a more general construct and relatedness satisfaction, justifying the isolated examination of relatedness support.

There are studies investigating the relation between relatedness supportive teacher behaviors, satisfaction of the basic need for relatedness, and student outcomes (Standage et al., 2005; Sparks et al., 2015, 2016), but there is no empirical research on this relationship at university level. This constitutes a significant gap in the literature, as the findings of several studies

point to the particular importance of a sense of community and relatedness for the outcomes of university students (e.g., Sheldon and Bettencourt, 2002; Beachboard et al., 2011; Walton and Cohen, 2011; Zainuddin and Perera, 2017; Marksteiner et al., 2019). To summarize, student relatedness satisfaction can be expected to act as a mediator between relatedness support and student motivation and vitality. Although the rationale of SDT would suggest that this relationship is universal and thus equally valid for everyone, research findings indicate that individual differences may play an important role in determining whether someone benefits from the satisfaction of their basic psychological needs (e.g., Schüler et al., 2010). This issue is further elaborated in the next section.

The Matching Hypothesis – Individual Differences in Relatedness Satisfaction

Recent research indicates that people differ in how much they benefit from the satisfaction of their basic needs. In their work on the matching hypothesis, Schüler et al. (2010), Schüler et al. (2014), Sheldon and Schüler (2011), Schüler and Brandstätter (2013) and Sieber et al. (2016a,b) propose that individual differences in motives (McClelland, 1985) have an impact on how strongly people benefit from basic need satisfaction and basic need support with respect to their motivation and well-being.

To date, researchers have predominantly focused on three motives: the achievement motive (i.e., recurrent concern in surpassing one's own standards of excellence; McClelland et al., 1953), the affiliation motive (i.e., preference to restore, establish, or maintain close and warm relationships with others, Atkinson et al., 1954; Gable, 2006), and the power motive (i.e., stable concern for influencing and controlling other people; e.g., Winter, 1973; Schultheiss et al., 2005). They further distinguish between implicit and explicit motives, with two independent motivational systems guiding human behavior. Implicit motives "are motivational dispositions [. . .] that operate outside of a person's conscious awareness" (Schultheiss, 2008, p. 603), Implicit motives develop in the early years and are rarely influenced by social norms and demands (McClelland, 1985; Koestner et al., 1991). They are expressed in long term behaviors and strongly affect non-declarative measures such as task-performance or physiological response (e.g., Schultheiss, 2008; Wegner et al., 2014). By contrast, explicit motives, "self-attributed motives" (McClelland et al., 1989), have a cognitive base and reflect subjective goals, behavioral intentions, and desires that are part of a person's self-concept (Weinberger and McClelland, 1990). Explicit motives are heavily influenced by the social environment and its expectations. They are associated with controlled behavior and conscious decisions, attitudes, or goals (McClelland et al., 1989; Schultheiss, 2008). Since explicit motives are conscious and reflect an individual's self-image, they can be assessed using self-reports.

Often, research based on the matching hypothesis is concerned with implicit motives rather than explicit ones. Schüler and colleagues found that the motives function as moderators of need satisfaction effects. For example, people with a high implicit achievement motive benefit more from the satisfaction of the need for competence in terms of flow and well-being, for example, in sports, at the workplace, and in learning environments (Schüler et al., 2010, 2013; Schüler and Brandstätter, 2013). Similar results have been found for people with a high implicit affiliation motive in the sport context: people with a high implicit affiliation motive benefited more from the satisfaction of the basic need for relatedness (Schüler and Brandstätter, 2013).

There is also plenty of evidence supporting the importance of assessing explicit motives when exploring the moderating effects on outcome variables. In an early research project on achievement Harackiewicz et al. (1985) showed that participants' explicit achievement motive, assessed using self-reporting, moderated the effect between competence need satisfaction and intrinsic interest. More so, Wegner et al. (2014) showed that individuals with a high explicit affiliation motive had a stronger need for affectionate relationships, displayed greater sociability and willingness to cooperate with others, and had more positive attitudes and greater mindfulness toward their teammates than individuals with a less pronounced explicit affiliation motive. A recent study conducted by Schüler and Wolff (2020) further found that participants with a high explicit achievement motive scored lower when a situation did not offer achievement incentives than when a situation did provide such incentives.

These studies show the effectiveness of choosing explicit motives instead of implicit motives in the assessment of motive dispositions and highlight the role of social incentives for the activation of explicit motives. We assumed that the physical isolation during the COVID-19 pandemic means that people are conscious of the social isolation inherent in the situation. Since explicit motives are conscious, we hypothesize that the explicit motives of participants, reflected in respondent behaviors and declarative measures, will influence whether students benefit from the support and satisfaction of their basic need for relatedness. This study did not test the implicit affiliation motive because of the arguments presented above and due to logistical constraints.

Relatedness in Online Learning Environments

Relatedness and peer interaction play a crucial role in online environments. Thus, it is not surprising that some recent studies highlighted their importance during the COVID-19 pandemic for life satisfaction in general (Teuber et al., 2021), well-being (Yang et al., 2021), motivation (Besser et al., 2020; Camacho et al., 2021), self-regulation (Zhou et al., 2021), and student engagement (Chiu, 2021). However, none of those studies has specifically tested the mediating role of relatedness satisfaction between relatedness support and intrinsic motivation and vitality during online classes. Before the outbreak of COVID-19, most studies on relatedness and peer interaction in online environments focused on a combination of online and on-site teaching (Kramer and Kusurkar, 2017; Manwaring et al., 2017; Wang et al., 2019). In a study of undergraduate and graduate-level online courses, the assignment of a mentor was associated with a greater sense of

relatedness during the semester, which in turn had a positive effect on final course grades (Baranik et al., 2017). Research also shows that students' relatedness experience was significantly lower during online lectures then when taught in person (Butz and Stupnisky, 2016). These results suggest that it is important to examine ways in which technology can facilitate or impede the provision of relatedness.

Research into online communication has examined the role of different types of media used on relational processes in the classroom. Using a variety of media formats not only encourages student–student and teacher–student communication, but also promotes relational processes since the use of media facilitates the transfer and the reception of non-verbal social cues (e.g., facial expressions, gestures, intonation, external features), which are essential for communication. Not using media in the online classroom impedes qualitatively rich communication and increases the time spent clarifying misunderstandings, which are more common when communication lacks non-verbal forms of expression (Short et al., 1976; Baltes et al., 2002). In their social presence theory, Short et al. (1976) define social presence as the degree to which an individual is perceived as "real" in virtual environments, arguing that communication media differ in their degree of social presence due to the varying ability of communication mediums to transmit verbal and visual cues. Conceptualized as the quality of a communication medium, social presence is thought to determine how individuals interact and communicate with one another. The authors posit that people perceive different communication media as having different degrees of social presence, with video conferencing having a higher degree of social presence than, say, audio tools. More importantly, people associate a communication medium with a higher social presence with warmth, closeness, and more personal social connections than a medium lower in social presence, showing that media with a high social presence are more beneficial for relatedness development as they are more personal. Within the educational context, this has led to the assumption that when interaction is restricted, such as by an asynchronous online learning environment, and students do not have the opportunities to create in-depth connections with other course participants, academic performance can be hampered (Moore, 1991; Ahern et al., 1992; Grabinger, 1996; Dowling et al., 2003; Nieuwoudt, 2020; Xi and Gao, 2020).

Other research suggests that the issue is more complex (Roseth et al., 2011). It may be that a speaker adjusts his or her language, intonation, and volume to compensate for the absence of non-verbal social cues (Reicher et al., 1995; Walther, 1996), such as by using emoticons in text-based forms of communication (e.g., email, chats) to transfer affective and interpersonal information (Walther et al., 2005). Within the educational context, Clark (1983) argues that school performance is not directly linked to the richness of the media environment. He proposes that the various types of media merely constitute the medium by which content can be conveyed, but that they do not influence student performance (Clark, 1983; Bernard et al., 2014). This is also in line with theories on the so-called surface and deep structures of learning in online environments, where it is hypothesized that simply looking at surface structures (such as methods used or communication channels) does not provide enough information about processes triggered in the online classroom; that aspects of teaching quality below the surface (i.e., deep structures of learning such as the relatedness support of a lecturer) must also be considered (Voss and Wittwer, 2020).

Summing up, on the basis of media richness theory (Daft and Lengel, 1986) and social presence theory (Short et al., 1976), one could therefore assume that video chat is superior to other communication channels for the provision of relatedness. In line with recent research, one could also suggest that relatedness satisfaction is facilitated by a lecturer using video chat.

Another surface level feature, type of a class (seminar vs. lecture), might also be associated with the provision of relatedness. Based on previous research on the role of different types of a class, it can be assumed that seminars have a positive impact on the relatedness support of lecturers. In seminars, students are more often given the opportunity to contribute to the lesson (Bär et al., 2004; Young et al., 2009), an important aspect of relatedness supportive teaching (Standage et al., 2005). By contrast, lectures are usually more structured and teacher centered. A lecture is also generally directed toward a large number of students and thus naturally more impersonal, allowing for fewer student–student and teacher–student interactions (Garside, 1996; McKeachie, 2002; Black, 2005).

The Study

This study examines the relation between perceived relatedness support and relatedness satisfaction and student outcomes in the early stage of the COVID-19 pandemic. The expectation is that students who perceive their lecturers as relatedness supportive during online classes experience more relatedness satisfaction and more intrinsic motivation (Hypothesis 1a) and vitality during the lessons in this specific class (Hypothesis 1b). In a second step, the role of individual differences in this relation is examined. Following the tenets of the matching hypothesis, we expect students with a high affiliation motive to benefit more strongly from relatedness satisfaction in terms of motivation (Hypothesis 2a) and vitality (Hypothesis 2b) during online classes.

This study also examines the possible impact of the different teaching conditions adopted by lecturers in response to the pandemic, such as communicating with and without video chat and any differences there may be between lectures and seminars. We hypothesize that the positive relations between perceived relatedness support and relatedness satisfaction are moderated by the inherent interactive potential of the communication channels used (Hypothesis 3). We also expect that the type of a class could influence the degree to which relatedness support is possible, whereas seminars are expected to provide more opportunities for providing relatedness support compared to lectures (Hypothesis 4).

Summing up the present research aims to test the following hypotheses:

> H1: Students who perceive their lecturers to be relatedness supportive during online classes experience more relatedness satisfaction which in turn enhances their motivation (H1a) and vitality (H1b).

H2: The affiliation motive moderates the relation between relatedness satisfaction and intrinsic motivation (H2a) and vitality (H2b) (We changed preregistered hypothesis "Students with a high affiliation motive benefit more strongly from relatedness satisfaction in terms of motivation and vitality during online classes" to avoid the causal language).

H3: The use of video chat (video call) moderates the association between perceived relatedness supportive behavior and relatedness need satisfaction (We changed preregistered hypothesis "The use of video chat reinforces the beneficial effect of relatedness supportive behavior on relatedness need satisfaction" to avoid the causal language).

H4: Perceived relatedness support is higher in a seminar compared to a lecture (We changed preregistered hypothesis "Relatedness supportive behavior from a lecturer is facilitated in a seminar compared to a lecture" to avoid the causal language).

Figure 1 shows all the hypotheses that are tested in our study.

MATERIALS AND METHODS

Study Design and Sample

A correlational field study with one measurement time point was conducted online. Three weeks after social life in Switzerland was largely restricted and the government mandated that teaching had to move entirely online to prevent the spread of COVID-19, an email was sent to all lecturers at a Swiss university, using the official university contact list, inviting them to participate in the study and forward a questionnaire to their students. The study is part of a large research project, involving both student and lecturer questionnaires (see https://osf.io/jsa35 for more information and the preregistration of the analyses presented below). In total the students' questionnaire was online for 2 weeks. No reward was offered for participating in the study. Because we could not predict how long COVID-19 measures would continue, we used convenience sampling, which is considered a fast way to recruit participants. The sample size was determined by the number of students who agreed to participate while the study was running. A total of n = 538 students agreed to participate in the research; n = 103 opted out of the questionnaire before reaching the teaching related questions. To detect participants who rushed through the questionnaire, a relative completion speed index (RSI) was used (see Leiner, 2019). The RSI reflects the sample's median web-page completion time divided by the individual completion time. Following the recommendations of Leiner (2019), we used a cut-off of 2.0. This means that individuals who were twice as fast as a typical respondent were excluded (n = 1). Participants who reported that they did not attend their class or studied at another university were also excluded (n = 6). The further reduction of the sample to n = 337 is a result of the nested structure of the data. If lecturers taught multiple classes, they were asked to forward the questionnaire to the students of the first class they taught in a regular week. The students were then instructed to answer the questions while thinking about the online lessons of the last 2 weeks regarding that specific class. By class we mean the specific class taught by one single university lecturer. Thus, the students answered the questions with regard to a specific lecture or seminar and not with regard to an entire module or cluster of courses. Every link a specific lecturer sent out had a randomly generated identifying number. This number could be retrieved in the analyses to cluster the students according to which class they attended. To avoid unreliable model estimates, small clusters with $n < 6$ students had to be excluded from the analyses (see, e.g., Bentler and Chou, 1987; Kelley and Maxwell, 2003), resulting in a total of N = 337 participants (75% females and 23% males; M_{age} = 23.96, SD = 7.44, range: 18–73 years) who were enrolled in n = 30 classes. Note that for the sake of clarity and in order to avoid causal language, we slightly altered the naming of the preregistered hypotheses in the paper. In contrast to the preregistration, we divide H1 into H1a with motivation as the dependent variable and H1b with vitality as the dependent variable. We deleted the preregistered Hypothesis H2a because we aimed to control for life satisfaction before the outbreak of COVID-19. However, both life-satisfaction before and during the pandemic were each assessed using a single, Likert-type item (i.e., an ordinal scale). Variables measured on an ordinal scale can be problematic to include in parametric statistical models such as structural equation model (SEM) (Jamieson, 2004; Lubke and Muthen, 2004). Additionally, we changed H2b into two new hypotheses: H2a for motivation and H2b for vitality.

Instruments

Relatedness support was measured with five items from Standage et al. (2005), a scale which has been found to have good reliability and validity (Standage et al., 2003, 2005; Sparks et al., 2016). Participants answered how supported they felt in terms of relatedness by their lecturers (e.g., "We experience the lecturer as friendly towards us," 1 = do not agree at all, 4 = neutral, 7 = fully agree, α = 0.76, ω = 0.87, M = 5.95, SD = 0.85).

Students' relatedness need satisfaction during the lesson was measured with six items adapted from Van den Broeck et al. (2010) (e.g., "I feel part of a group," 1 = do not agree at all, 4 = neutral, 7 = fully agree, α = 0.77, ω = 0.81, M = 4.67, SD = 1.25).

Vitality was assessed with a German version of the Vitality Scale (Ryan and Frederick, 1997) by Bertrams et al. (2020). This scale has been used often and has been found to be valid and reliable (see for example Sieber et al., 2019; Bertrams et al., 2020). Participants were instructed to respond to the six items describing how they felt during the class (e.g., "I felt energized during the class," 1 = not at all true, 6 = very true, α = 0.91, ω = 0.93, M = 3.82, SD = 1.32).

Student motivation during the class is measured with seven items from the Intrinsic Motivation Inventory (IMI, Ryan, 1982), which is a widely used reliable and valid measure (see for example Cortright et al., 2013; Sieber et al., 2016b) (e.g., "I enjoyed the class," 1 = not at all true, 7 = very true, α = 0.91, ω = 0.93, M = 5.09, SD = 1.17).

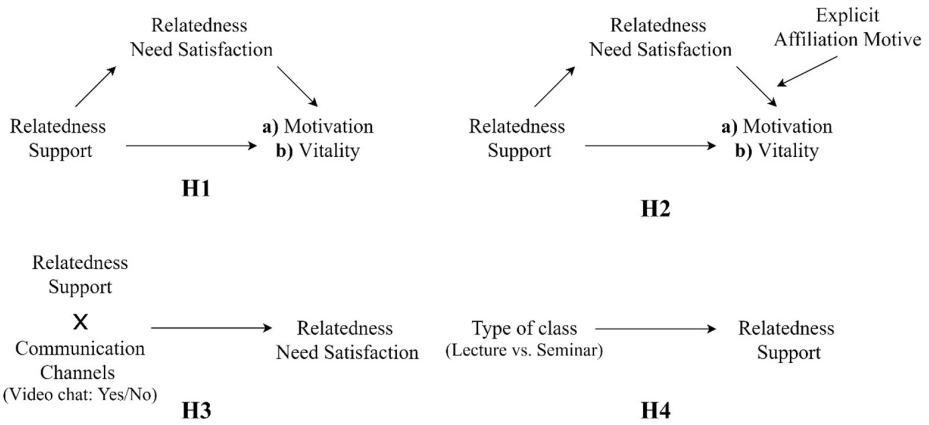

FIGURE 1 | Conceptual models for the tested hypotheses (H1a, H1b, H2a, H2b, H3, and H4). For H1 and H2, motivation and vitality are assessed in separate models.

The affiliation motive was measured with six items taken from Schönbrodt and Gerstenberg (2012), which has been previously found to be a valid and reliable measure (e.g., Kaufman et al., 2019), measuring the hope component of the affiliation motive (e.g., "I try to get to know other people," 1 = strongly disagree, 6 = strongly agree, $\alpha = 0.87$, $\omega = 0.90$, $M = 4.34$, SD = 0.90).

The communication channels were assessed with a single item developed by the authors of the study. University lecturers responded to the question "What methods of communication have you been using since the onset of COVID-19 to interact with your students during the class?" with a multiple response option format: 0 = None, 1 = Provision of material (e.g., PowerPoint slides) on an E-learning platform (e.g., OLAT, Moodle), 2 = Audio recordings, 3 = Video recordings (e.g., podcasts), 4 = Mail, 5 = Text chat and forums (e.g., Microsoft Teams, OLAT, Board.net, Moodle, WhatsApp, Skype), 6 = Audio chat *via* streaming platforms (e.g., Zoom, Microsoft Teams, Skype, Discord), 7 = Video chat *via* streaming platforms (e.g., Zoom, Microsoft Teams, Skype, Discord). In order to investigate Hypothesis 4, we generated a dichotomous variable that only held the information video chat yes vs. no. Of all of students, $n = 180$ attended classes using video chat and $n = 157$ attended classes that were taught using other communication channels (e.g., text chat, provision of materials online, e-mail, etc.). In contrast to the preregistration, we did not analyze different communication channels with respect to their degree of interactivity. Instead, we used a dichotomous variable – video chat/no video chat. This was because most lecturers were using video chat and few were using the other categories. We therefore decided to only contrast video chat to all of the other options.

The format taught was assessed with a single item designed by the authors. It captured whether the class was taught as a lecture, a seminar, an exercise group, a tutorial, or a colloquium. As we wanted to compare lectures with seminars, a dichotomous variable was generated. Of all students $n = 173$ attended lectures and $n = 72$ attended a seminar. The remaining 92 students attended other types of classes. This means that the analyses focusing on the role of the type of a class (i.e., Hypothesis 4) are based on a reduced pool of participants ($N = 245$ in 18 clusters).

Data Analyses

Descriptive analyses were conducted using SPSS Version 25. Results of the confirmatory factor analyses (CFA) for each scale are shown in **Table 1**.

We ran a series of SEMs using Mplus software Version 8.4 (Muthén and Muthén, 1998–2017). We used the maximum likelihood estimation with robust standard errors (MLR) and full information maximum likelihood (FIML) to deal with missing data.

Our data have a nested structure with students attending different classes at the university. All of the constructs in the student questionnaire (i.e., relatedness support, relatedness satisfaction, student motivation, vitality, and affiliation motive) were assessed at the individual level. The two surface features, communication channel and class format, were measured at the class level since all students attending the same class experience identical conditions. In Hypotheses 1a, 1b, 2a, and 2b, the unit of interest is the student since they focus on the role of student relatedness and individual differences in relatedness satisfaction. In Hypotheses 3 and 4, which concentrate on surface structures of learning in online environments, the unit of interest is the class level. Therefore, when investigating Hypotheses 1a, 1b, 2a, and 2b, the variables were modeled at the individual level only; the nested structure of the data was taken into account by using the "type = complex" command. For Hypotheses 3 and 4, all variables measured at the student level were modeled simultaneously at the individual and at the class level, but results are reported for the class level only. All the scale indicators in the models are categorical.

The first two models (M1a and M1b) were mediation models. Due to the large number of predictor variables and indicators in our models, we ran the models separately for the two outcomes, intrinsic motivation and vitality. This reduced the number of parameters that had to be estimated, thus avoiding computation

issues. All three variables were modeled as latent factors with multiple indicators, taking measurement error into account. The models for Hypothesis 2 (M2a and M2b) were identical to M1a and M1b, except that they also included the affiliation motive as a moderator between relatedness satisfaction and intrinsic motivation. This means that both the latent interaction between the affiliation motive and relatedness satisfaction as well as the factor affiliation motive were included as predictors. The models for Hypotheses 3 and 4 (M3 and M4) were multilevel models, where the student variables were conceptualized at both levels. Modeling these variables as latent factors led to model non-convergence due to the disproportionate relation of the (large) number of parameters to the (small) number of clusters. We therefore calculated the mean across all items belonging to the same scale for each student and included these manifest variables in the models. In M3, relatedness satisfaction was regressed on perceived relatedness support at both levels. At the between level, the moderating role of the communication channel was examined by including this manifest variable as well as the interaction between perceived relatedness support and the communication channel as predictors. In M4, the relation between of the type of a class and perceived relatedness support was investigated by including the type of a class as a manifest variable at the between level. It is important to note that the standardized output is not available in multilevel models with interactions unless the Bayes estimator is used. Therefore, we used unstandardized coefficients for Hypotheses 3 and 4. In section "Results," we could only report the model fit indices for H4. For the remaining hypotheses, overall model fit calculation was not possible in Mplus (Muthén and Muthén, 1998–2017). The AVE (average variance extracted) for each construct (see **Table 2**) was satisfactory for all scales except relatedness satisfaction. The convergent validity of the construct is still adequate if the AVE is less than 0.5 but composite reliability is higher than 0.6 (Fornell and Larcker, 1981). Since, the AVE was 0.430 and composite reliability was 0.815 for relatedness satisfaction, we consider convergent validity as satisfactory. Moreover, the square root of AVE for each construct was larger than the correlation coefficients among the constructs, indicating sufficient discriminant validity (Fornell and Larcker, 1981; Tsai et al., 2020).

RESULTS

Descriptive Statistics and Bivariate Correlations

Descriptive statistics and bivariate correlations between the within level variables are presented in **Table 2**. Correlations between all of the variables in the table were from small to moderate in size. Perceived relatedness support was significantly and positively correlated with relatedness satisfaction, intrinsic motivation, and vitality. However, it was not significantly correlated with affiliation motive. Relatedness satisfaction was significantly and positively correlated with all of the assessed variables. Affiliation motive was only significantly correlated with relatedness satisfaction. The correlations between the outcome variables (i.e., intrinsic motivation and vitality) were significant and positive.

Main Analyses

Hypotheses 1a and 1b

A SEM model was calculated to test whether students' relatedness satisfaction mediated the relation between perceived relatedness support and their intrinsic motivation (see **Figure 1**). The results showed that perceived relatedness need support was significantly related to relatedness satisfaction in the expected direction ($\beta = 0.234$, SE = 0.066, $p < 0.001$), and that relatedness satisfaction was also significantly associated with intrinsic motivation ($\beta = 0.182$, SE = 0.067, $p = 0.007$). The indirect effect of perceived relatedness support on intrinsic motivation was significant ($\beta = 0.043$, $p = 0.025$). The total effect was $\beta = 0.454$, SE = 0.058, $p < 0.001$, meaning that the indirect effect only made up 9.3% of the total effect. Note that significance testing of indirect effects can be problematic, since indirect effects are not always normally distributed (Hayes, 2018). Applying a bootstrap method can remedy this problem (Eid et al., 2017) but this was not possible for our models, because the large number of parameters resulted in convergence problems.

The mediating role of university students' relatedness satisfaction between perceived relatedness support and students' vitality was examined. The results showed that perceived relatedness support was significantly and positively associated with relatedness satisfaction ($\beta = 0.229$, SE = 0.067, $p = 0.001$) in the expected direction. Relatedness satisfaction also had a significant positive association with students' vitality ($\beta = 0.199$, SE = 0.079, $p = 0.011$) in the expected direction. The analyses revealed a significant indirect effect of perceived relatedness support on vitality, $\beta = 0.046$, $p = 0.015$. The total effect was $\beta = 0.198$, SE = 0.066, $p = 0.003$, meaning that the indirect effect made up 23.1% of the total effect.

Figure 2 shows the results of the mediation model for Hypotheses 1a and 1b with intrinsic motivation and vitality as outcomes.

Hypotheses 2a and 2b

Hypothesis 2 was tested using a moderated mediation analysis. The explicit affiliation motive was expected to moderate the association between perceived relatedness satisfaction and intrinsic motivation (and vitality for H2b, respectively). The analyses revealed that the affiliation motive was not significantly related to intrinsic motivation ($\beta = -0.081$, SE = 0.062, $p = 0.194$), and did not statistically significantly moderate the abovementioned relationship ($\beta = -0.025$, SE = 0.042, $p = 0.554$).

Similarly, the moderating role of university students' affiliation motive in relation to their relatedness satisfaction and vitality was examined in a moderated mediation model. Again, the explicit affiliation motive ($\beta = -0.019$, SE = 0.058, $p = 0.737$) and the interaction between the affiliation motive and need satisfaction ($\beta = -0.020$, SE = 0.047, $p = 0.669$) was not significantly related to vitality.

Figure 3 shows the results of the moderated mediation models for Hypothesis 2 with intrinsic motivation and vitality as outcomes.

TABLE 1 | CFA model fit indices for each scale.

Variable	χ^2	df	*p*	RMSEA	CFI	TLI	SRMR
Relatedness support	16.0	5	0.007	0.081	0.993	0.986	0.018
Relatedness satisfaction	111.5	9	<0.001	0.184	0.928	0.880	0.053
Vitality	18.2	5	0.002	0.089	0.998	0.996	0.013
Intrinsic motivation	116.1	14	<0.001	0.147	0.980	0.970	0.024
Affiliation motive	41.2	9	<0.001	0.103	0.988	0.980	0.022

TABLE 2 | Means, standard deviations, AVE, square root of AVE, and manifest bivariate correlations of the variables included in the analyses (Pairwise).

Variable	AVE	1	2	3	4	5
1. Relatedness support	0.58	(0.76)				
2. Relatedness satisfaction	0.43	0.20**	(0.66)			
3. Vitality	0.73	0.18**	0.26**	(0.85)		
4. Intrinsic motivation	0.66	0.39**	0.24**	0.47**	(0.81)	
5. Affiliation motive	0.61	0.04	0.18**	0.06	−0.01	(0.78)
M		5.95	4.77	3.82	5.09	4.34
SD		0.86	1.24	1.32	1.17	0.90
α		0.76	0.75	0.91	0.91	0.87

***p < 0.01. Note that for some variables the N might be slightly smaller due to missing variables. The numbers in parentheses on the diagonal represent square root of average variance extracted (AVE) of the construct.*

Hypothesis 3

Hypothesis 3 tested whether the use of video chat facilitated perceived relatedness support. The analyses showed that although the interaction effect lacked statistical significance (b = 1.46, SE = 0.773, p = 0.060), the inclusion of the interaction between communication channel and relatedness support increased the explained variance of relatedness satisfaction by 18.9%. The unexplained standardized variance of relatedness satisfaction drops from 0.952 in the model without the interaction to 0.763 when interaction is included in the model. This means that the use of video chat seems to facilitate the provision of relatedness support.

Hypothesis 4

The relation between type of a class (i.e., seminar vs. lecture) and perceived relatedness support was investigated. The results showed that the class type was not related to perceived relatedness support (b = −0.115, SE = 0.175, p = 0.512). The hypothesis that seminars enabled more relatedness support than lectures was not supported by the data. The model fit the data well [$\chi^2(1) = 0.4$, $p < 0.49$; CFI = 1, RMSEA = 0, $SRMR_{within} = 0$, $SRMR_{between} = 0.003$].

DISCUSSION

This study demonstrates that relatedness support provided by lecturers is associated with students' relatedness satisfaction, which in turn is associated with enhanced motivation and vitality in online classes. This relationship was found during times of social isolation when social distancing measures were enforced to prevent the spreading of COVID-19. Feelings of isolation and reduced interaction were among the most significant effects resulting from universities switching to online teaching and learning (Banerjee and Rai, 2020; Elmer et al., 2020). A closer look at our results reveals that the provision of relatedness is especially fruitful when provided *via* video. Interestingly, the extent to which lecturers were perceived to support students' relatedness did not differ between lectures and seminars. Moreover, contrary to our expectations, the affiliation motive was not a statistically significant moderator between need satisfaction and motivation (and vitality, respectively).

The results relating to Hypotheses 1a and 1b confirm that students' perceived relatedness support from their lecturers relates positively to their experience of intrinsic motivation and vitality during classes, and that relatedness need satisfaction mediates this relationship. Our results further substantiate existing research which suggests that basic psychological needs explain motivation and vitality within the school context (e.g., Black and Deci, 2000; Niemiec and Ryan, 2009; Mouratidis et al., 2013; Stroet et al., 2013; Vergara-Torres et al., 2020). While studies which were conducted within the theoretical framework of SDT during the COVID-19 pandemic have examined relatedness along with competence and autonomy as a mediator between an autonomy-supportive climate and student outcomes (see Shah et al., 2021), the relationship between specifically relatedness supportive behaviors and relatedness satisfaction has largely been neglected in this context so far. This is insofar interesting, as studies conducted in Israel (Besser et al., 2020) and China (Yang et al., 2021; Zhou et al., 2021) have shown that the satisfaction of the need for relatedness and related constructs (e.g., sense of belonging) was especially important in this period for university students. Moreover, in an intervention study relatedness support specifically fostered eighth and ninth graders' relatedness satisfaction during the pandemic (Chiu, 2021). This is also in line with studies conducted before the

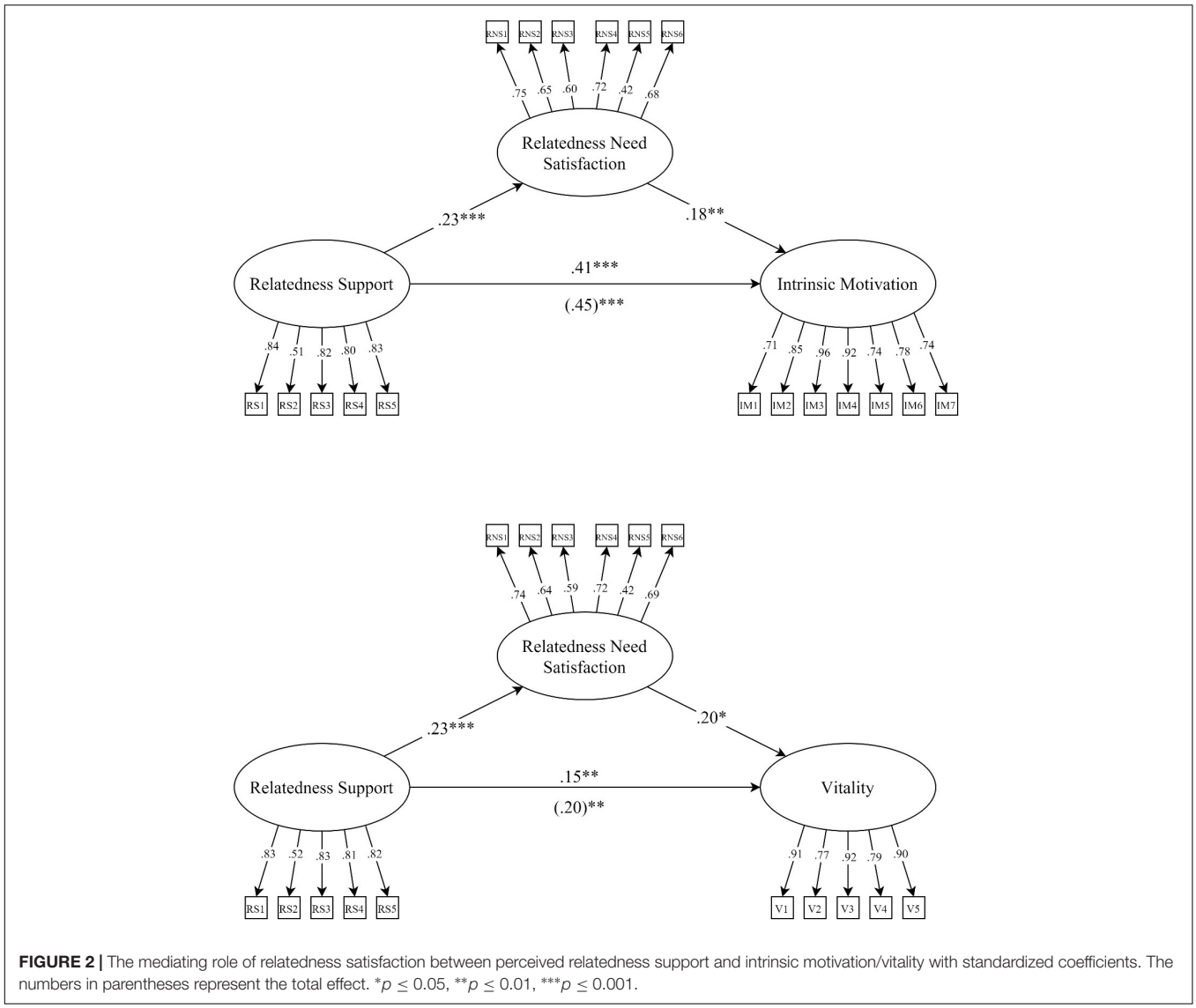

FIGURE 2 | The mediating role of relatedness satisfaction between perceived relatedness support and intrinsic motivation/vitality with standardized coefficients. The numbers in parentheses represent the total effect. $^{*}p \leq 0.05$, $^{**}p \leq 0.01$, $^{***}p \leq 0.001$.

pandemic (e.g., Sparks et al., 2016, 2017). By linking relatedness support and relatedness satisfaction, this study theoretically contributes to understanding the interplay of these factors in the university context in online classes. Most importantly, however, our study shows that even in a setting with obstacles to relatedness, teacher behaviors fostering this specific need are important. By adopting a mediation perspective, this research shows the importance of focusing not only on teacher behaviors, but also on how students respond to what teachers do in terms of relatedness satisfaction. This is consistent with an opportunity and use notion discussed in current theoretical models (see the opportunity-use model, Helmke, 2017, and the MAIN-TEACH model, Charalambous and Praetorius, 2020). Within such models it is postulated that it is central to examine not only the learning opportunities provided within a learning environment (i.e., the support of relatedness), but also the use of these opportunities by the students (i.e., relatedness satisfaction) in order to understand what defines high-quality teaching. Following this reasoning, it can be assumed that relatedness support is only effective if it is able to satisfy the students' need for relatedness.

Interestingly, however, there are also studies that do not confirm the positive effect of relatedness satisfaction on student outcomes. In their studies conducted at different school levels and across different cultural contexts, Holzer et al. (2021a,b,c) found mixed results regarding the relation between relatedness and intrinsic motivation. For one, the relation between relatedness and intrinsic motivation differed across cultures. For example, a positive relation between relatedness and intrinsic motivation was found for university students in Finland but not in Austria (Holzer et al., 2021c). Further, it is important to point out that they defined relatedness as a more general construct, which could explain why their results were discrepant from our study. Our findings thus highlight the importance of the specific context in which need satisfaction is assessed when looking at the relationship with student outcomes. By conducting a study in Switzerland, the present research adds this cultural perspective to

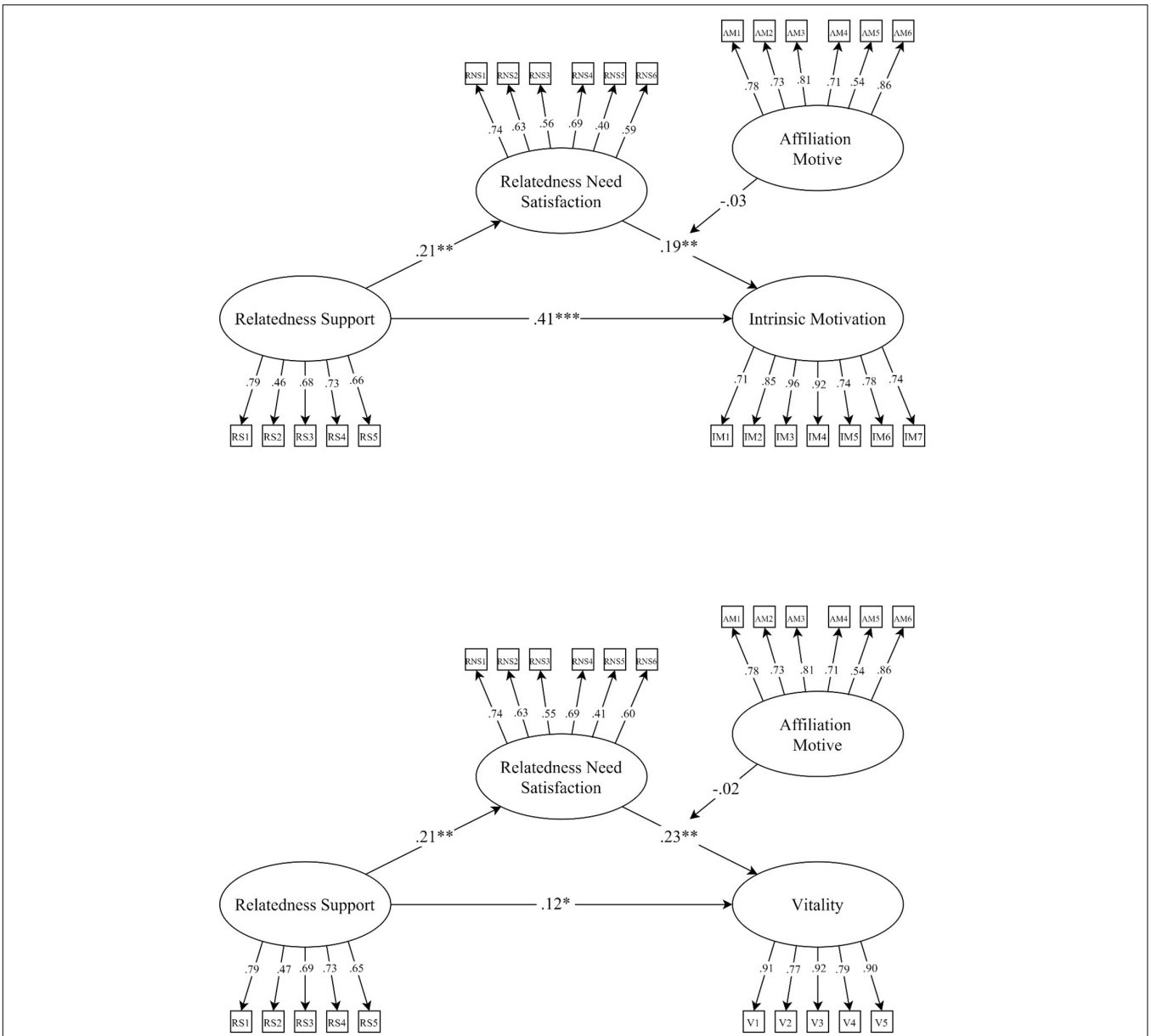

FIGURE 3 | The moderating role of the affiliation motive between relatedness satisfaction and intrinsic motivation and vitality with standardized coefficients. $^{*}p \leq 0.05$, $^{**}p \leq 0.01$, $^{***}p \leq 0.001$.

the literature. For future research it will be interesting to further examine these relations in different settings and countries.

The second hypothesis extends the above findings by considering the affiliation motive as an important moderator of the mediation model described above (Hypothesis 2). However, contrary to our hypotheses, the interaction between relatedness satisfaction and the explicit affiliation motive did not have a statistically significant relation to intrinsic motivation and vitality during online classes (Hypothesis 2). These findings do not fit with the idea of a matching hypothesis (see Schüler et al., 2010). The lack of a statistically significant effect in our study could be due to three reasons: first, there is reason to assume that the emergence of the pandemic as an unfamiliar and life changing event has influenced participants' personal perception and response behavior. Although it is generally believed that individual differences in personality become more apparent during periods of social and environmental change (Caspi and Moffitt, 1993), other studies show the opposite (e.g., Stewart, 1982; Stewart and Healy, 1985). Stewart (1982) found that the effects of individual differences are minimized when participants enter new and unfamiliar periods of life. Indeed, it has been argued that "external life changes [are] a major catalyst for personality change" (Stewart and Healy, 1985, p. 140), resulting in distorted results when assessing personality variables during

those periods. From this perspective it can be argued that the novelty of the situation had not yet affected individuals' differences in affiliation motive, reducing the differences between participants. To investigate this further, it would be interesting to continue to study the affiliation motive in online classes, since it can be assumed that people have become accustomed to the transition by now. To find out whether new situations affect the impact of explicit motives in university classes, one could focus on transitions, such as the transition from high school to university, which is associated with difficulties and challenges (Anderson et al., 2000).

Second, cultural disasters, crises, and epidemics have been shown to evoke people's helpfulness (James, 1911; Fritz, 1961; Anderson, 2020; Bregman, 2020). Global crises such as the COVID-19 pandemic act as incentives to do good as they "require us to act, and act altruistically, bravely, and with initiative in order to survive or save our neighbors, no matter their wealth or how they vote" (Solnit, 2009, p. 7; see also Bregman, 2020; ONS, 2020; Populus, 2020). This social engagement and spirit of goodwill might have caused lecturers and students to be more aware of the need to support one another and share acts of kindness in order to maintain a sense of community and togetherness at a time of social isolation, independent of their individual affiliation motive.

Third, explicit motives, assessed using self-reports, are conscious reflections of what a person desires, and thus can be susceptible to social expectations and demands as well as inaccurate self-theories (McClelland et al., 1989; Schultheiss, 2008). Several researchers found that they were important predictors of behavior (e.g., Wegner et al., 2014; Schüler and Wolff, 2020). However, some researchers question their suitability as moderators between need satisfaction and motivational outcomes. Ryan and Deci (2000) claim that "part of the problem with assessing need strength as a moderator of the effects of satisfying the need also results from confusion between needs and their conscious representations" (Ryan and Deci, 2000, p. 328), criticizing studies using self-reported motives as moderators (e.g., Harackiewicz et al., 1985; Richer et al., 2002). Compared to their explicit counterparts based on cognition, implicit motives are based on affect and can thus better represent deep-rooted desires and preferences (cf. section "The Matching Hypothesis – Individual Differences in Relatedness Satisfaction"). Variables such as motivation and vitality lead to spontaneous, affect based decisions that are rarely influenced by social pressure or expectations and demands established by the environment (McClelland et al., 1989). By contrast, responding to items assessing the explicit affiliation motive requires greater cognitive effort as they address not only the individual but also others, activating social values and pressures. This can cause social desirability effects, distorting participants' perceptions and ultimately their responses. The lack of alignment between intrinsic measures of motivation and vitality and the explicit affiliation motive is therefore considered to be a viable reason for the absence of this effect in this study. Future research could therefore assess implicit and explicit motives in parallel to investigate specific effects on different outcomes. Explicit motives could be assumed to have a stronger influence on aspects such as attitudes toward online instruction (see for example Brewer and Klein, 2000), and implicit motives could be assumed to have a stronger influence on intrinsic motivation and vitality (see for example Sieber et al., 2016b). Further, by recording implicit and explicit motives in parallel, effects of congruence between those motivational systems on satisfaction and motivation in online classes could be explored. Positive effects on well-being and motivation can be expected when these motivational systems are in congruence (see for example Baumann et al., 2005; Schüler et al., 2008).

Although individual differences in the affiliation motive were not found to play an important role in this study, the communication channel chosen to deliver the lesson did affect how successful lecturers were in supporting their students' relatedness. Although not statistically significant, the inclusion of the interaction between communication channel and relatedness support increased the explained variance of relatedness satisfaction by 18.9%, which speaks in favor of our Hypothesis 4. The change in explained variance could be interpreted as a sign that the interaction between the communication channel and relatedness support should be considered when predicting relatedness satisfaction. This result, however, remains inconclusive, and needs further studies with more power, that is, larger sample sizes. Indeed, choosing video chat seemed to enhance the effects of a relatedness supportive teaching style. Our finding contributes to the recent studies showing that hosting interactive real time lessons with video chat enhances positive experiences and motivation in online classes (Krammer et al., 2020; Fabriz et al., 2021) and student relatedness satisfaction (Chiu, 2021). Our finding also accords with media richness theory (Daft and Lengel, 1986) and social presence theory (Short et al., 1976) which posit that the use of media high in social presence in the classroom not only improves communication but also promotes relationship processes as the use of such media facilitates the transmission and reception of non-verbal social cues that are important in the personal exchange (e.g., facial expressions). A very important aspect of the present study is that the interaction of communication channel and lecturer behavior was investigated in a moderation hypothesis. This approach takes into account a highly topical theoretical discussion on surface and deep structures, which states that the isolated view of either surface or deep structures might not be sufficient to explain the effects of teaching on students. Our finding suggest focusing on the interplay of those aspects, an issue that has recently been addressed by several researchers in the field (Decristan et al., 2020; Hess and Lipowsky, 2020).

Finally, our analyses did not confirm that seminars lead to more relatedness supportive lecturer behavior (Hypothesis 4). One reason for this result can be that the class type does not convey much information about what actually happens in a lesson. Like communication channels, class type can be considered a surface aspect of teaching, but the effects probably largely depend on which teaching methods lecturers use. What constitutes a seminar or a lecture can also differ across disciplines as well as between lecturers. While lectures are assumed to be less learner-centered, giving students fewer opportunities for direct involvement (see Bär et al., 2004), some lectures might allow for

student interaction and group assignments (Murphy and Sharma, 2010). Although controlling for these influences would be of great interest, such analyses in this study were not possible due to the small sample size at the between level.

Practical Implications

Our results suggest that even in environments that are suboptimal with respect to relatedness, enhancing relatedness supportive behavior by lecturers is desirable. This could be achieved by encouraging the use of relatedness supportive techniques (Sparks et al., 2016; Gruno et al., 2018), fostering cooperation and teamwork between students (Sparks et al., 2016), creating a climate of mutual acceptance, respect, caring, and support (Standage et al., 2005), hosting interactive real-time lessons where students can contribute to the lesson, or creating small teacher–student support groups (see Chiu, 2021). Our results also indicate that students can be motivated and feel vital when their relatedness satisfaction is supported. Lecturers should be open to discuss how best to satisfy their students' relatedness need during online lessons. Our results on the use of video chat show that the targeted use of appropriate tools can enhance the beneficial effects of relatedness support on relatedness satisfaction. To this end, modern teaching techniques specifically designed for online lessons could be employed, such as discussions in breakout rooms, creating diagrams and mind maps on online whiteboards, conducting online polls, surveys, and quizzes, writing a class blog to encourage content related exchange, and maintaining discussion boards for individual lesson topics (see Krammer et al., 2020; Chiu, 2021; Wut and Xu, 2021).

Limitations

Our study used a convenience sample. Moreover, our study is cross-sectional and correlational in nature as the measurements were made after the changes due to COVID-19 were implemented. Future research on higher education should investigate the hypothesized relations longitudinally. Further studies would ideally compare on-site and online teaching in university settings in experimental designs or interventions (for a recent study examining different digital support strategies for need satisfaction during COVID-19 with eighth and ninth graders, see Chiu, 2021). Experimental designs in applied domains could actively manipulate lecturers' relatedness support by, for example, instructing lecturers to behave in a relatedness-supportive way, encouraging a respectful interaction based on mutual interest and cooperation (see Standage et al., 2005; Sparks et al., 2016; Gruno et al., 2018).

Another limitation of the study is the small cluster size (n = 30). Although, we took the nested structure of the data into account, future research should conduct multilevel SEM using a larger cluster size. The study also used self-reporting instruments for all assessed variables. For future research we recommend including other types of measurement such as observer- or teacher-ratings (for further discussion on that topic see Fauth et al., 2020). Our study focused on the beneficial effects of relatedness support and the subsequent satisfaction of the basic need for relatedness. Yet, some authors emphasize the importance of distinguishing between satisfaction and the thwarting of a basic need (Bartholomew et al., 2011; Costa et al., 2015; Shah et al., 2021). Their research on differentiating between the satisfaction and thwarting of a basic need highlights that the satisfaction of a basic need predicts positive outcomes, while the thwarting of a basic need predicts negative aspects more effectively. In the situation elicited by COVID-19, in which relatedness might be restricted due to the circumstances discussed in our paper, the assessment of need thwarting would be of great interest for future research, especially when predicting negative outcomes, such as burnout or depression (see Bartholomew et al., 2011).

Although our results showed no statistically significant effect of the affiliation motive on relatedness satisfaction, future research should use other measures to assess the affiliation motive. For example, following the reasoning of Schüler and Brandstätter (2013) and Schüler et al. (2017), implicit motives rather than explicit motives might affect how strongly someone benefits from the satisfaction of the basic need for relatedness. Individuals with a high implicit affiliation motive benefit more strongly from the support and the experience of relatedness (Schüler and Brandstätter, 2013; Schüler et al., 2017). In contrast, when confronted with affiliation-related goal instructions, individuals with a low affiliation motive are less motivated, report lower levels of well-being, and show poorer performance (Schüler et al., 2017). Investigating whether relatedness support has equally positive effects for all individuals in online classes is thus of great importance, especially given that there is room for variation in terms of the surface structure.

CONCLUSION

Our study provides evidence that supporting relatedness is beneficial for motivation and vitality during online classes in a university setting when distance learning is mandated and that this relation is mediated by the satisfaction of students' need for relatedness. Moreover, the communication channels used seem to play an important role in how successful lecturers are in supporting students' relatedness, indicating that it is important to look at the interaction of surface and deep structures of instruction when aiming at understanding student outcomes. Therefore, this research supports recent calls to consider the interplay between aspects of surface and deep structures.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

VC-S conceived and designed the study and collected the data with JH. A-KP provided advice on the study design and questionnaire. CK carried out main data analysis and conducted additional analyses for the second and third versions of the manuscript. JH and AAC created the descriptive analyses, tables, and figures. VC-S drafted the first version of the manuscript. AAC and VC-S drafted the second and third versions of the manuscript. All authors were involved in writing the manuscript.

FUNDING

AAC was funded by a Swiss Government Excellence Scholarship (ESKAS No. 2019.0503). Publication fees were covered by the publication funds in the humanities and social sciences from the University Library Zurich.

REFERENCES

Ahern, T., Peck, K., and Laycock, M. (1992). The effects of teacher discourse in computer-mediate discussion. *J. Educ. Comput. Res.* 8, 291–309. doi: 10.2190/hfpw-jyr3-ymbe-0j7d

Anderson, L. W., Jacobs, J., Schramm, S., and Splittgerber, F. (2000). School transitions: beginning of the end or a new beginning? *Int. J. Educ. Res.* 33, 325–339. doi: 10.1016/S0883-0355(00)00020-3

Anderson, R. E. (2020). Community during the pandemic and civil unrest. *Int. J. Wellbeing* 4, 293–298. doi: 10.1007/s42413-020-00070-x

Atkinson, J. W., Heyns, R. W., and Veroff, J. (1954). The effect of experimental arousal of the affiliation motive on thematic apperception. *J. Abnorm. Soc. Psychol.* 49, 405–410. doi: 10.1037/h0053499

Baltes, B. B., Dickson, M. W., Sherman, M. P., Bauer, C. C., and LaGanke, J. S. (2002). Computer-mediated communication and group decision making: a meta-analysis. *Organ. Behav. Hum. Decis. Process.* 87, 156–179. doi: 10.1006/obhd.2001.2961

Banerjee, D., and Rai, M. (2020). Social isolation in COVID-19: the impact of loneliness. *Int. J. Soc. Psychiatry* 66, 525–527. doi: 10.1177/0020764020922269

Bär, H., Rößling, G., and Mühlhäuser, M. (2004). "Improving interaction during lectures: a minimal-distraction approach," in *Proceedings of ED-MEDIA 2004-World Conference on Educational Multimedia, Hypermedia & Telecommunications*, eds L. Cantoni and C. McLoughlin (Charlottesville, VA: Association for the Advancement of Computing in Education (AACE)), 1250–1255.

Baranik, L. E., Wright, N. A., and Reburn, K. L. (2017). Mentoring relationships in online classes. *Internet High. Educ.* 34, 65–71. doi: 10.1016/j.iheduc.2017.05.001

Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., and Thøgersen-Ntoumani, C. (2011). Psychological need thwarting in the sport context: assessing the darker side of athletic experience. *J. Sport Exerc. Psychol.* 33, 75–102. doi: 10.1123/jsep.33.1.75

Baumann, N., Kaschel, R., and Kuhl, J. (2005). Striving for unwanted goals: stress-dependent discrepancies between explicit and implicit achievement motives reduce subjective well Being and increase psychosomatic symptoms. *J. Pers. Soc. Psychol.* 89, 781–799. doi: 10.1037/0022-3514.89.5.781

Baumeister, R. F., and Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychol. Bull.* 117, 497–529. doi: 10.1037/0033-2909.117.3.497

Beachboard, M. R., Beachboard, J. C., Li, W., and Adkison, S. R. (2011). Cohorts and relatedness: self-determination theory as an explanation of how learning communities affect educational outcomes. *Res. High. Educ.* 52, 853–874. doi: 10.1007/s11162-011-9221-8

Bentler, P. M., and Chou, C. H. (1987). Practical issues in structural modeling. *Sociol. Methods Res.* 16, 78–117. doi: 10.1177/0049124187016001004

Bernard, R. M., Borokhovski, E., Schmid, R. F., Tamim, R. M., and Abrami, P. C. (2014). A meta-analysis of blended learning and technology use in higher education: from the general to the applied. *J. Comput. High. Educ.* 26, 87–122. doi: 10.1007/s12528-013-9077-3

Bertrams, A., Dyllick, T. H., Englert, C., and Krispenz, A. (2020). German adaptation of the subjective vitality scales (SVS-G). *Open Psychol.* 2, 57–75. doi: 10.1515/psych-2020-0005

Besser, A., Flett, G. L., and Zeigler-Hill, V. (2020). Adaptability to a sudden transition to online learning during the COVID-19 pandemic: understanding the challenges for students. *Scholarsh. Teach. Learn. Psychol.* doi: 10.1037/stl0000198

Black, A. E., and Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: a self-determination theory perspective. *Sci. Educ.* 84, 740–756. doi: 10.1002/1098-237X(200011)84:6<740::AID-SCE4<3.0.CO;2-3

Black, L. W. (2005). Dialogue in the lecture hall: teacher–student communication and students' perceptions of their learning. *Qual. Res. Rep. Commun.* 6, 31–40. doi: 10.1080/17459430500262125

Bregman, R. (2020). *Humankind: A History of Hope*. Boston, MA: Little, Brown and Company.

Brewer, S. A., and Klein, J. D. (2000). *Effects of Small Group Practice on Achievement and Continuing Motivation of Adult Re-Entry Students*. : Vol. 26. 2000 Annual Proceedings-Denver.

Butz, N. T., and Stupnisky, R. H. (2016). A mixed methods study of graduate students' self-determined motivation in synchronous hybrid learning environments. *Internet High. Educ.* 28, 85–95. doi: 10.1016/j.iheduc.2015.10.003

Camacho, A., Correia, N., Zaccoletti, S., and Daniel, J. R. (2021). Anxiety and social support as predictors of student academic motivation during the COVID-19. *Front. Psychol.* 12:644338. doi: 10.3389/fpsyg.2021.644338

Caspi, A., and Moffitt, T. E. (1993). When do individual differences matter? A paradoxical theory of personality coherence. *Psychol. Inq.* 4, 247–271. doi: 10.1207/s15327965pli0404_1

Charalambous, C. Y., and Praetorius, A.-K. (2020). Creating a forum for researching teaching and its quality more synergistically. *Stud. Educ. Eval.* 67:100894. doi: 10.1016/j.stueduc.2020.100894

Chen, K.-C., and Jang, S.-J. (2010). Motivation in online learning: testing a model of self-determination theory. *Comput. Hum. Behav.* 26, 741–752. doi: 10.1016/j.chb.2010.01.011

Chiu, T. K. F. (2021). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *J. Res. Technol. Educ.* 4, 1–17. doi: 10.1080/15391523.2021.1891998

Clark, R. E. (1983). Reconsidering research on learning from media. *Rev. Educ. Res.* 53, 445–459. doi: 10.3102/00346543053004445

Cortright, R. N., Lujan, H. L., Blumberg, A. J., Cox, J. H., and DiCarlo, S. E. (2013). Higher levels of intrinsic motivation are related to higher levels of class performance for male but not female students. *Adv. Physiol. Educ.* 37, 227–232. doi: 10.1152/advan.00018.2013

Costa, S., Ntoumanis, N., and Bartholomew, K. J. (2015). Predicting the brighter and darker sides of interpersonal relationships: does psychological need thwarting matter? *Motiv. Emot.* 39, 11–24. doi: 10.1007/s11031-014-9427-0

Daft, R. L., and Lengel, R. H. (1986). Organizational information requirements media richness and structural design. *Manag. Sci.* 32, 554–571. doi: 10.1287/mnsc.32.5.554

Deci, E. L., and Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior (Softcover Reprint of the Original 1st ed. 1985). Perspectives in Social Psychology*. New York, NY: Springer Science+Business Media.

Deci, E. L., and Ryan, R. M. (eds) (2002). *Handbook of Self-Determination Research*. Rochester, NY: The University of Rochester Press.

Deci, E. L., and Ryan, R. M. (2008). Facilitating optimal motivation and psychological well-being across life's domains. *Can. Psychol.* 49, 14–23. doi: 10.1037/0708-5591.49.1.14

Decristan, J., Hess, M., Holzberger, D., and Praetorius, A.-K. (2020). Oberflächen- und tiefenmerkmale [Surface and depth features]. *Z. Pädagogik* 66, 102–116. doi: 10.3262/ZPB2001102

Dowling, C., Godfrey, J. M., and Gyles, N. (2003). Do hybrid flexible delivery teaching methods improve accounting students' learning outcomes. *Account. Educ.* 12, 373–391. doi: 10.1080/0963928032000154512

Eid, M., Gollwitzer, M., and Schmitt, M. (2017). *Statistics and Research Methods [Statistik und Forschungsmethoden]*. Weinheim, Germany: Beltz.

Elmer, T., Mepham, K., and Stadtfeld, C. (2020). Students under lockdown: assessing change in students' social networks and mental health during the COVID-19 crisis in Switzerland. *PLoS One* 15:e0236337. doi: 10.1371/journal.pone.0236337

Fabriz, S., Mendzheritskaya, J., and Stehle, S. (2021). Impact of synchronous and asynchronous settings of online teaching and learning in higher education on students' learning experience during COVID-19. *Front. Psychol.* 12:733554. doi: 10.3389/fpsyg.2021.733554

Fauth, B., Göllner, R., Lenske, G., Praetorius, A.-K., and Wagner, W. (2020). Who sees what? Conceptual considerations on the measurement of teaching quality from different perspectives. *Z. Pädagogik* 66, 138–155. doi: 10.3262/ZPB2001138

Fornell, C., and Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* 18, 39–50. doi: 10.1177/002224378101800104

Fritz, C. (1961). *Disasters and Mental Health: Therapeutic Principles Drawn from Disaster Studies*. Newark, DE: University of Delaware Disaster Research Center.

Furrer, C., and Skinner, E. (2003). Sense of relatedness as a factor in children's academic engagement and performance. *J. Educ. Psychol.* 95, 148–162. doi: 10.1037/0022-0663.95.1.148

Gable, S. L. (2006). Approach and avoidance motivation in the social domain. *Pers. Soc. Psychol. Bull.* 32, 378–391. doi: 10.1177/0146167205282153

Garside, C. (1996). Look who's talking: a comparison of lecture and group discussion teaching strategies in developing critical thinking skills. *Commun. Educ.* 45, 212–227. doi: 10.1080/03634529609379050

Grabinger, R. S. (1996). "Rich environments for active learning," in *The Handbook of Research for Educational Communications and Technology*. ed. D. H. Jonassen (New York, NY: Mcmillan), 403–437.

Gruno, J., Gibbons, S. L., Condie, R., and Wilton, D. (2018). Girls in action: fostering relatedness in and beyond physical and health education. *Strategies* 31, 19–25. doi: 10.1080/08924562.2018.1465872

Harackiewicz, J. M., Sansone, C., and Manderlink, G. (1985). Competence, achievement orientation, and intrinsic motivation: a process analysis. *J. Pers. Soc. Psychol.* 48, 493–508. doi: 10.1037/0022-3514.48.2.493

Hayes, A. F. (2018). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach Methodology in the Social Sciences*, 2nd Edn. New York, NY: The Guilford Press.

Helmke, A. (2017). *Unterrichtsqualität und Lehrerprofessionalität: Diagnose, Evaluation und Verbesserung des Unterrichts [Teaching Quality and Teacher Professionalism: Diagnosis, Evaluation, and Improvement of Teaching] (7. Auflage). Schule Weiterentwickeln, Unterricht Verbessern Orientierungsband*. Seelze: Klett/Kallmeyer.

Hess, M., and Lipowsky, F. (2020). Zur (Un-)abhängigkeit von oberflächen- und tiefenmerkmalen im grundschulunterricht [On the (in)dependence of surface and depth features in primary school teaching]. *Z. Pädagogik* 66, 117–131. doi: 10.3262/ZPB2001117

Holzer, J., Korlat, S., Haider, C., Mayerhofer, M., Pelikan, E., Schober, B., et al. (2021a). Adolescent well-being and learning in times of COVID-19: a multi-country study of basic psychological need satisfaction, learning behavior, and the mediating roles of positive emotion and intrinsic motivation. *PLoS One* 16:e0251352. doi: 10.1371/journal.pone.0251352

Holzer, J., Lüftenegger, M., Käser, U., Korlat, S., Pelikan, E., Schultze-Krumbholz, A., et al. (2021b). Students' basic needs and well-being during the COVID-19 pandemic: a two-country study of basic psychological need satisfaction, intrinsic learning motivation, positive emotion and the moderating role of self-regulated learning. *Int. J. Psychol.* 56, 843–852. doi: 10.1002/ijop.12763

Holzer, J., Lüftenegger, M., Korlat, S., Pelikan, E., Salmela-Aro, K., Spiel, C., et al. (2021c). Higher education in times of COVID-19: university students' basic need satisfaction, self-regulated learning, and well-being. *AERA Open* 7, 1–13. doi: 10.1177/23328584211003164

Hsu, H.-C. K., Wang, C. V., and Levesque-Bristol, C. (2019). Reexamining the impact of self-determination theory on learning outcomes in the online learning environment. *Educ. Inf. Technol.* 24, 2159–2174. doi: 10.1007/s10639-019-09863-w

James, W. (1911). *Memories and Studies*. New York, NY: Longmans.

Jamieson, S. (2004). Likert scales: how to (ab)use them. *Med. Educ.* 38, 1212–1218. doi: 10.1111/j.1365-2929.2004.02012.x

Kaufman, S. B., Yaden, D. B., Hyde, E., and Tsukayama, E. (2019). The light vs. dark triad of personality: contrasting two very different profiles of human nature. *Front. Psychol.* 10:467. doi: 10.3389/fpsyg.2019.00467

Kelley, K., and Maxwell, S. E. (2003). Sample size for multiple regression: obtaining regression coefficients that are accurate, not simply significant. *Psychol. Methods* 8, 305–321. doi: 10.1037/1082-989X.8.3.305

Klieme, E., Pauli, C., and Reusser, K. (2009). "The Pythagoras study: investigating effects of teaching and learning in Swiss and German mathematics classrooms," in *The Power of Video Studies in Investigating Teaching and Learning in the Classroom*, eds T. Janík and T. Seidel (Münster: Waxmann), 137–160.

Koestner, R., Weinberger, J., and McClelland, D. C. (1991). Task-intrinsic and social-extrinsic sources of arousal for motives assessed in fantasy and self-report. *J. Pers.* 59, 57–82. doi: 10.1111/j.1467-6494.1991.tb00768.x

Kramer, I. M., and Kusurkar, R. A. (2017). Science-writing in the blogosphere as a tool to promote autonomous motivation in education. *Internet High. Educ.* 35, 48–62. doi: 10.1016/j.iheduc.2017.08.001

Krammer, G., Pflanzl, B., and Matischek-Jauk, M. (2020). Aspekte der online-lehre und deren zusammenhang mit positivem erleben und motivation bei lehramtsstudierenden: mixed-method befunde zu beginn von COVID-19 [Aspects of online teaching and their relationship with positive experience and motivation among student teachers: mixed-method findings at the beginning of COVID-19]. *Z. Bildungsforschung* 10, 337–375. doi: 10.1007/s35834-020-00283-2

Kunter, M., and Trautwein, U. (2013). *Psychologie des Unterrichts [Psychology of Teaching]. StandardWissen Lehramt*, Vol. 3895. Paderborn: Ferdinand Schöningh.

Leiner, D. J. (2019). Too fast, too straight, too weird: non-reactive indicators for meaningless data in internet surveys. *Surv. Res. Methods* 13, 229–248. doi: 10.18148/SRM/2019.V13I3.7403

Lubke, G. H., and Muthen, B. O. (2004). Applying multigroup confirmatory factor models for continuous outcomes to likert scale data complicates meaningful group comparisons. *Struct. Equ. Model.* 11, 514–534. doi: 10.1207/s15328007sem1104_2

Mageau, G. A., and Vallerand, R. J. (2003). The coach-athlete relationship: a motivational model. *J. Sport Sci.* 21, 883–904. doi: 10.1080/0264041031000140374

Manwaring, K. C., Larsen, R., Graham, C. R., Henrie, C. R., and Halverson, L. R. (2017). Investigating student engagement in blended learning settings using experience sampling and structural equation modeling. *Internet High. Educ.* 35, 21–33. doi: 10.1016/j.iheduc.2017.06.002

Marksteiner, T., Janke, S., and Dickhäuser, O. (2019). Effects of a brief psychological intervention on students' sense of belonging and educational outcomes: the role of students' migration and educational background. *J. Sch. Psychol.* 75, 41–57. doi: 10.1016/j.jsp.2019.06.002

McClelland, D. C. (1985). *Human Motivation*. Glenview, IL: Foresman & Co.

McClelland, D. C., Atkinson, J. W., Clark, R. A., and Lowell, E. L. (1953). *Century Psychology Series. The Achievement Motive*. New York, NY: Appleton-Century-Crofts.

McClelland, D. C., Koestner, R., and Weinberger, J. (1989). How do self-attributed and implicit motives differ? *Psychol. Rev.* 96, 690–702. doi: 10.1037/0033-295X.96.4.690

McKeachie, W. J. (2002). McKeachie's Teaching Tips: Strategies, Research, and Theory for College and University Teachers. Boston: Houghton, Mifflin.

Moore, M. G. (1991). "Computer conferencing in the context of theory and practice of distance education," in *Proceedings of the International Conference on Computer Conferencing* (Columbus, OH: Ohio State University), 1–9.

Mouratidis, A., Vansteenkiste, M., Michou, A., and Lens, W. (2013). Perceived structure and achievement goals as predictors of students' self-regulated learning and affect and the mediating role of competence need satisfaction. *Learn. Individ. Differ.* 23, 179–186. doi: 10.1016/j.lindif.2012.09.001

Murphy, R., and Sharma, N. (2010). What don't we know about interactive lectures? *Seminar.net Int. J. Media Technol. Lifelong Learn.* 6, 111–120.

Muthén, L. K., and Muthén, B. O. (1998-2017). *Mplus User's Guide*, 8th Edn. Los Angeles, CA: Muthén & Muthén.

Niemiec, C. P. (2014). "Eudaimonic well-being," in *Encyclopedia of Quality of Life and Well-Being Research*, ed. A. C. Michalos (Dordrecht: Springer). doi: 10.1007/978-94-007-0753-5_929

Niemiec, C. P., and Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom: applying self-determination theory to educational practice. *Theory Res. Educ.* 7, 133–144. doi: 10.1177/1477878509104318

Nieuwoudt, J. E. (2020). Investigating synchronous and asynchronous class attendance as predictors of academic success in online education. *Australas. J. Educ. Technol.* 36, 15–25. doi: 10.14742/ajet.5137

Nix, G. A., Ryan, R. M., Manly, J. B., and Deci, E. L. (1999). Revitalization through self-regulation: the effects of autonomous and controlled motivation on happiness and vitality. *J. Exp. Soc. Psychol.* 35, 266–284. doi: 10.1006/jesp.1999.1382

ONS (2020). *Opinions and Lifestyle Survey*. Available online at: https://www.ons.gov.uk/ (accessed April 21, 2021).

Populus (2020). *Character in Crisis Survey*. Available online at: https://www.jubileecentre.ac.uk/media/news/article/6695/Polling-Shows-British-Public-Still-Value-Compassion-in-Others-but-Place-Less-Value-on-Civic-Virtues (accessed April 21, 2021).

Praetorius, A.-K., Klieme, E., Herbert, B., and Pinger, P. (2018). Generic dimensions of teaching quality: the German framework of three basic dimensions. *ZDM* 50, 407–426. doi: 10.1007/s11858-018-0918-4

Reeve, J., and Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *J. Educ. Psychol.* 98, 209–218. doi: 10.1037/0022-0663.98.1.209

Reicher, S. D., Spears, R., and Postmes, T. (1995). A social identity model of deindividuation phenomena. *Eur. Rev. Soc. Psychol.* 6, 161–198. doi: 10.1080/14792779443000049

Richer, S. F., Blanchard, C., and Vallerand, R. J. (2002). A motivational model of work turnover. *J. Appl. Soc. Psychol.* 32, 2089–2113. doi: 10.1111/j.1559-1816.2002.tb02065.x

Roseth, C. J., Saltarelli, A. J., and Glass, C. R. (2011). Effects of face-to-face and computer-mediated constructive controversy on social interdependence, motivation, and achievement. *J. Educ. Psychol.* 103, 804–820. doi: 10.1037/a0024213

Ryan, R. M. (1982). Control and information in the intrapersonal sphere: an extension of cognitive evaluation theory. *J. Pers. Soc. Psychol.* 43, 450–461. doi: 10.1037/0022-3514.43.3.450

Ryan, R. M., and Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am. Psychol.* 55, 68–78. doi: 10.1037//0003-066X.55.1.68

Ryan, R. M., and Deci, E. L. (2002). "Overview of self-determination theory: an organismic dialectical perspective," in *Handbook of Self-Determination Research*, eds E. L. Deci and R. M. Ryan (Rochester, NY: University of Rochester Press), 3–33. doi: 10.1111/bjhp.12054

Ryan, R. M., and Deci, E. L. (2017). *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness*. New York, NY: Guilford Publications.

Ryan, R. M., and Frederick, C. (1997). On energy, personality, and health: subjective vitality as a dynamic reflection of well-being. *J. Pers.* 65, 529–565. doi: 10.1111/j.1467-6494.1997.tb00326.x

Schönbrodt, F. D., and Gerstenberg, F. X. (2012). An IRT analysis of motive questionnaires: the unified motive scales. *J. Res. Pers.* 46, 725–742. doi: 10.1016/j.jrp.2012.08.010

Schüler, J., and Brandstätter, V. (2013). How basic need satisfaction and dispositional motives interact in predicting flow experience in sport. *J. Appl. Soc. Psychol.* 43, 687–705. doi: 10.1111/j.1559-1816.2013.01045.x

Schüler, J., Brandstätter, V., and Sheldon, K. M. (2013). Do implicit motives and basic psychological needs interact to predict well-being and flow? Testing a universal hypothesis and a matching hypothesis. *Motiv. Emot.* 37, 480–495. doi: 10.1007/s11031-012-9317-2

Schüler, J., Guidon, L., Hofstetter, D., Suter, T., Sieber, V., and Wegner, M. (2017). Affiliation-related goal instructions the secret of sporting success for affiliation motivated individuals. *Int. J. Sport Psychol.* 48, 133–142.

Schüler, J., Job, V., Fröhlich, S. M., and Brandstätter, V. (2008). A high implicit affiliation motive does not always make you happy: a corresponding explicit motive and corresponding behavior are further needed. *Motiv. Emot.* 32, 231–242. doi: 10.1007/s11031-008-9096-y

Schüler, J., Sheldon, K. M., and Fröhlich, S. M. (2010). Implicit need for achievement moderates the relationship between competence need satisfaction and subsequent motivation. *J. Res. Pers.* 44, 1–12. doi: 10.1016/j.jrp.2009.09.002

Schüler, J., Wegner, M., and Knechtle, B. (2014). Implicit motives and basic need satisfaction in extreme endurance sports. *J. Sport Exerc. Psychol.* 36, 293–302. doi: 10.1123/jsep.2013-0191

Schüler, J., and Wolff, W. (2020). What brings out the best and worst of people with a strong explicit achievement motive? The role of (lack of) achievement incentives for performance in an endurance task. *Front. Psychol.* 11:932. doi: 10.3389/fpsyg.2020.00932

Schultheiss, O. C. (2008). "Implicit motives," in *Handbook of Personality: Theory and Research*, 3rd Edn, eds O. P. John, R. W. Robins, and L. A. Pervin (New York, NY: Guilford Press), 603–633.

Schultheiss, O. C., Wirth, M. M., Torges, C. M., Pang, J. S., Villacorta, M. A., and Welsh, K. (2005). Effects of implicit power motivation on men's and women's implicit learning and testosterone changes after social victory or defeat. *J. Pers. Soc. Psychol.* 88, 174–188. doi: 10.1037/0022-3514.88.1.174

Shah, S. S., Shah, A. A., Memon, F., Kemal, A. A., and Soomro, A. (2021). Online learning during the COVID-19 pandemic: applying the self-determination theory in the 'new normal'. *Rev. Psicodidáctica* 26, 168–177. doi: 10.1016/j.psicod.2020.12.004

Sheldon, K. M., and Bettencourt, B. A. (2002). Psychological need-satisfaction and subjective well-being within social groups. *Br. J. Soc. Psychol.* 41(Pt 1), 25–38. doi: 10.1348/014466602165036

Sheldon, K. M., and Schüler, J. (2011). Wanting, having, and needing: integrating motive disposition theory and self-determination theory. *J. Pers. Soc. Psychol.* 101, 1106–1123. doi: 10.1037/a0024952

Short, J., Williams, E., and Christie, B. (1976). *The Social Psychology of Telecommunications*. London: Wiley.

Sieber, V., Flückiger, L., Mata, J., Bernecker, K., and Job, V. (2019). Autonomous goal striving promotes a nonlimited theory about willpower. *Pers. Soc. Psychol. Bull.* 45, 1295–1307. doi: 10.1177/0146167218820921

Sieber, V., Schüler, J., and Wegner, M. (2016a). The effects of autonomy support on salivary alpha-amylase: the role of individual differences. *Psychoneuroendocrinology* 74, 173–178. doi: 10.1016/j.psyneuen.2016.09.003

Sieber, V., Wegner, M., and Schüler, J. (2016b). Autonomie als prädiktor intrinsischer motivation im schulsport: eine person × situation-perspektive [Autonomy as a predictor of intrinsic motivation in school sport]. *Z. Gesundheitspsychol.* 24, 162–168. doi: 10.1026/0943-8149/a000166

Solnit, R. (2009). *A Paradise Built in Hell: The Extraordinary Communities that Arise in Disaster*. London: Penguin.

Sparks, C., Dimmock, J., Lonsdale, C., and Jackson, B. (2016). Modeling indicators and outcomes of students' perceived teacher relatedness support in high school physical education. *Psychol. Sport Exerc.* 26, 71–82. doi: 10.1016/j.psychsport.2016.06.004

Sparks, C., Dimmock, J., Whipp, P., Lonsdale, C., and Jackson, B. (2015). "Getting connected": high school physical education teacher behaviors that facilitate students' relatedness support perceptions. *Sport Exerc. Perform. Psychol.* 4, 219–236. doi: 10.1037/spy0000039

Sparks, C., Lonsdale, C., Dimmock, J., and Jackson, B. (2017). An intervention to improve teachers' interpersonally involving instructional practices in high school physical education: implications for student relatedness support and in-class experiences. *J. Sport Exerc. Psychol.* 39, 120–133. doi: 10.1123/jsep.2016-0198

Standage, M., Duda, J. L., and Ntoumanis, N. (2003). A model of contextual motivation in physical education: using constructs from self-determination and achievement goal theories to predict physical activity intentions. *J. Educ. Psychol.* 95, 97–110. doi: 10.1037/0022-0663.95.1.97

Standage, M., Duda, J. L., and Ntoumanis, N. (2005). A test of self-determination theory in school physical education. *Br. J. Educ. Psychol.* 75, 411–433. doi: 10.1348/000709904X22359

Stewart, A. J. (1982). The course of individual adaptation to life changes. *J. Pers. Soc. Psychol.* 42, 1100–1113. doi: 10.1037/0022-3514.42.6.1100

Stewart, A. J., and Healy, J. M. (1985). Personality and adaptation to change. *Perspect. Pers. Theory Meas. Interpers. Dyn.* 44, 117–144.

Stroet, K., Opdenakker, M.-C., and Minnaert, A. (2013). Effects of need supportive teaching on early adolescents' motivation and engagement: a review of the literature. *Educ. Res. Rev.* 9, 65–87. doi: 10.1016/j.edurev.2012.11.003

Taylor, I. M., and Lonsdale, C. (2010). Cultural differences in the relationships among autonomy support, psychological need satisfaction, subjective vitality, and effort in British and Chinese physical education. *J. Sport Exerc. Psychol.* 32, 655–673. doi: 10.1123/jsep.32.5.655

Teuber, Z., Jia, H., and Niewöhner, T. (2021). Satisfying students' psychological needs during the COVID-19 outbreak in German higher education institutions. *Front. Educ.* 6:679695. doi: 10.3389/feduc.2021.679695

Tsai, H., Lee, Y. P., and Ruangkanjanases, A. (2020). Understanding the effects of antecedents on continuance intention to gather food safety information on websites. *Front. Psychol.* 11:579322. doi: 10.3389/fpsyg.2020.579322

Van den Broeck, A., Vansteenkiste, M., Witte, H., Soenens, B., and Lens, W. (2010). Capturing autonomy, competence, and relatedness at work: construction and initial validation of the work-related basic need satisfaction scale. *J. Occup. Organ. Psychol.* 83, 981–1002. doi: 10.1348/096317909X481382

Vansteenkiste, M., Niemiec, C. P., and Soenens, B. (2010). "The development of the five mini-theories of self-determination theory: an historical overview, emerging trends, and future directions," in *Advances in Motivation and Achievement: The Decade Ahead: Theoretical Perspectives on Motivation and Achievement*, 1st Edn. Vol. 16, eds T. C. Urdan and S. A. Karabenick (London: Emerald Group Publishing Limited), 105–165. doi: 10.1108/S0749-74232010000016A007

Vergara-Torres, A. P., Tristán, J., López-Walle, J. M., González-Gallegos, A., Pappous, A. S., and Tomás, I. (2020). Students' perceptions of teachers' corrective feedback, basic psychological needs and subjective vitality: a multilevel approach. *Front. Psychol.* 11:558954. doi: 10.3389/fpsyg.2020.558954

Voss, T., and Wittwer, J. (2020). Unterricht in zeiten von corona: ein blick auf die herausforderungen aus der sicht von unterrichts- und instruktionsforschung [Teaching in times of corona: a look at the challenges in teaching and instruction research]. *Unterrichtswissenschaft* 48, 601–627. doi: 10.1007/s42010-020-00088-2

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.

Walther, J. B. (1996). Computer-mediated communication: impersonal, interpersonal, and hyperpersonal interaction. *Commun. Res.* 23, 3–44. doi: 10.1177/009365096023001001

Walther, J. B., Loh, T., and Granka, L. (2005). Let me count the ways. *J. Lang. Soc. Psychol.* 24, 36–65. doi: 10.1177/0261927X04273036

Walton, G. M., and Cohen, G. L. (2011). A brief social-belonging intervention improves academic and health outcomes of minority students. *Science* 331, 1447–1451. doi: 10.1126/science.1198364

Wang, C., Hsu, H.-C. K., Bonem, E. M., Moss, J. D., Yu, S., Nelson, D. B., et al. (2019). Need satisfaction and need dissatisfaction: a comparative study of online and face-to-face learning contexts. *Comput. Hum. Behav.* 95, 114–125. doi: 10.1016/j.chb.2019.01.034

Waterman, A. S. (2008). Reconsidering happiness: a eudaimonist's perspective. *J. Posit. Psychol.* 3, 234–252. doi: 10.1080/17439760802303002

Wegner, M., Bohnacker, V., Mempel, G., Teubel, T., and Schüler, J. (2014). Explicit and implicit affiliation motives predict verbal and nonverbal social behavior in sports competition. *Psychol. Sport Exerc.* 15, 588–595. doi: 10.1016/j.psychsport.2014.06.001

Weinberger, J., and McClelland, D. C. (1990). "Cognitive versus traditional motivational models: irreconcilable or complementary?," in *Handbook of Motivation and Cognition: Foundations of Social Behavior*, 2nd Edn. eds E. T. Higgins and R. M. Sorrentino (New York, NY: The Guilford Press), 562–597.

Williams, G. C., and Deci, E. L. (1996). Internalization of biopsychosocial values by medical students: a test of self-determination theory. *J. Pers. Soc. Psychol.* 70, 767–779. doi: 10.1037/0022-3514.70.4.767

Williams, G. C., Grow, V., Freedman, Z. R., Ryan, R. M., and Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *J. Pers. Soc. Psychol.* 70, 115–126. doi: 10.1037//0022-3514.70.1.115

Winter, D. G. (1973). *The Power Motive*. New York, NY: Free Press.

Wut, T., and Xu, J. (2021). Person-to-person interactions in online classroom settings under the impact of COVID-19: a social presence theory perspective. *Asia Pac. Educ. Rev.* 22, 371–383. doi: 10.1007/s12564-021-09673-1

Xi, L., and Gao, L. (2020). Students' sense of community and perspectives of taking synchronous and asynchronous online courses. *Asian J. Distance Educ.* 15, 169–179. doi: 10.5281/zenodo.3881614

Yang, J., Peng, M. Y.-P., Wong, S., and Chong, W. (2021). How e-learning environmental stimuli influence determinates of learning engagement in the context of COVID-19? Sor model perspective. *Front. Psychol.* 12:584976. doi: 10.3389/fpsyg.2021.584976

Young, M. S., Robinson, S., and Alberts, P. (2009). Students pay attention! Combating the vigilance decrement to improve learning during lectures. *Active Learn. High. Educ.* 10, 41–55. doi: 10.1177/1469787408100194

Zainuddin, Z., and Perera, C. J. (2017). Exploring students' competence, autonomy and relatedness in the flipped classroom pedagogical model. *J. Furth. High. Educ.* 43, 115–126. doi: 10.1080/0309877X.2017.1356916

Zhou, X., Chai, C. S., Jong, M. S.-Y., and Xiong, X. B. (2021). Does relatedness matter for online self-regulated learning to promote perceived learning gains and satisfaction? *Asia Pac. Educ. Res.* 30, 205–215. doi: 10.1007/s40299-021-00579-5

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The handling editor declared a past collaboration with one of the authors A-KP.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 31 January 2022
doi: 10.3389/fpsyg.2021.734257

Juggling School and Work From Home: Results From a Survey on German Families With School-Aged Children During the Early COVID-19 Lockdown

Deborah Canales-Romero[1†] *and Axinja Hachfeld*[1,2*†]

[1] *Empirical Educational Research, Department of History, Sociology, Empirical Educational Research and Sport Science, University of Konstanz, Konstanz, Germany,* [2] *Pädagogische Hochschule Thurgau, Kreuzlingen, Switzerland*

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Oz Guterman, Western Galilee College, Israel
Steven Jacob Bosworth, University of Reading, United Kingdom

***Correspondence:**
Axinja Hachfeld
axinja.hachfeld@uni-konstanz.de

†ORCID:
Deborah Canales-Romero
orcid.org/0000-0003-4877-6636
Axinja Hachfeld
orcid.org/0000-0002-9080-5392

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *22 December 2021*
Published: *31 January 2022*

Citation:
Canales-Romero D and Hachfeld A (2022) Juggling School and Work From Home: Results From a Survey on German Families With School-Aged Children During the Early COVID-19 Lockdown. Front. Psychol. 12:734257. doi: 10.3389/fpsyg.2021.734257

As consequence to the coronavirus outbreak, governments around the world imposed drastic mitigation measures such as nationwide lockdowns. These measures included the closures of schools, hence, putting parents into the position of juggling school and work from home. In the present study, we investigated the well-being of parents with school-aged children and its connection to mitigation measures with particular focus on parental roles "caregiver," "worker," and "assistant teacher" as stressors. In addition to direct effects, we expected indirect effects on well-being through changes in household dynamics. Data were collected via an online survey (N = 1313, 85.5% female; 53.2% university degree) conducted during the first wave of school closures in Germany. We observed that during the early COVID-19 pandemic, parental well-being in general was quite positive. Comparing the positive and negative PANAS subscales, parents agreed significantly more with the positive than with the negative items, $t(1299) = 28.55$, $p < 0.001$. Parents also reported an increase in positive family activities during the lockdown, $t(1272) = 43.96$, $p < 0.001$. Although a significant increase in negative household dynamics, such as disputes, was also observed to a lower extent, $t(1295) = 7.78$, $p < 0.001$. Using structural equation modeling, we observed that "homeoffice" was not significantly related to parents' well-being, but positively affected household dynamics. Taking on the role of "assistant teacher" was negatively related to household dynamics. Additionally, we found a significant direct effect on negative affect for "assistant teacher." We conclude that parents of school-aged children have mostly been able to establish positive dynamics in their households during the lockdown given the extra time they got to spend with their children by working from home. However, our results identify the role of "assistant teacher" as a potential stressor for parents. Bridging the gap between teachers and parents seems warranted especially if (some) distance-learning continues, in order to avoid long-term consequences for the students.

Keywords: COVID-19, distance-learning, homeoffice, stress, stressor, caregiver, parents, homeschooling

INTRODUCTION

The coronavirus disease (COVID-19) outbreak turned into a worldwide crisis in the beginning of 2020. Although three major influenza epidemics (Kilbourne, 2006) and many other non-influenza ones—such as HIV—had been recorded in the 20th century, none had reached the levels of global propagation and fatality within such a short timeframe as the 2019 pandemic caused by SARS-CoV-2. Consequently, many governments decided on imposing drastic mitigation measures such as nationwide lockdowns, which included the closure of non-essential businesses, universities, child daycare centers and schools. After it was clear that in-person teaching would not resume for a considerable amount of time, schools around the world continued their curricula remotely via online platforms[1]. This meant not only that all workers from non-essential businesses should work from home (do "homeoffice"[2]); but also, in case of parents, they had to simultaneously care for their children. For families with school-aged children, parents had to help them study from home and take on a role as "assistant teacher." In essence, parents were burdened with juggling three concurrent roles from home: worker, parent, and assistant teacher.

Previous research on the effects of (short-term) school closures suggest they are considerably impactful measures against an outbreak (Ferguson et al., 2006). A study in the United States (Johnson et al., 2008) inquired about the hardship faced by families with school-aged children brought on by school closures due to an influenza B outbreak in North Carolina in late 2006. It found that parents' attitudes toward the measure were overwhelmingly positive and the measure did not represent significant hardship for the affected families. However, the localized nature of the studied influenza outbreak differed in proportion and contagiousness to that of the COVID-19 outbreak. Dealing with this outbreak involves longer-term and more stringent mitigation measures—including not only school closures, but the halting of most activities that require close social contact. Thus, calling into question the applicability of the aforementioned study's results for the current pandemic, and also about the generalizability of country-specific results due to diverse handling of the crisis by different governments. Some evidence to that effect was found in an early COVID-19 study in Canada (Findlay and Arim, 2020), which reported that anxiety levels were high regarding family stress during the lockdown. So although the empirical base about the psychological and social consequences of the pandemic is growing rapidly, its full impact—especially on families—is presently unknown (cp. Prime et al., 2020) and thus requires further study.

According to some, the COVID-19 pandemic and its associated mitigation measures will have similar effects to those of ecological disasters, terrorist attacks, political coups and other catastrophic events (Baker et al., 2020). It is important to know if the mitigation measures used around the world against COVID-19 are having adverse side effects on families because these can spill over within the family system and continue to be felt by the members and families as a whole in the years to come. Armed with this information, governments could improve such measures in future events of a similar nature or enact countermeasures. Due to the lack of information on the impact this type of crisis has on families with school-aged children, the focus of the present study was to investigate how families in Germany[3] were coping and what effect the mitigation measures (especially, the closures of schools and non-essential businesses) have had on the well-being of parents in particular.

The Family as a Dynamic System

The family is the most immediate context for the individual and has been described by social scientists as the primary social unit (Ebrahim and Ebrahim, 1982). Families perform multiple functions that provide benefits to individuals within them and to our society (Patterson, 2002). These functions are: (1) membership and family formation, (2) economic support, (3) nurturance, education, and socialization, (4) protection of vulnerable members.

The bioecological model by Bronfenbrenner and Morris (2006) highlights that the family is embedded in the community level, and the community level is, in turn, embedded in the social level. Because of their nested-ness, the different levels have mutual influence. This underlines the importance of studying families: because it provides a picture of an individual within his/her context. As a family is established through (commonly) the union of a couple, a set of habits, rituals and (tacit) rules are slowly forged by the members through their interaction (Ford, 1983; Fiese et al., 2002). At the same time that each of the members help forge this "family dynamic", they are also influenced by it in a feedback loop (see Prime et al., 2020). It is the mechanism through which family members influence each other and their dyadic relationships. Children are especially susceptible to changes in rituals, habits and rules, possibly impacting their developmental outcomes (Browne et al., 2015). Therefore, any crisis or event that shifts these dynamic processes could have lasting spillover effects to be felt for many years to come.

This notion about how family members influence each other and their dynamic is the one of the basic tenets of systems theories (Prime et al., 2020). Parents, as the leaders of families, have a main role in shaping family dynamics. Thus, changes in their well-being can result in changes in the family system, also referred to as spillover or "cascading effects" (Prime et al., 2020). It is often helpful to compare the family system as a cog machine, so a change or disruption in one will in turn change

[1]Naturally, schools differed on how smoothly and efficaciously they implemented the change and in their expectations regarding the supporting role of the parents.

[2]This term (alternative spelling "home-office") will be used throughout this paper to shorten "working from home." However, it should be noted that this is more of a German term, different from the American English term "home office," which refers to an office space at home, or the British English "Home Office," which refers to a governmental department (German Language Blog, 2020). In Germany, another term that is used in official documents is "telework."

[3]Our questionnaire was in German and was aimed (and disseminated) mainly to German residents. However, we did not discard participants from other German-speaking countries from the final sample (such as Austria or Switzerland), which took similar mitigation measures roughly during the same timeframe (Schweizer Bundesrat, 2020; Blum and Dobrotic, 2021).

or disrupt all of the others. So, any stressors affecting parental well-being negatively can also affect the well-being of the children negatively (Baker et al., 2001; Kaplan et al., 2001; Yotyodying and Wild, 2016). As an example, some of the "cascading effects" associated with lower levels of well-being amongst parents are harsher parenting practices and favoritism (Prime et al., 2020), which in turn have effects on the children's well-being.

However, Prime et al. (2020) identify the family system also as a source for resilience because a well-functioning system can buffer negative effects of social changes on parents' and children's well-being. The defining feature of the family system are the relationships between its members which likely have changed due to the mitigating measures. With schools and workplaces closed, most families were spending more time together. While previous research shows that this can increase conflicts between all family members (Prime et al., 2020), it might also have positive effects if parents use the opportunity to spend more quality time with their children.

In sum, in this study, we investigate how the social changes, i.e., the mitigating measures, are related to parental well-being. The mitigating measures could affect parental well-being directly or indirectly, through changes in family or household dynamics. Families could differ with regard to how the mitigating measures affect their household dynamics. While we assume that the mitigating measures are stressors that are more likely to lead to negative changes, positive changes are also plausible. Hence, in this study, we were also interested in understanding how the family or household dynamics (namely, frequency and type of bonding activities and arguments) have changed since the introduction of COVID-19-related mitigation measures and how these changes relate to parental well-being.

Effects of Mitigating Measures on Well-Being and Changes in Household Dynamics

In Hobfoll's (1989) conservation of resources model, stress is an individual's reaction to any type of loss: both perceived and actual loss, or even lack of gain. These situations that signify loss are also known as stressors. The direct threat of COVID-19 is the loss of health or potential loss of life of one or more members of the family. However, in the particular case of the COVID-19 pandemic, we can expect that this crisis will have also indirect effects on families and family members due to the mitigation measures imposed by governments (Brown et al., 2020). These mitigation measures have changed the quantity and quality of roles parents take on, thereby affecting parents well-being directly but also indirectly via changes in household dynamics. We will now discuss the two avenues of effects that we will focus on in this study.

Direct Effect on Well-Being

Stressors can have a direct psychological effect on individuals by the simple virtue of being. Hence, the mere knowledge of the pandemic and/or the mitigation measures themselves could already have adverse effects on individuals. Previous studies have established the direct link between external stressors and well-being (Errázuriz Arellano et al., 2012; Cobham et al., 2016), and recent studies during the COVID-19 pandemic have confirmed it (Masten and Motti-Stefanidi, 2020; Achterberg et al., 2021). Data from the German Socio-Economic Panel (SOEP), a household survey with approximately 15,000 households, showed a decline in life satisfaction in parents, as well as satisfaction with family-life during the pandemic. To test this, the researchers compared data from 2018 with data from May–June 2020. Parents with children below 11 years of age were especially prone to a decrease in levels of satisfaction (Huebener et al., 2020). The highest decline was found in parents with children under the age of three. Similarly, a longitudinal study during the pandemic among parents with preschool children found an increase in self-reported stress levels from November 2020 to beginning of 2021. Parents whose children had to stay at home due to the mitigating measures reported the highest level of stress (Autorengruppe Corona-KiTa-Studie, 2021).

Given the self-reinforcing nature of the family system and that parents are the family leaders—and are therefore the ones who putatively lead the family to manage the lockdown by adapting their habits, rituals and rules—we think it is particularly important to check for their well-being as a proxy or indicator of how the family is doing and will do in the future.

Changes in Household Dynamics Due to Changes in Parental Roles (Indirect Effect on Well-Being)

As we have mentioned before, parental roles have changed as consequence not of the pandemic, but of the mitigation measures enacted in every respective country. Here we go more in depth regarding the general changes brought on by the mitigation measures on the roles parents play in the household.

Caregiver

With the closure of all non-essential businesses, families have found themselves homebound with few entertainment and recreational options. Social-distancing required to avoid close contact people outside one's own household circle. This is a considerable change to the everyday life of most families and will require for the family habits, rituals and rules to adapt to this new reality. The process of adapting to change involves the whole family, however, parents as the leaders of the unit will need to use more of their resources to lead the family in such process. It is expected that the normal levels of stress related to parenting (Greenberger and O'Neil, 1993) and family stress (Patterson, 2002) will be elevated by this adaptational process. We believe that due to these changes, the role of "caregiver" will pose more stress than usual, particularly if this role is unequally distributed among the parental dyad, i.e., one parent takes on more of the "caregiving" responsibilities than the other. For Germany, the main caregiver is usually the mother. This in mind, it is not surprising that Huebener et al. (2020) found gender differences in family life satisfaction (lower in mothers than in fathers) in families with small children during the COVID-19 lockdown in Germany, that the authors attributed to the higher share of caretaking responsibilities on the mothers' side. However, for some families the extra time they have to spend together may

provide an opportunity to engage in activities that promote the bonding and enrich dyadic relationships (Huebener et al., 2020). This has already been observed during the pandemic, as shown by a study from the United Kingdom (Benzeval et al., 2020). Cohen et al. (2020) also found evidence for positive as well as negative changes. While parents agreed to enjoy spending more time with their children and with the family, they also found it difficult to reconcile work and family. As a consequence, many parents agreed that they feel stressed because of the many obligations and challenges. Parents who reported having financial worries were significantly more likely to agree with items assessing negative household changes compared to parents without financial burdens.

Assistant Teacher

Although schools in most countries closed down, education was expected to continue – also referred to as emergency remote education (ERE; Letzel et al., 2020). While some countries were well-prepared to shift from classroom teaching to online teaching (because the infrastructure was already available), other countries struggled finding ways to implement it. For Germany, a country in which homeschooling is legally prohibited, the sudden change to distance-learning posed particular problems (for a distinction between "homeschooling" and "distance-learning" see Jolly and Matthews, 2018). In comparison to other Western countries, Germany lagged behind on digitalization, and the educational system in particular lacks the necessary structures for and experiences with digital teaching and learning (Bos et al., 2014; Eickelmann et al., 2019; Huber et al., 2020). Hence, before the pandemic teachers used digital media less often than teachers in other countries and often feel ill-prepared to handle it (Bos et al., 2014; Eickelmann et al., 2019). When schools first closed down, on March 16th, 2021, there was no system in place to give structured support and guidance to the teachers. Instead, schools were left alone with how to organize their teaching, which formats to implement (synchronous or asynchronous, etc.), which digital platforms to use and how and how often to get in contact with the students and their parents. It is not surprising then that during the first lockdown parents reported low levels of contact with the teachers (Porsch and Porsch, 2020; Wildemann and Hosenfeld, 2020; Steinmayr et al., 2021; Ulrich et al., in press) and a reduction of individual support (Wildemann and Hosenfeld, 2020). Instruction was often implemented by sending out tasks once a week and requiring students to send their answers back (Steinmayr et al., 2021). At the same time, feedback on the sent solutions was often not provided; and importantly, teachers were not allowed to grade student assignments during the first lockdown. In the study by Steinmayr et al. (2021), parents reported between 33 and 50% feedback rates from science/biology and language arts teachers, respectively. Video conferencing or other distance-learning activities were rarely held, and if so, would often take place only once a week (Steinmayr et al., 2021). The school closures, therefore, resulted in a loss of external structure that was not buffered by a new structure provided by the teachers. In light of this, and in comparison to regular classroom adherence, adherence to "homeschooling" is likely to be (more) dependent on (1) personality traits of the students themselves (cp. Martarelli et al., 2021), and (2) on the parents. An early German study reported that, indeed, parents were feeling overwhelmed by their new role as assistant teachers and stressed because of their inexperience with it (Letzel et al., 2020). These findings are echoed by another study done on parents with school-aged children in Poland, who found that educating their child at home was a "difficult" task (Parczewska, 2020). On that account, we chose to focus also on how this particular role as a "teaching assistant" would affect parents and the family as a whole.

Worker

As previously mentioned, parents who work have an additional role to juggle during this crisis, which is their role as a worker. For many, the work location shifted from the workplace to the "office at home." This lack of physical separation between home and work could have effects in their productivity and motivation, which in turn might cascade into frictions in the dyadic parent-child relationships. In order to organize work and childcare, approximately half of the parents in a german study shifted their work time (e.g., worked early in the morning, late at night, or during weekends) or took turns (Autorengruppe Corona-KiTa-Studie, 2021). Yet, working at home could also have beneficial effects by making it easier to work and care for the children simultaneously, not having to waste time commuting or being in the office when there is not much work to do, thus allowing for parents to use this time differently. An early German study that focused on the impact of working from home during the COVID-19 crisis had on workers who were not used to it, found that workers seemed to be adapting well to the situation and their well-being improved during the 2-week study period (Schade et al., 2021). However, this study did not particularly focus on parents. For those whose work could not shift to the homeoffice, working hours were often reduced by the employers ("short-time work"), and employees received government-funded "short-time work money." Möhring et al. (2021) found that having to reduce their work time did in fact negatively affect mothers' well-being, while it did not affect fathers'.

Taken together, we hypothesized that during the enactment of mitigation measures against COVID-19, the changes in these three roles ("caregiver," "teaching assistant," and "worker") will result in a change in family dynamics within the household. In line with the transactional theory of stress and the conceptional framework on family functioning proposed by Prime et al. (2020), we assume that there is a direct relation between parental well-being and these stressors; and also an indirect effect via the changes in household dynamics (see **Figure 1**). Since the changes in household dynamics could be negative and positive, we consider both aspects in our study.

In our study, we focus on parental well-being during the first lockdown in German families and investigate two questions:

(1) How was parental well-being affected by the mitigating measures which led to changes in the three roles of caregiver, worker, and assistant teacher?
(2) Can part of the effect of these stressors on well-being be explained by changes in household dynamics?

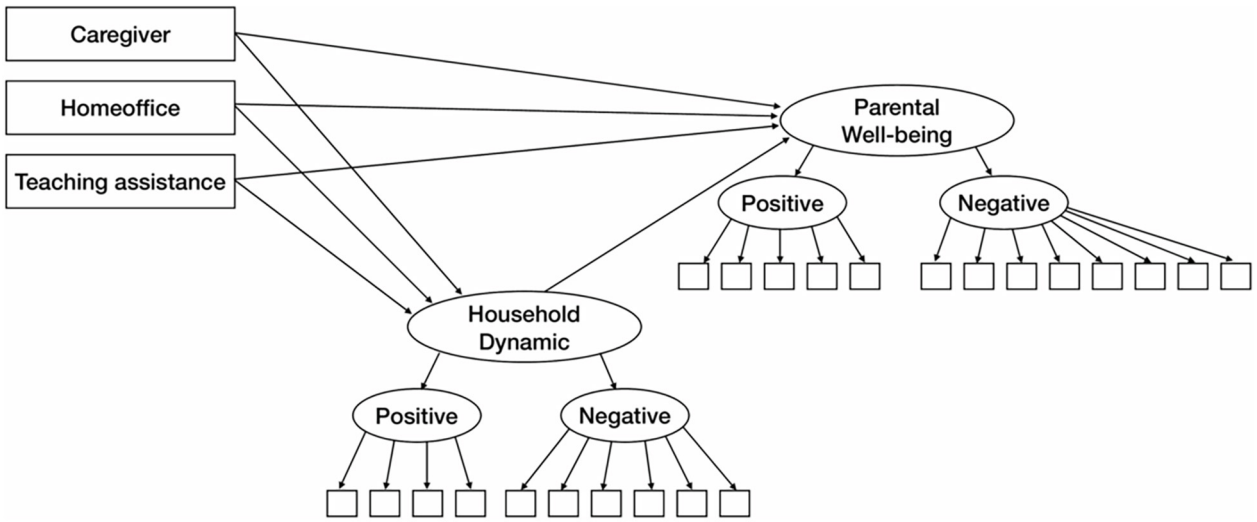

FIGURE 1 | Hypothesized model for partially latent structural regression.

MATERIALS AND METHODS

Procedure and Participants

For this study, an online survey was programmed in German and hosted on the SoSci Survey platform[4]. Parents were invited to answer the 15-min questionnaire. At the beginning of the questionnaire, participants gave informed consent or else were redirected to an exit page. Convenience sampling through multiple-medium promotion (exclusively online, e.g., via Facebook, Twitter, e-mails to parent representatives) yielded 1,725 participants mostly from the German state of Baden-Württemberg (76.6%). Cases in which more than 50% of the questionnaire data was missing were excluded from analysis, resulting in 1,313 cases to be analyzed (85.5% female; 53.2% with university degree, further details in **Table 1**). The excluded cases were exclusively due to participant dropout before answering 50% of the questions, as it was deemed that we could not rely on participant seriousness when this threshold had not been reached. Data were gathered in April 2020 during the "first wave" of school lockdowns, more precisely between the third to fifth week after government-mandated school closures in Germany.[5] We aimed at this early period to catch the time of greatest instability. We assumed that during the first weeks, parents and children would not yet have had enough time to adapt to the change and develop new daily routines.

Interested participants could join a lottery of 20 gift cards with a value of 25€ each. For the study design and procedure, established ethical guidelines for psychological research were followed.

Although parents with children of any age were allowed to participate, we encouraged them to focus on a single child—preferably the one closest to the age of 12, i.e., the 6th grade in the German educational system—to answer the questions. This focus was of particular interest for the researchers for two reasons: first, most children change from elementary school to secondary school at around 10 or 11 years of age (after fourth grade) and this change puts academic demands on the children; hence, we expect families to be still concerned about the educational progress of their child at this stage. Secondly, children at the age of 12 are already expected to work independently on their school tasks even during distance learning; therefore, we expected parents of children that age to be fluctuating between providing support and expecting independence. In our sample, most children (55.24%) were in secondary school, which comprises 5th to 10th grade in most of Germany (except Berlin were children change after grade 6), and of these children, the majority (64.83%) were in the highest (academic) track secondary school ("Gymnasium").

Regarding parent and family characteristics, the sample resembles that of other studies conducted during the school lockdown (e.g., Porsch and Porsch, 2020; Steinmayr et al., 2021). Families with higher educational degrees and higher socio-economic background were overrepresented (**Table 1**). We asked participants how they get along economically and 88% answered to get by well or very well. Roughly, 85% percent said they had enough space in their current living situation. For our study, we asked families to let the parent who is mainly responsible for childcare and distance teaching answer the questionnaire. Thusly, most respondents in our study were female (85.5%)—as in other corona studies—suggesting that mothers are over-proportionally responsible for the children during the pandemic. Further sociodemographic statistics are summarized in **Table 1**.

Measures

The parent survey assessed a variety of questions capturing how families had experienced and coped during the lockdown, and how they had organized their family life and distance learning.

[4]www.soscisurvey.de

[5]School-closures were ongoing as this study was finished.

TABLE 1 | Sample descriptive statistics.

Variables	*n*	%	*n*	%	*n*	%
Child	**Total sample**					
Year of birth	1232					
2007–2010 (10–13 years old)	720	54.9%				
Sex	1301					
Female	646	49.2%				
Male	649	49.4%				
Diverse	6	0.5%				
Disability	1303					
Yes	67	5.1%				
No	1236	94.1%				
Parent	**Total sample**		**Fathers**		**Mothers**	
Teacher	1256	–	129	–	1120	–
Yes	153	11.6%	16	12.4%	135	87.7%
No	1103	84.0%	113	87.6%	985	12.0%
Education	1257	–	129	–	1123	–
None	3	0.2%	1	0.8%	1	0.1%
Volkschule/Hauptschule	35	2.7%	3	2.3%	32	2.8%
Realschulabchluss/Mittlere Reife	271	20.6%	24	18.6%	246	21.9%
Hochschulreife/Abitur	249	19%	16	12.4%	232	20.7%
Hochschulabschluss	699	53.2%	85	65.9%	612	54.5%
Relationship to child	1253	–	–	–	–	–
Father figure	129	9.8%	–	–	–	–
Mother figure	1123	85.5%	–	–	–	–
Other	1	0.08%	–	–	–	–
Single parent	1253	–	129	–	1123	–
Yes	139	10.6%	6	4.6%	133	11.8%
No	1030	78.4%	113	87.6%	916	81.6%
Partly/mostly	84	6.4%	10	7.7%	74	6.6%
Main caregiver (of child/children)	1024	–	113	–	910	–
Myself	569	43.3%	10	7.7%	559	49.7%
Both of us together	403	30.7%	71	55.0%	332	29.6%
Partner	47	3.6%	30	23.3%	16	1.4%
Other person	5	0.4%	2	1.5%	3	0.3%
Work status	1241	–	126	–	1085	–
Retired	9	0.7%	3	2.3%	6	0.5%
Looking for a job/unemployed	59	4.5%	3	2.3%	56	5.0%
Parental leave	38	2.9%	0	0.0%	9	3.4%
Studying	21	1.6%	1	0.8%	20	1.8%
Mini job	39	3.0%	0	0.0%	39	3.5%
Part-time job	621	47.3%	18	13.9%	603	53.7%
Full-time job	304	23.2%	84	65.1%	220	19.6%
Freelance/company owner	150	11.4%	17	13.2%	132	11.8%
Income rating	1251	–	128	–	1121	–
Live comfortably	658	50.1%	64	49.6%	594	52.9%
Get by	499	38.0%	55	42.6%	444	39.5%
Difficulty getting by	68	5.2%	7	5.4%	61	5.4%
Only barely get by	26	2%	2	1.5%	22	1.9%

(Continued)

TABLE 1 | (Continued)

Variables	*n*	%	*n*	%	*n*	%
Homeoffice (those who work)	1122	–	121	–	1000	–
Yes	546	41.6%	75	58.1%	471	41.9%
Partly	188	14.3%	17	13.2%	170	15.1%
No	388	29.6%	29	22.5%	359	32.0%
Assistant teacher	1286	–	128	–	1114	–
Strongly disagree	236	18.0%	26	20.1%	199	17.7%
Disagree	406	30.9%	34	26.4%	364	32.4%
Agree	437	33.3%	51	39.5%	368	32.8%
Strongly agree	207	15.8%	17	13.2%	183	16.3%

Missing data suppressed from this table but considered for percentages. N for each category title represents the amount of people who answered the item(s) from the total sample used. For brevity, only the most represented category of year of birth is reported here. Further breakdown of parent descriptives according to parent gender (only fathers and mothers) included. Parent gender was assessed via the question "relationship to the child," in which the category of "other" and no answer was possible.

In the present analyses, we focus on parental well-being as our main outcome of interest. Following the conceptional framework on family functioning proposed by Prime et al. (2020) and the transactional theory of stress, we understand the social changes, represented by the mitigating measures, as stressors that influence parent's well-being and family's household dynamics directly. Changes in household dynamics, in turn, could either amplify negative effects of the mitigating measures or—when changes are positive—serve as a buffer and a source of resilience.

Well-Being

In order to assess parents' well-being, we used an abbreviated version of the Positive and Negative Affect Schedule (PANAS; Krohne et al., 1996). Usually consisting of 20 items, we selected the 12 most relevant items for the lockdown situation: five items for positive affect and seven for negative affect (all questions used for this study can be found in **Supplementary Appendix A**). Because of the uncertainty of the unprecedented situation, we also included the additional item "unsettled" (original: "verunsichert"), resulting in 13 items. The traditional 5-point Likert response scale was used, ranging from 1 ("very slightly or not at all") to 5 ("extremely"). The instruction was modified to "How have you felt in the last days [since the lockdown]?" in order to only capture the current emotional state of the individuals since the lockdown and not their general feeling (trait). To avoid priming effects, the PANAS was presented before the other scales, but after asking their children's demographics. Our abbreviated version of the PANAS scale had a good internal consistency for positive (Cronbach's $\alpha = 0.74$) and negative items (Cronbach's $\alpha = 0.85$) despite the fewer number of items in the former.

Household Dynamic

Parents were asked a series of 10 items related to the household activities/events during the school closures compared to their frequency before the school closures. We included positive and negative household activities/events. The positive items focused on activities that families could do together at home despite the lockdown measures and that could be described as "quality time." Examples for positive activities or events are "cooking or eating together" or "doing recreational activities together like playing board games or music together." The negative items focused (1) on the relationship between parent and child or between the siblings, since previous research has shown that similar threats can increase the potential for conflicts, arguments, and aggression. Example items are: "dispute about use of smartphones, tablets or similar" or "dispute with siblings." Also, because we were interested in the effects of the school closures, negative items (2) focused on schoolwork related negative events. Examples are: "dispute about completing schoolwork" or "dispute about checking the schoolwork." Answers were given on a scale from 1 ("much less often") to 5 ("much more often"), with 3 being a theoretical middle point of "same/no change." The only exception to this was the following item: "My child reacts annoyed when I explain schoolwork to him/her," which only had a response range from 1 ("strongly disagree") to 4 ("strongly agree"). To be included in the scale, the response range was standardized to match the others. The full scale included four positive (Cronbach's $\alpha = 0.62$) and six negative items (Cronbach's $\alpha = 0.79$), which showed acceptable internal reliability. Although the positive scale's reliability is considerably lower than the negative ones, this might be due to a lower number of items. However, this can still be considered an acceptable reliability value for psychological constructs (Field, 2013).

Stressors

To assess changes in the family's lifestyle that the pandemic has brought on, three single items were included. These three items aimed at three central stressors brought on by the mitigation measures on families with children that we wanted to focus on, namely on taking on the role of "assistant teacher," doing "homeoffice," and "caregiver." To assess requirements of distance learning, the respondents were asked the following question: "The teachers of my child include me to provide learning support," with answers from 1 ("strongly disagree") to 4 ("strongly agree"). To assess the working conditions, we added the following item: "Can or must you currently work from home (because of the Corona protection regulations)?", with answers from 1 ("yes"), 2 ("in part") and 3 ("no"). To assess amount of childcare responsibility, we asked: "Who is in your home the main person in charge of taking care of the child?", with answers from 1 ("myself"), 2 ("my partner"), 3 ("both of us together"), and

4 ["other person(s)"]. This variable was dummy coded into involved in child rearing or not, with answers "my partner" and "other person(s)" coded 1, and "myself" along with "both of us together" coded 2.

Data Analysis

Data were analyzed using RStudio (Team R Studio, 2020) version 1.3.1073 "Giant Goldenrod." In order to test the interrelation of all of our variables in context, we decided to use structural equation modeling (SEM) using the *lavaan* package version 0.6-7. Zero-order correlations were obtained using the *rcorr* function of the *Hmisc* library. **Figure 1** depicts our hypothesized model and how we considered our variables to be interrelated. For the final model, we controlled for socioeconomic status.

Missing data was treated using pairwise deletion for the descriptive statistics and zero-order correlations. Due to the limited nature of the response scales (1–5), outlier deletion was not deemed necessary. The total number of used observations in the SEM model was $n = 960$ (only complete observations used); using Full Information Maximum Likelihood (FIML), that number increased to $n = 1301$. The Goodness of Fit Indices (GFI) cutoff values used were those compiled by Kline (2005) for SEM models: non-significant χ^2, CFI > 0.9 as "good", RMSEA < 0.10 as "acceptable" and <0.08 as "good," SRMR < 0.08 as "good." On account of the large sample size, the chi-square value was not considered to assess the fitness of the model, yet is still reported. For the measurement part of the model, a cutoff value of 0.40 for factor loadings was considered, as low factor loadings could indicate that the latent variable is not adequately measured by that item and therefore should probably be discarded (Chin, 1998; Hair et al., 2011).

RESULTS

Descriptive Results

To explore how parents experienced the first lockdown emotionally, we analyzed the PANAS data (**Table 2**). Comparing the positive and negative affect subscales, the positive items received significantly higher scores ($M_{PA} = 2.92$, $SD_{PA} = 0.68$) than the negative items ($M_{NA} = 2.06$, $SD_{NA} = 0.72$), $t(1299) = 28.55$, $p < 0.001$, suggesting that parents were experiencing more positive than negative emotions during the time of the lockdown. The positive item with a highest score was "attentive" ($M = 3.50$, $SD = 0.88$). Whereas the negative item with the highest score was "distressed" ($M = 2.51$, $SD = 1.04$). The item we added to the modified PANAS scale for this particular study ("unsettled") was within the range of the rest of the negative items ($M = 2.27$, $SD = 1.03$). Fathers and mothers did not significantly differ in average scores for the positive [mothers: $M = 2.92$, $SD = 0.67$; fathers: $M = 2.94$, $SD = 0.67$; $t(158.67) = 0.31$, $p = 0.75$] or the negative scale [mothers: $M = 2.06$, $SD = 0.71$; fathers: $M = 2.01$, $SD = 0.74$; $t(156.29) = -0.75$, $p = 0.45$].

Regarding the current household dynamics, we looked at the responses to the HHD scale (**Table 3**). Keeping in mind that this scale was designed to show relative frequency, an answer of 3 would represent no change in the frequency of activities relative to the time before the lockdown. Participants responded that the frequency of the inquired activities in the positive subscale was slightly, though significantly, higher ($M_P = 3.65$, $SD_P = 0.54$) during the lockdown than before, $t(1272) = 43.96$, $p < 0.001$. These activities included cooking or eating together (64.5% reported a higher frequency than before) or doing recreational activities together (57.7% reported a higher frequency than before). The change reported by parents for negative items was lower ($M_N = 3.15$, $SD_N = 0.71$), but still significantly different to the hypothetical midpoint of 3, $t(1295) = 7.78$, $p < 0.001$. For example, 34.6% reported more disputes about homework than before. Roughly half (50.2%) of parents reported that their children have been irritated when parents have to explain schoolwork. Similar to the PANAS scales, female and male caregivers did not significantly differ in average scores for the positive [mothers: $M = 3.67$, $SD = 0.53$; fathers: $M = 3.64$, $SD = 0.56$; $t(155.92) = -0.60$, $p = 0.54$] or the negative HHD scale, [mothers: $M = 3.16$, $SD = 0.70$; fathers: $M = 3.09$, $SD = 0.69$; $t(159.52) = -1.01$, $p = 0.31$]. Altogether, the HHD scale indicates that the household dynamic and atmosphere reported by the majority of parents in our sample has changed, with an increase in positive activities (especially cooking and sharing meals) compared to before the lockdown, and a lower but still significant increase in negative activities or events, like arguing.

TABLE 2 | Itemized response percentages for the PANAS scale, grouped by subscale.

	Positive scale%						Descriptives	
Item	**1**	**2**	**3**	**4**	**5**		**M**	**SD**
1 Active	3.0	14.1	45.7	28.1	8.0		3.24	0.90
6 Inspired	19.1	31.2	34.3	12.6	1.5		2.45	0.99
8 Enthusiastic	28.7	27.8	30.0	10.2	2.3		2.29	1.06
10 Determined	6.9	17.4	39.6	28.0	6.7		3.10	1.00
11 Attentive	2.0	9.0	36.6	39.8	11.1		3.50	0.88
						Subscale	2.92	0.68
	Negative scale%							
2 Distressed	15.6	39.3	25.4	15.1	3.5		2.51	1.04
3 Upset	33.2	35.6	16.5	10.7	3.0		2.14	1.09
4 Startled	47.3	29.1	13.7	7.1	1.8		1.86	1.02
5 Hostile	73.6	16.1	6.5	2.1	0.4		1.37	0.74
7 Irritable	22.2	41.2	17.1	14.9	3.4		2.35	1.09
9 Nervous	39.2	31.7	15.2	11.3	1.4		2.03	1.06
12 Scared	40.8	37.7	11.2	7.3	1.8		1.90	0.99
13 Unsettled	22.0	45.5	16.2	12.0	3.0		2.27	1.03
						Subscale	2.06	0.72

Response options 1 ("very slightly or not at all"), 2 ("a little"), 3 ("moderately"), 4 ("quite a bit"), 5 ("extremely").

Structural Equation Modeling Results

As a first step, we ran correlations (**Table 4**) between the outcome variables of "parental well-being" and "household dynamic" with stressors brought on by the pandemic: "homeoffice," "caregiver,"

TABLE 3 | Itemized response percentages for the HHD scale, grouped by subscale.

Item content		Positive items	
	1–2	*3*	*4–5*
1. Cooking or eating together	1.3	30.6	64.5
2. Doing recreational activities together	6.5	31.7	57.7
3. Watch television together	5.7	46.9	40.8
8. Long conversations about a topic	2.3	38.1	56.1
		Negative Items	
4. Disputes about doing homework	14.9	42.6	34.6
5. Disputes about inspecting homework	14.9	48.9	24.3
6. Disputes about the use of electronic devices	9.8	46.3	35
7. Disputes about other topics	17.4	57.0	19.1
9. Disputes with siblings	12.6	36.6	30.9
10. My child reacts irritated when I explain schoolwork to him/her	48	–	50.2

These are all percentages from the final sample used for analysis. Missings not shown in table but considered for percentages. Item 10 had a 1–4 scale, which was later standardized for analysis, hence the lack of observations in the middle value. Response options for items 1 to 9: 1 ("much less often"), 2 ("less often"), 3 ("same/no change"), 4 ("more often"), 5 ("much more often").
Response options for item 10: 1 ("strongly disagree") to 4 ("strongly agree").

and "teaching assistant."[6] **Table 4** shows that having to assist in school teaching ("teaching assistance") had a significant positive correlation with the negative subscales of both the PANAS, $r = 0.17$, $p < 0.001$, and the HHD scales, $r = 0.24$, $p < 0.001$. The amount of responsibility with the children ("caregiver") was not significantly correlated with any of the outcome variables. The "homeoffice" variable showed a significant relationship with the positive subscale of the HHD, $r = 0.19$, $p < 0.001$, and a significant negative relationship with "caregiver," $r = -0.07$, $p < 0.025$.

Next, we followed the two-step approach to structural regression models by Anderson and Gerbing (1988), which suggests to first test the fit of the measurement part of the model and then add the structural part of the model. Both measurement models—HHD and PANAS—were tested first using the CFA (confirmatory factor analysis) function of *lavaan*. Improvements in fit were reached by adding correlated errors in the PANAS scale among items 12 ("scared") and 13 ("unsettled"); as well as between items 3 ("upset"), 5 ("hostile") and 7 ("irritable"). The correlated errors in the PANAS scale were well-justified as the word groups have very similar meanings; items 3, 5, and 7 are more related to anger whereas the other two items are more related to anxiety. These types of item groups with the PANAS scale have also arisen in the original version (Thompson, 2007).

[6]Note that this correlation table cannot be used to reproduce the subsequent model, since in our model we do not use subscale scores, but the data on each individual item. The correlation table on which our model is based on can be found in **Supplementary Appendix B**.

A three-factor model for the PANAS—to separate the anger-related items and the anxiety-related items—was attempted and did not result in a good fit (**Table 5**). The data suggested that a two-factor model was the best fit, $\chi^2(60) = 451.3$, $p < 0.001$, CFI = 0.934, RMSEA = 0.071, SRMR = 0.055.

Moving on to the HDD scale, items 7 ("disputes over other topics") and 9 ("disputes with siblings") were eliminated due to factor loadings below our selected threshold, yielding a model with a very good fit, $\chi^2(19)$ 43.76, $p = 0.001$, CFI = 0.988, RMSEA = 0.035, SRMR = 0.033. A model including both measurement models also resulted in a good fit, $\chi^2(179) = 722.92$, $p < 0.001$, CFI = 0.926, RMSEA = 0.053, SRMR = 0.062. A second-order CFA was considered for both scales to better approximate the hypothesized model, however low correlation among the PANAS subscales ($r = -0.26$, $p < 0.001$) and HDD subscales ($r = -0.18$, $p < 0.001$) indicated the subscales were best represented as two different factors, not as parts of higher-order latent factors. Thus, we modified our hypothesized model accordingly.

Finally, we ran the analysis including the structural part of the model with possible mediation of our three selected stressors ("caregiver," "homeoffice," and "teaching assistant") through household dynamics, including socioeconomic status as a control variable. The resulting model showed adequate global fit indices, $\chi^2(210) = 786.814$, $p < 0.001$, CFI = 0.915; RMSEA = 0.051, SRMR = 0.056. In order to ensure the robustness of the model, we also ran the model using FIML to treat missing data, which now used 1,301 cases and showed minimal changes in GFIs and estimates compared to the model without FIML, $\chi^2(230) = 974.97$, $p < 0.001$, CFI = 0.914; RMSEA = 0.050, SRMR = 0.053 (see **Table 5** for a summary of models attempted and their GFIs). In this last model (**Figure 2**), the range of factor loadings for each of our latent factors was between 0.51 and 0.74 for the positive PANAS subscale, 0.44–0.76 for the negative, 0.45–0.73 for the positive HDD subscale and 0.49–0.90 for the negative.

Regarding how all endogenous variables are interrelated, we found parents' well-being was directly related to the household dynamics (HHD) where positive HDD had a direct effect on positive emotions ($\beta = 0.17$, $SE = 0.04$, $p < 0.001$) and negative HDD a direct effect on negative emotions ($\beta = 0.31$, $SE = 0.03$, $p < 0.001$). Negative HDD were also related to fewer positive emotions ($\beta = -0.26$, $SE = 0.04$, $p < 0.001$), and positive HDD also related to fewer negative emotions, however, the latter relationship was not significant at the 0.05 level ($\beta = -0.05$, $SE = 0.04$, $p = 0.17$).

We were also interested in investigating whether the stressors ("caregiver," "homeoffice," and "teaching assistance") directly or indirectly through HDD affected participants' well-being. Analyzing the three stressor variables on the final model (**Table 6**), "caregiver" had no significant effect on any of the endogenous variables.

"Homeoffice" did not have a significant direct effect on the positive or negative affect; nevertheless, it did have a direct effect on positive HDD ($\beta = 0.25$, $SE = 0.36$, $p < 0.001$). Hence, results suggest an indirect (mediated) effect between homeoffice and well-being via positive HHD of 0.043 (0.25*0.17). However, its

TABLE 4 | Zero-order correlations, Cronbach's alphas, means, and standard deviations for main variables in this study.

	1	2	3	4	5	6	7
(1) PA_pos	(0.74)						
(2) PA_neg	−0.22***	(0.85)					
(3) HHD_pos	0.15***	−0.07*	(0.62)				
(4) HHD_neg	−0.24***	0.40***	−0.10***	(0.79)			
(5) Caregiver†	0.00	−0.01	−0.01	0.00	1.00		
(6) Homeoffice	0.04	0.00	0.19***	−0.01	−0.07*	1.00	
(7) Teaching assistance	0.00	0.17***	0.03	0.24***	0.02	0.03	1.00
M	2.92	2.06	3.65	3.1	1.95	2.14	2.48
SD	0.68	0.72	0.54	0.67	0.20	0.90	0.97
Scale	1–5	1–5	1–5	1–5	1–2	1–3	1–4

*Higher scores on the last three variables indicate higher levels of responsibility in child rearing, having to do more homeoffice and more activities regarding schoolwork support. Cronbach's alphas for each subscale are reported in parenthesis on the main diagonal where appropriate. PANAS positive subscale (PA_pos), PANAS negative subscale (PA_neg), HHD positive subscale (HHD_pos), HHD negative subscale (HHD_neg). *p < 0.05, ***p < 0.001, †biserial correlations.*

TABLE 5 | Attempted models and GFIs.

	χ^2	df	$\chi^2\Delta$ (df)	CFI	RMSEA	CI	SRMR	AIC
PANAS (measurement model)								
Model A (two-factor model)	1,305.92	64	–	0.789†	0.123	0.117–0.128	0.081	42,474.79
Model B (three-factor model)	590	62	715.49(2)***	0.910	0.081†	0.075–0.087	0.060	41,763.30
Model C (two-factor model with correlated errors)	451.38	60	139.06(2)***	0.934	0.071	0.065–0.077	0.055	41,628.24
HDD (measurement model)								
Model D (two-factor model)	245.85	34	–	0.904	0.084†	0.074–0.094	0.058	20,863.11
Model E (two-factor model without items 7 and 9)	43.76	19	–	0.988	0.035	0.021–0.049	0.033	20,048.19
PANAS and HDD (measurement model)								
Model F	722.92	179	–	0.926	0.053	0.049–0.058	0.062	54,035.85
Final model (measurement and structural parts)								
Model G	786.14	226	–	0.915	0.051	0.047–0.055	0.056	46,368.89
Final model with FIML								
Model H	974.97	226	–	0.914	0.050	0.047–0.054	0.053	70,942.52

*All χ^2 values in this table are significant. Chi-square difference test values provided only for comparison among nested models. ***p < 0.001, †beyond cutoff value.*

total effect on the positive PANAS is diminished (to 0.38) by the alternate indirect effect it has through its non-significant relationship via negative HHD, which subtracts 0.004 (0.017*–0.26). In the end, homeoffice has no significant total effect on well-being (**Table 6**).

'Teaching assistance" was found to have a significant direct effect only on the negative PANAS subscale (β = 0.08, *SE* = 0.03, $p = 0.009$); and a positive direct effect on the negative subscale of the HDD (β = 0.24, *SE* = 0.03, $p < 0.001$). Consequently, it also had an indirect effect (partial mediation) on the negative PANAS subscale through the negative HDD subscale (as a reminder, β = 0.31, *SE* = 0.04, $p < 0.001$). Therefore, the indirect effects of "teaching assistance" on the negative PANAS subscale by way of the negative HHD amounts to 0.07 (0.24*0.31). In total, indirect and direct effects, "teaching assistance" has an effect on the negative PANAS of 0.15 (0.08 + 0.07), $R^2 = 0.131$, indicating that for every standard deviation increase in teaching assistance there is an increase of 0.15 standard deviations in the negative PANAS subscale. The variance in the negative PANAS explained by the model is 13.1%. Full mediation also occurs between teaching assistance and the positive PANAS because of significant indirect effects (β = −0.05, *SE* = 0.01, $p < 0.001$). However, the total effect of teaching assistance on positive affect is non-significant. The variance of the positive PANAS explained by the model is of 11.3%.

DISCUSSION

Our aims with this study were to investigate the well-being of parents with school-aged children, and how it was affected by mitigation measures imposed by the German government due

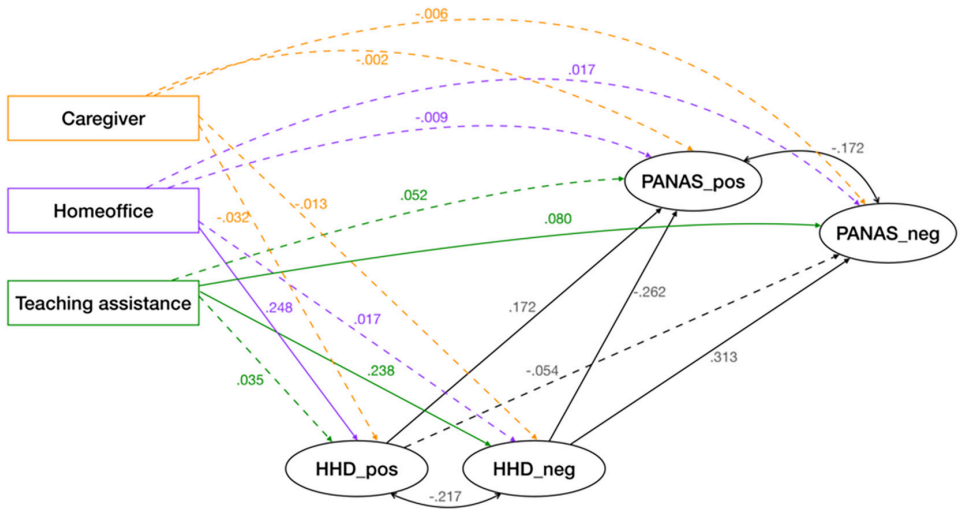

FIGURE 2 | Final (structural) model for partially latent structural regression using FIML with standardized coefficients. Non-significant paths are in dotted lines, whereas significant ones are in solid lines.

TABLE 6 | Effects breakdown between exogenous and endogenous variables of the final model showing mediated effects.

	Endogenous variables							
	HHD_pos		HHD_neg		PA_pos		PA_neg	
Causal variables	β	***SE***	β	***SE***	β	***SE***	β	***SE***
Caregiver								
Direct effect	−0.032	0.034	−0.013	0.029	−0.002	0.032.	−0.006	0.030
Total indirect effect	–	–	–	–	−0.002	0.011	−0.002	0.010
Total effect	−0.032	0.034	−0.013	0.029	−0.004	0.033	0.009	0.031
Homeoffice								
Direct effect	0.248***	0.036	0.017	0.031	−0.009	0.036	0.017	0.034
Total indirect effect	–	–	–	–	0.038*	0.015	−0.008	0.014
Total effect	0.248***	0.036	0.017	0.031	0.029	0.035	0.009	0.034
Teaching assistance								
Direct effect	0.035	0.034	0.238***	0.029	0.052	0.032	0.080**	0.030
Total indirect effect	–	–	–	–	−0.056***	0.014	0.073***	0.013
Total effect	0.035	0.034	0.238***	0.029	−0.005	0.032	0.152***	0.030
HHD_pos								
Direct effect	–	–	–	–	0.172***	0.041	−0.054	0.039
Total indirect effect	–	–	–	–	–	–	–	–
Total effect	–	–	–	–	0.172***	0.041	−0.054	0.039
HHD_neg								
Direct effect	–	–	–	–	−0.262***	0.035	0.312***	0.033
Total indirect effect	–	–	–	–	–	–	–	–
Total effect	–	–	–	–	−0.262***	0.035	0.312***	0.033

*Total indirect effects through different mediators (the two HDD subscales) were calculated by simple addition due to low correlation among HHD subscales. *p < 0.05, **p < 0.01, ***p < 0.001.*

to COVID-19 with particular focus on parental roles "caregiver," "worker," and "assistant teacher" as stressors. We also assumed that the stressors, i.e., the mitigating measures, would not only directly affect parental well-being but also indirectly by consequent changes in household dynamics. With this purpose we did a cross-sectional online survey in which we asked one parent per household to respond, preferably, the main caregiver of the children.

In our study, and contrary to our assumptions, participants seemed to experience the first wave of the lockdown rather positively—at least regarding to their well-being—notwithstanding the radical changes in everyday life that the

mitigation measures entailed. The feelings they most endorsed were "active," "attentive," and "determined". This seems to suggest that they might be aware of the challenges posed by the pandemic and are therefore engaging all their resources to handle it. Although we expected parents to feel "unsettled"—hence, adding this additional item to the original PANAS scale to accommodate for the unique situation of the pandemic—they did not report high levels of this affect during early lockdown. This might have been due (at least in part) to an increase in positive household dynamics. In our sample, positive activities in households increased more than negative ones (although these also increased to a lesser extent). Our SEM model results support the findings from the United Kingdom study (Benzeval et al., 2020) that doing more homeoffice has granted families the opportunity to do more positive activities together, such as cooking, eating and doing recreational activities; which in turn has a positive correlation with parents' emotional well-being. We confirm the findings of Schade et al. (2021) that showed that German workers seem to be adapting well to the situation and reporting an increase in well-being during early lockdown. Different results were found by Möhring et al. (2021) who reported a decrease in well-being among mothers with pandemic-induced "short-work" schedules. This difference might be explained by financial concerns that go hand in hand with short-time work. The mothers in our sample were mainly able to work from home, hence, less likely to experience great financial losses. Furthermore, we did not find gender differences in the PANAS or the HHD scales in our sample. One reason might be the selection of the sample: we asked respondents that the person providing the answers to our survey should be the main caregiver of the children, hence, all the men included in the sample were more likely to take on the role that is usually taken by the mother.

On the other hand, there does seem to be issues with the change in dynamics regarding schoolwork. Our findings suggest that this new parental role of "assistant teacher" showed a direct positive relation with negative affect, and also a positive relation with the amounts of arguments and disagreements among parents and their children. According to our model, this last effect in turn, has a negative relationship on the well-being of parents via a twofold mechanism: increasing negative affect and reducing positive affect. This contrasts with the effects of homeoffice, which only had a direct positive relationship on positive household activities, thus increasing positive affect. In line with what Letzel et al. (2020) reported in their paper, we found that German parents were having difficulties with taking on the role of "assistant teacher" (for insightful highlights from parents responses to their qualitative interviews, see Letzel et al., 2020). In their study, Letzel et al. (2020) found a significant decrease in parental well-being during the early COVID-19 lockdown, whereas parents in our sample reported high levels of well-being. Yet, due the cross-sectional nature of our study, we cannot draw conclusion about changes in relative well-being. Another point of discrepancy is the use of a different well-being measure. We used a (modified) PANAS scale, as did Schade et al. (2021), whereas Letzel et al. (2020) used the Positive and Negative Activation and Valence (PANAVA) instrument. Another possibility to explain this discrepancy, depending on the order of the questionnaire items in the study by Letzel et al. (2020) are priming effects. Because parents are having negative experiences with distance-learning, this might have impacted their responses in the well-being measure. However, this would only be the case if the PANAVA was included after the questions regarding distance-learning. In our study, the PANAS scale was included only after child demographics were asked, thus reducing the possibility of priming effects.

As to the reasons why parents are having such difficulties with distance-learning, we can speculate that there might be a few variables at play that have been appeared in other studies in Germany. As we had mentioned before, German parents are not even remotely acquainted with homeschooling practices, while at the same time teachers feel ill-prepared when facing the prospect of distance-teaching (Eickelmann et al., 2019). The lack of appropriate infrastructure for digital-teaching in Germany (Bos et al., 2014; Eickelmann et al., 2019; Huber et al., 2020) might also have helped to widen the gap between parents and teachers regarding what can be expected from each other in order to help students adapt to distance-learning. This lack of coordination among parents and teachers might have consequences for students if not resolved, and some might even prove to be long-term.

We had expected that being the main "caregiver" would have an impact on well-being and household dynamic, nevertheless this was not the case. However, longitudinal studies such as the ones performed by Huebener et al. (2020) and Möhring et al. (2021), found that relative well-being (previous years versus during the pandemic) has had a significant downward trend for mothers. It must be noted that, in these studies, (subjective) well-being was measured as satisfaction with different aspects such as general life satisfaction, family satisfaction and satisfaction with childcare for the former study; and family life satisfaction and work satisfaction for the latter. Possible reasons for this discrepancy may lie in the different operationalization of and instruments to measure well-being.

Although most of the variance in the PANAS scales was unaccounted for in our model, still these stressors (with the exception of "caregiver") did have a significant impact on parental well-being and household dynamics, and therefore, might contribute to the build-up or curbing of family/parental stress. Most of the participants in our sample seemed to be doing quite well, despite the circumstances. Nevertheless, the lockdown measures have been extended and societies have had to live under these circumstances for over a year now; the outlook might have changed during that time and the amount of accumulated stress could be considerable. Now that vaccination against COVID-19 has been started in many countries, families will have to slowly re-adapt to their previous *status quo*. It remains to be seen if a "return to normality" is attainable, yet setbacks caused by sporadic outbreaks may make it a protracted process. Forcing parents to constantly re-adapt to changing circumstances might prove to be another stressor, which they must face. Therefore, we consider longitudinal or experience sampling studies of families with school-aged children best suited to understand the many effects the COVID-19 pandemic has had and will have on them.

Several implications can be drawn from our study. First, it is not the mitigating measures *per se* that are related to parents' well-being (with the exceptions of teaching assistance), but rather the household dynamics. Governments should set or keep up their social support structures for families, offering assistance, and open spaces for parents and children. Second, parents differ with regard to how much they can and want to take on the role as "assistant teacher," and schools differ regarding the expectations they have for parents' support and how explicit they made their expectations. Previous research (Fan and Chen, 2001; Sheldon and Epstein, 2005; Fan and Williams, 2010; Jeynes, 2012) has shown that parent-school-cooperation can improve students' educational outcomes, but that its potentials are not fully exhausted in Germany (Wild, 2003; Sacher et al., 2019). Our study did show that distance-learning may not only affect students but also their parents: we found that taking on the role as "assistant teacher" was an important factor related to parents' well-being. Hence, school should aim at improving partnerships, setting up clear expectations, and assisting parents who have fewer means to support their children.

Third, due to the school closures, German schools were forced to set up technical structures and implement tools for distant teaching and learning. Now in place, schools will and should keep using these tools. Communicating with parents about which support they need regarding novel technical tools, and how technology can be supportive instead of an additional burden seems therefore warranted.

Limitations

Not included in our analysis are many other factors that could impact families and have been commonplace during the pandemic: job loss, loss of income, separation, and death of loved ones as more direct factors but also psychological aspects such as pressure, lack of control (e.g., Miller et al., 2020), or more specific parenting scales (e.g., Brown et al., 2020; Ren et al., 2020). Due to questionnaire-length concerns, we focused on our main points of interest; namely, we were especially interested in how the school closure, and with it, the new role of parents as assistant teachers, influenced parents' well-being and the household dynamics. Due to the novelty of the situation, this aspect is still understudied.

It must be highlighted that the sample used for our study was not a representative sample because of the convenience sampling procedure. Self-selection bias is to be expected. Additionally, our measures of well-being and household dynamics rely on self-report about events before and after the COVID-19 pandemic, which might be biased due to memory and/or other variables. Therefore, it is important to juxtapose the findings in this paper with longitudinal studies on parental well-being that happened to occur just before the pandemic started, as they have the advantage of contemporaneous well-being assessments. Moreover, such a study would also serve as a quasi-experimental study that could more convincingly prove a causal relationship among variables.

Similar to the majority of studies conducted during the first lockdown our sample was preponderantly female (Brose et al., 2020; Porsch and Porsch, 2020; Sander et al., 2020; Wildemann and Hosenfeld, 2020; Blume et al., 2021; Steinmayr et al., 2021). Women are usually overrepresented in psychological studies (Dickinson et al., 2012), but in the case of the present study the reason most likely lies in the instruction. As previously mentioned, respondents were required to be the main caregiver of the child (or children), which usually is the mother in Germany. Another limitation is that only one questionnaire was filled in per household, therefore, we lack the information how the partner (in the cases where there was one) perceived the situation. As aforementioned, results from previous studies showed that fathers' and mothers' well-being was differentially affected by the pandemic and its mitigating measures (Möhring et al., 2021). However, when considering the important role that the main caregiver has for the family system, and hence, for the well-being and development of the children, we decided to focus on this individual to obtain a report on the entire family.

Moreover, we considered an online questionnaire as the best method under the lockdown circumstances. As other researchers (e.g., Heller and Zuügel, 2020; Huber and Helm, 2020; Lorenz et al., 2020), we exclusively used online media to recruit our sample, such as Facebook, Twitter, or e-mail. However, this of course biased the sample to those families with internet access and those more familiar with internet surveys, who tend to be more educated and of a higher socioeconomic class. This is also reflected in our sample which was skewed with regard to socioeconomic and educational background. Hence, it can be assumed that these families had less difficulties assisting their children with schoolwork and faced fewer socioeconomic problems during the pandemic (and were therefore more available to answer our questionnaire). Consequently, our results may not be able to be extrapolated to participants who do not fit in these categories. Other studies, especially conducted during the first wave and working with convenience samples, face this problem as well (cp. Steinmayr et al., 2021). Future studies should aim to include more diverse sample or a more representative sample, for example by using different methodological approaches (e.g., focus group interviews or representative sampling); as findings with such samples would provide a more complete picture of how German families are coping with the pandemic-induced lifestyle changes, which can then be extrapolated to countries with similar conditions.

Finally, another limitation is the correlational nature of our study. This implies that we cannot prove causation among the studied variables, only correlations.

CONCLUSION

For our German convenience sample, we observed that during the early COVID-19 pandemic parental well-being in general was quite positive despite parents' struggle with their new role as "assistant teachers." Parents of school-aged children have mostly been able to establish positive dynamics in their households given the extra time they get to spend with their children, and this has in turn benefited their well-being. However, it is important to bridge the gap between parents and teachers regarding distance-learning because it is a source of stress for parents and a prolonged period under these circumstances may lead to a breakdown in parent-child and parent-teacher relationships and negative long-term consequences for the students.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the current study in accordance with the local legislation and institutional requirements. All ethical guidelines provided by the German Psychological Society (DGPs) were followed. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AH contributed to the conception and design of the study. DC-R implemented the survey, performed the statistical analysis, and was the lead author of the manuscript with guidance and contributions from AH. AH and DC-R organized the database. Both authors contributed to manuscript revision, read, and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.734257/full#supplementary-material

REFERENCES

Achterberg, M., Dobbelaar, S., Boer, O. D., and Crone, E. A. (2021). Perceived stress as mediator for longitudinal effects of the COVID-19 lockdown on wellbeing of parents and children. *Sci. Rep.* 11:2971. doi: 10.1038/s41598-021-81720-8

Anderson, J. C., and Gerbing, D. W. (1988). Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. *Psychol. Bull.* 103, 411–423.doi: 10.1037/0033-2909.103.3.411

Autorengruppe Corona-KiTa-Studie (2021). *3. Quartalsbericht der Corona-KiTa-Studie (I/2021) [3rd Quarterly Report of the Corona-Daycare Study]*. München: DJI.

Baker, C. K., Perilla, J. L., and Norris, F. H. (2001). Parenting stress and parenting competence among Latino men who batter. *J. Interpers. Viol.* 16, 1139–1156. doi: 10.1177/088626001016011003

Baker, S., Bloom, N., Davis, S., and Terry, S. (2020). *COVID-Induced Economic Uncertainty*. Cambridge, MA: National Bureau of Economic Research, doi: 10.3386/w26983

Benzeval, M., Burton, J., Crossley, T. F., Fisher, P., Jäckle, A., Perelli-Harris, B., et al. (2020). *Understanding Society - COVID-19 Survey - May Briefing Note: Family relationships, Understanding Society Working Paper No 13/2020*. Essex: University of Essex, 1–19.

Blum, S., and Dobrotic, I. (2021). "Die Kita- und Schulschließungen in der COVID-19-Pandemie [The daycare and school closures in the COVID-19 pandemic]," in *Schule während der Corona-Pandemie: Neue Ergebnisse und Überblick über ein dynamisches Forschungsfeld*, eds D. Fickermann and B. Edelstein (Münster: Waxmann), 81–99. doi: 10.25656/01:21515

Blume, F., Schmidt, A., Kramer, A. C., Schmiedek, F., and Neubauer, A. B. (2021). Homeschooling during the SARS-CoV-2 pandemic: The role of students' trait self- regulation and task attributes of daily learning tasks for students' daily self- regulation. *Zeitschrift für Erziehungswissenschaft* 24, 367–391. doi: 10.1007/s11618-021-01011-w

Bos, W., Eickelmann, B., Gerick, J., Goldhammer, F., Schaumburg, H., Schwippert, K., et al. (eds) (2014). *ICILS 2013 Computer- und informationsbezogene Kompetenzen von Schülerinnen und Schülern in der 8 . Jahrgangsstufe im internationalen Vergleich [ICILS 2013 Computer and information-related skills of pupils in the 8th grade in an international comparison]*. Münster: Waxmann.

Bronfenbrenner, U., and Morris, P. (2006). "The Bioecological Model of Human Development," in *Handbook of child psychology: Vol. 1. Theoretical models of human development*, 6th Edn, Vol. 1, eds R. M. Lerner and W. Damon (Hoboken, NJ: John Wiley & Sons), 793–828.

Brose, A., Blanke, E. S., Schmiedek, F., Kramer, A. C., Schmidt, A., and Neubauer, A. B. (2020). Change in mental health symptoms during the COVID-19 pandemic: The role of appraisals and daily life experiences. *J. Pers.* 2020:12592. doi: 10.1111/jopy.12592

Brown, S. M., Doom, J. R., Lechuga-Peña, S., Watamura, and Koppels, T. (2020). Stress and parenting during the global COVID-19 pandemic. *Child Abuse Neglect* 110:104699. doi: 10.1016/j.chiabu.2020.104699

Browne, D. T., Plamondon, A., Prime, H., Puente-Duran, S., and Wade, M. (2015). Cumulative risk and developmental health: an argument for the importance of a family-wide science. *Wiley Interdiscipl. Rev. Cognit. Sci.* 6, 397–407. doi: 10.1002/wcs.1349

Chin, W. W. (1998). The partial least squares approach to structural equation modelling. *Modern Methods Bus. Res.* 295, 295–336.

Cobham, V. E., McDermott, B., Haslam, D., and Sanders, M. R. (2016). The Role of Parents, Parenting and the Family Environment in Children's Post-Disaster Mental Health. *Curr. Psychiatry Rep.* 18, 1–9. doi: 10.1007/s11920-016-0691-4

Cohen, F., Oppermann, E., and Anders, Y. (2020). *Familien und Kitas in der Corona-Zeit. Zusammenfassung der Ergebnisse [Families and daycares in Corona Times: Summary of results]*. Bamberg: University of Bamberg.

Dickinson, E. R., Adelson, J. L., and Owen, J. (2012). Gender balance, representativeness, and statistical power in sexuality research using undergraduate student samples. *Arch. Sexual Behav.* 41, 325–327. doi: 10.1007/s10508-011-9887-1

Ebrahim, G. J., and Ebrahim, G. J. (1982). "The family as a child-rearing unit of society," in *Child Health in a Changing Environment*, ed. G. J. Ebrahim (London: Macmillan Education UK), 68–97. doi: 10.1007/978-1-349-17031-9_3

Eickelmann, B., Bos, W., and Labusch, A. (2019). "Kapitel I: Die Studie ICILS 2018 im Überblick - Zentrale Ergebnisse und mögliche Entwicklungspespektiven [Chapter I: The ICILS 2018 Study in Overview – Main results and possible development perspectives]," in *ICILS 2018# Deutschland: Computer- und informationsbezogene Kompetenzen von Schülerinnen und Schülern im zweiten internationalen Vergleich und Kompetenzen im Bereich Computational Thinking*, eds B. Eickelmann, W. Bos, J. Gerick, F. Goldhammer, H. Schaumburg, K. Schwippert, et al. (Münster: Waxmann), 7–31.

Errázuriz Arellano, P. A., Harvey, E. A., and Thakar, D. A. (2012). A Longitudinal Study of the Relation Between Depressive Symptomatology and Parenting Practices. *Fam. Relat.* 61, 271–282. doi: 10.1111/j.1741-3729.2011.00694.x

Fan, W., and Williams, C. M. (2010). The effects of parental involvement on students' academic self-efficacy, engagement and intrinsic motivation. *Educat. Psychol.* 30, 53–74. doi: 10.1080/01443410903353302

Fan, X., and Chen, M. (2001). Parental Involvement and Students' Academic Achievement: A Meta-Analysis. *Educat. Psychol. Rev.* 13, 1–12. doi: 10.1023/A:1009048817385

Ferguson, N. M., Cummings, D. A. T., Fraser, C., Cajka, J. C., Cooley, P. C., and Burke, D. S. (2006). Strategies for mitigating an influenza pandemic. *Nature* 442, 448–452. doi: 10.1038/nature04795

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*, 4th Edn. Thousand Oaks, CA: SAGE Publications.

Fiese, B. H., Tomcho, T. J., Douglas, M., Josephs, K., Poltrock, S., and Baker, T. (2002). A review of 50 years of research on naturally occurring family routines and rituals: Cause for celebration? *J. Fam. Psychol.* 6, 381–390. doi: 10.1037/0893-3200.16.4.381

Findlay, L., and Arim, R. (2020). *Canadians report lower self-perceived mental health during the COVID-19 pandemic*. Ottawa, ON: Statistics Canada.

Ford, F. R. (1983). Rules: The Invisible Family. *Fam. Process* 22, 135–145. doi: 10.1111/j.1545-5300.1983.00135.x

German Language Blog (2020). *The Curiosity of the Word "Homeoffice"*. Available online at: https://blogs.transparent.com/german/the-curiosity-of-the-word-homeoffice/ (accessed June 09, 2021).

Greenberger, E., and O'Neil, R. (1993). Spouse, Parent, Worker: Role Commitments and Role-Related Experiences in the Construction of Adults' Well-Being. *Dev. Psychol.* 29, 181–197. doi: 10.1037/0012-1649.29.2.181

Hair, J. F., Ringle, C. M., and Sarstedt, M. (2011). Journal of Marketing Theory and Practice PLS-SEM: Indeed a Silver Bullet. *J. Marketing Theory Pract.* 19, 139–152. doi: 10.2753/MTP1069-6679190202

Heller, S., and Zuügel, O. (2020). *"Schule zu Hause" in Deutschland – Bestandsaufnahme im Corona-Lockdown aus Sicht von Schuülern und Eltern ["School at home" in Germany – Inventory of the Corona-Lockdown from the perspective of students and parents]*. Zürich: Accelerom AG.

Hobfoll, S. E. (1989). Conservation of Resources: A New Attempt at Conceptualizing Stress. *Am. Psychol.* 44, 513–524. doi: 10.1037/0003-066X.44.3.513

Huber, S. G., and Helm, C. (2020). COVID-19 and Schooling: Evaluation, Assessment and Accountability in Times of Crises-Reacting Quickly to Explore Key Issues for Policy, Practice and Research with the School Barometer. *Educat. Assess. Evaluat. Accountabil.* 32, 237–270. 09322-y doi: 10.1007/s11092-020-

Huber, S. G., Günther, P. S., Schneider, N., Helm, C., Schwander, M., Schneider, J., et al. (2020). *COVID-19 und aktuelle Herausforderungen in Schule und Bildung: Erste Befunde des Schul-Barometers in Deutschland, Österreich und der Schweiz. Bibliografische Informationen der Deutschen Nationalbibliothek [COVID-19 and current challenges in schools and educations: First findings of the school barometer in Germany, Austria and Switzerland. Bibliographic information from the German National Library]*. Münster: Waxmann.

Huebener, M., Spieß, C. K., Siegel, N., and Wagner, G. (2020). Wohlbefinden von Familien in Zeiten von Corona: Eltern mit jungen Kindern am stärksten beeinträchtigt [Well-being of families in times of Corona: Parents with young children most affected]. *DIW Wochenbericht* 87, 527–537. doi: 10.18723/diw_wb:2020-30-1

Jeynes, W. H. (2012). A meta-analysis of the efficacy of different types of parental involvement programs for urban students. *Urban Educat.* 47, 706–742. doi: 10.1177/0042085912445643

Johnson, A. J., Moore, Z. S., Edelson, P. J., Kinnane, L., Davies, M., Shay, D. K., et al. (2008). Household responses to school closure resulting from outbreak of influenza B, North Carolina. *Emerging Infect. Dis.* 14, 1024–1030. doi: 10.3201/eid1407.080096

Jolly, J. L., and Matthews, M. S. (2018). Educational Review The shifting landscape of the homeschooling continuum. *Educ. Rev.* 72, 269–280. doi: 10.1080/00131911.2018.1552661

Kaplan, D. S., Kaplan, H. B., and Liu, X. (2001). Influence of parents' self-feelings and expectations on children's academic performance. *J. Educ. Res.* 94, 360–370. doi: 10.1080/00220670109598773

Kilbourne, E. D. (2006). Influenza Pandemics of the 20th Century. *Emerg. Infect. Dis.* 12:9. doi: 10.3201/eid1201.051254

Kline, R. B. (2005). *Principles and Practice of Structural Equation Modeling*, 2nd Edn. New York, NY: Guilford Press.

Krohne, H. W., Egloff, B., Kohlmann, C.-W., and Tausch, A. (1996). Untersuchungen mit einer deutschen Version der "Positive and Negative Affect Schedule" (PANAS) [Investigations with a German version of the Positive and Negative Affect Schedule (PANAS)]. *Diagnostica* 42, 139–156. doi: 10.1037/t49650-000

Letzel, V., Pozas, M., and Schneider, C. (2020). Energetic Students, Stressed Parents, and Nervous Teachers: A Comprehensive Exploration of Inclusive Homeschooling During the COVID-19 crisis. *Open Educat. Stud.* 2, 159–170. doi: 10.1515/edu-2020-0122

Lorenz, R., Lepper, C., Brüggemann, T., and McElvany, N. (2020). *Unterricht während der Corona-Pandemie: Lehrkräftebefragung Ergebnisse Teil 1 "Der Unterricht" [Teaching during the Corona pandemic: Results of a teacher survey, Part 1 „ The Teaching"]*. Dortmund: Institut für Schulentwicklung.

Martarelli, C. S., Pacozzi, S. G., Bieleke, M., and Wolff, W. (2021). High Trait Self-Control and Low Boredom Proneness Help COVID-19 Homeschoolers. *Front. Psychol.* 12:594256. doi: 10.3389/fpsyg.2021.594256

Masten, A. S., and Motti-Stefanidi, F. (2020). Multisystem Resilience for Children and Youth in Disaster: Reflections in the Context of COVID-19. *Advers. Resil. Sci.* 1, 95–106. doi: 10.1007/s42844-020-00010-w

Miller, J. J., Cooley, M. E., and Mihalec-Adkins, B. P. (2020). Examining the Impact of COVID-19 on Parental Stress: A Study of Foster Parents. *Child Adolesc. Soc. Work J.* 2020, 1–10. doi: 10.1007/s10560-020-00725-w

Möhring, K., Naumann, E., Reifenscheid, M., Wenz, A., Rettig, T., Krieger, U., et al. (2021). The COVID-19 pandemic and subjective well-being: longitudinal evidence on satisfaction with work and family. *Eur. Soc.* 23, S601–S617. doi: 10.1080/14616696.2020.1833066

Parczewska, T. (2020). Difficult situations and ways of coping with them in the experiences of parents homeschooling their children during the COVID-19 pandemic in Poland. *Education* 2020, 1–12. doi: 10.1080/03004279.2020.1812689

Patterson, J. M. (2002). Integrating family resilience and family stress theory. *J. Marriage Fam.* 64, 349–360. doi: 10.1111/j.1741-3737.2002.00349.x

Porsch, R., and Porsch, T. (2020). Fernunterricht als Ausnahmesituation [Distance-learning as an exceptional situation]. *Die Deutsche Schule* 61–78. doi: 10.31244/9783830992318.03

Prime, H., Wade, M., and Browne, D. T. (2020). Risk and resilience in family well-being during the COVID-19 pandemic. *Am. Psychol.* 75, 631–643. doi: 10.1037/amp0000660

Ren, J., Li, X., Chen, S., Chen, S., and Nie, Y. (2020). The Influence of Factors Such as Parenting Stress and Social Support on the State Anxiety in Parents of Special Needs Children During the COVID-19 Epidemic. *Front. Psychol.* 11:565393. doi: 10.3389/fpsyg.2020.565393

Sacher, W., Berger, F., and Guerrini, F. (2019). *Schule und Eltern – eine schwierige Partnerschaft. Wie Zusammenarbeit gelingt [School and Parents – a difficult partnership]*. Stuttgart: Kohlhammer.

Sander, A., Schäfer, L., and van Ophuysen, S. (2020). *Erste Ergebnisse aus dem Projekt „Familiäre Lernbegleitung in Zeiten von Schulschließungen aufgrund der Corona- Pandemie (FamiLeb)"–Eine online-Befragung von Eltern in NRW [First results of the Project: „Family learning support in times of school closings due to the corona pandemic (FamiLeb)" – An online survey of parents in NRW]*. Münster: Universität Münster.

Schade, H. M., Digutsch, J., Kleinsorge, T., and Fan, Y. (2021). Having to Work from Home: Basic Needs, Well-Being, and Motivation. *Int. J. Environ. Res. Public Health* 18:5149. doi: 10.3390/ijerph18105149

Schweizer Bundesrat (2020). *Bundesrat verschärft Massnahmen gegen das Coronavirus zum Schutz der Gesundheit und unterstützt betroffene Branchen [Federal Council tightened measures against the coronavirus to protect health and supports affected industries] [Media release]*. Available online at: https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen/bundesrat.msg-id-78437.html (accessed March 13, 2020).

Sheldon, S. B., and Epstein, J. L. (2005). Involvement Counts: Family and Community Partnerships and Mathematics Achievement. *J. Educat. Res.* 98, 196–207. doi: 10.3200/JOER.98.4.196-207

Steinmayr, R., Lazarides, R., Weidinger, A. F., and Christiansen, H. (2021). Teaching and learning during the first COVID-19 school lockdown: Realization and associations with parent-perceived students' academic outcomes: A study and preliminary overview. *Zeitschrift Fur Padagogische Psychol.* 35, 85–106. doi: 10.1024/1010-0652/a000306

Team R Studio (2020). *RStudio: Integrated Development Environment for R*. Boston, MA: PBC.

Thompson, E. R. (2007). Development and validation of an internationally reliable short-form of the Positive and Negative Affect Schedule (PANAS). *J. Cross Cult. Psychol.* 38, 227–242. doi: 10.1177/0022022106297301

Ulrich, M., Hachfeld, A., and Möhrke, P. (in press). Gemeinsame Bildungsverantwortung in der Corona-Pandemie: Einschätzungen von Lehrpersonen und Eltern während der Schulschließungen [Joint responsibility

for education in the corona pandemic: assessments by teachers and parents during school closings]. *Lehren & Lernen*.

Wild, E. (2003). Einbeziehung des Elternhauses durch Lehrer: Art, Ausmaß und Bedingungen der Elternpartizipation aus der Sicht von Gymnasiallehrern [Inclusion of the parents' home by teachers: type, extent and conditions of parental participation from the point of view of high school teachers]. *Zeitschrift für Pädagogik* 49, 513–533.

Wildemann, A., and Hosenfeld, I. (2020). *Bundesweite Elternbefragung zu Homeschooling während der Covid 19-Pandemie Erkenntnisse zur Umsetzung des Homeschoolings in Deutschland [National Parent Survey about Homeschooling during the COVID-19 pandemic]*. Mainz: Universität Koblenz-Landau.

Yotyodying, S., and Wild, E. (2016). Predictors of the quantity and different qualities of home-based parental involvement: Evidence from parents of children with learning disabilities. *Learn. Individ. Differ.* 49, 74–84. doi: 10.1016/j.lindif.2016.05.003

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

frontiers in Psychology

ORIGINAL RESEARCH
published: 07 February 2022
doi: 10.3389/fpsyg.2022.734138

Austrian College Students' Experiences With Digital Media Learning During the First COVID-19 Lockdown

Carrie Kovacs, Tanja Jadin and Christina Ortner*

Faculty of Informatics, Communications and Media, Institute of Communication and Knowledge Media, University of Applied Sciences Upper Austria, Hagenberg, Austria

OPEN ACCESS

Edited by:
Karin Gehrer, Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Cristina Mª García-Fernández, University of Cordoba, Spain
Carmen Köhler, Leibniz Institute for Research and Information in Education (DIPF), Germany
Michael Beck, University of Teacher Education St. Gallen, Switzerland

***Correspondence:**
Tanja Jadin
Tanja.Jadin@fh-hagenberg.at

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *11 January 2022*
Published: *07 February 2022*

Citation:
Kovacs C, Jadin T and Ortner C (2022) Austrian College Students' Experiences With Digital Media Learning During the First COVID-19 Lockdown. Front. Psychol. 13:734138. doi: 10.3389/fpsyg.2022.734138

In 2020, the COVID-19 pandemic forced many nations to shut-down schools and universities, catapulting teachers and students into a new, challenging situation of 100% distance learning. To explore how the shift to full distance learning represented a break with previous teaching, we asked Austrian students ($n = 874$, 65% female, 34% male) which digital media they used before and during the first Corona lockdown, as well as which tools they wanted to use in the future. Students additionally reported on their attitudes and experiences with online learning. Results showed that students used certain tools, such as video, audio, e-assessments, and web conferencing systems, much more often during lockdown than they had before. Their use of classic digital media, such as e-mail, social communication tools, such as chat or online forums, and other interactive tools, such as wikis or educational games, hardly changed at all. Their attitudes toward multimedia learning were positively related to their media use. In their open responses ($n = 137$), students identified advantages of online learning (flexibility and self-directed learning), as well as disadvantages (limited social interaction) and challenges (motivation and self-discipline). As a group, they also expressed a clear preference for a balanced combination of online- and offline teaching in the future. However, individual students did prefer fully online or offline learning modes, depending on their personal circumstances and educational goals. We view this as a call to researchers and educators alike to explore ways in which the advantages of online and face-to-face learning can best be combined to meet the changed needs and expectations of organizations, students, and teachers in a future "after Corona."

Keywords: COVID-19, multimedia learning, digital media use, online learning, e-learning, interactive media, attitudes, online tools

INTRODUCTION

In spring of 2020, the COVID-19 pandemic precipitated a widespread shut-down of public life throughout the world. Along with countless other public and private organizations, schools and universities found themselves in an unprecedented situation. Though countries all around the world were in similar circumstances, higher education institutions in different countries

employed widely different response strategies (Crawford et al., 2020). In many countries, including Austria, universities suddenly closed, switching to a complete distance learning modus—generally using some form of online instruction—within a few days or even hours.

As might be expected, such an abrupt upheaval was not only challenging for instructors, but also for students. Lack of motivation, Internet problems, limited interaction among students and instructors, trouble concentrating, difficulty finding school-life balance, learning problems, and lack of support were identified as particularly important challenges in two early COVID-19 studies (Adnan and Anwar, 2020; Aguilera-Hermida, 2020). In addition to these problems, students reported deficiencies in the quality of online discussions and an absence of structure in online class settings (Nambiar, 2020). Despite such drawbacks, students also identified benefits in the new learning situation. US students, for instance, reported having more time for family, hobbies, self-care, and personal growth (Aguilera-Hermida, 2020). Indian students reported practical advantages, such as time saved commuting and having online videos of lectures to refer to after class (Nambiar, 2020). Different factors played a role in how positively students viewed the distance-learning situation. For instance, one study found that instructional quality played an important part in predicting students' satisfaction with online learning (Gopal et al., 2021). Austrian and Finish students' self-reported feelings of competence were the strongest predictor for positive emotions during online learning, though both competence and autonomy predicted intrinsic learning motivation (Holzer et al., 2021). In a further study looking at perceptions of online learning during the lockdown, Rizun and Strzelecki (2020) used data from 1,692 Polish participants to predict students' acceptance of distance learning. They found that distance-learning enjoyment and self-efficacy were better predictors of acceptance than computer experience or anxiety, but also that perceived ease of use and perceived usefulness were key mediators between enjoyment/self-efficacy and overall attitudes toward and intention to use distance learning. Thus, pedagogical and psychological factors as well as specific technical aspects seem central in determining how university students perceive distance learning generally and online learning during the COVID-19 lockdown specifically.

Online learning itself is not new or unique to the COVID-19 pandemic. Before COVID-19, higher education institutions had long pursued various e-learning strategies, both in the form of fully online learning and in blended online/offline formats. E-learning has both advantages and disadvantages. On the one hand, online learning offers more flexibility in time and space, ease of access to a huge amount of information, different interaction possibilities, reduced costs (e.g., travel), lower barriers in initiating certain kinds of communication, and support of self-paced, individual learning (Arkorful and Abaidoo, 2014). Paechter and Maier (2010), investigating Austrian students' preferences, found that online learning was considered better in offering clear content structure and supporting individual learning processes. Conversely, students favored face-to-face learning for communication and collaborative learning processes. A similar result was found among US students asked to explain either their satisfaction or dissatisfaction with online learning. Satisfied students most commonly cited convenience as the cause for their satisfaction; dissatisfied students most commonly cited lack of interaction and communication as reason for their dissatisfaction (Cole et al., 2014). Such reports of interactional deficits in online learning also fit with results showing that the "nature of e-learning"—including its impersonal nature and lack of interaction with other learners—was considered a central barrier to future online learning among a group of Australian employees (Becker et al., 2013). Similarly, both Taiwanese and American students rated face-to-face courses more positively than online courses in terms of communication/interaction (Young and Duncan, 2014; Bali and Liu, 2018). These findings all echo and support a more general claim that subjective feelings of social presence during online communication are an important predictor of student satisfaction and thus particularly relevant in computer-mediated learning contexts (e.g., Gunawardena, 1995; Lowenthal, 2010).

Given this evidence that limited social interaction is a challenge to successful online learning, a closer examination of how specific online media tools may facilitate communication processes seems merited. Hsieh and Cho (2011), for instance, argued that instructor-student interactive tools are more useful and satisfying to students than self-paced tools because they provide greater media richness, social presence, and thus greater information quality. These authors found correlational evidence among a group of Chinese students to support their claim that e-learning tools' ability to facilitate social interaction is a key aspect driving students' evaluations of those tools. A similar focus on interaction is also found in Anderson's (2008) theoretical classification of educational media along two dimensions: the extent to which a medium can be used independently of time and distance, and the extent to which it supports interaction. Media such as television—or, more recently, online educational videos—can be used largely independently of time and place, but they allow for relatively little interaction. Face-to-face discussions show an opposite pattern, with low independence of time and place but high levels of interaction. Media such as video or audio conferencing fall somewhere in between. According to Anderson, successful online learning occurs when teachers are able to switch flexibly between appropriate media and communication forms for a given learning context.

As educators flexibly respond to students' needs, new technologies and an ever-growing collection of readily available educational software have radically increased the size of the media toolbox from which they can draw. Web 2.0 and social media allow for flexible and spontaneous interaction inside and outside the classroom, falling fairly high on both the interaction and the independence dimension of Anderson's model. In fact, e-learning with social media embedded in specific course design has been shown to facilitate knowledge acquisition and knowledge building (Mauss and Jadin, 2013; Mnkandla and Minnaar, 2017). Ubiquitous mobile devices have further increased learners' independence of time and place, while simulation software and virtual reality technologies expand the bounds of feasible hands-on exercises. Besides supporting

independence of time and place, such new tools are also often high in interactive potential, meaning that they offer ever more and easier technological possibilities for interactive learning. Even below any new cutting edge of technological developments, however, computer-supported collaborative learning has long been possible and didactically effective, as shown by a meta-analysis of 143 studies published between 2004 and 2014 (Jeong et al., 2019).

Despite this potential, interactive communication media have traditionally remained underused in tertiary education (OECD, 2005; Persike and Friedrich, 2016). For instance, Persike and Friedrich (2016) found that classic tools, such as e-mail, were still the dominant media used for online learning among a Germany-wide sample of 27,473 university students. More than 50% of students were classified either as "PDF-users" (employing primarily classic digital media, such as PDF-documents, e-mail, and presentation slides) or as "e-examinees" (employing classic digital media and e-assessments only). While a further 22% were "video-learners," who reported high usage of classic and audiovisual media, only 21% of students could be classified as "digital all-rounders" employing a wide variety of digital media in their studies, including interactive media. This is in line with results of a much smaller Romanian study, which found that although students rated Web 2.0 and collaborative tools as helpful and useful for educational purposes, they used such tools primarily for finding information (e.g., on Wikipedia) and not as intended by the innovators in the sense of user generated content (Popescu, 2010). Effectively using Web 2.0 and other new technologies to facilitate collaborative learning and communication processes demands distinctive pedagogical approaches. Kreijns et al. (2003) argued that instructors must steer clear of two major pitfalls when implementing collaborative online learning: taking social interaction for granted and restricting social interaction to cognitive processes. In order to realize the full interactive potential of online communication media, they suggest instructors must actively promote "sociable" collaborative online learning environments through a variety of instructional strategies. This is in line with research on face-to-face education, which shows that effective collaborative learning depends in large part on appropriate instructor support (Webb, 2009). It follows that one of the reasons for underutilization of online communication media in the past has been that it was not accompanied by appropriate pedagogical strategies. In addition to pedagogical concerns, issues of workload, cost, inadequate infrastructure, and lack of technical support have also been named as barriers to online teaching in higher education settings (Keengwe and Kidd, 2010). Thus, the 2020 COVID-19 lockdown forced online learning on an educational community with some decades' worth of e-learning experience in principal, but very limited e-learning prevalence in practice.

Such lack of e-learning experience can no longer be reasonably assumed; everyone in school systems subject to the lockdown gained experience with distance learning in 2020, generally through some form of online instruction. Teachers (Nambiar, 2020) as well as students (Rahiem, 2020) reported using a variety of different online tools. The current study expands on this research by exploring which types of tools specifically "boomed" in Austrian higher education institutions during the first COVID-19 lockdown. In addition to asking students which specific media they used for educational purposes during the lockdown, we also questioned them about their former usage habits ("before Corona") and about their desired usage in a future "after Corona." Purpose of this explorative quantitative survey was (1) to get a general impression of usage and changes in usage of specific media types during the first Corona lockdown and (2) to determine how media usage (and desired usage) related to students' overall attitudes toward multimedia learning. As part of our first broad research question, we also explored whether and in what proportions we could identify individuals corresponding to the four media user types of Persike and Friedrich's (2016) categorization based on students' "before Corona" media usage reports. Assuming that we could find similar media user types, we were interested in discovering how these groups' media use developed during the lockdown. Due to the large number of rather elaborated answers to an open-ended question at the end of the questionnaire, we were unexpectedly able to extend our explorative quantitative methodology into a mixed-methods approach. Students' spontaneous statements allowed us (3) to explore what they saw as central differences between online and offline learning, what conditions for successful online learning they identified, and what they recommended for future online practice in higher education.

MATERIALS AND METHODS

Study Design and Recruitment

In order to explore students' use of educational media before and during the lockdown, we drew upon a correlational, cross-sectional, and largely quantitative survey design. We subsequently extended our study by a qualitative analysis of written comments left by participants at the end of the survey, resulting in an explorative mixed-methods approach. The study was planned and conducted with the help of 16 students fulfilling a research course requirement in their interdisciplinary Bachelor's degree program. In April and May of 2020, we distributed an online questionnaire to representatives of all 96 public and private universities located in Austria at that time. In addition to using official contact e-mail addresses obtained from the websites of these institutions, students also used their private connections to student representative groups and members of individual study programs to recruit participants. Through this combination of systematic and convenience sampling, we were able to recruit an initial 1,514 hits on the first page of the online questionnaire. Of these initial visitors to the instruction page, 1100 (73%) gave their consent to participate in the study. Only those 1,037 (68%) participants who reported being current university students were asked to continue with the survey; this number was further reduced to 1,033 students who reported attending an Austrian (as opposed to German) school. The sample decreased to 874 (58%) through a control question halfway through the survey, which instructed participants to select a specific answer option. Of these 874 students, 132 provided comments about

e-learning at the end of the survey. Five additional students left such comments after having skipped or incorrectly answered the control question. Though careless responding seemed likely for these students' rating scale data and justified its continued omission from the quantitative analysis, their open responses were plausible and relevant. Thus, we chose to include these comments in the qualitative analysis. This resulted in a final qualitative sample of 137 students.

Measures

In addition to basic information about their age, gender, course of studies, and home institution, students were asked to estimate the intensity of their use of specific digital media for educational purposes before and during the first COVID-19 lockdown (March 2020), their preferred intensity of such media use in the future, as well as their overall attitudes toward multimedia learning. At the end of the survey, they were asked whether they had any further comments and provided with an open text input field.

Media use items were adapted from a publically funded German educational research study conducted by Persike and Friedrich in 2016. The original study asked students to report whether they used 20 specific digital media types in the course of their studies. These media were grouped into five broad categories: (1) *classic digital media* (e.g., digital texts and e-mail), (2) *social communication tools* (e.g., chat and forums), (3) *e-exams* (e-assessments and e-exams), (4) *audiovisual media* (audio, video, and web-based tutorials), and (5) *interactive tools* (e.g., educational games, and online office tools). Though we largely adopted this list and categorization, we changed the survey instructions to ask students how intensely they had used the given media for purposes related to their studies (a) before the lockdown and (b) during the lockdown, as well as (c) how intensely they hoped to use these media in the future "after Corona." We changed the original 4-point categorical response scale to an ordered 6-point scale with the categories *very intensely* (6, "sehr intensiv"), *fairly intensely* (5, "ziemlich intensiv"), *intensely* (4, "intensiv"), *moderately* (3, "mäßig"), *slightly* (2, "wenig"), and *not at all* (1, "gar nicht"). Participants were additionally provided with a *do not know* ("weiß nicht") answer option, which was treated as a missing value in subsequent analyses. Based on qualitative feedback from the 16 students involved in survey construction and a small-scale pretest ($n < 10$), we also changed the original items slightly to clarify their meaning. On the one hand, we added concrete examples to three media descriptions—for instance, "Chat" became "Chat/Messenger (e.g., WhatsApp, Slack)." Additionally, because students had trouble differentiating between the items "E-Assessments" and "E-Exams," we combined them to form a single item "E-Assessments/E-Exams" (this meant that the final media category *e-exams* consisted of only one item). To form our media usage indices, we calculated the mean self-reported usage intensity for each of the five broad media categories; this made it possible to perform cluster analyses conceptually comparable to those of Persike and Friedrich (2016).

Attitude toward multimedia learning was measured using a 10-item instrument developed by Tigges (2008). Participants were asked to rate their agreement on a 4-point scale with the answer options *agree* (4, "stimme voll zu"), *somewhat agree* (3, "stimme eher zu"), *somewhat disagree* (2, "stimme eher nicht zu"), and *disagree* (1, "stimme nicht zu"). Seven of the 10 items indicated positive attitudes toward multimedia learning (e.g., "Multimedia increases motivation.") while three reverse-coded items indicated negative attitudes (e.g., "Virtual instruction makes people lonely."). Two items made obsolete by the current lockdown (e.g., "I think it would be good to be able to take part in online classes from home and not have to come to the university as often.") were adapted to refer to a future after the lockdown (e.g., "Even after the Corona crisis is over, I think it would be good […]").

Additionally, students' *appraisal of online learning* in their open comments was rated in terms of valence by two authors of the study using inductive structuring qualitative content analysis according to Mayring (2014). Using an open coding approach based on initial perusal of the data, we developed category definitions, anchor examples, and coding rules to classify students' appraisals of online learning. We then applied these coding rules to rate individual comments as either *negative* (−1), *neutral* (0), or *positive* (+1). This rating was applied to each comment as a whole, resulting in an *overall valence of open response* rating. Because students' appraisals of online learning in general often explicitly contradicted their appraisals of their experienced implementation of online learning during the lockdown, we additionally used the same category levels to rate students' general *appraisal of online learning* as well as their *appraisal of online learning implementation* separately. We felt this to be an interesting distinction in understanding attitudes toward online learning, especially negative or ambivalent attitudes, since it revealed that these could be due more to problematic implementation than inherent objections to online learning (though experiences of concrete implementation presumably do impact abstract attitudes toward online learning and vice versa). If students made no general statements about online learning or no specific statements about online learning implementation, ratings for the given variable were coded as missing. For instance, the comment "Online learning is a great addition but should not be treated as a replacement" was given an overall neutral valence rating (0), since positive and limiting statements were roughly balanced. It also received neutral ranking as an appraisal of online learning but was coded as missing in terms of online learning implementation. In contrast, the statement "I think that many universities are way behind with digital media and also aren't willing to switch to something new. I hope the current situation changes that!" was coded as having overall negative valence (−1), as constituting a negative appraisal of online learning implementation, and as including no appraisal of online learning in general. As mentioned above, only comments dealing in some way with online learning were included in the qualitative sample, so that all comments received an overall valence rating as well as a rating in at least one of the two coded subcategories. Overall valence ratings were independently coded by a second

rater, showing substantial (Landis and Koch, 1977) interrater reliability (Cohen's $\kappa = 0.67$).

Sample Characteristics

Our final sample of 874 Austrian students consisted of 386 (44%) students from public universities, 385 (44%) students from applied universities, 65 (7%) students from private colleges, and 38 (4%) students from other tertiary education institutes (e.g., teacher training colleges and seminaries). Due to varying participation among individual institutions, the final sample was geographically skewed, with 344 (39%) students attending schools in Upper Austria, 175 (20%) in Lower Austria, 150 (17%) in Tyrol, 71 (8%) in Vienna, 55 (6%) in Styria, 41 (5%) in Burgenland, 33 (4%) in Salzburg, and only five students in Carinthia and Vorarlberg combined. About half of these students ($n = 426$, 49%) was pursuing a bachelor's degree, 254 (29%) were in a master's program, 128 (15%) were in the traditional Austrian diploma program which provides the equivalent of a bachelor's and master's degree when completed, 46 (5%) were pursuing a doctorate, and 20 (2%) students gave no response or reported being in other degree programs (e.g., medical degree). The majority of these students ($n = 602$, 69%) reported being part of full-time degree programs originally designed to consist primarily of face-to-face teaching; a further 214 (25%) students reported being in a part-time face-to-face program aimed at working students. Only 24 (3%) students reported having signed up for a part-time distance learning degree program, while six (1%) students reported being in a full-time distance learning program. A total 570 (65%) students identified as female, 296 (34%) as male, three students as diverse and five students gave no gender information. Participants' ages ranged from 17 to 69, with a median of 24 years and a mean age of 27 years ($SD = 8.8$), though a substantial portion of the sample ($n = 183$, 21%) gave no age information.

A total of 137 (16%) students left comments at the end of the survey dealing in some way with e-learning or the distance learning situation, allowing them to be included in the qualitative analysis (19 additional comments were omitted from analysis because they referred to the survey itself or gave unrelated information about students' personal situations). In order to identify any systematic differences between our full sample and the participants who left comments, we performed a drop-out analysis using logistic regression to predict inclusion in the qualitative analysis on the basis of gender, age, school location, type of school (university, applied university, etc.), type of degree program (bachelor's, master's, etc.), media usage during the lockdown, and attitudes toward multimedia learning. Due to the very small case numbers, we excluded the categories "diverse" and "no answer" from the variable gender, the states Carinthia and Vorarlberg from school locations and the categories "other" and "other private educational institution" from the variable school type. Results of the full logistic regression model showed a significant omnibus model test, $X^2(21) = 41.06$, $p = 0.006$ with a Cox and Snell R^2 of 0.06 and a Nagelkerke R^2 of 0.11. An examination of individual predictors showed that age ($OR = 1.03$, $p = 0.037$), multimedia learning attitudes, ($OR = 0.68$, $p = 0.026$), as well as interactive ($OR = 1.79$, $p = 0.005$) and social communication ($OR = 0.66$, $p = 0.009$) tool usage during the first Corona lockdown reached statistical significance in predicting whether a participant commented or not. Commenting students were older ($M = 29$ years, $SD = 10.5$) than non-commenting students ($M = 27$ years, $SD = 8.3$) and reported less positive attitudes toward multimedia learning ($M = 2.58$, $SD = 0.76$) than non-commenting students ($M = 2.70$, $SD = 0.65$). They also reported slightly less intense use of social communication tools ($M = 2.36$, $SD = 0.85$) than non-commenting students ($M = 2.58$, $SD = 0.95$). Though the mean scores of interactive media use were descriptively equal for commenting and non-commenting students ($M = 2.52$, $SD = 0.77$), the odds ratio of 1.79 found in the regression analysis revealed that commenting students were actually likely to report more intense use of interactive media than non-commenting students when controlling for other relevant variables. Thus, our qualitative analyses (which reflect only the statements of commenting students) were not completely representative for our total sample: older participants with slightly less positive media attitudes and lower social communication tool usage (but higher interactive tool usage) seem to be somewhat overrepresented in relation to the total sample contributing to our quantitative results.

Data Analyses

Quantitative analyses were performed using IBM SPSS Version 27 and JASP Version 0.10.2,[1] graphs were created using Microsoft Excel and base R. Qualitative analyses were conducted with the help of MAXQDA 2018.

Students' appraisals of online learning were quantified according to Mayring (2014), as described in the Measures section above. Additionally, a data-driven, category-based thematic qualitative content analysis was used to gain a deeper understanding of the full breadth of students' open comments (see Kuckartz, 2019).

In order to determine overall changes in media use for individual types of media over time, we calculated a MANOVA with time (*before*, *during*, and *after*) as within-subject factor and usage of each of the 19 digital media as the outcome variables. Due to the explorative nature of the study and the large number of variables, we chose to analyze individual digital media usage ratings only descriptively on the basis of means and standard deviations instead of reporting all possible univariate and post-hoc tests. In general, because the assumptions for statistical inference (random sampling and independent observations) were not met by our data, all our inferential analyses should be seen as a type of small-scale data-mining with the aim of identifying possible effects of interest, not as stringent hypothesis tests.

In order to explore relationships between media use and attitudes, we aggregated the usage ratings for the 19 media types into the five mean usage indices described above (*classic digital media*, *social communication tools*, *e-exams*, *audiovisual media*, and *interactive tools*) for each assessed time point (before, during, and after the first Corona lockdown). Relationships

[1]https://jasp-stats.org/

between these media usage indices and overall *attitude toward multimedia learning* were calculated using Pearson's correlation coefficients. Relationships between usage indices and *appraisals of online learning* gleaned from the open-ended questions were quantified using Kendall's rank coefficient τ. The large number of relationships tested means that our correlational analyses likely suffer from alpha-inflation.

We also attempted to reproduce Persike and Friedrich's (2016) media usage typology based on the "before Corona" media usage indices, since these seemed most likely to be comparable to the 2016 data and would thus allow us to see differences between these groups' original media usage and their self-reported usage during the first Corona lockdown as well as their desired usage "after Corona." We performed *k*-means cluster analysis on the five *z*-standardized usage indices, assuming a 4-cluster solution (based on the number of clusters found by Persike and Friedrich). We then performed a univariate ANOVA to ensure that resulting clusters differed in terms of the usage indices on which they had been based, and a discriminant analysis to cross-validate the classification of individuals to specific clusters (assuming marginal totals based on the observed frequency distribution among the four clusters). Note that this was not a direct replication of Persike and Friedrich's analysis, since their original classification was based on dichotomous usage reports aggregated to percentage usage scores, not on mean usage indices. After forming the clusters, we tested association between cluster membership and attitudes through a univariate ANOVA with cluster (*PDF-user*, *video-learner*, *e-examinee*, and *digital all-rounder*) as between-subjects factor and *attitude toward multimedia learning* as the outcome variable.

RESULTS

Media Use

Students' self-reported use of different digital media is shown in **Figure 1**. The MANOVA calculated across all of the 19 digital media types showed significant overall differences in usage across time, $F(38,488) = 68.14$, $p < 0.001$. *Classic digital media* use was reported as fairly high before the 2020 lockdown, with presentation tools, e-mail, databases, and digital texts all

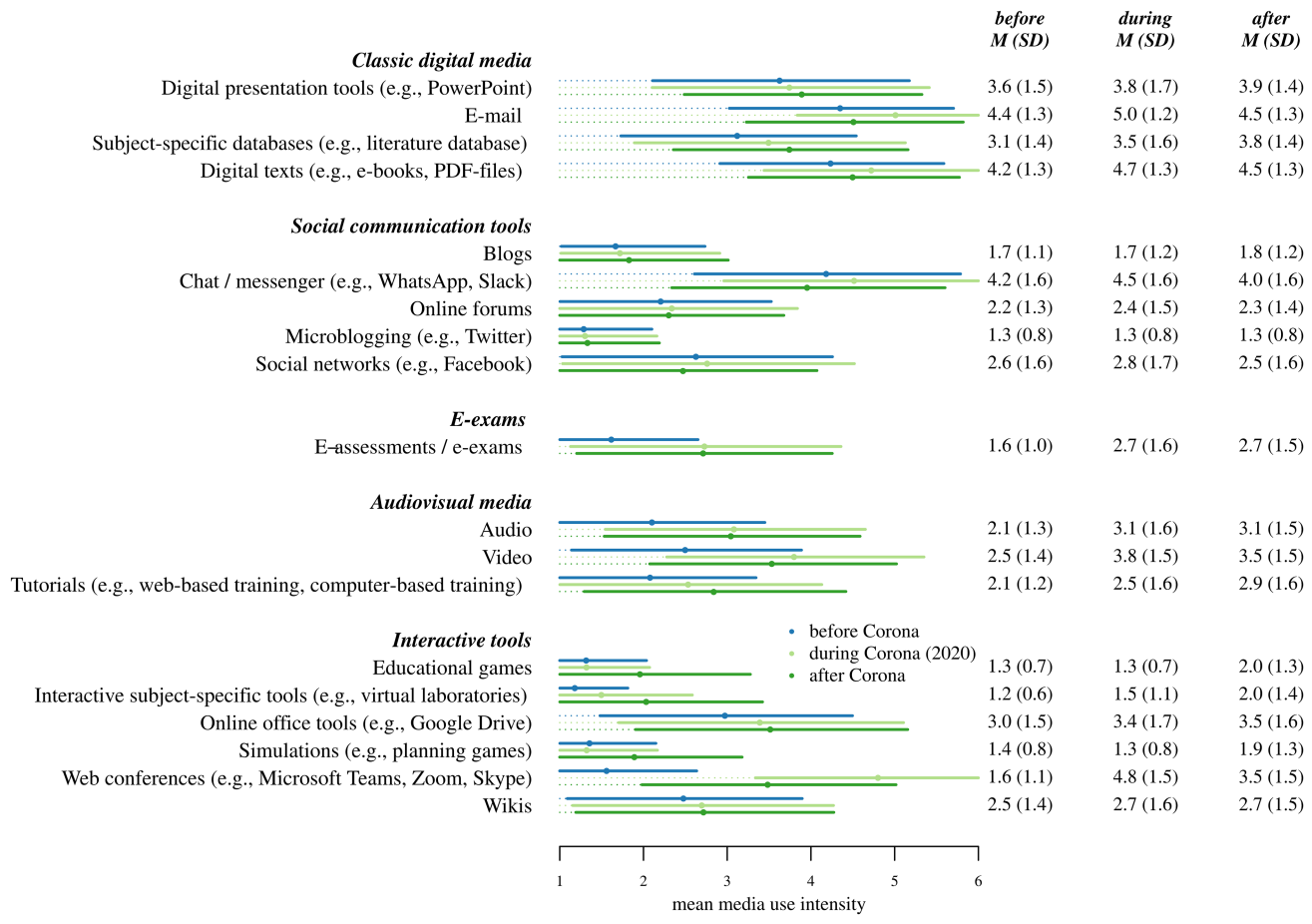

FIGURE 1 | Self-reported intensity of media use *before* and *during* the first Corona lockdown, as well as intensity desired *after* Corona ($751 < n < 873$, error bars represent standard deviations, truncated where they exceed the limits of the response scale).

showing mean usage above the response scale midpoint (3, "moderately"). Among all other types of media, only chat/messenger (in the category *social communication tools*) reached similarly high usage levels, though online office tools (among the *interactive tools*) were used moderately before the lockdown. Use of all other tools was comparatively low. This profile changed substantially during the lockdown. There was a sharp rise in use of *audiovisual media* (e.g., video and online tutorials), and a particularly steep increase in the interactive tool web conferencing, which changed from a seldom-used tool to one of the most frequently used tools, second only to e-mail and comparable to digital texts or chat. Web conferencing also showed the largest absolute discrepancy between usage "during Corona" and desired usage "after Corona"—students reported a desire to use this medium much less intensely after the end of the lockdown. In contrast, many of the seldom-used interactive tools showed a discrepancy in the opposite direction: students wished these rare tools to be used a bit more intensely after Corona, though not as intensely as, for instance, audiovisual media or e-assessment. Students also, however, expressed quite a bit of uncertainty in these "wish" ratings. While the number of "do not know" answers per tool ranged between 0 and 46 (5%) for media use before and during the lockdown, individual tools like wikis and interactive subject-specific tools received up to 86 (10%) "do not know" ratings when participants were asked how often these should be used hypothetically in the future.

Media Use Types

We were able to generate an acceptable 4-cluster media use typology based on the "before Corona" media usage indices. Univariate ANOVAs comparing the resulting clusters showed significant differences for all media usage indices (all $p < 0.001$), and a subsequent discriminant analysis resulted in correct re-classification of 97% of clustered cases (36% would be expected by chance based on the observed cluster distribution). Based on their pre-lockdown media usage, we were able to identify clusters corresponding roughly to the original typology. Of the 874 students classified, 418 (48%) could be called "PDF-users," reporting a high percentage of classic digital media use and moderate to low use of all other media types. A second group of 96 (11%) "e-examinees" had a profile very similar to this first cluster, except that they reported high, rather than low, e-exam use. A large cluster of 289 (33%) students corresponded roughly to the original "video-learner" group, which was also similar to the "PDF-users" group except that students reported higher audiovisual and interactive media use. The smallest cluster was formed by 71 (8%) "digital all-rounders," who reported consistently moderate to high use of all five media types, though their e-exam use was slightly lower than the "e-examinee" group. **Figure 2** shows usage intensity profiles for each of the resulting clusters before and during the lockdown, as well as their desired usage "after Corona." All groups showed an increase in use of e-exams, audiovisual media, and interactive tools during the first Corona lockdown, though this increase was smallest for those clusters with higher initial values (i.e., digital all-rounders and e-examinees). Though use of these three types of media did increase for "PDF-users," this group maintained the lowest usage levels among the four clusters in their "during Corona" and "after Corona" values. Use of social communication tools showed almost no change for any of the clusters, while classic digital media increased only slightly. Desired media usage after Corona was virtually identical to usage during the first lockdown for all user groups and all types of media, with the exception of interactive tools: all four groups desired slightly less intense usage of these tools in the future.

Attitudes Toward Multimedia and Online Learning

Comparing the four clusters in terms of attitudes toward multimedia learning showed a coherent picture: PDF-users reported the least positive attitudes ($M = 2.5$, $SD = 0.67$), digital all-rounders reported the most positive attitudes ($M = 3.1$, $SD = 0.54$), and e-examinees ($M = 2.8$, $SD = 0.69$) and video-learners ($M = 2.8$, $SD = 0.64$) fell between these two extremes, $F(3,825) = 351.66$, $p < 0.001$. This echoed the results of correlation analysis showing that multimedia attitudes related positively to all forms of media use, though this relationship was descriptively stronger when considering desired future media use ($0.23 < r < 0.51$) than actual use before or during the first Corona lockdown ($0.09 < r < 0.23$; see **Table 1**).

Attitudes toward multimedia learning also correlated positively with attitudes expressed in open-ended questionnaire responses ($0.33 < \tau < 0.55$). The tone of these statements was more often negative ($n = 57$) than neutral ($n = 43$) or positive ($n = 37$). However, separating these overall evaluations into attitudes toward online teaching *per se* and attitudes toward online learning implementation revealed a slightly different picture. While statements on how universities actually implemented online teaching were mostly negative (negative $n = 28$, neutral $n = 5$, positive $n = 11$), positive and negative statements about online learning in general occurred with roughly equal frequency (negative $n = 43$, neutral $n = 30$, positive $n = 44$).

Due to the small sample size, the error margins for estimating correlations between media use and attitude measures obtained by classifying students' open comments were quite large. Thus, though these correlations' direction and magnitude were descriptively quite similar to the relationships found with attitudes toward multimedia learning gathered through the standardized self-report scale, most could not be reliably distinguished from a null correlation. One exception to this general descriptive similarity could be found in students' appraisals of the quality of current implementation of online learning. Students' appraisal of implementation seemed to correlate somewhat more strongly with use of audiovisual media and interactive tools before and during the lockdown ($0.24 < r < 0.38$) than with other media use ratings ($-0.02 < r < 0.26$). However, given the large uncertainty in these estimates, this descriptive difference may very well be due to chance.

Differences Between Online and Offline Learning

Analysis of the 137 open responses revealed issues that were relevant for students during the first lockdown and gave insight into their perceptions of online learning. In

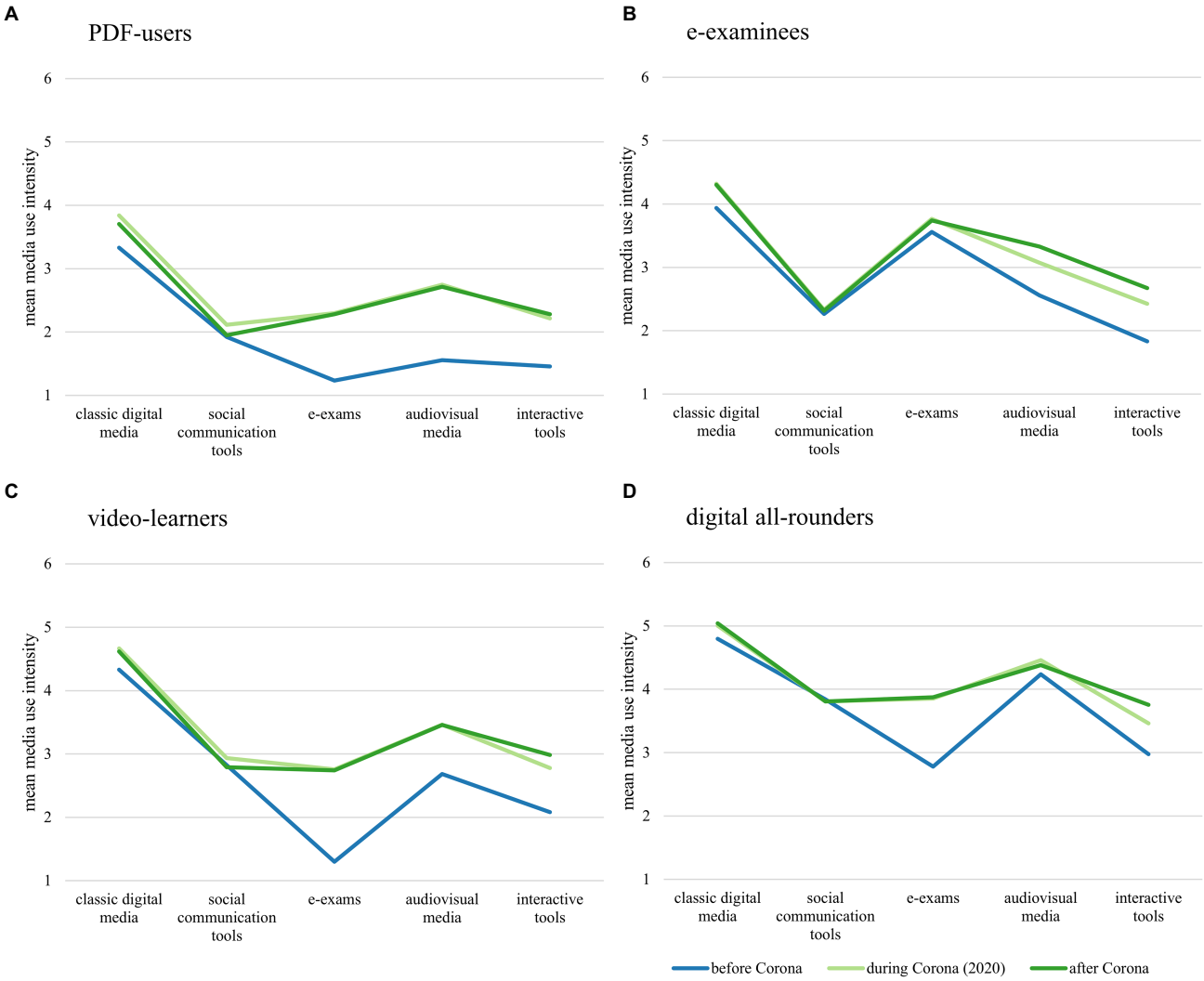

FIGURE 2 | Students' media usage profiles before and during the 2020 Corona lockdown as well as their desired use after Corona. Graphs **(A–D)** show data for each of the 4 media use clusters respectively (clusters based on self-reported media usage "before Corona").

their statements, students touched upon a wide range of issues, which can be bundled into four main themes: differences between online and offline learning, conditions for successful online teaching, preferences in how online versus offline instruction are used, and general comments on social and psychological consequences of online learning. A total of 88 participants discussed differences between online and offline learning, including (dis)advantages resulting from that. Fifty-one comments touched upon flexibility in time and space, which was mostly seen as an advantage (42 were positive). Students appreciated that they could adjust their study times to fit their current level of motivation and that they could look through learning materials several times, skip parts they did not find helpful, or do additional research whenever necessary. Video and audio recordings were mentioned as being particularly helpful in this context, since they could be repeatedly watched, stopped, rewound, and watched again. Additionally, participants appreciated saving time and money by not needing to travel to campus. This seemed to be especially attractive for students living far away from their university or under tight financial constraints. Moreover, flexibility in time and space was seen to facilitate the coordination of school with other responsibilities (e.g., job meetings, business trips, medical appointments, and illness), which was especially attractive for part-time students. Only one participant found that distance learning made it more difficult to combine work and school responsibilities. For her, it had been easier when she had a clear structured schedule of courses at the university. Another difficulty in learning outside the university building mentioned by five other students, however, was limited access to specific resources, such as laboratory equipment.

TABLE 1 | Correlations between attitude toward multimedia learning and intensity of media use.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Media use before Corona																			
(1)	classic digital media	(0.66)																	
(2)	social communication tools	0.42***	(0.69)																
(3)	e-exams	0.19***	0.18***	—															
(4)	audiovisual media	0.30***	0.47***	0.30***	(0.78)														
(5)	interactive tools	0.37***	0.50***	0.25***	0.56***	(0.61)													
Media use during Corona (2020)																			
(6)	classic digital media	0.68***	0.36***	0.14***	0.22***	0.32***	(0.69)												
(7)	social communication tools	0.34***	0.81***	0.12***	0.39***	0.42***	0.46***	(0.70)											
(8)	e-exams	0.19***	0.24***	0.39***	0.18***	0.23***	0.32***	0.28***	—										
(9)	audiovisual media	0.15***	0.32***	0.08*	0.46***	0.36***	0.33***	0.45***	0.41***	(0.74)									
(10)	interactive tools	0.25***	0.40***	0.11**	0.37***	0.64***	0.42***	0.50***	0.38***	0.58***	(0.67)								
Desired media use after Corona																			
(11)	classic digital media	0.72***	0.41***	0.17 ***	0.30***	0.36***	0.73***	0.42***	0.25***	0.29***	0.36***	(0.73)							
(12)	social communication tools	0.35***	0.76***	0.16***	0.41***	0.45***	0.37***	0.81***	0.23***	0.40***	0.45***	0.49***	(0.72)						
(13)	e-exams	0.17***	0.21***	0.39***	0.19***	0.23***	0.21***	0.19***	0.38***	0.22***	0.22***	0.32***	0.28***	—					
(14)	audiovisual media	0.16***	0.24***	0.14***	0.45***	0.32***	0.24***	0.28***	0.20***	0.55***	0.39***	0.37***	0.40***	0.52***	(0.81)				
(15)	interactive tools	0.26***	0.27***	0.12***	0.35***	0.54***	0.30***	0.30***	0.23***	0.38***	0.57***	0.44***	0.43***	0.50***	0.65***	(0.80)			
Attitudes																			
(16)	attitude toward multimedia learning	0.17***	0.14***	0.09*	0.19***	0.23***	0.15***	0.10**	0.16***	0.20***	0.22***	0.31***	0.23***	0.46***	0.48***	0.51***	(0.89)		
(17)	overall valence of open response[a]	0.16*	0.15*	0.11	0.07	0.19**	0.21**	0.16*	0.29**	0.21**	0.30**	0.23**	0.26**	0.37**	0.37**	0.39**	0.50**	—	
(18)	appraisal of online learning[a]	0.16*	0.11	0.09	0.00	0.17*	0.19*	0.14	0.24**	0.17*	0.27**	0.24**	0.27**	0.42**	0.40**	0.47**	0.55**	0.86**	—
(19)	appraisal of online learning implementation[a]	−0.02	0.13	0.01	0.24	0.32*	0.06	0.15	0.26	0.34*	0.38**	0.15	0.15	0.04	0.33*	0.19	0.33*	0.68**	0.06

768 < n < 874 for all variables except valence of open response (122 < n < 138), appraisal of online learning (105 < n < 117), and appraisal of online learning implementation (35 < n < 44). Pearson correlations reported except where noted otherwise; numbers in parentheses represent McDonald's ω.

[a]*Kendall's τ.*

**p < 0.05; **p < 0.01; ***p < 0.001.*

A second characteristic of online teaching mentioned by 36 participants was limited social presence and interaction. This was mainly seen as a disadvantage (34 comments were negative) and often used as an argument for preferring face-to-face teaching. Two participants reported that in online settings, teachers were less able to grasp students' mood and respond to it, for instance by explaining things more slowly. In addition, students felt that they tended to ask fewer questions, that discussions in courses were rarer and less animated, and that spontaneous debates did not occur after class. Two students found it harder to communicate with their teachers. Another student, however, thought digital media intensified contacts to teachers who took the time to answer. For collaboration in groups, we also found contradicting views: Two students felt it was harder to share thoughts, develop ideas, and solve problems in online teams, while another student experienced online group work as more efficient. According to the comments, social constraints online not only hindered learning progress; they also limited opportunities for getting to know people, sharing personal experiences, staying in touch, developing friendships, and building private and professional networks.

A third difference addressed in the open responses was effectiveness of online teaching compared to classroom teaching. The majority of participants who commented on this aspect (22 of 26) perceived online teaching as less effective. The main reason they gave to explain this was that they had trouble staying concentrated and motivated. Students reported drifting away mentally during online lectures, being distracted, or starting to do other things. This caused them to process content less intensively and to need additional explanations. They noted that the lack of compulsory attendance, combined with a set schedule and challenging deadlines, made it harder to stay motived. Moreover, students experienced interactive methods and practical exercises as less fruitful, which constituted a barrier to critical reflection on and application of theoretical knowledge. As a result,—so their impression—both teachers and students needed to invest more time and effort in order to achieve the same output, and teachers' didactic competences were even more important than in a face-to-face classroom setting. Only few participants ($n = 4$) felt they learned more during online teaching; this was because they were better able to concentrate at home, experienced teamwork as more efficient, or found it helpful to learn *via* video content.

Based on the differences outlined above, 31 students reflected on the suitability of online teaching for different learning settings. Online learning was described as unsuitable for practical training (e.g., in hospitals or companies), for laboratory exercises, or for acquiring physical skills like learning to play an instrument or sew a wound. This is why some students of medicine, chemistry, automation engineering, music, and art perceived online teaching as inadequate for their discipline. In addition, online teaching was characterized as being less appropriate for courses with interactive and collaborative elements like brainstorming, discussions, or group work. Some students of theology, philosophy, or the social sciences who perceived discourse as crucial to their discipline explained their preference for face-to-face teaching using this argument. In contrast, courses focused on knowledge acquisition, such as traditional lectures, were mentioned as being suitable for online teaching. Two students even preferred online to classroom teaching for theoretical courses in general; others differentiated between specific subjects.

Conditions for Successful Online Teaching

In the unusual situation of the first COVID-19 lockdown, where distance learning was set up almost overnight, students had a good opportunity to observe how (lack of) existing resources impacted the success of online teaching. Analysis of the 47 student comments dealing with this aspect point to the importance of meeting basic requirements for online instruction at an organizational level. Students reported that they were not able to attend courses because these had been canceled or overlapped in terms of scheduling. Information about when, where (i.e., which communication platform), and in which form courses and exams would take place was missing or unclear. This led to a delay in some students' studies. Access to adequate learning platforms, video conference tools, and collaboration software (including software that met adequate privacy and data security standards) were missing at some universities, as was sufficient technical equipment for teachers.

A high level of institutional flexibility, innovativeness, and willingness to change combined with established e-learning practices were mentioned as key factors for managing this situation. In addition, teachers' flexibility and willingness to try new tools and methods were seen as important. Students expressed their desire for teachers to keep them updated, stay in contact, and recognize and consider their needs when designing instruction. Thus, a high level of teacher engagement was named as crucial for successful online teaching, together with digital media skills and didactic competencies.

Digital skills and motivation were also mentioned as prerequisites for students themselves to be able to handle new online tools and maintain self-discipline during online learning, respectively. According to two participants, prior experience with e-learning and a positive attitude toward this type of instruction was helpful. A very basic precondition also named by students is a quiet room equipped with adequate technical resources (e.g., personal laptop or computer, large monitor or second screen, and stable Internet connection); this was not available to all participants.

Preferences for Online/Offline Teaching Design

Based on their experiences during the lockdown, 65 students expressed preferences for the future of (online) teaching at universities. A question discussed quite often (47 students) was the preferred proportion of online to offline instruction. Most commenters (25) opted for an intelligent mixture of both forms in order to combine their respective advantages. The combination of online and offline elements could

be either done at the curricular level (e.g., providing both online and offline courses) or at the course level (e.g., *via* hybrid or blended learning concepts). This, so one of the participants, would prepare students for the increasingly but not fully digitalized working world of the future. Another group of 14 students clearly opted for face-to-face teaching, stating that they would prefer not to attend any online courses at all after the Corona crisis. Nevertheless, additional online elements, such as recordings of class lectures or the possibility to attend courses online in exceptional cases (e.g., illness), were welcomed. In contrast to the group with a clear preference for face-to-face learning, eight other students were quite enthusiastic about online teaching and said they would like to be able to attend major parts of their studies online in the future.

In 20 open responses, we found concrete recommendations for how online and offline teaching could be combined at the course level. These suggestions all served the purpose of letting students choose their preferred modus of teaching. The first recommendation was to hold classes face-to-face but to provide video- or audio recordings of the sessions. This would help students who were unable to attend class at a specific time or day and make it easier to study for exams. A second suggestion was a hybrid setting which would allow students to either attend a course in class or participate live online. One student, however, noted that this scenario required some way of ensuring a minimum number of attendants in class to avoid teachers speaking to an empty room. A third suggestion was to offer online exams as alternatives to face-to-face assessment when the situation allowed, for instance in the case of multiple choice tests or individual oral exams.

Based on what did not work well during lockdown, nine students also gave recommendations for how teachers should structure online courses. Since online sessions were experienced as more exhausting, one suggestion was to have more breaks than in face-to-face class and to limit class length to a maximum of 3 h. Given the constraints in social interaction, students suggested finding new ways of activating students in order to avoid fully teacher-centered lectures. When choosing a tool for online courses, they suggested, teachers should ensure the possibility for video and audio calls, since only written chats are not interactive enough. If a course includes self-directed learning, students should be provided with professional learning material (e.g., lecture notes, audio recordings, and videos), tips for further learning resources (e.g., additional explanations and readings), as well as opportunities for asking questions. Finally, when adapting a course from face-to-face to online, students suggested reducing the amount of content covered.

Possible Consequences of Online Learning for Individuals and Society

Besides these rather practical considerations, we found several ($n = 18$) more fundamental reflections about what a shift to online teaching at universities could mean for individuals and society in the long term. On the individual level, aspects of health and wellbeing were discussed. These included physical aspects, such as eye strain, muscle tension, and back pain resulting from increased screen time, as well as negative psychological effects, such as overburdening, isolation, loneliness, sadness, depression, aggression, or even suicidal thoughts. One participant, however, identified avoiding infections as a positive health effect of online settings. Concerns on a societal level dealt with the loss of interpersonal encounters and social skills on the one hand, and worries about data security and privacy on the other hand. Moreover, one of the participants expressed concern that education runs the risk of being reduced to knowledge acquisition *via* standardized learning materials, neglecting discourse and diversity of thought as fundamental elements of university learning. Three students, however, also identified a positive environmental effect of online teaching on society, namely, the reduction of car traffic.

DISCUSSION

Our quantitative results illustrate the dramatic change in the use of media in higher education that occurred during the first Corona lockdown in 2020. Students reported much more intensive use of audiovisual media, e-assessments, and interactive tools during the lockdown than they had experienced before Corona. The results also, however, suggest that this change was not quite as radical as might have been expected. The use of classic digital media like e-mail and digital texts remained stable at high levels; the use of social communication tools remained stable at those high (chat/messenger), medium (social networks and online forums), or low (microblogging) levels that had characterized them before Corona. Though differences between the pre-Corona cluster of "PDF-users" and "digital all-rounders" decreased during lockdown, their usage profiles remained distinct: the very large group of PDF-users continued to use digital media much less intensely than the much smaller group of digital all-rounders, with "video-learners" and "e-examinees" falling somewhere in between. Examining the change in interactive tool use more closely also shows that really only the use of web conferencing skyrocketed during the first Corona lockdown. Interactive tools that had been used fairly intensely before Corona—online office tools and wikis—continued to be used at a slightly higher rate during the lockdown. Rare interactive tools, such as educational games and simulations, remained rarely used. This may have been due to pragmatic reasons, such as the cost and effort involved in developing appropriate educational games or virtual laboratories. It stands to reason that instructors catapulted suddenly into full distance teaching may not have had the time or resources to produce more than rudimentary interactive content. The fact that, among audiovisual media, use of online tutorials increased less than that of audio or video formats is in keeping with this explanation. Many of the comments in the qualitative analysis also suggest that traditional face-to-face learning scenarios (e.g., lectures) were translated 1:1 into online web conferences, with occasional audio or video recordings of those classes but no major adaptations in pedagogy or course

structure. Long online sessions without variety or sufficient breaks, lack of interaction and communication, teacher-centered lectures, and insufficient learning materials for self-directed learning were all mentioned by students, showing that even fairly basic pedagogical changes necessary for engaging online instruction were not always implemented. Given the crisis setting, this is understandable. However, it also suggests that, though distance learning brought about a complete change in *where* instruction was carried out, the changes in *how* instruction was structured were much more moderate.

In fact, since one of the most frequent complaints of students was a lack of interaction in online classes, we could argue that the interactive potential of e-learning remained underutilized. It is possible that students simply did not experience the full interactive potential of online instruction because only rudimentary use was made of interactive tools. This is in line with arguments that changes in pedagogy are necessary to facilitate interactive learning (e.g., Webb, 2009) and that effective online teaching requires specific didactic strategies for promoting social interaction (e.g., Kreijns et al., 2003). Though such untapped potential presumably played a substantial role in decreasing the interactivity of online learning during the first Corona lockdown, the inherent social limits of online communication are also likely to have contributed. As long as online communication cannot recreate the full richness of interpersonal contact, feelings of social presence will not be equivalent to face-to-face interaction (e.g., Lowenthal, 2010). In fact, a defining element of the online distance learning situation—independence of place—guarantees that even if new technologies were able to perfectly simulate classroom presence, they could not ensure that students share the same learning context. After class, students would be immediately "transported" back into their own individual environments, and many of the informal opportunities for social interaction that come with the physical limitations of such a shared context (e.g., *ad-hoc* discussions after class and shared breaks) would not occur. The fact that students repeatedly mentioned the disappearance of incidental communication as a clear disadvantage of online learning underlines its subjective relevance.

Despite the limited online interactivity apparent in our data, the open responses also showed the many pragmatic advantages of flexibility in time and place of instruction for students. Without time-consuming journeys to and from campus, students had more time to spend on learning or leisure activities. Online learning was seen as especially attractive for students with other family- or work-related commitments. This is in line with earlier studies touting the sheer convenience of online instruction (e.g., Cole et al., 2014). While this flexibility was seen as challenging in terms of self-discipline and time management, it also allowed students to choose when and how they engaged with course material in accordance with their individual learning needs. Thus, it also promoted self-directed learning.

Overall, the very heterogeneity of results showed that online learning preferences are ultimately individual and depend strongly on students' specific personal situations as well as the specific content being taught. Though many students reported having concentration and motivation problems, some students were able to learn effectively. Students' perception of whether online learning was a suitable format depended not only on their personal needs and experiences but also on the content, learning goals, and the relevance of hands-on skills in their own course of studies. Such results bolster Anderson's (2008) call for flexible use of a variety of instructional media suited to each specific learning context and suggest that context-specific combinations of online and offline instruction are likely to be the most effective course of action. This, however, raises the future research question of which specific learning settings (e.g., face-to-face learning, blended learning, learning with collaborative media, and hybrid learning, …) can best support which specific learning needs and goals, and which individual differences mediate perceptions of the effectiveness of such (online) learning settings. It also raises the practical question of how educational institutions can support teachers in implementing such flexible instructional practices, both in terms of didactic training and in terms of technical support and infrastructure.

Our exploration of student attitudes toward online learning offers some tentative insight into the question of students' perception of online learning settings. Students' general attitudes toward multimedia learning showed positive relationships with their media use both before and during the lockdown, as well as a somewhat stronger relationship with their desired media use after Corona. This positive correlation could mean that more intensive media use during the lockdown positively impacted participants' attitudes toward multimedia. Conversely, it could mean that participants with positive *a priori* multimedia attitudes had actively sought study programs with more infrastructure and opportunities for media use that then carried over into the lockdown. Such students may also have availed themselves of the media accessible through their institutions more thoroughly (e.g., by engaging more intensively with multimedia course materials and using media for informal course-related communication). Alternatively, media use attitudes and experiences might both be driven by an unmeasured third variable, such as universities' financial resources. Whatever its underlying cause, this association was echoed in the qualitative results. Comparing general multimedia attitudes with participants' comments at the end of the questionnaire showed that these two evaluations harmonized. This was true both in the sense that students with more positive attitudes also made more positive comments, and in the sense that relationships between appraisals of online learning in the comments and media use were quite similar to the relationships between multimedia attitudes and media use described above. Interestingly, students' appraisals of the quality of concrete implementation of online learning revealed almost no relationship with their appraisals of online learning in general. This shows that some students differentiated between the potential of online learning *per se* and their current experiences. Nevertheless, both these appraisals tended to correlate positively with attitudes toward multimedia learning, media usage during the first Corona lockdown, and desired usage after—though students' appraisals of concrete

online learning implementation did seem to correlate slightly more strongly with their own use of interactive and audiovisual tools during the lockdown than with their use of other types of media. This could mean that the intensity with which universities provided audiovisual and interactive tools was particularly relevant in shaping students' appraisals of online learning. Though caution is necessary when speculating about the causal mechanisms responsible for these correlations, our results are certainly compatible with the assumption that attitudes toward online learning stand in a reciprocal relationship with past online learning experiences and are a reasonably strong predictor of future e-learning wishes.

In interpreting these results, several additional limitations should be kept in mind. First, we gathered cross-sectional data in a non-probabilistic sample. This imbues all our statistics with a larger degree of uncertainty (i.e., possible bias) than would be the case for a study with random sampling and mandatory participation. Though we did send invitations to participate in the survey to all Austrian universities, self-selection and school-specific communication policies clearly played a substantial role in determining which schools chose to pass on the survey link to their students, and which of those students chose to participate in the survey. Our additional use of convenience sampling *via* personal contacts also tapped specific social networks, possibly making our sample more homogenous in terms of interests and experiences than a truly random sample would have been. Such homogeneity would tend to make confidence intervals artificially narrow and statistical tests more liberal than suggested by a significance level of 5%. Thus, our results—especially those involving inferential statistics—should be seen as possible starting points for further research, not as solid evidence of population effects.

In addition to the limitations of data gathered from a non-probabilistic sample, we relied on self-reports of behavior and attitudes. Asking students to compare their past with their current media use was particularly cognitively challenging. Estimations of past media use are bound to have been biased by the current situation, though it is unclear whether such a bias can be expected to cause contrast or assimilation effects (i.e., whether high current usage is more likely to make previous usage seem artificially low or to inflate estimates of previous usage to align more closely with current high values). Regardless of how exactly these results are skewed, they should certainly be interpreted as *reports* of media use, and thus, imperfect estimations of actual media use behavior. Nevertheless, comparing these results to self-reported media tool usage gathered before the lockdown (e.g., Persike and Friedrich, 2016; Händel et al., 2020) shows that our participants' self-reported media use before Corona was quite similar in comparison. We were even able to identify media user types similar to those found by Persike and Friedrich, though we did observe a substantially larger group of "PDF-users." Overall, however, memory effects do not seem to have negatively influenced the general plausibility of this media usage data.

A third major limitation is the rather narrow scope of collected data. As part of a small, informal study performed in the course of teaching, the questionnaire encompassed only a very small selection of relevant variables based on a limited selection of prior empirical research rather than a broad theoretical foundation. Thus, we are able to offer only a restricted overview of students' media use and attitudes toward multimedia learning during the first Corona lockdown in 2020, including the themes and experiences they most associated with online learning at this point in time. We did not consider the role of socioeconomic or cultural background, access to adequate "home study" infrastructure, physical impairment, or any of myriad personal and context variables that are likely to have impacted students' online learning. We also gathered no data about the substantial challenges faced by teachers during this time period, or how organizational resources and support helped shape their online instruction experiences. Because our mixed-methods approach was unplanned, the open responses categorized through qualitative analysis were also limited to short sentences written by a subsample of students with—presumably—particularly strong opinions about online learning. Despite these limitations, we hope that the large and fairly broad sample, high topical relevance, and unique insight into students' thoughts and experiences during this unprecedented upheaval in educational practice justifies dissemination of these limited but interesting results.

Ultimately, the study shows how online learning is embedded in the organizational context and technical infrastructure of the educational institutions in which it occurs, and how strongly its success is determined by the technological, financial, motivational, and pedagogical resources of the students and teachers who create it. Besides the digital and didactic competencies necessary to adapt instructional scenarios to students' needs and flexibly integrate appropriate digital tools into engaging online lessons, teachers must bring high levels of motivation and consideration into the virtual classroom. Similarly, students are challenged to maintain the motivation, initiative, and self-regulation necessary for successful self-directed learning. Organizations must offer the necessary IT-infrastructure and support to ensure the functionality and usability of online learning environments. Through the 2020 COVID-19 lockdown, students, teachers, and universities alike were thrown into a highly challenging online learning situation in which these criteria were only imperfectly met. It remains for future research to determine whether the use of interactive tools integrated into holistic pedagogical concepts has become more frequent or varied as the lockdown continues into 2021, and what developments the return to face-to-face instruction will bring. At least some long-lasting changes seem likely. Students have experienced intensive online learning firsthand, including the practical advantages that come with independence of time and place as well as self-directed learning. They have also experienced the interactional limitations of online communication and presumably garnered a new appreciation for the power of face-to-face interaction. The greatest practical and theoretical challenge facing higher education at the moment is determining how to best integrate and leverage the strengths of both forms of learning in a way that not only ensures positive educational outcomes but also meets the changed needs and expectations of organizations, students, and teachers alike.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CK contributed to the concept and design of the study and performed the statistical analysis. CO was responsible for the qualitative data analysis. TJ contributed to the introduction and discussion. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

The authors would like to thank the 16 students of the empirical research project for their help in creating the online questionnaire and collecting data.

REFERENCES

Adnan, M., and Anwar, K. (2020). Online learning amid the COVID-19 pandemic: students' perspectives. *J. Pedagogical Socio. Psychol.* 1, 45–51. doi: 10.33902/JPSP.2020261309

Aguilera-Hermida, A. P. (2020). College students' use and acceptance of emergency online learning due to COVID-19. *Inter. J. Educ. Res. Open* 1:100011. doi: 10.1016/j.ijedro.2020.100011

Anderson, T. (2008). "Towards a theory of online learning," in *The Theory and Practice of Online Learning. 2nd Edn* (Edmonton: AU Press), 45–74.

Arkorful, V., and Abaidoo, N. (2014). The role of e-learning, the advantages and disadvantages of its adoption in higher education. *Int. J. Educ. Res.* 2, 397–410.

Bali, S., and Liu, M. C. (2018). Students' perceptions toward online learning and face-to-face learning courses. *J. Phys. Conf. Ser.* 1108:012094. doi: 10.1088/1742-6596/1108/1/012094

Becker, K., Newton, C., and Sawang, S. (2013). A learner perspective on barriers to e-learning. *Australian J. Adult Learn.* 53, 211–233.

Cole, M. T., Shelley, D. J., and Swartz, L. B. (2014). Online instruction, e-learning, and student satisfaction: A three year study. *IRRODL* 15, 111–131. doi: 10.19173/irrodl.v15i6.1748

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., et al. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *J. Appl. Learn. Teach.* 3, 1–20. doi: 10.37074/jalt.2020.3.1.7

Gopal, R., Singh, V., and Aggarwal, A. (2021). Impact of online classes on the satisfaction and performance of students during the pandemic period of COVID 19. *Educ. Inf. Technol.* 26, 6923–6947. doi: 10.1007/s10639-021-10523-1

Gunawardena, C. N. (1995). Social presence theory and implications for interaction and collaborative learning in computer conferences. *Int. J. Educ. Telecommun.* 1, 147–166.

Händel, M., Stephan, M., Gläser-Zikuda, M., Kopp, B., Bedenlier, S., and Ziegler, A. (2020). Digital readiness and its effects on higher education students' socio-emotional perceptions in the context of the COVID-19 pandemic. *J. Res. Technol. Educ.* 1–13. doi: 10.1080/15391523.2020.1846147 [Epub ahead of print]

Holzer, J., Lüftenegger, M., Korlat, S., Pelikan, E., Salmela-Aro, K., Spiel, C., et al. (2021). Higher education in times of COVID-19: university students' basic need satisfaction, self-regulated learning, and well-being. *AERA Open* 7, 1–13. doi: 10.1177/23328584211003164

Hsieh, P.-A. J., and Cho, V. (2011). Comparing e-learning tools' success: The case of instructor-student interactive vs. *Comput. Educ.* 57, 2025–2038. doi: 10.1016/j.compedu.2011.05.002

Jeong, H., Hmelo-Silver, C. E., and Jo, K. (2019). Ten years of computer-supported collaborative learning: A meta-analysis of CSCL in STEM education during 2005–2014. *Educ. Res. Rev.* 28:100284. doi: 10.1016/j.edurev.2019.100284

Keengwe, J., and Kidd, T. T. (2010). Towards best practices in online learning and teaching in higher education. *MERLOT J. Online Learn. Teach.* 6:9.

Kreijns, K., Kirschner, P. A., and Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Comput. Hum. Behav.* 19, 335–353. doi: 10.1016/S0747-5632(02)00057-2

Kuckartz, U. (2019). "Qualitative text analysis: A systematic approach," in *Compendium for Early Career Researchers in Mathematics Education*. eds. G. Kaiser and N. Presmeg (Cham: Springer International), 181–197.

Landis, J. R., and Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics* 33:159. doi: 10.2307/2529310

Lowenthal, P. R. (2010). "Social presence," in *Social Computing: Concepts, Methodologies, Tools, and Applications*. ed. S. Dasgupta (United States: IGI Global), 129–136.

Mauss, D., and Jadin, T. (2013). Knowledge Acquisition *via* Facebook: Learning Facts and Concepts about Intercultural Communication. In *Proceedings Cross-Cultural Conference*. 209–215. Shaker.

Mayring, P. (2014). Qualitative content analysis: theoretical foundation, basic procedures and software solution. Available at: https://www.ssoar.info/ssoar/handle/document/39517 (Accessed January 20, 2022).

Mnkandla, E., and Minnaar, A. (2017). The use of social media in e-learning: A metasynthesis. *IRRODL* 18, 227–248. doi: 10.19173/irrodl.v18i5.3014

Nambiar, D. (2020). The impact of online learning during COVID-19: students' and teachers' perspective. *Inter. J. Indian Psychol.* 8, 783–793. doi: 10.25215/0802.094

OECD (2005). E-learning in tertiary education: where do we stand? organisation for economic co-operation and development. doi:10.1787/9789264009219-en

Paechter, M., and Maier, B. (2010). Online or face-to-face? Students' experiences and preferences in e-learning. *Internet High. Educ.* 13, 292–297. doi: 10.1016/j.iheduc.2010.09.004

Persike, M., and Friedrich, J.-D. (2016). Lernen mit digitalen Medien aus Studierendenperspektive [Learing with digital media from a student perspective; working paper no. 17]. Hochschulforum Digitalisierung. Available at: https://hochschulforumdigitalisierung.de/de/lernen-digitale-medien-studierendenperspektive (Accessed January 20, 2022).

Popescu, E. (2010). Students' acceptance of web 2.0 technologies in higher education: findings from a survey in a Romanian university. *2010 Workshops on Database and Expert Systems Applications*, 92–96. doi:10.1109/DEXA.2010.38

Rahiem, M. D. H. (2020). The emergency remote learning experience of university students in Indonesia amidst the COVID-19 crisis. *Inter. J. Learn. Teach. Educ. Res.* 19, 1–26. doi: 10.26803/ijlter.19.6.1

Rizun, M., and Strzelecki, A. (2020). Students' acceptance of the COVID-19 impact on shifting higher education to distance learning in Poland. *Int. J. Environ. Res. Public Health* 17:6468. doi: 10.3390/ijerph17186468

Tigges, A. (2008). Geschlecht und digitale Medien: Entwicklung und Nutzung digitaler Medien im hochschulischen Lehr–/Lernkontext [Gender and media: Development and use of digital media in tertiary education]. VS, Verlag für Sozialwissenschaften.

Webb, N. M. (2009). The teacher's role in promoting collaborative dialogue in the classroom. *Br. J. Educ. Psychol.* 79, 1–28. doi: 10.1348/000709908X380772

Young, S., and Duncan, H. E. (2014). Online and face-to-face teaching: how do student ratings differ? *MERLOT J. Online Learn. Teach.* 10, 70–79.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Education

ORIGINAL RESEARCH
published: 17 February 2022
doi: 10.3389/feduc.2022.743770

Predictors of Central Student Learning Outcomes in Times of COVID-19: Students', Parents', and Teachers' Perspectives During School Closure in 2020—A Multiple Informant Relative Weight Analysis

Christoph Helm[1,2] *and Stephan Gerhard Huber*[1*†]

[1]University of Teacher Education Zug, Zug, Switzerland, [2]Department of Education Research, Linz School of Education, Johannes Kepler University of Linz, Linz, Austria

OPEN ACCESS

Edited by:
Karin Gehrer,
Leibniz Institute for Educational Trajectories (LG), Germany

Reviewed by:
Jeffrey M. DeVries,
Technical University Dortmund, Germany
Michael Cahapay,
Mindanao State University-General Santos, Philippines

***Correspondence:**
Stephan Gerhard Huber
stephan.huber@phzg.ch

[†]Paula Günther, Nadine Schneider, Marius Schwander, Julia Schneider, and Jane Pruitt assisted in the data collection

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: 19 July 2021
Accepted: 07 January 2022
Published: 17 February 2022

Citation:
Helm C and Huber SG (2022) Predictors of Central Student Learning Outcomes in Times of COVID-19: Students', Parents', and Teachers' Perspectives During School Closure in 2020—A Multiple Informant Relative Weight Analysis. Front. Educ. 7:743770. doi: 10.3389/feduc.2022.743770

School closures associated with the COVID-19 pandemic very quickly led to many studies on distance education. Currently, there are only studies available that explored the importance of different features of distance education for student learning during school lockdowns in 2020 relying on a single perspective—student, parent, or teacher data. Thus, we present results from a multiple informant study in which we compared prediction models based on the different perspectives of relevant actors in the school system. Against the background of the context, input, process, and output model, we explored the impact of a broad range of features of distance education on central student learning outcomes using data from students (N = 315), parents (N = 518), and teachers (N = 499) in German and Austrian secondary schools. Although findings from relative weight analysis portray a relatively similar pattern of relevant predictors for students' learning outcomes (i.e., self-rated achievement, learning effort, and intrinsic motivation) across the three respondent groups, some predictors largely differ between the groups. While students' ability to self-organize emerged as the most significant predictor across all three informant groups, predictors, such as the lack of parental support during school closure, turned out to be relevant only from parents' perspective. We discuss the implications of these findings for future educational practice and research.

Keywords: COVID-19, student learning (at school), predictors and associations, structural equating modeling, multiple informant data, international study

1 INTRODUCTION

The crisis caused by the COVID-19 virus in 2020 had far-reaching effects in nearly all social areas, including education. Indeed, schools were closed in the spring of 2020 in nearly all European countries (and beyond). Only a few countries, such as Sweden, decided to keep the schools open. In the context of this new and challenging situation of school lockdown, information on how this new situation was experienced by different actors was needed instantly to inform education policy and practice (see Helm et al. (2021) for a first review of approximately 100 surveys conducted in Germany, Austria, and

Switzerland). Although studies that investigated the new situation with descriptive analysis have increased sharply since the first school lockdown, explanatory studies that investigated associations between different aspects of COVID-19 pandemic-related distance education are still rare and only just emerging (see **Section 4** for a first elaboration). Moreover, to the best of our knowledge, we are not aware of studies that investigate students' learning during school lockdown from multiple perspectives—that is, using multiple informant groups. Relying on the reports of only one informant group, such as either student reports, parent reports, or teacher reports, although common, runs the risk of biased estimates. Our review (Helm et al., 2021) indicates large differences between student, parent, and teacher ratings on various aspects of distance education. For instance, regarding the lack of technical equipment at home, the student and parent ratings range between 3% and 25% (depending on the survey), whereas teacher ratings range (depending on the survey) between 28% and 75%. Hence, the question arises as to which studies that explore student learning on the basis of different informants (students, parents, and teachers) yield converging findings.

2 RESEARCH AIMS

Huber et al. (2020) were the first to launch a comprehensive survey www.schul-barometer.netthat included all three informant groups with around 25,000 respondents between late March 2020 and early April 2020. First results were published as an open access article on 21 April 2020 (Huber et al., 2020) and have been followed by further studies (e.g., Huber and Helm, 2020a). Using data from the international school-barometer survey, we performed a multiple informant study to answer two research questions that have been scarcely explored so far:

1) What are the relevant predictors of student learning during COVID-19 pandemic-related distance education in Germany and Austria in spring 2020?
2) To what extent do the results of Research Question 1 converge if the same analyses are based on data from different informant groups (i.e., students, parents and teachers)? That is, do different perspectives yield the same conclusions about the most relevant predictors of students' learning during distance education in the spring of 2020?

We attempted to answer these questions against the background of a theoretical framework that is widely used in educational research—that is, the context, input, process, and output model (CIPO, e.g., Scheerens, 1990) and the offer-and-use model (Helmke, 2009). Both models are based on a system theory that describes student learning by a school-initiated transformation process of inputs (e.g., teacher knowledge) into outputs (e.g., student achievement). This process is embedded in a context that provides enabling or disabling conditions (e.g., the composition of the student body). The transformation process itself can be described by quality characteristics (e.g., opportunity to learn). Both the individual components and their relationship to each other must be thought of at different levels of the school system (e.g., school level, classroom level, and individual level). While the internationally widely used CIPO model views the transformation process as a black box, the offer-and-use model, which is widely used in the German tradition of educational effectiveness research, complements this view by describing the instructional process as a co-construction of teachers and learners from a more pedagogical-psychological perspective. Accordingly, teaching does not lead directly to effects. Rather, the transformation process is influenced by whether and how learners perceive the instruction offered and by the motivational, volitional, emotional, and social processes that occur on the student side (Fischer et al., 2011). From an empirical perspective, we base our study on existing educational research on the COVID-19 pandemic, drawn from both a systematic literature review on descriptive studies (Helm et al., 2021) and existing explanatory studies. Based on survey data from students, parents, and teachers, we used structural equation modeling techniques (latent correlations, latent regressions, and latent relative weight analyses) to examine the extent to which the same predictors of student learning in COVID-19 pandemic-related distance education emerged as particularly significant from the perspective of different groups of actors in the school system.

3 THEORETICAL FRAMEWORK

How does distance education in times of the COVID-19 pandemic work from a theoretical point of view? Which aspects of teaching and learning come more to the fore in distance education, which more to the background? In early COVID-19 pandemic-related educational research, many scholars attempted to answer these questions from a theoretical (e.g., Klieme, 2020; Köller et al., 2020; Meyer, 2020; Voss and Wittwer, 2020), quantitative (e.g., Grewenig et al., 2020; Huber and Helm, 2020a; Porsch and Porsch, 2020; Holzer et al., 2021; Steinmayr et al., 2021) and qualitative perspective (e.g., Frohn, 2020; Letzel et al., 2020). In line with some of these early research initiatives (e.g., Wildemann and Hosenfeld, 2020; Züchner and Jäkel, 2021) we adopted the CIPO/offer-and-use logic outlined above to delineate and identify relevant predictors of student learning during the pandemic. More specifically, we used models from homework research (e.g., Trautwein et al., 2006; Kohler, 2011). In line with the offer-and-use model, these models postulate that parental support and parental involvement in students' learning at home, as well as home resources for learning in general (e.g., socioeconomic background, technical equipment at home), strongly influence the quality and success of home learning processes. A prominent model in the literature is the homework model developed by Trautwein et al. (2006). The homework model is based, among other things, on different motivational theories—especially expectancy-value theory (Wigfield and Eccles, 2000)—and common teaching-learning theories—especially the offer-and-use model (Helmke, 2009).[1]

[1]Assumptions about multilevel logic and domain specificity are also incorporated into the model.

While the offer-and-use model represents a comprehensive collection of factors whose impact on the learning process is empirically well established, Trautwein et al. (2006) focused more strongly on aspects that are relevant to homework practice, namely parental involvement, student motivation, quality of homework practice, and student homework behavior. More concretely, Trautwein et al. (2006) postulated that input factors, such as features of the learning environment, characteristics of teachers, students, and parents, parental learning support, etc., affect students' motivation to learn. Student motivation, in turn, is hypothesized to be a necessary antecedent of students' homework behavior, which is associated with student achievement.

Although the model focuses on the role of parents in students' (external) learning, by nature, it makes no claims about distance education during the COVID-19 pandemic. Therefore, we draw attention below to existing assumptions and findings from the still-early research on distance education in the spring of 2020.

3.1 Relevant Predictors of Student Outcomes in COVID-19 Pandemic-Related Distance Education

In the theoretical frameworks outlined above, the aspects listed below are assumed to be conducive to student outcomes (such as student achievement, student effort, and student motivation) in distance education during the school lockdown caused by COVID-19.

3.1.1 Self-Organization Skills

According to constructivist views, learning is always a self-regulated and self-organized process, regardless of whether students learn at school or at home. From a theoretical point of view, self-regulated learning skills can be defined as the ability to plan, monitor, and evaluate individual learning processes and adjust the learning process if necessary (Dignath and Veenman, 2021). Existing theories suggest that learners with high skills in self-regulation engage "actively and constructively in a process of meaning generation and that they adapt their thoughts, feelings, and actions as needed to affect their learning and motivation." (Boekaerts and Corno, 2005, p. 201) Empirical findings about the significance of students' self-regulation skills—particularly resource or time management—underpin their central role; especially in forms of digital learning (Broadbent and Poon, 2015). This is true for distance learning during school closures as well. Findings by Blume et al. (2021) reveal that students with higher self-regulation skills are more likely to learn independently and ask for assistance (from parents, peers, or teachers) fewer times. Furthermore, they are more likely to communicate their needs precisely and thus to seek help in a more effective way (Blume et al., 2021).

In the present study, we use the term self-organization to indicate that students' self-regulation skills needed in distance learning go beyond planning, monitoring, evaluating and adjusting individual learning processes and include other aspects central to independent learning in distance education, such as structuring one's daily routine, getting up early, shielding oneself from distracting activities, or maintaining an attitude conducive to learning.

Learning during school closures was associated with greater autonomy and increased student responsibility. With the closure of schools, many elements that structure learning were missing, challenging students' self-organization skills. For instance, during school lockdown in spring 2020, the usual distribution of learning to the morning and leisure activities to the afternoon, the rhythms and structures of learning, for instance by schedules, by structuring lectures of teachers, and by common routines in schools, as well as the structuring of breaks and recreational phases, etc., were dropped. Moreover, important supportive elements of self-regulated and self-organized learning, such as target setting by the teachers, direct affective feedback (i.e., praise, admonition), content-related feedback, cooperative learning, and many more, were dropped too. Thus, distance learning increased demands upon students' self-regulation (Blume et al., 2021). Consequently, there is no doubt that students' self-organization and self-regulation skills are considered central for distance education. In line with this assumption, many studies confirmed the strong relationship between self-organization/self-regulation and student outcomes, such as student motivation, engagement, and rated achievement in distance learning (Huber and Helm, 2020b; Grewenig et al., 2020; Blume et al., 2021; Holzer et al., 2021; Korlat et al., 2021; Pelikan et al., 2021; Steinmayr et al., 2021).

3.1.2 Parental Learning Support

The role of parents in children's and adolescents' learning at school has come into focus as a result of distance learning. But even before COVID-19 related distance learning, a research tradition was established in which the concept of parental involvement in children's and adolescents' learning processes at home was and is still being researched. Parental involvement refers to activities that parents set with the goal of supporting their children's learning (e.g., Boonk et al., 2018). Based on self-determination theory (e.g., Deci and Ryan, 1985), two domains were distinguished: autonomy-supportive vs. controlling involvement (e.g., Pomerantz and Grolnick, 2017). For example, Moroni et al. (2015) showed that both quantitatively too high levels of involvement and controlling involvement are negatively associated with student achievement, whereas autonomy-supportive involvement has positive effects on achievement.

School closings due to the COVID-19 pandemic promoted parents to teachers—whether they liked it or not. From 1 day to the next, traditional instructional tasks, such as providing individual learning support, had to be taken over by parents. Therefore, the question arose quickly as to the extent to which parents are able to compensate for the loss of services usually delivered by schools and teachers. Early parent surveys (Porsch and Porsch, 2020) reported that in the most frequent cases (between 68% and 71%) parental learning support consisted of checking the correctness and completeness of the students' assignments. Similarly, the

majority of parents solved tasks together with their children. Another major task of parents was to motivate their children in home schooling, as 71% of parents reported in a survey by Wildemann and Hosenfeld (2020). Most often (50% and 46%, respectively), parents resorted to appealing for insight and understanding, or to spending leisure time together (e.g., playing, watching movies). In addition to these descriptive studies, several studies already exist that examine the role of parental involvement in distance learning using multivariate analyses. A recent German study by Sander et al. (2021) focusing on socioeconomic status (SES-)differences in involvement during school closures in spring 2020 found that higher-SES parents and non-German speaking parents paid more attention to the establishment of structures during distance learning (e.g., regular study times). Interestingly, they found that lower-SES parents and non-German speaking parents reported more process-focused learning support (e.g., help to apply meaningful learning methods). Similarly, a study from Portugal (Ribeiro et al., 2021) also found that lower-SES parents were more involved in terms of time in their children's learning during school closures. Finally, Weber et al. (2021) examined whether social and ethnic disparities in the reading achievement of primary school students have widened during COVID-19-related school closures in spring 2020 and whether disparities were mediated by parental involvement in distance learning. Moreover, a series of mediation models did not provide any support for the hypothesis that parental involvement explained family background effects on reading achievement during the lockdown period.

3.1.3 Technical Equipment at Home

Due to contact restrictions enacted as part of the pandemic containment measures, the use of digital media represents the only means of transmitting learning materials, learning tasks, and teacher-student communication, in addition to postal delivery or pick-up and drop-off of analog work packages. Hence, sufficient technical equipment for students at home is a necessary prerequisite and condition for initiating learning processes in distance education. Thus, it is not surprising that technical equipment represents one of the most frequently studied issues identified in online surveys conducted regarding COVID-19 pandemic-related distance education. These studies show that the use of digital tools is widespread. Across all surveys reviewed in Helm et al. (2021), an average of 70% of respondents indicated that e-mail was used most often as a means of communication in distance education. This was followed by learning platforms (45%) and the telephone/mobile phone (42%). Lastly, on average, across students, parents, and teachers, around 30% of the respondents stated that video chats and conferencing, messenger services, and the (school's own) website were used as further communication media. As expected, most student surveys (e.g., Schwerzmann and Frenzel, 2020), parent surveys (e.g., Bezirkselternausschuss, 2020; Langmeyer et al., 2020; Thies and Klein, 2020), and teacher surveys (e.g., Eickelmann and Drossel, 2020; forsa, 2020) showed that digital tools were used much more often at the secondary school level than at the primary school level. Surveys conducted later during the pandemic yielded a higher proportion of respondents reporting that learning management systems, such as MS Teams or Moodle, were used. Hence, there is evidence that the use of these tools has increased over the duration of the pandemic (Helm et al., 2021; Helm and Postlbauer, 2021; Wößmann et al., 2021). Lastly, teacher surveys (e.g., Lorenz et al., 2020; Steiner et al., 2020; Tengler et al., 2020) showed that insufficient technical equipment caused challenges for distance education and thus might have been detrimental to students' learning outcomes.

3.1.4 Students' Workplaces at Home

Another requirement of learning is an adequate study space (and the associated learning atmosphere). In school-based learning the learning space is provided by schools and thus usually does not vary between students. This is probably why the learning space was hardly perceived and researched as a relevant variable in the teaching-learning process before the pandemic (Talbert and Mor-Avi, 2019). reviewed existing studies in the field of Active Learning Classrooms, i.e., formal spaces in which learners convene for educational activities. The authors conclude that none of the studies encountered aimed to address the question of what specific architectural elements contribute the most to student outcomes. This research imperative will likely be resolved soon due to COVID-19-related distance learning. Many experts argued that in COVID-19-related distance learning students' an appropriate study place at home is central for students' learning. Particularly for students from socially disadvantaged backgrounds, it is questionable whether they have their own workplace/room for studying at home. With several children at home, it is also questionable whether a quiet and concentrated learning atmosphere is guaranteed. If this is not the case, an important prerequisite for a high share of learning time is missing.

3.1.5 Instructional Quality of Distance Education

Generic conceptual frameworks of instructional quality often demarcate three basic quality dimensions (Klieme et al., 2009; Fauth et al., 2014b; Praetorius and Charalambous, 2018) with several inherent facets. Firstly, classroom management comprises teacher actions that maximize students' time on task and thus ensure an orderly learning environment free of disruption. High levels of discipline and attention arise, for instance, from teachers' communication of clear rules and their monitoring of student activities. Secondly, the multifaceted construct of student learning support entails various approaches to meet students' basic psychological needs and thus approaches to foster self-regulated learning. To support students' experiences of competence, teachers provide differentiated and adaptive instruction, align the pacing of instruction to the learner group in attendance, and give constructive feedback. To enhance students' experience of autonomy, teachers allow individual choices among (differentiated) tasks and create learning material that is of practical relevance and interest to students' lives. To foster experiences of social relatedness, teachers demonstrate openness towards students' opinions and contributions whilst encouraging the students to treat each other

in a friendly, considerate, and helpful way. All these means aim to establish a warm and trusting learning climate. Thirdly, cognitive activation results from cognitively challenging tasks, questions, or even demanding problems. Furthermore, teachers who put students' prior knowledge to the test, elicit and continually explore students' lines of thinking, or stimulate discursive and co-constructive learning activities also take effective measures to foster students' more extensive elaboration and understanding of the instructional content.

A vast and extensive number of studies (e.g., Baumert et al., 2010; Kunter, 2013; Fauth et al., 2014b; Förtsch et al., 2016; Schiepe-Tiska et al., 2016; Dorfner et al., 2018; Praetorius and Charalambous, 2018) document positive relationships between the three instructional quality attributes and student outcomes. In particular, classroom management has been found to be most strongly related to student achievement. For cognitive activation, the findings are somewhat more heterogeneous—presumably because cognitive activation in the sense of promoting students' understanding is more likely to have an effect if it is operationalized as being domain-specific. Social learning support, on the other hand, is assumed to be less of a predictor of student achievement than that of student motivation (which in turn is associated with student achievement), what has been empirically confirmed (e.g., Klieme et al., 2009).

Klieme (2020), Voss and Wittwer (2020), and Meyer (2020) argued on the basis of theoretical considerations that the three constructs of instructional quality also represent important aspects of high-quality in distance education. Initial empirical work on distance education (Frohn, 2022; Helm et al., 2021; Jaekel et al., 2021; Steinmayr et al., 2021) supports these assumptions with both quantitative and qualitative data. For instance, Jaekel et al. (2021) found that teaching methods enabling social connectedness revealed positive associations with students' and parents' ratings of instructional quality and students' learning experiences during distance learning. Finally, Steinmayr et al. (2021) found that distance teaching activities that corresponded with dimensions of teaching quality (e.g., feedback, teacher-child-communication) were comparatively strongly correlated with students' motivation and learning progress during the school lockdown for both elementary and secondary school students.

4 LITERATURE REVIEW ON EXPLANATORY STUDIES PREDICTING STUDENT OUTCOMES DURING COVID-19 PANDEMIC-RELATED DISTANCE EDUCATION

In the present study we focus on predicting three central student outcomes in times of school closures: student achievement, student effort, and student motivation. Student achievement and student motivation are traditionally studied in school and teacher effectiveness research as central outcomes of educational processes (e.g., Fraser and Fisher, 1982; Kunter et al., 2005; Klieme et al., 2009). The reason is that cognitive (performance) and non-cognitive/affective (motivation) outcomes are inherent components of the concept of competence ("skill and will," Weinert, 2002). In addition, we focus on student effort. In line with Skinner and Belmont (1993), we define student effort as the behavioral component of student engagement. That is engaged students exert intense effort and concentration in the implementation of learning task. Therefore, in the present study we focus on students' learning time. We do so because the shift from face-to-face to distance learning greatly or completely reduced nominal instructional time and learning time. In distance learning students had to take much greater control and responsibility of their own learning time. Hence, student effort represents another central outcome in times of school closures. The three outcomes are mutually related to each other, which is why they are included in all models of the present study as either predictors or outcomes. Thus, reciprocal relations are hypothesized and (partially) empirically confirmed between 1) student achievement and student motivation (Shavelson et al., 1976; Schaffner et al., 2016; Hebbecker et al., 2019), 2) student achievement and student effort (Xu et al., 2018), and 3) student motivation and student effort (Skinner and Belmont, 1993). By analyzing these three outcomes, we focus on a complex but broad web of key variables that are aims of learning processes in traditional instruction and also in distance learning.

Although the first COVID-19 pandemic-induced lockdown in the spring of 2020 was only a year ago, there are already empirical studies that used advanced methods to predict key student outcomes. For example, Champeaux et al. (2020), Grewenig et al. (2020), Zaccoletti et al. (2020), Blume et al. (2021), Nusser et al. (2021), and Steinmayr et al. (2021) used ratings from parents to predict the learning outcomes of children during the lockdown. Dietrich et al. (2020), Huber and Helm C. (2020b), Grätz and Lipps (2021), Holzer et al. (2021), Pelikan et al. (2021) and Züchner and Jäkel (2021) used student data to explain self-reported ability to complete tasks during distance education. These studies identified several variables that significantly predicted the rated student outcomes of primary and/or secondary students during lockdown. In the following paragraphs, we summarize these existing findings as follows. First, we report only predictors of the three student outcomes analyzed in the present paper: student achievement, student effort, and student intrinsic motivation. Second, we initially sort them into predictors that are positively and negatively correlated to the outcomes and then, within these two categories, into individual and contextual characteristics.

4.1 Student Achievement

Regarding student achievement (assessed by self-measures and external ratings), existing studies have identified the following positively correlated individual predictors: student age (Huber and Helm C. 2020b), students' subject-specific (e.g., grade point average) and interdisciplinary skills (Züchner and Jäkel, 2021), students' self-reported ability to use digital media before school closure (Züchner and Jäkel, 2021), and students' self-organization skills (Huber and Helm C. 2020b). Further, students' engagement (as reported by their parents, Steinmayr et al., 2021) and students'

self-reported invested learning time (Huber and Helm C. 2020b) positively predict learning success during COVID-19 pandemic-related distance education. Lastly, positive emotions (Huber and Helm C. 2020b) and leisure activities that promote learning, such as reading (Champeaux et al., 2020), are positively associated with student achievement during lockdown. Significantly positively correlated contextual predictors include features of the quality of distance education, such as teacher feedback on learning tasks (Huber and Helm C. 2020b; Steinmayr et al., 2021; Züchner and Jäkel, 2021) and student/parent-teacher communication (Steinmayr et al., 2021) as well as parental satisfaction with school support (Nusser et al., 2021). Negatively correlated individual predictors of learning success include the learning time invested by students at home (Züchner and Jäkel, 2021), the time spent at home in front of the screen, the time spent for extracurricular activities (Champeaux et al., 2020), and negative emotions experienced by students during the pandemic (Huber and Helm C. 2020b). The assessment of student solutions by teachers (Steinmayr et al., 2021) and regular family support for learning (Züchner and Jäkel, 2021) represent negatively correlated contextual predictors of self- and externally rated student achievement. The negative influence of invested learning time and family support is surprising. These unexpected findings are good examples of the challenging interpretation of cross-sectional results. Züchner and Jäkel (2021) argued that these findings might be interpreted in terms of reversed causality:

"Rather, the results of this sample indicate that those who spend more time on tasks and need regular parental support more often have difficulties coping with tasks—possibly family support and the amount of learning time is increased when task coping is less successful." (Züchner and Jäkel, 2021).

In the study by Huber and Helm C. (2020b), the indicators of the quality of the teacher-student relationship and the quality of the family's handling of the crisis also showed surprisingly weak negative effects on self-reported learning success. However, the corresponding bivariate correlations were positive. Hence, these findings should be interpreted with caution. Steinmayr and Christiansen (2020) also argued that the observed unexpected negative influence of parents' assessed language competence of their children on perceived learning success in lockdown should be interpreted with caution, as no theory is able to plausibly explain this negative influence, and as bivariate correlations turn out positive.

4.2 Student Effort

When predicting students' learning time during lockdown, the following variables have been identified as positively correlated individual predictors: age, gender, performance, diligence, emotions. Regarding students' ages, the findings are heterogeneous. While Grewenig et al. (2020) pointed out that the reduction in learning time due to school closure was significantly less pronounced for younger students, Grätz and Lipps (2021) reported that this reduction was greater for secondary school students than for students older than 18 years. Grewenig et al. (2020) also reported that the reduction in learning time was significantly higher for boys than for girls. Students' prior performance also matters: low achievers had a significantly greater reduction in learning time than high achievers. In addition to performance, students' independence (Huber and Helm C. 2020b) and diligence (Grewenig et al., 2020) predict the amount of learning time invested during COVID-19 pandemic. Lastly, at the student level, positive *and* negative emotions (Huber and Helm C. 2020b) are important positive predictors of students' effort. However, the positive influence of negative emotions should not be overinterpreted, as this effect is not observable in bivariate analyses and could therefore represent a methodological artifact (see Steinmayr et al., 2021). Positively correlated contextual predictors include school type (more learning time is invested by students from academic track, Grewenig et al., 2020), teaching quality characteristics such as the intensity of teacher support and task control by the teacher (Dietrich et al., 2020; Huber and Helm C. 2020b), learning support from classmates or friends (Dietrich et al., 2020), as well as home/family resources such as regular learning support, handling of the crisis, and technical equipment at home (Huber and Helm C. 2020b; Züchner and Jäkel, 2021). So far, no negatively correlated individual predictors have been identified in the previous studies available to us. By contrast, a few negatively correlated contextual predictors of learning time during COVID-19 pandemic-related school closures were observed. In particular, a home learning environment that is judged to be less conducive to learning (Dietrich et al., 2020) and errands for parents that keep students from learning (Huber and Helm C. 2020b) have a negative effect on the amount of time invested in learning in distance education.[2] It should be pointed out that there are also studies (e.g., Nusser et al., 2021) that could not identify any significant predictors of students' learning time during school closure. This indicates that predicting student learning time in distance education is likely to be difficult.

"Overall, the regression results show that neither gender, type of school attended, nor reading skills measured in the previous year (start of school year 2018/2019; grade 7) have an impact on reported learning time during school closures. The educational background of the parents also has no influence on the mean reported learning time. This means that these characteristics hardly explain the differences in the average learning times of the students per week during the school closures. This is also confirmed by the low variance explanation of 6 percent (R2 = 0.06)." (Nusser et al., 2021, p. 40, p. 40).

4.3 Student Motivation

Regarding the prediction of students' intrinsic learning motivation during lockdown, the following positively correlated individual predictors proved significant: In line with self-determination theory, students' individual

[2]Interestingly, Grewenig et al. (2020) found that mothers assessed the learning time of their children significantly lower than fathers.

experiences of autonomy and competence are positive predictors of learning motivation in distance education (Holzer et al., 2021). Furthermore, a number of students' learning strategies (study goals and plans, meta-cognition, time management, Pelikan et al., 2021), as well as their learning engagement and diligence (Steinmayr et al., 2021), are positively correlated to students' intrinsic motivation to learn. Lastly, students' hours spent at home on extracurricular activities and learning are significant positive predictors of students' emotional status (Champeaux et al., 2020). Positively correlated contextual predictors were identified in the study by Steinmayr et al. (2021). Teaching quality characteristics, such as student/parent-teacher communication, the frequency of learning tasks sent, and teacher feedback, represent significant predictors of students' intrinsic motivation. Negatively correlated individual predictors of students' learning motivation are students' age (Huber and Helm C. 2020b; Zaccoletti et al., 2020), students' negative emotionality (Steinmayr et al., 2021), students' individual social inclusion and self-regulated learning (Holzer et al., 2021), and students' procrastination (Pelikan et al., 2021). Negatively correlated contextual predictors are the grading of learning tasks by teachers (Steinmayr et al., 2021).

Having presented the state of research regarding predictors of student outcomes in COVID-19 pandemic-related distance education, we want to point out methodological issues that make it difficult to compare and contrast the findings of the different studies. First, these studies used different effect sizes (e.g., unstandardized vs. standardized coefficients). Second, some studies (e.g., Huber and Helm C. 2020b; Steinmayr et al., 2021; Züchner and Jäkel, 2021) reported possible suppression effects, which can lead to unexpected findings.[3] Third, the studies used different informants; that is, they were either based on data from student surveys or from parent surveys. Given the different perspectives associated with different validities and biases, the question arises as to the extent to which the findings of these studies, which are based on different informant groups, are comparable or similar.

5 THE NEED FOR MULTIPLE INFORMANT STUDIES

The previous framework outlined describes the relationship between context, input, process, and output variables. However, social and ecological theories (Bronfenbrenner, 1996; Bandura, 2001) postulate that these variables are perceived differently (and their interrelations are differently pronounced) depending on who is asked to provide information on these variables. For example, Mitchell et al. (2010, p. 272) argued that although actors in a school (e.g., students and teachers) "share a common objective experience, their differing roles within the school will likely lead to discrepant perceptions of the environment." Different factors at multiple levels within the school influence each actor's perception. There are a number of reasons given in the literature for differences in perceptions between students and teachers, all of which can be more or less attributed to the different positions of these actors in the school system (i.e., perspective validity and bias):

- *Role-specific knowledge:* Students, parents, and teachers each have role-specific knowledge and experience due to their specific positions, making them experts in their domains (Baumert et al., 2004; Wagner et al., 2010; Fauth et al., 2014a; Wettstein et al., 2018). For instance, teachers have pedagogical expertise that allows them—in comparison to students and parents—to better (or more adequately) assess certain aspects of instruction (e.g., achievement of instructional goals; instructional disruptions).
- *Role-specific socially desirable response tendency:* Depending on the position, different informants display different social response behaviors (What is expected of me in my position?). In the literature, this effect is called "wishful thinking" (Krammer et al., 2019), "impression management" (Wagner et al., 2010), "self-serving strategies" (Aldrup et al., 2018), "cheerleader effect" (Bingham et al., 1993), etc.
- *Role-specific goal orientation:* Informant-related differences in assessments can also result from different tasks and goals. For example, teachers' tasks and goals are to teach material and foster students' understanding, while students often aim to interact with other learners. This conflict of goals can lead to different perceptions of, for example, classroom disruptions (Wettstein et al., 2018).
- *Role-specific situational framework of the rater:* In class, the teacher is confronted with high social density, unstructured problems, dynamic situations, and multiple demands; and he/she must act under pressure. Students observe lessons from a largely comfortable situation and thus have an observational advantage over the teacher (Wettstein et al., 2018).
- *Role-dependent difficulty of assessment:* Some aspects are more difficult to assess, depending on the position of the rater (Brok et al., 2006; Wettstein et al., 2018; Krammer et al., 2019). For instance, some behaviors, such as clarity or strong control, "may also be easier to self-assess, raising the question of whether teachers and students base their responses on the same observational cues" (Krammer et al., 2019, p. 598).
- *Role-dependent assessment focus:* It is also conceivable that students, teachers, and parents each focus on different aspects when assessing certain dimensions (e.g., classroom structure and clarity), and thus each group of individuals "might add a particularly valuable perspective" (Kunter and Baumert, 2006; Aldrup et al., 2018, p. 1069).
- *Role-specific variables influencing ratings:* Studies (Desimone et al., 2010; Mitchell et al., 2010; Aldrup

[3]In a few studies (e.g., Huber and Helm, 2020b; Steinmayr et al., 2021; Züchner and Jäkel, 2021) unexpected effects were observed in multivariate procedures that are not observed in bivariate analyses.

et al., 2018; Cipriano et al., 2019) show that ratings of different informants depend on characteristics of the individuals and respective contexts. For example, at the individual level, background variables such as students' gender, age, socioeconomic status, ethnicity, motivation, prior achievement, and teacher popularity were shown to influence student ratings. For teachers, similar characteristics, such as gender, age, ethnicity, teaching experience, teacher self-efficacy and beliefs were related to teacher ratings. At the classroom level, high proportion of students with disruptive behavior problems, classroom climate, and teacher-student relationships were identified as predictors of student ratings. Finally, at the school level, staff and student turnover as well as student-teacher ratio were observed to influence assessments of school climate.

The manifold reasons for systematic differences between different informant groups outlined above are often cited as reasons for the lack of validity of self-assessment data. However, because survey data is often collected and used to inform decision-making, the data should be reliable and valid (Desimone et al., 2010). Hence, approaches that foster increased validity in surveys are needed. Multiple informant (report) studies or assessments (also called cross-informant studies/assessments) represent such an approach. In multiple informant studies the information of interest is collected from different perspectives—that is, groups of interest, such as students, parents, teachers, and school leaders. Multiple informant studies capture the unique perspectives of different informants on the same item (i.e., a question or statement). An underlying assumption is that different informants each have unique and valid perspectives (De Los Reyes et al., 2013); see the argument of the role-dependent assessment focus above.

Closely related to the validity problem of single informant studies is the common method bias/variance problem. Single-informant studies run into methodological problems such as common method bias (Podsakoff et al., 2003). If a single method (e.g., online questionnaires) and one source of information (e.g., students) are used, it is likely that the observed associations among the study variables are, to some degree, attributable to the single method used for all items. According to Podsakoff et al. (2003, p. 887), a major cause of common method bias is assessing study variables (i.e., predictors and criteria) from the same rater or source, and "one way of controlling for it (common method bias) is to collect the measures of these variables from different sources." Thus, various biases (e.g., social desirability, lenient tendencies, implicit theories, dispositional, and transient mood states) can be avoided (Podsakoff et al., 2003, p. 887).

Regarding research related to COVID-19 and distance learning, existing studies run the risk of the problems listed above as they often examine very similar research questions but draw on single informant groups. For example, Champeaux et al. (2020), Zaccoletti et al. (2020), Blume et al. (2021), and Steinmayr et al. (2021) examined predictors of central student outcomes in distance education based on parent data, whereas Huber et al. (2020), Pelikan et al. (2021), Holzer et al. (2021), Züchner and Jäkel (2021) relied on student data. Further, central aspects of students' learning processes during COVID-19 pandemic-related school lockdown, such as students' learning progress and the instructional quality of distance education, are often assessed by teacher ratings only (i.e., Lorenz et al., 2020). Therefore, teachers' data represent another important source for analyzing predictors of student learning success during COVID-19 pandemic. Given the role-specific influences discussed above, this raises the question of whether the use of the same questionnaire items yields the same findings regardless of the group inquired, or whether they are more likely to map perspective validities (e.g., Kunter et al., 2007). Hence, multiple informant studies on COVID-19 related distance learning are of particular interest. To date only a limited number of descriptive surveys have made use of multiple informants to increase validity (Bildungsdirektion, 2020; Huber et al., 2020; Letzel and Pozas, 2020; Schwab et al., 2020; Schwerzmann and Frenzel, 2020; Tengler et al., 2020; Trültzsch-Wijnen and Trültzsch-Wijnen, 2020; Garrote et al., 2021). However, to the best of our knowledge, there are no explanatory studies investigating student outcomes during lockdown that make use of multiple informants.

To sum up, our present study is motivated by the aim of showing that different informant sources may reveal different findings and lead to different conclusions. This is particularly important for COVID-19-related educational research as parents' ratings are often used—which is rarely the case in "traditional" school and teaching effectiveness research. Hence, the validity of parents' ratings is of high interest in COVID-19-related educational research. Therefore, our goal is to close this research gap by examining the impact of a broad range of features of distance education on central student learning outcomes using reports from multiple informants, that is, students, parents, and teachers from German and Austrian secondary schools.

6 STUDY DESIGN

6.1 Sample

The findings in the present paper are based on data from the second measurement occasion of the school-barometer survey (www.schul-barometer.net), which was conducted from 11 June 2020 to 22 July 2020 in Germany, Austria, and the German-speaking regions of Switzerland, including all stages of compulsory education (i.e., primary, lower secondary, and upper secondary school). We developed online questionnaires for students, parents, and teachers. We carefully recorded the same constructs with the same items in all questionnaire versions so that we could perform multiple informant analyses of predictors of student outcomes from all three perspectives.

As the response rate was low for the Swiss sample, as well as for the primary school type, we decided to exclude these samples and focus on secondary school data from Germany

TABLE 1 | Sample by country and school type.

School type	Students		Parents		Teachers		
	N = 315		*N* = 518		*N* = 499		
	Missing = 150		Missing = 99		Missing = 188		
	GER	AUT	GER	AUT	GER	AUT	Total
LowSec	23	39	111	116	90	70	449
UppSec	27	76	105	87	90	61	446

Missing, Missing values on both Country and School type; GER, germany; AUT, austria; LowSec = Lower secondary school, UppSec = Upper secondary school.

and Austria. In order to maintain a sufficient sample size for all three survey groups, we decided against conducting the analyses based on data from one country. However, pooling the data from Germany and Austria runs the risk of further increasing the heterogeneity in the data. Although the education systems and also the education policy responses to the COVID-19 pandemic are very similar in the two countries, they are not identical. Nevertheless, in distance learning aspects of different educational systems are assumed to be of less importance when predicting students' learning outcomes because students do learn outside the school system in their homes and families which are assumed not to differ systematically between the two countries. Nevertheless, to exclude the influence of the country on the findings, we included country as a control variable in the subsequent analyses.

Table 1 provides information on the composition of the three assessed informant groups (students, parents and teachers). The ratio of the school type is quite similar across the parent and teacher sample (54% and 51%). Only in the student sample low secondary students are less strongly represented (38%).

For reasons of anonymity and ease of data collection, we refrained from collecting matched data. That is, we did not design the data collection process in a way that would have allowed links to be made between students, parents, and teachers; for instance, by means of a self-generated code. Thus, the analyzed samples are "separate samples of each group."

6.2 Study Variables

Table 2 provides an overview of the constructs assessed in the school-barometer survey and analyzed in this paper. All of the items were self-developed but validated in previous research (Huber S. G. and Helm C., 2020). The response options for all the items ranged from 1 (strongly disagree) to 5 (strongly agree). Only student effort was assessed with an item that ranged from 1 to 40 h a week.

Information on the descriptive statistics (mean, standard deviation) and the reliability (Cronbach's alpha) of the constructs are provided in **Table 2** for the three different informant groups. In examining the mean values of the constructs, lack of technical equipment, lack of parental support, and student's workplace at home showed comparatively low/high approval ratings in the student and/or parent sample, which may indicate bottom/ceiling effects. That is,

TABLE 2 | Descriptive statistics and reliability information for the study variables in the three samples.

Construct	Item text	No	Students			Parents			Teachers		
			M	SD	α	M	SD	α	M	SD	α
ach	If I had to take a test now on what I had to learn in the last few weeks, I would do well	4	3.09	0.98	0.79	2.99	0.98	0.79	2.70	0.77	0.76
eff	I currently spend X hours per week learning and doing tasks for school	1	17.28	10.70	NA	16.50	11.10	NA	14.91	9.03	NA
mot	I enjoyed the distance learning	4	3.35	1.14	0.89	2.73	1.09	0.88	2.64	0.68	0.81
sos	During school closure it was easy for me to get up early and to have a regular daily routine	4	3.58	1.04	0.81	3.02	1.10	0.81	2.35	0.70	0.78
tec	Because of poor internet connection, I often can't access things I need for studying or participate in video conferences	4	1.61	0.70	0.71	2.85	0.45	0.77	2.90	0.36	0.86
sup	During the school closure, I could always ask the teachers if I got stuck	5	3.60	0.87	0.80	2.93	1.04	0.87	4.21	0.54	0.67
str	Our teachers use an online platform (e.g., Teams, Moodle) that is well structured and clear	3	3.56	0.91	0.75	3.43	0.98	0.78	4.33	0.66	0.67
mlt	I have daily contact with my teachers via digital media (e.g., teams, Zoom, email, smart phone)	2	3.21	1.18	0.76	2.27	1.09	0.83	3.28	0.99	0.58
coa	Our teachers expect me to be able to explain my solutions	2	3.92	0.86	0.48	2.53	1.20	0.83	3.69	0.99	0.58
par	For me, the most challenging part of school closure is that my parents cannot help me	2	1.57	0.75	0.55	1.86	0.86	0.53	2.93	0.78	0.52
hom	I have a sufficiently large workplace (e.g., desk) for studying and working at home	2	4.58	0.76	0.45	4.66	0.74	0.63	3.06	0.92	NA

Note.
ach, student achievement; eff, student effort (invested learning hours per week).
mot, intrinsic motivation, sos, self-organization skills, tec, technical equipment at home.
sup, teachers' support of individual learning, str, teachers' support of structure in online lessons.
mlt, teachers' maximization of learning time, coa, teachers' support of cognitive activation.
par, parental support, hom, workplace at home. School type and country are not included.
No = number of items.
In the teacher sample the hom variable was only assessed with a single item. Hence, we report no α value.

many students and/or parents (but not as many teachers) reported that the lack of technical devices, the lack of parental learning support, and the quality of students' workplace at home were *not* detrimental for distance education. These three predictors showed quite low standard deviations. Due to the low variance in these constructs, they are less likely predictive of student outcomes and less likely to be predicted by other variables themselves.

A closer look at the group differences in the descriptive statistics offered the following insights: The effect size (Cohen's *d*) of the group mean differences (of at least one of the three possible group comparisons) is relevant (i.e., $d > 0.5$) for all constructs, except for student effort. The reported average number of hours students invest does not significantly differ between the three informant groups. However, regarding all other constructs several different pictures emerged. In general, student ratings have the highest average approval rate, except regarding the two instructional features, learning support and structure, which were rated more positively by the teachers. While teachers tended to rate instructional features comparatively positively, parents tended to rate these features comparatively less positively. By contrast, students and parents rated home learning resources (parental support, workplace at home) comparatively positively, while teachers rated these resources comparatively less positively. Lastly, students rated their learning progress and learning motivation, as well as their self-organization skills, significantly better than parents and teachers did. The descriptive results also showed that most of the constructs assessed by teacher ratings have comparatively low standard deviations. Teachers seemed to agree more strongly regarding the evaluation of the constructs assessed.

Regarding the internal consistency of the scales, the low alpha values (below 0.6) of the constructs teachers' support of cognitive activation, lack of parental support, and student's workplace at home across all three informant groups were striking. The low values were primarily explained by the low number of items (two for each construct) that were available in the data for the operationalization of the respective construct. Across groups, the reliability values were lowest for the instructional features in the teacher sample. Beyond that, however, no further obvious deviations were discernible in the reliability values.

6.3 Statistical Analyses

6.3.1 Analytic Approach

According to the research questions outlined in the introductory section, we aimed to identify the most relevant predictors of students' learning during COVID-19 pandemic-related distance education. Moreover, we aimed to identify relevant differences in the importance of the predictors between the three respondent groups. To this end, the following statistical procedures were conducted separately for each informant group: students, parents, and teachers.

First, based on measurement error-adjusted constructs, we analyzed latent correlations to uncover bivariate relationships between various aspects of distance education and central student outcomes. Second, by means of latent regression analysis, we tested the extent to which the latent bivariate relations observed in analysis step (1) persisted when the influence of all predictors was modeled simultaneously. Lastly, based on latent bivariate correlations from analysis step (1), we performed a latent relative weight analysis (Tonidandel and LeBreton, 2011) to extend the findings from steps (1) and (2) regarding the following aspects:

- RWA assesses the direct and indirect effects of the predictors on the criterion variables and therefore provides information on the total effect of the predictor variables on the outcome variables.
- RWA illustrates the contribution of the respective predictor (i.e., aspect of distance education) in explaining the variance in the outcome variables (i.e., student achievement, student effort, and student motivation in distance education).
- In RWA, in contrast to regression analysis, high multicollinearity between constructs is not problematic (Stadler et al., 2017). Unlike in regression analysis, constructs do not need to be excluded if they are highly associated with other predictors.

To identify relevant RWA-differences between the respondent groups, we applied the following general principle: we only interpreted differences (Δ) between two informant groups which were higher than 5%. Like the *p* value this number was arbitrarily chosen. However, Hattie (2009) ground-breaking work argues that an effect size (Cohen *d* value) of more than 0.40 is of relevant magnitude in educational science. This effect size equals an R^2 difference of 4% and larger. Hence, we submit that a difference in R^2 greater than 5% should work acceptably as a plausible threshold for relevant effects.

To conclude the analysis strategy, we would like to point out that a multi-group comparison would be the most effective way to analyze latent differences between two or more groups. However, we opted for relative weight analysis (RWA) as major analysis strategy as to our knowledge there is no software that does RWA for multiple groups simultaneously.

6.3.2 Model Fit Evaluation

As described in the previous section, we estimated a latent correlation matrix for each survey group, i.e., students, parents and teachers (see **Tables 4–6** in the text for the correlations of interest and **Supplementary Tables SA7–SA9** for the full correlation matrix). In addition, we estimated 9 latent regression analyses (see **Table 7**); specifically, for each combination of outcome (i.e., student achievement, student effort, student motivation) and survey group (3 × 3 design). Each of the latent correlation matrices and latent regressions represent statistical models which we evaluated using common model fit indices (Little, 2013): the Bentlers comparative fit index ($CFI \geq 0.90$), the Tucker-Lewis index ($TLI \geq 0.90$), the root mean square error of approximation ($RMSEA \leq 0.08$), and the standardized root mean square residual ($SRMR \leq 0.10$). See **Table 3** for the model fit evaluation.

TABLE 3 | Model fit of latent correlation and latent regression models.

	Par	χ^2	df	χ^2/df	CFI	TLI	RMSEA	loCI	upCI	SRMR
Latent correlation analyses										
Student data	168	645.26	461	1.40	0.909	0.889	0.049	0.040	0.058	0.062
Parent data	164	839.24	430	1.95	0.936	0.922	0.048	0.043	0.052	0.048
Teacher data	155	716.26	372	1.93	0.898	0.872	0.043	0.038	0.048	0.085
Latent regression analyses—Student achievement										
Student data	183	686.86	482	1.43	0.901	0.878	0.051	0.042	0.059	0.063
Parent data	178	921.14	451	2.04	0.928	0.910	0.050	0.045	0.054	0.048
Teacher data	170	731.91	390	1.88	0.901	0.874	0.042	0.037	0.047	0.083
Latent regression analyses—Student effort										
Student data	183	686.86	482	1.43	0.901	0.878	0.051	0.042	0.059	0.063
Parent data	178	921.14	451	2.04	0.928	0.910	0.050	0.045	0.054	0.048
Teacher data	170	731.91	390	1.88	0.901	0.874	0.042	0.037	0.047	0.083
Latent regression analyses—Student motivation										
Student data	183	686.86	482	1.43	0.901	0.878	0.051	0.042	0.059	0.063
Parent data	178	921.14	451	2.04	0.928	0.910	0.050	0.045	0.054	0.048
Teacher data	170	731.91	390	1.88	0.901	0.874	0.042	0.037	0.047	0.083

Note.
Par = Number of Parameter, χ2 = Chi square, df = Degrees of freedom.
CFI, comparative fit index; TLI, Tucker Lewis index.
RMSEA, root mean square error of approximation, loCI/upCI, Lower/Upper confidence interval of RMSEA.
SRMR, standardized root mean square residual.

6.3.3 Missing Values

Across all three datasets, the share of missing values was lower than 5% for the vast majority of items. The highest share of missing values for a single item was around 10% (students: 9%, parents: 12%, teachers: 12%). We used full maximum information likelihood (FIML) estimation, as employed in lavaan (Rosseel, 2012), to impute missing values. A central assumption of the FIML procedure is that conditioning on all variables in the analysis, the missing data of the analysis variables is missing at random; that is, the missing data is independent of the level of other variables in the analysis. Since our analyses did not include variables that are assumed to be related to missing data, such as objective student achievement and socioeconomic background, this assumption may not be entirely fulfilled. However, given the low share of missing values, we consider this a minor problem for the reliability of our findings.

6.3.4 Measurement Invariance

Prior to the analyses of the associations between the study variables, we checked for measurement invariance of the assessed constructs between the three informant groups; that is, whether the items used in this study equally assessed the same construct in all three informant groups. Different types of measurement invariance have been distinguished in the literature. Most common are configural, metric, and scalar measurement. As we only investigated latent associations between the study variables in the present study, and because latent mean comparisons of the study variables are not of interest, the confirmation of configural and metric invariance is sufficient (Byrne et al., 1989; Temme and Hildebrandt, 2009). The confirmation of stronger types of measurement invariance, such as scalar invariance, is not needed but reported. The measurement invariance tables are provided in the Appendix. Metric invariance was assessed using the rule of thumb according to Chen (2007) and Cheung and Rensvold (2002). If the model fit does not drop too much; that is, as long as the CFI does not decrease by more than 0.005–0.010 units and the RMSEA does not increase by more than 0.015 units), metric measurement invariance can be assumed. The tables in the Appendix show that for all constructs except the constructs lack of technical equipment at home and teachers' support of students' learning, metric invariance is given. With regard to the construct teachers' support of students' learning, partial metric invariance is obtained if the loading of the item The completion of the learning/teaching tasks was monitored by the teachers during the school closure is allowed to vary across the three respondent groups.

6.3.5 Statistical Software

All statistical analyses were conducted using the statistical software, R (R Core Team, 2014). The R package lavaan (Rosseel, 2012) was used to estimate the measurement models, latent correlations, and the latent regressions. To conduct RWA, a statistical code was written in R using (Johnson, 2000) formula.

7 RESULTS

7.1 Model Fit Evaluation

In **Table 3** we present indices for evaluating the model fit of a) the latent correlations of all study variables (shown in **Tables 4–6**; **Supplementary Tables SA7–SA9**) and b) the latent regression analysis for each of the three outcome variables and the three samples (shown in **Table 7**). The indices point to an acceptable model fit for all models estimated. That is, with

TABLE 4 | Latent correlations of the study variables with achievement outcome.

Construct	Informant groups			z values (difference tests)			*p* values (difference tests)		
	Students	Parents	Teachers	S vs. P	S vs. T	P vs. T	S vs. P	S vs. T	P vs. T
ach	1	1	1	NA	NA	NA	NA	NA	NA
eff	0.136	0.306	0.331	1.940	2.130	0.370	0.050	0.030	0.710
mot	0.663	0.673	0.706	0.190	0.820	0.820	0.850	0.410	0.410
sos	0.584	0.585	0.725	0.020	2.560	3.280	0.990	0.010	0.000
tec	–0.215	–0.122	–0.449	1.040	2.730	4.800	0.300	0.010	0.000
sup	0.380	0.481	0.223	1.340	1.780	3.960	0.180	0.070	0.000
str	0.481	0.513	0.202	0.460	3.300	4.830	0.650	0.000	0.000
mlt	0.335	0.502	0.465	2.210	1.600	0.650	0.030	0.110	0.520
coa	0.361	0.430	0.434	0.890	0.890	0.060	0.370	0.370	0.950
par	–0.278	–0.658	–0.017	5.430	2.770	1.260	0.000	0.010	0.000
hom	0.412	0.200	0.481	2.550	0.890	4.290	0.010	0.370	0.000
typ	0.019	–0.094	0.205	1.230	1.940	4.020	0.220	0.050	0.000

Note. *S = students, P = parents, T = Teachers. See* ***Table 1*** *for the meaning of the construct names.*

TABLE 5 | Latent correlations of the study variables with effort outcome.

Construct	Informant groups			z values (difference tests)			*p* values (difference tests)		
	Students	Parents	Teachers	S vs. P	S vs. T	P vs. T	S vs. P	S vs. T	P vs. T
ach	0.136	0.306	0.331	1.940	2.130	0.370	0.050	0.030	0.710
eff	1	1	1	NA	NA	NA	NA	NA	NA
mot	0.051	0.117	0.315	0.720	2.830	2.770	0.470	0.000	0.010
sos	0.266	0.086	0.372	2.010	1.220	4.050	0.040	0.220	0.000
tec	–0.066	0.096	–0.329	1.760	2.840	5.830	0.080	0.000	0.000
sup	0.104	–0.023	0.056	1.370	0.500	1.050	0.170	0.620	0.290
str	0.000	0.064	0.224	0.690	2.350	2.180	0.490	0.020	0.030
mlt	0.113	0.040	0.222	0.790	1.150	2.470	0.430	0.250	0.010
coa	0.148	0.008	0.145	1.530	0.030	1.840	0.130	0.970	0.070
par	–0.001	–0.026	0.038	0.270	0.400	0.850	0.790	0.690	0.400
hom	0.013	0.009	0.202	0.040	1.980	2.620	0.970	0.050	0.010
typ	0.098	–0.026	0.234	1.340	1.440	3.510	0.180	0.150	0.000

Note. *S = students, P = parents, T = Teachers. See* ***Table 1*** *for the meaning of the construct names.*

TABLE 6 | Latent correlations of the study variables with motivation outcome.

Construct	Informant groups			z values (difference tests)			*p* values (difference tests)		
	Students	Parents	Teachers	S vs. P	S vs. T	P vs. T	S vs. P	S vs. T	P vs. T
ach	0.663	0.673	0.706	0.190	0.820	0.820	0.850	0.410	0.410
eff	0.051	0.117	0.315	0.720	2.830	2.770	0.470	0.000	0.010
mot	1	1	1	NA	NA	NA	NA	NA	NA
sos	0.768	0.767	0.727	0.020	0.970	1.230	0.990	0.330	0.220
tec	–0.179	–0.222	–0.368	0.490	2.120	2.140	0.630	0.030	0.030
sup	0.312	0.402	0.228	1.120	0.930	2.590	0.260	0.350	0.010
str	0.334	0.470	0.328	1.760	0.080	2.270	0.080	0.940	0.020
mlt	0.349	0.432	0.429	1.060	0.980	0.040	0.290	0.330	0.970
coa	0.423	0.438 0.360	0.200	0.770	1.240	0.840	0.440	0.220	
par	–0.335	-0.604	0.144	3.790	5.080	11.230	0.000	0.000	0.000
hom	0.490	0.214	0.360	3.440	1.630	2.130	0.000	0.100	0.030
typ	0.202	0.048	0.165	1.700	0.390	1.580	0.090	0.690	0.110

Note. *S = students, P = parents, T = Teachers. See* ***Table 1*** *for the meaning of the construct names.*

exception of *T LI* the indices are above (*CFI*) or below (*RMSEA*, *SRMR*) the cut-off values suggested in the literature. According to the simulation study by Shi et al. (2019), *CFI* and *T LI* values can be underestimated when large models are estimated based on small samples. Hence, we argue that our estimated models are sufficiently well able to reproduce the data (i.e., the variance-covariance matrix) and thus are reasonably consistent with the data.

TABLE 7 | Latent regression analyses to predict student outcomes.

	Rated student achievement						Student effort						Student motivation					
	S	p val	P	p val	T	p val	S	p val	P	p val	T	p val	S	p val	P	p val	T	p val
ach	0.000	NA	0.000	NA	0.000	NA	0.194	0.213	0.589	0.000	0.298	0.287	0.270	0.017	0.303	0.002	0.432	0.012
eff	0.111	0.015	0.245	0.000	0.133	0.316	0.000	NA	0.000	NA	0.000	NA	−0.159	0.037	−0.027	0.585	−0.127	0.418
mot	0.485	0.228	0.316a	0.007	0.507	0.022	−0.499	0.040	−0.068	0.589	−0.332	0.407	0.000	NA	0.000	NA	0.000	NA
sos	0.121	0.528	−0.035	0.771	0.226	0.188	0.609	0.008	0.045	0.711	0.211	0.394	0.634	0.000	0.515	0.000	0.424	0.042
tec	0.053	0.745	0.036	0.623	−0.094	0.570	0.108	0.436	0.097	0.215	−0.031	0.928	0.234	0.036	−0.089	0.155	−0.037	0.875
sup	−0.169	0.598	−0.047	0.897	0.668	0.455	0.263	0.451	−0.521	0.173	−1.515	0.360	−0.052	0.795	−0.304	0.269	−0.933	0.393
str	0.359	0.150	0.033	0.785	−0.549	0.281	−0.357	0.195	0.177	0.159	0.922	0.314	−0.050	0.771	0.131	0.158	0.536	0.397
nlt	0.105	0.564	0.149	0.628	−0.164	0.767	0.155	0.390	0.307	0.358	0.812	0.451	0.175	0.142	0.197	0.408	0.453	0.519
coa	−0.036	0.770	0.084	0.330	0.133	0.088	0.083	0.483	−0.087	0.359	0.000	0.999	0.008	0.934	0.108	0.097	0.071	0.377
par	−0.019	0.856	−0.519	0.019	−0.139	0.549	0.044	0.759	0.418	0.070	0.297	0.422	−0.046	0.695	−0.031	0.826	0.311	0.211
hom	0.087	0.703	−0.189	0.196	0.184	0.220	−0.155	0.563	0.182	0.208	−0.373	0.099	0.148	0.537	−0.025	0.808	−0.261	0.083
typ	−0.115	0.141	−0.119	0.030	0.025	0.762	0.028	0.755	0.022	0.728	0.032	0.822	0.006	0.931	0.019	0.681	−0.101	0.283
cou	−0.104	0.238	−0.004	0.950	−0.102	0.463	0.022	0.820	0.131	0.031	0.258	0.243	0.058	0.448	−0.057	0.176	0.145	0.342

Note. See ***Table 1*** *for the meaning of the construct names. S = students, P = parents, T = Teachers. p val =* p *value.*

7.2 Latent Correlations

See **Supplementary Tables SA7–SA9** for the full correlation matrices.

7.2.1 Rated Student Achievement

Table 4 (see the left part) shows that irrespective of the informant (i.e., students, parents or teachers) chosen, self- and externally assessed student achievement was (most) strongly related to students' intrinsic motivation and self-organization skills. In addition, we observed strong correlations between student achievement and the lack of parental learning support, as well as quality features of distance education (teachers' support of structure in online lessons and teachers' maximization of learning time) in the parent dataset. The statistical tests of the differences between the correlations of two different samples (see the right part of **Table 4**) showed that a couple of associations were significantly higher in the teacher dataset than in the other two datasets (self-organization skills, lack of technical equipment at home, school type). By contrast, some associations were significantly lower in the teacher dataset than in the other two datasets (teachers' support of individual learning and teachers' support of structure in online lessons). Student effort was significantly more strongly associated with student achievement in the parent and teacher datasets than in the student dataset. Lastly, workplace at home was significantly less strongly associated with achievement in the parent dataset than in the other two datasets.

7.2.2 Student Effort

Table 5 (see the left part) shows that irrespective of the informant (i.e., students, parents or teachers) chosen, student effort was (most) strongly related to students' self- and externally rated achievements and self-organization skills. In addition, negative correlations between student effort and the lack of technical equipment at home were observed in the teacher dataset. The statistical tests of the differences between the correlations of two different samples (see the right part of **Table 5**) showed that a few of associations were significantly higher in the teacher dataset than in the other two datasets (students' intrinsic motivation, lack of technical equipment at home, teachers' support of structure in online lessons, workplace at home). Students' effort was more strongly linked to school type and teachers' maximization of learning time in the teacher sample than in the parent sample. Furthermore, achievement was less strongly correlated with student effort when assessed by student data than by parent or teacher data. By contrast, students' self- organization skills were less strongly associated with students when we used parent data instead of student and teacher data.

7.2.3 Student Intrinsic Motivation

Table 6 (see the left part) shows that irrespective of the informant (i.e., students, parents or teachers) chosen, student intrinsic motivation was (most) strongly related to student achievement (see above) and to student self-organization skills. We observed a negative correlation between student motivation and a lack of parental support in the parent data. The statistical tests of the differences between the correlations of two different samples (see

the right part of **Table 6**) showed that a couple of associations were significantly higher in the teacher dataset than in the other two datasets (student effort, lack of technical equipment at home). Features of instructional quality during distance education (teachers' support of individual learning and teachers' support of structure in online lessons) were less strongly correlated with student motivation in the teacher data than in the parent data. Workplace at home was less related to the outcome in the parent data than in both other datasets. Lastly, the lack of parental support during lockdown was most strongly related to student motivation in the parent dataset—and significantly higher than in the other two datasets.

The findings from bivariate latent correlation analyses indicate that only students' self-organization skills were significantly related to all three outcomes across all three informant groups. However, regarding all other predictors of student learning during lockdown, the presented analyses revealed different patterns between the different informant groups. These differences underscore the need for cautious interpretation of findings based solely on one informant group, as such findings may be colored by a single perspective.

7.3 Latent Regression Analyses

Latent correlation analyses show that many of the study variables were significantly related with each other. This raises the question of whether and to what extent the predictors of student outcomes are confounded, and thus lead to spurious relationships among the predictors and the outcome variables. Therefore, there is a risk of reporting spurious correlations; that is, two variables are associated but not causally related due to either coincidence or the presence of a certain third, unseen variable. To prevent this risk of misinterpretation, we performed multivariate regression analyses that controlled for other relevant variables by including them as explanatory variables. **Table 7** shows the results of nine different regression models. For each of the three informant groups, the three student outcomes are predicted by all other study variables. However, some of the very high regression coefficients—particularly when student effort was regressed on the dimensions of instructional quality (teachers' support of individual learning: $\beta = -1.515$, teachers' support of structure in online lessons: $\beta = 0.922$ and teachers' maximization of learning time: $\beta = 0.812$)—and some of their huge standard errors (S.E. = 1.076–2.453) point to issues of multicollinearity and are thus not trustworthy. Moreover, the high latent correlations observed in **Supplementary Tables SA7–SA9** (e.g., between teachers' support of individual learning and teachers' maximization of learning time, $r = 0.778$) also point to multicollinearity problems. These issues call for other analytic approaches that are less sensitive to multicollinearity, such as relative weight analyses.

Table 7 provides information on the latent regressions predicting central student outcome variables in the three different samples.

7.4 Relative Weight Analyses

Tables 8–10 provide information on the results of the relative weight analyses (RWA) for the three different informant samples.

TABLE 8 | Relative weight analysis for student achievement.

	Absolute R^2			Relative R^2		
	Students	**Parents**	**Teachers**	**Students**	**Parents**	**Teachers**
ach	—	—	—	—	—	—
mot	19	14	20	35	21	28
eff	1	7	3	2	10	5
sos	10	9	18	19	13	25
tec	1	0	4	1	1	6
sup	3	4	3	5	6	4
str	9	5	2	16	7	3
mlt	2	5	5	4	7	7
coa	3	4	7	5	5	10
par	2	17	1	3	25	1
hom	5	2	6	8	3	9
typ	1	1	1	2	2	2
tot	55	68	69	—	—	—

*Note. See **Table 1** for the meaning of the construct names.*

TABLE 9 | Relative weight analysis for student effort.

	Absolute R^2			Relative R^2		
	Students	**Parents**	**Teachers**	**Students**	**Parents**	**Teachers**
eff	—	—	—	—	—	—
ach	2	11	4	10	49	11
mot	3	1	2	15	6	6
sos	8	1	5	39	4	13
tec	0	1	4	2	5	11
sup	1	2	5	7	8	15
str	2	1	6	8	5	16
mlt	1	2	5	5	7	14
coa	1	1	0	6	3	1
par	0	2	1	1	10	3
hom	1	0	1	4	2	3
typ	1	0	2	3	0	6
tot	22	22	34	—	—	—

*Note. See **Table 1** for the meaning of the construct names.*

TABLE 10 | Relative weight analysis for student motivation.

	Absolute R^2			Relative R^2		
	Students	**Parents**	**Teachers**	**Students**	**Parents**	**Teachers**
mot	—	—	—	—	—	—
ach	18	15	20	24	21	28
eff	1	1	2	2	1	3
sos	30	28	22	41	40	31
tec	2	2	3	2	2	4
sup	2	2	3	2	4	5
str	2	4	4	3	6	6
mlt	4	3	7	5	4	10
coa	5	4	4	7	6	5
par	3	9	2	4	13	3
hom	7	1	3	9	1	4
typ	2	0	1	2	0	1
tot	75	69	71	—	—	—

*Note. See **Table 1** for the meaning of the construct names.*

Each table shows the absolute and relative R^2 values. Absolute R^2 values refer to each predictor's absolute contribution to the total explained variance in the outcome variable (left part of the tables). The tables also show the relative size of the absolute share when set in relation to the total explained variance (right part of the tables). As highlighted above, RWA values assess the direct and indirect effects of the predictors on the criterion variables and therefore provide information on the total effect of the predictor variables on the outcome variables. Following this interpretation, **Tables 8–10** present the following findings:

7.4.1 Rated Student Achievement

Depending on the informant sample, the total variance in student achievement was explained to 55%–69% by the study variables. In examining all three informant samples, students' intrinsic motivation emerged as the most important predictor of self-rated and externally rated student achievement during school-lockdown. Whereas 19% and 20% were explained from the student and teacher perspective, respectively, only 14% were explained from the parents' point of view. From parents' perspective, the lack of parental support during distance education was even more important (17%). Students' self-organization skills ranked second among the most relevant conducive features of distance education during the pandemic lockdown (9%–18%). The dimensions of instructional quality of distance education, as well as student effort and the quality of the workplace at home, ranked in the middle when we averaged the values across informant groups. However, the scatter was high, ranging from 1% to 9% in the student sample, for instance. Technical equipment at home and school type proved to be the least relevant when predicting students' self-rated and externally rated achievement during COVID-19 pandemic-related distance education (0%–4%).

7.4.2 Student Effort

Depending on the informant sample, 22%–34% of the total variance in student effort was explained by the study variables. By examining all three informant samples, students' self-rated and externally rated achievement, as well as students' self-organization skills, emerged as the most important predictors of the hours spent a week by students for learning and school issues during school closure. From the students' and teachers' perspectives, student self-organization skills seemed more relevant (8%–5%), whereas student achievement was more predictive if parent assessments were used (11%). Again, the dimensions of instructional quality of distance education ranked in the middle when we averaged the values across informant groups. However, the scatter was high, ranging from rather low values in the student and parent samples (i.e., 1%) to higher values in the teacher sample (i.e., 6%). Lack of parental support, technical equipment at home, and school type proved to be the least relevant when predicting students' learning effort in hours per week during COVID-19 pandemic-related distance education (0%–2%).

7.4.3 Student Motivation

Depending on the informant sample, 69%–75% of the total variance of students' intrinsic learning motivation was explained by the study variables. In considering all three informant samples, student self- organization skills emerged as the most important predictor of the students' intrinsic learning motivation during school-lockdown. From students' and parents' perspectives, around 30% of variation in student motivation was explained (30% and 28% respectively); however, student self-organization skills were less relevant from the teacher perspective (22%). Self-rated and externally rated student achievement emerged as the second most important predictor, with similarly high explanatory contributions across samples (ranging between 15% and 20%). As with the prediction of student achievement and student learning time per week, the quality dimensions of distance education also ranked in the middle for the prediction of student intrinsic motivation. However, the RWA values were quite low, as was the scatter of the contributed shares for explaining the variation in the motivation variable (2%–7%), indicating a comparable relevance of the quality characteristics in all three informant groups. The rest of the study variables only contributed marginally to the prediction of students' intrinsic learning motivation (e.g., student effort: 1%–2%, school type: 0%–2%).

7.4.4 Predictors With the Strongest Differences Between the Three Informant Groups

In addition to identifying significant predictors of student outcomes in the time of COVID-19 pandemic, the goal of this study was to examine the extent to which different sources of information lead to the same findings. We investigated the difference reported in **Tables 8–10** to obtain first indications.

Regarding the prediction of self-rated and externally rated student achievement, the main differences between the three informant groups are as follows: When we used students as informants, perceived teachers' support of structure in online lessons was more relevant than when teachers were considered as informants (Δ = + 7% R^2 contribution). When we used parents as informants, the predictors of *lack of parental support* (Δ = + 15–16% R^2 contribution) and student effort (Δ = + 4 to 6 percent point R^2 contribution) were of higher relevance than when using student or teacher reports. By contrast, students' intrinsic motivation (Δ = −5–6% R^2 contribution) was of lower relevance in the parent data than in the student and teacher data. Lastly, student self-organization skills (Δ = + 8–9% R^2 contribution) were much more relevant if analyses were based on teacher data.

Regarding the prediction of student effort, the main differences between the three informant groups are as follows: Self-rated and externally rated student achievement yields a much higher R^2 contribution in the parent data as opposed to the student and teacher data (Δ = + 7–9% R^2 contribution). In addition, student self-organization skills were more relevant in the student data analysis than in the parent data analysis (Δ = + 7% R2 contribution).

Regarding the prediction of student intrinsic motivation, the main differences between the three informant groups are as follows: If the analysis was performed on the basis of the

teacher data, students' self-organization skills represented a less relevant predictor when compared to the analyses conducted on the basis of the student and parent data (Δ = −6–8% R^2 contribution). As with the prediction of student self-rated and externally rated achievement, the *lack of parental support* was only relevant when we used parents as informants (Δ = + 6–7% R^2 contribution). Lastly, the relevance of the predictor workplace at home differed between students' and parents' perspectives, with higher R^2 contributions when assessed based on student reports (Δ = + 6% R^2 contribution).

8 DISCUSSION

COVID-19 pandemic-related school closures opened a completely new, entirely unstudied field for educational research, which very quickly attracted media attention too. The sudden and high demand for information from different stakeholders has led to an abundance of descriptive survey studies being presented very quickly, while explanatory studies on the prediction of student outcomes during the pandemic are still rare. Moreover, most studies have been based on only one source of information (e.g., students, parents, or teachers). The question remains as to what extent the findings obtained in this way are subject to perspective bias.

The present study fills these research gaps by presenting initial findings on the prediction of students' self- and externally-assessed learning success, learning engagement, and intrinsic motivation to learn during the COVID-19 pandemic based on student, parent, and teacher data.

Across all informant groups, students' intrinsic motivation and self-organization skills emerged as the most important predictors of self-rated and externally rated student achievement during school lockdown, while instructional quality during distance education only contributed little to explaining rated learning success. These findings extend existing research that has previously identified leisure activities conducive to learning, such as reading (Champeaux et al., 2020), teaching activities such as feedback, student communication, and student engagement (Steinmayr et al., 2021), and self-reported ability to use digital media before school closure (Züchner and Jäkel, 2021).

Regarding student effort, students' self-rated and externally rated achievement, as well as student self- organization skills, emerged as the most important predictors of students' effort across all informant groups. Again, instructional quality during distance education contributed little to explaining students' learning effort. The predictive power of rated student achievement is in line with the results from a study by Grewenig et al. (2020), who reported that high-achieving students invested more hours in school activities during COVID-19 pandemic. Although, prior research has identified several further predictive aspects of students' effort, such as students' learning environment at home, social support of classmates, teachers' support intensity (Dietrich et al., 2020), students' socioeconomic background, school type (Grätz and Lipps, 2021), and regular family learning support (Züchner and Jäkel, 2021), the present study adds new relevant predictors.

Students' intrinsic motivation during COVID-19 pandemic-related distance education was most strongly determined by students' self-organization skills and self-rated and externally rated student achievement across all informant groups. Again, instructional quality during distance education contributed little to explaining students' intrinsic motivation during distance education. In line with the findings by Holzer et al. (2021), our results indicate that—as postulated by self-determination theory (Deci and Ryan, 1985)—students that perceive competence are more likely to report higher intrinsic motivation during distance education. Further, in line with previous research (Pelikan et al., 2021), our findings show that students with higher self-organization skills are more strongly intrinsically motivated during distance education.

With respect to our second research question regarding whether different informant groups yield different findings, our study did not reveal a clear picture. Following social cognitive theory, we expected that those aspects which are assumed to be more strongly in the focus of the respective group (according to their role) should have significantly higher importance for the prediction of the student outcomes. For example, instructional quality in distance learning represents aspects for which teachers are responsible and which are part of their daily work. Therefore, it can be assumed that these aspects are particularly in the focus of the teachers and that they are also given a higher importance in the context of instructional processes. Accordingly, these characteristics are expected to have a stronger predictive power for predicting outcomes in the teacher sample than in the student and parent sample. However, as the results from RWA analysis show, this assumption is not supported by the data. The R^2 contributions of the instructional quality dimensions (sup, str, mlt, coa) do not vary significantly across the three samples. Only parental support (par) proves to be particularly predictive for all three outcomes in the parent sample, significantly more so than in the student and teacher sample. Considering all the findings, however, the assumption that some aspects can be assessed more "validly" (in the sense of a higher predictive validity) by one group than by other groups, is not confirmed in the present study.

In summary, the present study adds two aspects to the existing research:

1) Substantively, the findings point to the important role of learners' self-organization skills in coping with COVID-19 pandemic-specific school closures.
2) Methodologically, the findings point to relevant but not coherent influence of the selected samples as sources of information.

8.1 Limitations

This study has some theoretical limitations.

First, from a theoretical point of view we did not consider reciprocal effects between our study variables, particularly

between the dependent and independent variables. For instance, in studies on self-regulated learning, intrinsic motivation leads to a higher level of implemented learning strategies; accordingly, assuming and modeling self-organization skills as predictors of motivation should be carefully reflected. Our assumption was that in the context of distance learning students with higher self-organization skills are less overwhelmed and experience competence more frequently than students with lower self-organization skills. Therefore, we assumed students' self-organization skills being a central predictor of students' motivation. However, with our study design we cannot examine (and exclude) reciprocal effects. Nevertheless, RWA does model all indirect associations of the specified predictors (Johnson, 2000). That is, our RWA models not only estimate the direct effects of students' motivation and students' self-organization skills on the outcomes but also the indirect effects of each predictor via all other predictors, i.e., of a) students' motivation via students' self-organization skills on the outcomes; and b) students' self-organization skills via students' motivation on the outcomes. Thus, the reciprocal effects of predictors are therefore taken into account in our relative weight analyses.

Second, it is critical that the domain specificity of learning is not considered in the present study. Especially against the background of initial findings showing that the extent of digitally supported instruction during COVID-19 pandemic clearly depends on the subject (Heller and Zügel, 2020), the question arises as to what extent the findings in this paper can claim validity for all or at least for the main subjects equally. Steinmayr et al. (2021) showed that domain-specific teacher variables did not add to the prediction of students' motivation, competent and independent learning, and learning progress during the school lockdown. How- ever, the latter were not assessed domain-specifically. Hence, we argue that future research should conduct appropriate analyses with domain-specific measurement instruments to shed light on this question.

Third, regarding the type of school, while only secondary school students were used here, it is well known from other studies (e.g., Helm et al., 2021) that distance education during COVID-19 pandemic-related school closures was quite different at the primary level than at the secondary level. For example, a representative parent survey in Austria at the beginning of 2021 (Helm and Postlbauer, 2021) reported that primary students received only 45 min of online lessons per day, whereas students from upper secondary schools received.

4.2 h of online lessons per day. By contrast, in primary schools 78% of the parents' report that learning assignments are provided in paper form, while in upper secondary schools only 4% report receiving paper pencil assignments, but 83% report receiving assignments via digital learning platforms. Further studies need to investigate these different learning environments and should elaborate on differences in the determinants of learning across school levels (see, e.g., Steinmayr et al. (2021) for such analyses).

In addition, this study has some methodological limitations.

First, our study represents a cross-sectional study; hence, no causal statements can be made. Nevertheless, cross-sectional studies can provide meaningful insights into the possible longitudinal relations of variables if statistical analyzes are rooted in solid theoretical assumptions about predictors and outcomes and if central control variables are modeled. In the present study, we claim both. However, since our theoretical model assumes reciprocal relationships between the characteristics (see earlier discussion in this section), future studies should be longitudinal (see, e.g., Schober et al., 2020).

Second, our sample represents an ad hoc sample that is not representative of the student, parent, and teacher body population but controlled against different characteristics of the respective population. Particularly, the small student sample probably only represents a certain part of the lower secondary students. Therefore, strictly speaking, the findings cannot be generalized beyond our sample. However, in COVID-19 pandemic-related educational research, representative samples are rare (about only one-fifth of the 97 studies identified in the review in Helm et al. (2021) was based on representative samples). As in other current surveys, it can be assumed for our sample that people from educationally disadvantaged backgrounds, in particular, are underrepresented in the data. This could lead to an underestimation of the dispersion in some survey variables and thus their correlation with other variables. It is therefore possible that the effects reported here are too conservative.

Third, measurement invariance analysis indicates that the weak measurement invariance (i.e., equal loadings) of the construct lack of technical equipment at home was not achieved. Hence, a prerequisite for the comparison of the findings between the three informant groups was violated. According to Meitinger et al. (2020) there are various reasons for the lack of measurement invariance. On the one hand, the content of the construct may differ across groups, or the respondents attribute different meanings with the items. On the other hand, measurement invariance might be a result of other sources of measurement error (e.g., method bias). In the present study a lack of metric invariance means that the factor loadings are not equal across groups, i.e., some items are stronger indicators of the latent factor in certain groups of respondents. For the construct "technical equipment at home" the stepwise release of the equality constraints of the factor loadings shows that almost all items and all groups contribute to the missing measurement invariance. This means that the three groups of respondents attribute significantly different meanings to the items, for instance:

- Item 2 "The computer/laptop/tablet in our household is/are up to date" had a comparable low loading in the student group.
- Item 3 "Due to poor internet connection, I often cannot access things I need for learning or participate in video conferencing" had a comparable low factor loading in the student group too but had a very high factor loading in the teacher group.
- Item 4 "I have enough opportunities to work on the computer/laptop/tablet for school." had a comparable very high factor loading in the student group and an low factor loading in the parent group.

These differences show that while items 2 and 3 are good indicators of the construct in the parent and teacher group,

they are not so in the student group. In contrast, item 4 seems to work well in the student group, but very bad in the parent group. One interpretation of these findings is that, when asked about the appropriateness of their technical equipment at home for distance learning, from a students' perspective the number of opportunities to work on an electronical device is of higher importance then the quality of the internet connection and the whether the computer/laptop/tablet is up to date. For parents and teachers, it seems to be the other way around. It makes sense for teachers to think about internet connectivity first, as their focus is online teaching in distance learning. It also makes sense that the condition of the laptop is important for parents, since parents are probably especially needed by their children when there are technical problems with the user devices. These findings indicate that future studies aiming to examine students' technical equipment for distance learning at home should first construct a measurement scale consisting of items that are interpreted in the same way by different respondent groups or should contain carefully designed bespoke instruments for different groups.

Fourth, because we did not record information about which school the students, teachers, and parents belonged to (for reasons of anonymity), we also cannot account for the hierarchical structure in the data. This could lead to biased standard errors. However, intra-class correlation (ICC) values can be assumed to be low in the case of distance learning since classes have been disbanded and learning is more dependent on individual characteristics and home conditions. Findings from studies on distance learning point to rather low values below 10% (e.g., Jaekel et al., 2021). In addition, prior research from regular schooling shows that for motivational outcomes ICC values are low anyway (e.g., Kunter et al., 2005). Nevertheless, this lack of information is a key limitation that needs to be tackled in future research.

Fifth, for reasons of anonymity and ease of data collection, we refrained from collecting matched data. That is, we did not design the data collection process in a way that would have allowed links to be made between students, parents, and teachers. Therefore, a direct comparison of ratings of the same referent object from multiple perspectives is not possible in this study. This means, that the students who were assessed from the parents' and teachers' perspective (in the parent and teacher sample) do not necessarily coincide with the students of the student sample. Future studies should use matched samples to test the validity of the present findings.

Finally, it should be noted that student outcomes were assessed through self- and peer-ratings. This is especially critical for outcome learning success during lockdown. A meta-analysis by Hansford and Hattie (1982) concluded that self-ratings and performance measures are scarcely associated with each other or overlap only 4%–7%. It is therefore unclear to what extent the predictors identified here are also predictive of objectively assessed student performance measures.

8.2 Implications

Studies have repeatedly shown that children's and adolescents' abilities to self-organize and self-direct learning are predictive of the quality and outcomes of learning processes—not only in distance education (Boekaerts and Corno, 2005; Huber and Helm, 2020b; Steinmayr et al., 2021). Hence, in regular classes and in all different scenarios in which learning takes place without the supportive structures of school (e.g., lifelong learning, distance education due to natural disasters), it is particularly important to promote these skills intensively. For school practice, this could mean focusing more than before on types of learning environments that support self-directed learning and meta-learning, that is, learning how to regulate learning processes alone and with teachers. Findings from a student survey in Austria (Lenz and Helm, 2021) show that learners who were taught according to the concept of open and cooperative learning prior to COVID-19 pandemic are significantly more likely than students from traditional classes to report that they made higher progress during distance education. They also rated the quality of the teacher–student relationship during lockdown significantly higher than students from traditional classes. Huber (2021) discusses further implications for practice and policy in education, for example, the role of technology in promoting individualization and interactivity.

For researchers, the findings imply that both descriptive and explanatory analyses of distance education may arrive at partially different conclusion depending on which group of actors is used as the source of information. Only a few predictors, such as learners' self-direction skills, were found to be highly significant in predicting learning outcomes across all informant groups. Future studies should therefore critically reflect on the validity of single informant studies against this background by discussing possible perspective validity and bias, as well as issues of reliability. As stated earlier, longitudinal studies with representative samples (taking demographic, socioeconomic and further relevant characteristics into account) are needed.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Teacher University Zug. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

SH, CH, and Paula Günther, Nadine Schneider, Marius Schwander, Julia Schneider, and Jane Pruitt designed and carried out the study. CH performed the data analyses and was major contributor in writing the manuscript. All authors approved the submitted version.

FUNDING

This article was financially supported by the Open Access Publication Fund of the University of Teacher Education Zug.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2022.743770/full#supplementary-material

REFERENCES

Aldrup, K., Klusmann, U., Lüdtke, O., Göllner, R., and Trautwein, U. (2018). Social Support and Classroom Management Are Related to Secondary Students' General School Adjustment: A Multilevel Structural Equation Model Using Student and Teacher Ratings. *J. Educ. Psychol.* 110 (8), 1066–1083. doi:10.1037/edu0000256

Bandura, A. (2001). Social Cognitive Theory: An Agentic Perspective. *Annu. Rev. Psychol.* 52, 1–26. doi:10.1146/annurev.psych.52.1.1

Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., et al. (2010). Teachers' Mathematical Knowledge, Cognitive Activation in the Classroom, and Student Progress. *Am. Educ. Res. J.* 47 (1), 133–180. doi:10.3102/0002831209345157

Baumert, J., Kunter, M., Brunner, M., Krauss, S., Blum, W., and Neubrand, M. (2004). "Mathematikunterricht aus Sicht der PISA-Schülerinnen und -Schüler und ihrer Lehrkräfte. [Mathematics education from the perspective of PISA students and their teachers," in *PISA 2003. Der Bildungsstand der Jugendlichen in Deutschland: [PISA 2003. The educational attainment of young people in Germany.]*. Editors J. Baumert, W. Blum, R. Lehmann, D. Leutner, M. Neubrand, R. Pekrun, et al. (Waxmann), 314–354.

Bezirkselternausschuss, M. (2020). Eltern-Umfrage zum Homeschooling: Ergebnisse und Schlussfolgerun- gen. [Parent survey on homeschooling. Results and conclusions]. Available at: https://bea-mitte.de/doc/umfrage/BEA_Mitte_Ergebnisse_Homeschooling-Umfrage.pdf.

Bildungsdirektion, N. (2020). *Fernunterricht: fokusevaluation. [distance learning. Focus evaluation.]*. Stans.

Bingham, R. D., Haubrich, P. A., and White, S. B. (1993). Explaining Teacher/Principal Differences in Evaluating Schools. *J. Educ. Admin.* 31 (1), 70–76. doi:10.1108/09578239310024728

Blume, F., Schmidt, A., Kramer, A. C., Schmiedek, F., and Neubauer, A. B. (2021). Homeschooling during the SARS-CoV-2 Pandemic: the Role of Students' Trait Self-Regulation and Task Attributes of Daily Learning Tasks for Students' Daily Self-Regulation. *Z. Erziehungswiss.* 24, 367–391. doi:10.1007/s11618-021-01011-w

Boekaerts, M., and Corno, L. (2005). Self-regulation in the Classroom: A Perspective on Assessment and Intervention. *Appl. Psychol.* 54 (2), 199–231. doi:10.1111/j.1464-0597.2005.00205.x

Boonk, L., Gijselaers, H. J. M., Ritzen, H., and Brand-Gruwel, S. (2018). A Review of the Relationship between Parental Involvement Indicators and Academic Achievement. *Educ. Res. Rev.* 24, 10–30. doi:10.1016/j.edurev.2018.02.001

Broadbent, J., and Poon, W. L. (2015). Self-regulated Learning Strategies & Academic Achievement in Online Higher Education Learning Environments: A Systematic Review. *Internet Higher Education.* 27, 1–13. doi:10.1016/j.iheduc.2015.04.007

Brok, P. d., Bergen, T., and Brekelmans, M. (2006). "Convergence and Divergence between Students' and Teachers' Perceptions of Instructional Behaviour in Dutch Secondary Education," in *Contemporary Approaches to Research on Learning Environments*. Editors D. L. Fisher and M. S. Khine (World Scientific), 125–160. doi:10.1142/9789812774651_0006

Bronfenbrenner, U. (1996). *The Ecology of Human Development: Experiments by Nature and Design*. 9th ed. Harvard Univ. Press.

Byrne, B. M., Shavelson, R. J., and Muthén, B. (1989). Testing for the Equivalence of Factor Covariance and Mean Structures: The Issue of Partial Measurement Invariance. *Psychol. Bull.* 105 (3), 456–466. doi:10.1037/0033-2909.105.3.456

Champeaux, H., Mangiavacchi, L., Marchetta, F., and Piccoli, L. (2020). *Learning at home: Distance Learning Solutions and Child Development during the COVID-19 Lockdown: IZA Discussion Papers (No. 13819)*. Institute of Labor Economics IZA. Available at: https://ideas.repec.org/p/iza/izadps/dp13819.html.

Chen, F. F. (2007). Sensitivity of Goodness of Fit Indexes to Lack of Measurement Invariance. *Struct. Equation Model. A Multidisciplinary J.* 14 (3), 464–504. doi:10.1080/10705510701301834

Cheung, G. W., and Rensvold, R. B. (2002). Evaluating Goodness-Of-Fit Indexes for Testing Measurement Invariance. *Struct. Equation Model. A Multidisciplinary J.* 9 (2), 233–255. doi:10.1207/s15328007sem0902_5

Cipriano, C., Barnes, T. N., Pieloch, K. A., Rivers, S. E., and Brackett, M. (2019). A Multilevel Approach to Understanding Student and Teacher Perceptions of Classroom Support during Early Adolescence. *Learn. Environ Res.* 22 (2), 209–228. doi:10.1007/s10984-018-9274-0

De Los Reyes, A., Thomas, S. A., Goodman, K. L., and Kundey, S. M. (2013). Principles Underlying the Use of Multiple Informants' Reports. *Annu. Rev. Clin. Psychol.* 9, 123–149. doi:10.1146/annurev-clinpsy-050212-185617

Deci, E. L., and Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum Press.

Desimone, L. M., Smith, T. M., and Frisvold, D. E. (2010). Survey Measures of Classroom Instruction. *Educ. Pol.* 24 (2), 267–329. doi:10.1177/0895904808330173

Dietrich, H., Patzina, A., and Lerche, A. (2020). Social Inequality in the Homeschooling Efforts of German High School Students during a School Closing Period. *Eur. Societies.* 23, 1–22. doi:10.1080/14616696.2020.1826556

Dignath, C., and Veenman, M. V. J. (2021). The Role of Direct Strategy Instruction and Indirect Activation of Self-Regulated Learning-Evidence from Classroom Observation Studies. *Educ. Psychol. Rev.* 33 (2), 489–533. doi:10.1007/s10648-020-09534-0

Dorfner, T., Förtsch, C., and Neuhaus, B. J. (2018). Effects of Three Basic Dimensions of Instructional Quality on Students' Situational Interest in Sixth-Grade Biology Instruction. *Learn. Instruction.* 56, 42–53. doi:10.1016/j.learninstruc.2018.03.001

Eickelmann, B., and Drossel, K. (2020). *SCHULE AUF DISTANZ: Perspektiven und Empfehlungen für den neuen Schulalltag. Eine repräsentative Befragung von Lehrkräften in Deutschland. [SCHOOL AT A DISTANCE. Perspectives and Recommendations for the New Everyday School Life. A Represen- tative Survey of Teachers in Germany.]*. Düsseldorf: Vodafone Stiftung Deutschland. Available at: https://www.vodafone-stiftung.de/wp-content/uploads/2020/05/Vodafone-Stiftung- Deutschland_Studie_Schule_auf_Distanz.pdf.

Fauth, B., Decristan, J., Rieser, S., Klieme, E., and Büttner, G. (2014a). Grundschulunterricht aus Schüler-, Lehrer- und Beobachterperspektive: Zusammenhänge und Vorhersage von Lernerfolg*. *Z. für Pädagogische Psychol.* 28 (3), 127–137. doi:10.1024/1010-0652/a000129

Fauth, B., Decristan, J., Rieser, S., Klieme, E., and Büttner, G. (2014b). Student Ratings of Teaching Quality in Primary School: Dimensions and Prediction of Student Outcomes. *Learn. Instruction.* 29, 1–9. doi:10.1016/j.learninstruc.2013.07.001

Fischer, N., Holtappels, H. G., Klieme, E., Rauschenbach, T., Stecher, L., and Züchner, I. (2011). *anztagsschule: Entwicklung, Qualität, Wirkungen: Längsschnittliche Befunde der Studie zur Entwick- lung von Ganztagsschulen (StEG). [All-day school: development, quality, effects. Longitudinal Findings of the Study on the Development of All-Day Schools (StEG).]* (Weinheim: Beltz Juventa). Available at: http://www.socialnet.de/rezensionen/isbn.php?isbn=978-3-7799-2156-1.

forsa (2020). Das Deutsche Schulbarometer Spezial Corona-Krise. *[The German School Barometer Spe- cial Corona Crisis.]*. Berlin. Available at: https://deutsches-schulportal.de/unterricht/das-deutsche-schulbarometer-spezial-corona-krise/.

Förtsch, C., Werner, S., von Kotzebue, L., and Neuhaus, B. J. (2016). Effects of Biology Teachers' Professional Knowledge and Cognitive Activation on Students' Achievement. *Int. J. Sci. Education.* 38 (17), 2642–2666. doi:10.1080/09500693.2016.1257170

Fraser, B. J., and Fisher, D. L. (1982). Predicting Students' Outcomes from Their Perceptions of Classroom Psychosocial Environment. *Am. Educ. Res. J.* 19 (4), 498–518. doi:10.3102/00028312019004498

Frohn, J. (2020). Bildungsbenachteiligung im Ausnahmezustand. [Educational disadvantage in a state of emergency.]. *Z. für Schul- Professionsentwicklung.* 6 (2), 59–83. doi:10.4119/pflb-3908

Frohn, J. (2022). *Klassenführung, kognitive Aktivierung und konstruktive Unterstützung im Fernunter- richt: Ergebnisse einer Lehrkräftebefragung zur Unterrichtsgestaltung auf Distanz*. Editors S. G. Huber, C. Helm, and N. Schneider [Classroom manage- ment, cognitive activation, and constructive support in distance learning. Results of a teacher survey on teaching at a distance.] CovER. Münster: Waxmann.

Garrote, A., Neuenschwander, M., Hofmann, J., Mayland, C., Niederbacher, E., Prieth, V., et al. (2021). Fernunterricht während der Coronavirus-Pandemie: Analyse von Herausforderungen und Gelingensbedingungen. [Distance learning during the coronavirus pandemic. Analysis of challenges and conditions for success. *Fachhochschule Nordwestschweiz FHNW*. doi:10.26041/fhnw-3707

Grätz, M., and Lipps, O. (2021). Large Loss in Studying Time during the Closure of Schools in Switzerland in 2020. *Res. Soc. stratification mobility.* 71, 100554. doi:10.1016/j.rssm.2020.100554

Grewenig, E., Lergetporer, P., Werner, K., Wößmann, L., and Zierow, L. (2020). *COVID-19 and Educa- Tional Inequality: How School Closures Affect Low- and High-Achieving Students*. Munich, IZA: Institute for Labor Economics.

Hansford, B. C., and Hattie, J. A. (1982). The Relationship Between Self and Achievement/Performance Measures. *Rev. Educ. Res.* 52 (1), 123–142. doi:10.3102/00346543052001123

Hattie, J. (2009). *Visible Learning*. New York, NY: Routledge.

Hebbecker, K., Förster, N., and Souvignier, E. (2019). Reciprocal Effects between reading Achievement and Intrinsic and Extrinsic reading Motivation. *Scientific Stud. Reading.* 23 (5), 419–436. doi:10.1080/10888438.2019.1598413

Heller, S., and Zügel, O. (2020). Schule zu Hause in Deutschland: Bestandsaufnahme im Corona-Lockdown aus Perspektive der Schüler/-innen und Eltern. *[School at home in Germany. Taking stock in the corona lockdown from the perspective of students and parents.]*. Zurich. Available at: https://www.telekom-stiftung.de/sites/default/files/files/media/publications/Ergebnisbericht-Homeschooling.pdf.

Helm, C., Huber, S., and Loisinger, T. (2021). Was wissen wir über schulische Lehr-Lern-Prozesse im Distanzunterricht während der Corona-Pandemie? - Evidenz aus Deutschland, Österreich und der Schweiz. *Z. Erziehungswiss.* 24, 237–311. doi:10.1007/s11618-021-01000-z

Helm, C., and Postlbauer, A. (2021). *JKU bildungsbarometer #1. Schulen im 3. Lockdown: 1. Bericht zur repräsentativen elternumfrage in Österreich. Johannes Kepler Universität*. Linz: Johannes Kepler University Linz.

Helmke, A. (2009). *Unterrichtsqualität und Lehrerprofessionalität: Diagnose, Evaluation und Verbesserung des Unterrichts. [Teaching quality and teacher professionalism. Diagnosis, evaluation and improvement of teaching*. Stuttgart: Klett Kallmeyer

Holzer, J., Korlat, S., Haider, C., Mayerhofer, M., Pelikan, E., Schober, B., et al. (2021). Adolescent Well-Being and Learning in Times of COVID-19-A Multi-Country Study of Basic Psychological Need Satisfaction, Learning Behavior, and the Mediating Roles of Positive Emotion and Intrinsic Motivation. *PloS one.* 16 (5), e0251352. doi:10.1371/journal.pone.0251352

Huber, S. G., and Helm, C. (2020a). COVID-19 and Schooling: Evaluation, Assessment and Accountability in Times of Crises-Reacting Quickly to Explore Key Issues for Policy, Practice and Research with the School Barometer. *Educ. Assess. Eval. Account.* 32, 1–34. doi:10.1007/s11092-020-09322-y

Huber, S. G., and Helm, C. (2020b). "Lernen in Zeiten der Corona-Pandemie," in *Langsam vermisse ich die Schule. Schule während und nach der Corona-Pandemie. [I'm Starting to Miss School. " Schooling during and after the Corona Pandemic.]*. Editors D. Fickermann and B. Edelstein (Waxmann), 37–60. doi:10.31244/9783830992318.02

Huber, S. G., Günther, P. S., Schneider, N., Helm, C., Schwander, M., Schneider, J., et al. (2020). *COVID-19 und aktuelle herausforderungen in schule und bildung*. Münster: Waxmann.

Huber, S. G. (2021). Schooling and Education in Times of the COVID-19 Pandemic: Food for Thought and Reflection Derived from Results of the School Barometer in germany, austria and switzerland. *Int. Stud. Educ. Adm.* 49 (1), 6–17.

Jaekel, A.-K., Scheiter, K., and Göllner, R. (2021). Distance Teaching During the COVID-19 Crisis: Social Connectedness Matters Most for Teaching Quality and Students' Learning. *AERA Open.* 7, 233285842110520. doi:10.1177/23328584211052050

Johnson, J. W. (2000). A Heuristic Method for Estimating the Relative Weight of Predictor Variables in Multiple Regression. *Multivariate Behav. Res.* 35 (1), 1–19. doi:10.1207/S15327906MBR3501_1

Klieme, E. (2020). Guter Unterricht – auch und besonders unter Einschränkungen der Pandemie? [Teaching Quality – Also and especially under the Constraints of the Pandemic?]. In D. Fickermann and B. Edelstein (Eds.),. *[I'm Starting to Miss School . . ." Schooling during and after the Corona Pandemic.]* (pp. 117–135). Waxmann

Klieme, E., Pauli, C., and Reusser, K. (2009). "The Pythagoras Study: Investigating Effects of Teaching and Learning in Swiss and German Mathematics Classrooms," in *The Power of Video Studies in Investigating Teaching and Learning in the Classroom*. Editors T. Janik and T. Seidel (Waxmann), 137–160. Available at: http://www.ciando.com/ebook/bid-40151.

Kohler, B. (2011). Hausaufgaben. Überblick über didaktische Überlegungen und empirische Untersuchungen. [Homework. Survey about Didactical Considerations and Empirical Research.]. *DDS - Die Deutsche Schule.* 103 (3), 203–218.

Köller, O., Fleckenstein, J., Guill, K., and Meyer, J. (2020). "Pädagogische und didaktische Anforderungen an die häusliche Aufgabenbearbeitung," in *Langsam vermisse ich die Schule. Schule während und nach der Corona-Pandemie. [I'm Starting to Miss School. " Schooling during and after the Corona Pandemic.]*. Editors D. Fickermann and B. Edelstein (Waxmann), 163–174. doi:10.31244/9783830992318.10

Korlat, S., Kollmayer, M., Holzer, J., Lã¼ftenegger, M., Pelikan, E. R., Schober, B., et al. (2021). Gender Differences in Digital Learning During COVID-19: Competence Beliefs, Intrinsic Value, Learning Engagement, and Perceived Teacher Support. *Front. Psychol.* 12, 637776. doi:10.3389/fpsyg.2021.637776

Krammer, G., Pflanzl, B., and Mayr, J. (2019). Using Students' Feedback for Teacher Education: Measurement Invariance across Pre-service Teacher-Rated and Student-Rated Aspects of Quality of Teaching. *Assess. Eval. Higher Education.* 44 (4), 596–609. doi:10.1080/02602938.2018.1525338

Kunter, M., Baumert, J., and Köller, O. (2007). Effective Classroom Management and the Development of Subject-Related Interest. *Learn. Instruction.* 17 (5), 494–509. doi:10.1016/j.learninstruc.2007.09.002

Kunter, M., and Baumert, J. (2006). Who Is the Expert? Construct and Criteria Validity of Student and Teacher Ratings of Instruction. *Learn. Environments Res.* 9 (3), 231–251. doi:10.1007/s10984-006-9015-7

Kunter, M., Brunner, M., Baumert, J., Klusmann, U., Krauss, S., Blum, W., et al. (2005). Der Mathematikunterricht der PISA-Schülerinnen und -Schüler. *Z. für Erziehungwissenschaft.* 8 (4), 502–520. doi:10.1007/s11618-005-0156-8

Kunter, M. (2013). *Cognitive Activation in the Mathematics Classroom and Professional Competence of Teachers: Results from the COACTIV Project*, Vols. v. 8. New York: Springer.

Langmeyer, A., Guglhör-Rudan, A., Naab, T., Urlen, M., and Winklhofer, U. (2020). Kindsein in Zeiten von Corona: Erste Ergebnisse zum veränderten Alltag und zum Wohlbefinden von Kindern. *[Being a child in times of Corona. First results on the changed everyday life and well-being of children]*. Munich: Deutsches Jugendinstitut.

Lenz, S., and Helm, C. (2021). Do students from Open Learning Environments Perceive Advantages in Distance Learning during corona-related School Closures? Johannes Kepler Universität. Available at: https://edulead.net/schuba/factsheets/do-students-from-open-learning-environments-perceive-advantages-in-distance-learning-during-corona-related-school-closures/.

Letzel, V., and Pozas, M. (2020). "Inklusives Homeschooling aus Schüler/-innen-Eltern-und Lehrkräfteperspek- tive – Covid-19," in *[Inclusive Homeschooling from a Student-Parent and Teacher Perspective - Covid-19.]*. Editor U. Trier.

Letzel, V., Pozas, M., and Schneider, C. (2020). Energetic Students, Stressed Parents, and Nervous Teachers: A Comprehensive Exploration of Inclusive Homeschooling during the COVID-19 Crisis. *Open Education Stud.* 2, 159–170. doi:10.1515/edu-2020-0122

Little, T. D. (2013). *Longitudinal Structural Equation Modeling*. New York, NY: Guilford Press. Available at: http://site.ebrary.com/lib/subhamburg/Doc?id=10664545.

Lorenz, R., Brüggemann, T., and McElvany, N. (2020). *Unterricht während der Corona-Pandemie: Teil II Wohlbefinden der Lehrkräfte: Zweiter Ergebnisbericht*

der bundesweiten Lehrkräftebefragung. [Teaching during the Corona pandemic: Part II Teacher well-beingSecond report of results from the nationwide teacher survey.]. Dortmund: Institut für Schulentwicklungsforschung.

Meitinger, K., Davidov, E., Schmidt, P., and Braun, M. (2020). Measurement Invariance: Testing for It and Explaining Why It is Absent. *Survey Research Methods*, 14 (4), 345–349. doi:10.18148/srm/2020.v14i4.7655

Meyer, H. (2020). *Didaktische Maßstäbe für Homeschooling in Corona-Zeiten*. [Didactic benchmarks for homeschooling in Corona times.]. Cornelsen. Available at: https://www.cornelsen.de/magazin/beitraege/didaktische-massstaebe-homeschooling.

Mitchell, M. M., Bradshaw, C. P., and Leaf, P. J. (2010). Student and Teacher Perceptions of School Climate: a Multilevel Exploration of Patterns of Discrepancy. *J. Sch. Health.* 80 (6), 271–279. doi:10.1111/j.1746-1561.2010.00501.x

Moroni, S., Dumont, H., Trautwein, U., Niggli, A., and Baeriswyl, F. (2015). The Need to Distinguish between Quantity and Quality in Research on Parental Involvement: The Example of Parental Help with Homework. *J. Educ. Res.* 108 (5), 417–431. doi:10.1080/00220671.2014.901283

Nusser, L., Wolter, I., Attig, M., and Fackler, S. (2021). "Die Schulschließungen aus Sicht der Eltern. Ergebnisse des längsschnittlichen Nationalen Bildungspanels und seiner Covid-19-Zusatzbefragung," in *Schule während der Corona-Pandemie: Neue Ergebnisse und Überblick über ein dynamisches Forschungsfeld. [Schooling dur- ing the Corona Pandemic. New Results and an Overview of a Dynamic Field of Research.]*. Editors D. Fickermann and B. Edelstein (Waxmann Verlag GmbH), 33–50. doi:10.31244/9783830993315.02

Pelikan, E. R., Lüftenegger, M., Holzer, J., Korlat, S., Spiel, C., and Schober, B. (2021). Learning during COVID-19: the Role of Self-Regulated Learning, Motivation, and Procrastination for Perceived Competence. *Z. Erziehungswiss.* 24, 393–418. doi:10.1007/s11618-021-01002-x

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., and Podsakoff, N. P. (2003). Common Method Biases in Behavioral Research: a Critical Review of the Literature and Recommended Remedies. *J. Appl. Psychol.* 88 (5), 879–903. doi:10.1037/0021-9010.88.5.879

Pomerantz, E. M., and Grolnick, W. S. (2017). "The Role of Parenting in Children's Motivation and Competence: What Underlies Facilitative Parenting" in *Handbook of Competence and Motivation*. Editors A. J. Elliot, C. S. Dweck, and D. S. Yeager (Guilford Press), 566–585.

Porsch, R., and Porsch, T. (2020). "Fernunterricht Als Ausnahmesituation," in *Langsam vermisse ich die Schule. Schule während und nach der Corona-Pandemie. [I'm Starting to Miss School. " Schooling during and after the Corona Pandemic.]*. Editors D. Fickermann and B. Edel- stein (Waxmann), 61–78. doi:10.31244/9783830992318.03

Praetorius, A.-K., and Charalambous, C. Y. (2018). Classroom Observation Frameworks for Studying Instructional Quality: Looking Back and Looking Forward. *ZDM Mathematics Education.* 50 (3), 535–553. doi:10.1007/s11858-018-0946-0

R Core Team (2014). *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. Available at: http://www.R-project.org/.

Ribeiro, L. M., Cunha, R. S., Silva, M. C. A. e., Carvalho, M., and Vital, M. L. (2021). Parental Involvement during Pandemic Times: Challenges and Opportunities. *Education Sci.* 11 (6), 302. doi:10.3390/educsci11060302

Rosseel, Y. (2012). Lavaan: An R Package for Structural Equation Modeling. *J. Stat. Softw.* 48 (2), 1–36. doi:10.18637/jss.v048.i02

Sander, A., SchÃ¤fer, L., and van Ophuysen, S. (2021). Predictors of Process-Related and Structuring Parental Support during Distance Learning Due to Corona-pandemic. *Z. Erziehwiss.* 24, 1–24. doi:10.1007/s11618-021-01015-6

Schaffner, E., Philipp, M., and Schiefele, U. (2016). Reciprocal Effects between Intrinsic reading Motivation and reading Competence? A Cross-Lagged Panel Model for Academic Track and Nonacademic Track Students. *J. Res. Reading.* 39 (1), 19–36. doi:10.1111/1467-9817.12027

Scheerens, J. (1990). School Effectiveness Research and the Development of Process Indicators of School Functioning. *Sch. Effectiveness Sch. Improvement.* 1 (1), 61–80. doi:10.1080/0924345900010106

Schiepe-Tiska, A., Heine, J.-H., Lüdtke, O., Seidel, T., and Prenzel, M. (2016). Mehrdimensionale Bil- dungsziele im Mathematikunterricht und ihr Zusammenhang mit den Basisdimensionen der Unterricht- squalität: [Multi-Dimensional Educational Goals in Mathematics Classrooms and Their Relationship with Instructional Quality.]. *Unterrichtswissenschaft.* 44 (3), 211–225.

Schober, B., Lüftenegger, M., Spiel, C., Holzer, J., Ikanovic, S. K., Pelikan, E., et al. (2020). Lernen unter COVID-19-Bedingungen: Erste Ergebnisse Schüler*innen. *[Learning under COVID-19 conditions. First results Students]*. Vienna. Available at: https://lernencovid19.univie.ac.at/fileadmin/user_upload/p_lernencovid19/Zwischenergebnisse_Schueler_innen.pdf.

Schwab, S., Lindner, K.-T., and Kast, J. (2020). *Inclusive home Learning – Quality of Experience of Students, Teachers and Parents and Current Implementation of home Schooling*. Vienna.

Schwerzmann, M., and Frenzel, S. (2020). *Umfrage zum Fernunterricht: Ergebnisse der Befragung im Juni 2020. [Distance Education Survey. Results of the survey in June 2020.]. Bildungs- und Kulturdeparte- ment*. Lucerne.

Shavelson, R. J., Hubner, J. J., and Stanton, G. C. (1976). Self-Concept: Validation of Construct Interpretations. *Rev. Educ. Res.* 46 (3), 407–441. doi:10.3102/00346543046003407

Shi, D., Lee, T., and Maydeu-Olivares, A. (2019). Understanding the Model Size Effect on SEM Fit Indices. *Educ. Psychol. Meas.* 79 (2), 310–334. doi:10.1177/0013164418783530

Skinner, E. A., and Belmont, M. J. (1993). Motivation in the Classroom: Reciprocal Effects of Teacher Behavior and Student Engagement across the School Year. *J. Educ. Psychol.* 85 (4), 571–581. doi:10.1037/0022-0663.85.4.571

Stadler, M., Cooper-Thomas, H., and Greiff, S. (2017). A Primer on Relative Importance Analysis: Illustrations of its Utility for Psychological Research. *Psychol. Test Assess. Model.* 59, 381.

Steiner, M., Köpping, M., Leitner, A., and Pessl, G. (2020). COVID-19 LehrerInnenbefragung - Zwischen- ergebnisse: Was tun, damit aus der Gesundheitskrise nicht auch eine Bildungskrise wird? [COVID-19 Teacher survey - Interim results. What to Do to prevent the health crisis from becoming an educa- tion crisis as well?]. Available at: https://www.ihs.ac.at/de/publikationsportal/blog/beitraege/lehrerinnenbefragung- zwischenergebnisse/.

Steinmayr, R., and Christiansen, H. (2020). Vorabpressemitteilung: Studie Qualität von Homeschooling der TU Dortmund. *Advance press release study Quality of Homeschooling by TU Dortmund University*. Dortmund.

Steinmayr, R., Lazarides, R., Weidinger, A. F., and Christiansen, H. (2021). Teaching and Learning during the First COVID-19 School Lockdown: Realization and Associations with Parent-Perceived Students' Academic Outcomes. *Z. für Pädagogische Psychol.* 35, 85–106. doi:10.1024/1010-0652/a000306

Talbert, R., and Mor-Avi, A. (2019). A Space for Learning: An Analysis of Research on Active Learning Spaces. *Heliyon.* 5 (12), e02967. doi:10.1016/j.heliyon.2019.e02967

Temme, D., and Hildebrandt, L. (2009). Gruppenvergleiche bei hypothetischen Konstrukten - Die Prüfung der Übereinstimmung von Messmodellen mit der Strukturgleichungsmethodik. *Schmalenbachs Z. Betriebswirtsch Forsch.* 61 (2), 138–185. doi:10.1007/BF03372818

Tengler, K., Schrammel, N., and Brandhofer, G. (2020). Lernen trotz Corona: Chancen und Herausforderun- gen des distance learning an österreichischen Schulen. [Learning despite Corona. Opportunities and challenges of distance learning in Austrian schools.]. *Medienimpulse.* 58 (2), 1–37. doi:10.21243/mi-02-20-24

Thies, L., and Klein, Y. (2020). Unter Druck: Die Situation von Eltern und ihren schulpflichtigen Kindern während der Schulschließungen. *[Under pressure. The situation of parents and their school-age children during school closures.]*. Düsseldorf. Available at: https://www.vodafone-stiftung.de/wp-content/uploads/2020/04/Vodafone-Stiftung- Deutschland_Studie_Unter_Druck.pdf.

Tonidandel, S., and LeBreton, J. M. (2011). Relative Importance Analysis: A Useful Supplement to Regression Analysis. *J. Bus Psychol.* 26 (1), 1–9. doi:10.1007/s10869-010-9204-3

Trautwein, U., Lüdtke, O., Marsh, H. W., Köller, O., and Baumert, J. (2006). Tracking, Grading, and Student Motivation: Using Group Composition and Status to Predict Self-Concept and Interest in Ninth-Grade Mathematics. *J. Educ. Psychol.* 98 (4), 788–806. doi:10.1037/0022-0663.98.4.788

Trültzsch-Wijnen, C., and Trültzsch-Wijnen, S. (2020). *REMOTE SCHOOLING during the COVID- 19 LOCKDOWN IN AUSTRIA (spring 2020): KiDiCoTi National Report*. Salzburg.

Voss, T., and Wittwer, J. (2020). Unterricht in Zeiten von Corona: Ein Blick auf die Herausforderungen aus der Sicht von Unterrichts- und Instruktionsforschung. *Unterrichtswiss.* 48 (4), 601–627. doi:10.1007/s42010-020-00088-2

Wagner, S. M., Rau, C., and Lindemann, E. (2010). Multiple Informant Methodology: A Critical Review and Recommendations. *Sociological Methods Res.* 38 (4), 582–618. doi:10.1177/0049124110366231

Weber, C., Helm, C., and Kemethofer, D. (2021). "Bildungsungleichheiten durch Schulschließungen? Soziale und ethnische Disparitäten im Lesen innerhalb und zwischen Schulklassen," in *Schule und Schulpolitik während der Corona-Pandemie: Nichts gelernt? [Schools and School Politics During the Corona Pandemic: Nothing Learned?]*. Editors D. Fickermann, B. Edelstein, J. Gerick, and K. Racherbäumer (Waxmann Verlag GmbH), 83–99.

Weinert, F. (2002). *Leistungsmessungen in Schulen: [Performance Measurements in Schools.* Beltz.

Wettstein, A., Scherzinger, M., and Ramseier, E. (2018). Empirische Arbeit: Unterrichtsstörungen, Beziehung und Klassenführung aus Lehrer-, Schüler- und Beobachterperspektive. *Psychol. Erziehung Unterricht.* 65 (1), 58. doi:10.2378/peu2018.art04d

Wigfield, A., and Eccles, J. S. (2000). Expectancy-value Theory of Achievement Motivation. *Contemp. Educ. Psychol.* 25, 68–81. doi:10.1006/ceps.1999.1015

Wildemann, A., and Hosenfeld, I. (2020). *Bundesweite Elternbefragung zu Homeschooling während der Covid 19 Pandemie: Erkenntnisse zur Umsetzung des Homeschoolings in Deutschland.* Editor U Landau (Nationwide parent sur- vey on homeschooling during the Covid 19 pandemic. Findings on the implementation of homeschooling in Germany.]). Available at: http://www.zepf.eu/wp-content/uploads/2020/06/Bericht_HOMEschooling2020.pdf.

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Werner, K., and Zierow, L. (2021). Bildung erneut im Lockdown: Wie verbrachten Schulkinder die Schulschließungen Anfang 2021?. *[Education on lockdown again. How did school kids spend the early 2021 school closures?].* Munich.

Xu, J., Du, J., Wu, S., Ripple, H., and Cosgriff, A. (2018). Reciprocal Effects Among Parental Homework Support, Effort, and Achievement? an Empirical Investigation. *Front. Psychol.* 9, 2334. doi:10.3389/fpsyg.2018.02334

Zaccoletti, S., Camacho, A., Correia, N., Aguiar, C., Mason, L., Alves, R. A., et al. (2020). Parents' Perceptions of Student Academic Motivation During the COVID-19 Lockdown: A Cross-Country Comparison. *Front. Psychol.* 11, 592670. doi:10.3389/fpsyg.2020.592670

Züchner, I., and Jäkel, H. R. (2021). Fernbeschulung während der COVID-19 bedingten Schulschließungen weiterführender Schulen: Analysen zum Gelingen aus Sicht von Schülerinnen und Schülern. *Z. Erziehungswiss.* 24, 479–502. doi:10.1007/s11618-021-01006-7

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 24 February 2022
doi: 10.3389/fpsyg.2022.734160

German University Students' Perspective on Remote Learning During the COVID-19 Pandemic: A Quantitative Survey Study With Implications for Future Educational Interventions

Thomas Hoss, Amancay Ancina and Kai Kaspar*

Department of Psychology, University of Cologne, Cologne, Germany

OPEN ACCESS

Edited by:
Sina Fackler,
Deutsches Jugendinstitut, Germany

Reviewed by:
Christoph Helm,
University of Teacher Education Zug, Switzerland
Markus Nester,
Leibniz Institute for Educational Trajectories (LG), Germany

****Correspondence:***
Thomas Hoss
thomas.hoss@uni-koeln.de

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *30 June 2021*
Accepted: *10 January 2022*
Published: *24 February 2022*

Citation:
Hoss T, Ancina A and Kaspar K (2022) German University Students' Perspective on Remote Learning During the COVID-19 Pandemic: A Quantitative Survey Study With Implications for Future Educational Interventions. Front. Psychol. 13:734160. doi: 10.3389/fpsyg.2022.734160

The COVID-19 pandemic forced German universities to adjust their established operations quickly during the first nationwide lockdown in spring 2020. Lecturers and students were confronted with a sudden transition to remote teaching and learning. The present study examined students' preparedness for and perspective on this new situation. In March and April 2020, we surveyed n = 584 students about the *status quo* of their perceived digital literacy and corresponding formal learning opportunities they had experienced in the past. Additionally, the students reported the direction of changes in key study characteristics they expected from this new situation. Moreover, they reported the extent to which they believe they will be able to master this new study situation successfully. Two categories of independent variables were considered: context-related variables and person-related variables. Our results show that students did not have many learning opportunities to promote their digital literacy, suggesting that they were not appropriately prepared for this new situation. Results for digital literacy vary by competence area. However, there is a positive correlation between past formal learning opportunities and corresponding digital competences. Master students reported more learning opportunities and higher digital literacy only in one competence area compared to bachelor students. Regarding the expected change of key study characteristics, some characteristics were expected to worsen and fewer to improve. A multiple regression analysis explained 54% of the estimated probability of successful remote learning. Students' age, state anxiety, positive state affect, general self-efficacy, the availability of an own workplace, past learning opportunities in digital content creation, and the estimated preparedness of lecturers for remote teaching were significant explaining factors. Our results provide valuable insights into the perspective of students on studying during the COVID-19 pandemic and beyond. We discuss important factors that should be addressed by educational measures in the future.

Keywords: COVID-19, higher education, remote learning, student perspective, study success, digital literacy, key study characteristics

INTRODUCTION

The COVID-19 pandemic has strong impacts on people's everyday life and society on a large scale (Nicola et al., 2020). During the first nationwide lockdown in Germany in spring 2020, educational institutions had to create remote teaching and learning environments in a very short time. Similarly, lecturers and students had to rapidly adjust their former concepts and approaches for teaching and learning (Shapiro et al., 2020). In general, the pandemic has significantly amplified the digital transformation of university teaching and learning. At the same time, university students' express concerns about the impact of the COVID-19 pandemic on physiological, psychological, and educational issues (Branquinho et al., 2020). Therefore, the analysis of prerequisites, challenges, and expectations from a students' perspective comes into focus. The present work pursued three objectives for addressing this student perspective:

First, it analyzes the *status quo* of students' digital literacy and corresponding formal learning opportunities before the transition to remote learning. This analysis provides an assessment of whether students were adequately prepared for sudden remote learning and identifies areas of competence in which targeted support in formal university teaching would need to be strengthened.

Second, it explores the expectations of students regarding changes in key study characteristics associated with the transition to remote learning. This analysis is not only relevant as a historical classification, but also enables the identification of success and risk factors for good remote learning and can thus serve as a guideline for future measures to develop suitable learning opportunities.

Third, it examines a set of context- and person-related variables that may determine students' estimated probability to master this new study situation of remote learning successfully. This analysis provides an estimate of the influence of various sources on the perceived likelihood of success and helps to prioritize target variables for educational interventions.

Importantly, at the time the survey was designed and conducted in March and April 2020, there was no COVID-19-related literature on the topic of digital learning. However, multiple studies providing important insights into students' perspectives regarding digital learning during the pandemic have been published since then (e.g., Aristovnik et al., 2020; Krammer et al., 2020; Hamdan et al., 2021; Hawley et al., 2021). All these studies have in common that they have had to refer to research that predate the current pandemic. For this reason, the present study partially follows an exploratory approach. The corresponding results are highly relevant for the classification of the transformation processes in digital teaching and learning initiated at the beginning of the pandemic and serve as an important reference for the evaluation of the *status quo* as well as for the planning of future measures.

Pre-pandemic Digital Literacy and Formal Learning Opportunities

To understand university students' perspectives on learning in times of COVID-19, it is necessary to consider their prerequisites and prior experiences with remote learning. One essential prerequisite is digital literacy. Tang and Chaw (2016) identified digital literacy as an important factor for effective learning in digital learning environments. Digital literacy and ICT skills are important prerequisites for the successful participation of university students in learning processes (Shopova, 2014). Although students are familiar with technology and digital media, they might be more experienced in using technology for entertainment purposes than in the context of digital learning (Shopova, 2014; Prior et al., 2016). Past research also suggests that students sometimes overestimate their actual skills (Gross and Latham, 2012). Moreover, digital literacy is more than the ability to handle hardware and software properly. Just knowing the technology is not enough for successful learning (Coccoli et al., 2014). Digital literacy includes competences in reflective and critical thinking, management of information, and adequate online behavior (Tang and Chaw, 2016). The variety of different digital competences is described in the European Digital Competence Framework for Citizens (DigComp 2.1; Carretero et al., 2017). It consists of five competence areas: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. These five areas are subdivided into 21 specific competences. Previous studies on digital literacy have already applied the DigComp framework to examine differences in digital competence areas and associated proficiency levels, for instance, between different generations (Khan and Vuopala, 2019), teachers and students (Kuzminska et al., 2018), or different European universities (López-Meneses et al., 2020). Khan and Vuopala (2019) found that competences in the area of problem solving were the least developed across all areas. In addition to individual competences, corresponding learning opportunities are an important prerequisite for digital learning, as they form the fundament for the acquisition of digital literacy. Indeed, prior studies showed that formal learning opportunities in study programs can have a positive impact on respective competences (König et al., 2018). However, digital media was often not an integral part of teaching and learning at universities before the pandemic (Persike and Friedrich, 2016). A recent pre-pandemic survey among students from a large German university indicated that learning opportunities to promote digital literacy are rather sparse or superficial, but their extent also varies across different competence areas (Jäger-Biela et al., 2020). Moreover, Jäger-Biela et al. (2020) found that master students report more learning opportunities in digital competence areas than bachelor students. However, for every of the examined competence areas more than half of the master students reported not having any learning opportunities in their studies. To better understand the initial situation at the beginning of the pandemic, we examined university students' perceived digital literacy in terms of digital competences of the DigComp 2.1 and corresponding learning opportunities in formal university courses they had experienced (i.e. perceived) before the pandemic started. We asked:

RQ1: How do bachelor and master students evaluate the intensity of past formal learning opportunities and their level of competence in the respective areas, are there differences between competence areas, and are learning opportunities and competence assessments positively correlated?

Expected Changes in Key Study Characteristics

Given the *status quo* of university students' digital literacy and past formal learning opportunities, what were the expectations of students in spring 2020 regarding the upcoming semester, which was entirely based on remote teaching and learning? To get a more detailed picture, the following two questions need to be addressed: First, in which way will key study characteristics, such as the quality and quantity of learning materials or the support from other students, change? Second, on what factors does it depend whether students believe they can successfully master this new study situation?

From a students' perspective, remote learning might be accompanied by a variety of advantages and disadvantages, compared to well-known face-to-face learning environments. For example, remote learning is connected to an increased flexibility in time management and the reception of course material (Daymont et al., 2011), and it may also foster self-regulated learning (e.g., Rüth et al., 2021). Also, remote learning may increase the quantity and quality of teaching and learning materials (Lin et al., 2017). In contrast, several disadvantages of remote learning can manifest such as a lack of interactions with peers and lecturers and less effective learning methods (Arkorful and Abaidoo, 2015). Also, shortcomings regarding technological infrastructure of universities could negatively impact study characteristics (cf. Gilch et al., 2019). In general, many study characteristics may change positively or negatively in the context of forced remote learning during a pandemic. Hence, we asked:

RQ2: What changes in key study characteristics are expected by university students?

The Estimated Probability of Success

In addition to an analysis of expected changes in study characteristics due to a sudden transition to remote learning, the present study focused on factors that might explain interindividual differences in the belief that one can still learn successfully in this new situation (hereinafter referred to as "estimated probability of successful remote learning"). A person's estimated probability of success is generally defined as the perceived probability of reaching a certain goal and it is dependent on the individual's abilities (Zander and Heidig, 2020). The easier the goal is to achieve, the higher the person estimates his or her probability of success. In this study, we focused on basic context- and person-related variables. **Figure 1** shows the corresponding research model with all its variables for which a relation to the estimated probability of success could be assumed on the basis of previous study results, as outlined in the following sections.

The Role of Context-Related Variables

Working Environment

When it comes to remote learning from home, students' spatial- and technical infrastructure might influence their estimated probability of success. The immediate transition to remote learning makes the availability of an own adequate workspace and technical infrastructure necessary. Since students are forced to study at home, it is inevitable that their private space turns into a working space. In fact, "a suitable study desk located in a quiet area (preferably outside of the bedroom), free of distractions with plenty of natural light" (Brown et al., 2020, p. 24) was suggested as important factors for an appropriate learning environment. Alhabeeb and Rowley (2018) identified technical infrastructure, like internet access, communication tools, and their respective reliability, as an important success factor for digital learning. Indeed, students stated that an absence of technical infrastructure and an appropriate learning environment at home is problematic for studying during the COVID-19 pandemic (Kapasia et al., 2020). We hypothesized:

H1: The quality of technical equipment (H1a) and the availability of an own working space (H1b) are positively related to students' estimated probability of successful remote learning.

Perceived Preparedness of Lecturers

Just like students, the abrupt transition to remote teaching and learning also posed challenges for university lecturers. The level of digital literacy and therefore the readiness for remote teaching differs among lecturers. One study reported that only every third teacher feels somewhat prepared to teach remotely (ElSaheli-Elhage, 2021). Additionally, the conception and execution of e-learning measures (Rüth and Kaspar, 2017), especially at the beginning, is time-consuming and depends on the experiences and skills of the lecturers (Tinker, 2001). McPherson and Nunes (2008) described staff issues, such as experience and availability of suitable lecturers, as a critical success factor for the delivery of e-learning. Paechter et al. (2010) found that students' achievement goals and lecturer expertise are important predictors for knowledge, skill, and competence acquisition in e-learning courses. Variables like motivation, self-regulated and collaborative learning opportunities, as well as clarity of course structure also contributed significantly. In line with the above results, Joo et al. (2011) found that the characteristics of remote teaching influence students' satisfaction. According to the authors, teachers should organize courses to enable active learning, conversation, and inclusion in the course. Perceived e-learning satisfaction can be predicted by interactive learning environments and seems to be related to perceived usefulness and self-regulation (Liaw and Huang, 2013). Thus, lecturers' competences appear to have an important role for students' study success and overall satisfaction with e-learning. Indeed, lecturers' characteristics such as the ability to motivate students, their enthusiasm, and the ability to use e-learning systems effectively were considered as key factors for successful e-learning from the students' perspective (Alhabeeb and Rowley, 2018). Hence, students' perception of the lecturers' preparedness in delivering

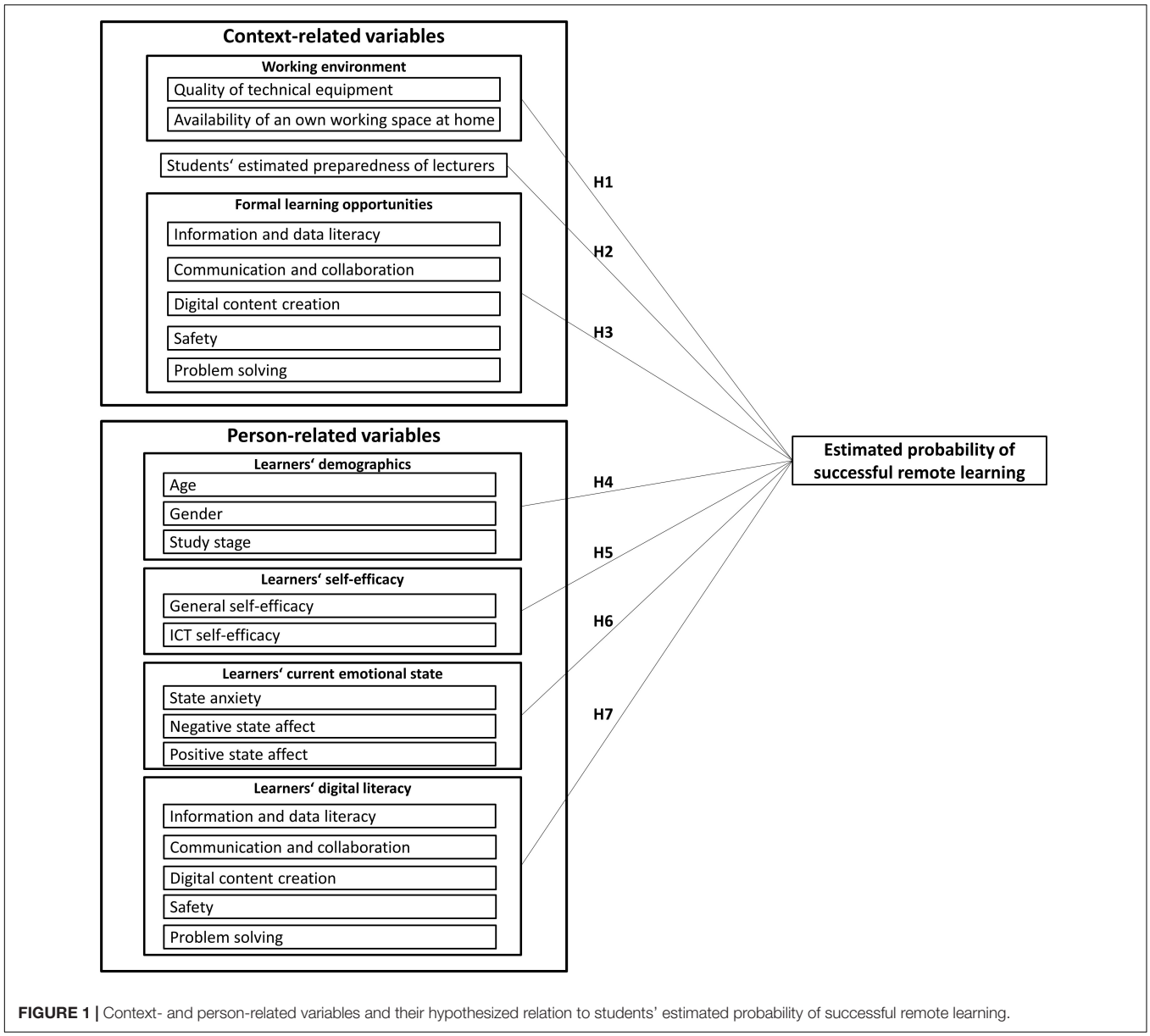

FIGURE 1 | Context- and person-related variables and their hypothesized relation to students' estimated probability of successful remote learning.

adequate remote teaching might explain differences in their estimated probability of successful remote learning:

> H2: The estimated preparedness of lecturers for remote teaching is positively related to students' estimated probability of successful remote learning.

Formal Learning Opportunities

We also considered students' past learning opportunities to promote digital literacy. Dealing with more demanding media applications requires more refined skills and learning opportunities (Pumptow and Brahm, 2020). In a nationwide study in Germany, learning with digital media was examined from a students' perspective (Persike and Friedrich, 2016). Results showed that digital media are mainly used for private purposes. The use of digital media is concentrated in certain study programs, such as computer science and medicine. Similarly, Jäger-Biela et al. (2020) found that learning opportunities to promote digital literacy are rather sparse in university courses. This *status quo* seems to be critical, because students who have experienced formal learning opportunities more intensively might feel more prepared and perceive their probability of successful remote learning higher. We hence hypothesized:

> H3: Experienced (i.e. perceived) learning opportunities to promote digital literacy are positively related to students' estimated probability of successful remote learning.

The Role of Person-Related Variables

Learners' Demographics

González-Gómez et al. (2012) found that female students score higher on average in e-learning courses, are more satisfied with

e-learning, and assign more importance to teaching methods and planning than male students. In contrast, Ramírez-Correa et al. (2015) stated that the adaption of e-learning does not seem to depend on gender. Besides gender, Adams et al. (2018) found that younger students in higher education considered themselves as less independent learners. More specifically, Lai and Hong (2015) showed that they rely more on clear instructions and information before trying something new and seem to favor group work more than older students do. Nevertheless, there is no clear evidence that different age groups of students significantly vary in their use of digital technology and digital learning characteristics (Selwyn, 2008; Lai and Hong, 2015). Finally, cohort comparisons of bachelor and master students (pre-service teachers) indicated a better performance of the latter in all domains for didactic and pedagogical knowledge (König et al., 2018). Although comparable results on the development of digital literacy across different study stages are not yet available, digital literacy could also increase as students do progress through their study program. Given this mixed and incomplete research findings, we hypothesized in an undirected manner:

> H4: Age (H4a) and gender (H4b) and study stage (H4c) are related to students' estimated probability of successful remote learning.

Learners' Self-Efficacy

The rising relevance of remote learning changed the accompanying demands students experience in higher education. These changing demands require students to adapt to the new situation. Self-efficacy is a personal belief about the self-evaluated competence of being able to handle such situations in a way to reach desired outcomes (Bandura, 1977) and it is a predictor of academic success (Zajacova et al., 2005). Students with higher perceived self-efficacy are more satisfied with e-learning university courses (Joo et al., 2013). Furthermore, self-efficacy has a significant impact on learning achievement, which in turn significantly affects learning persistence. However, in an exceptional pandemic situation, university students' perception of academic self-efficacy might be reduced (Alemany-Arrebola et al., 2020). Besides a general dimension, self-efficacy should also be evaluated concerning the specific domain (Pajares, 1996; Klassen and Chiu, 2010). For the domain of remote learning, ICT self-efficacy showed a positive relation to achievements in the area of computer and information literacy (Rohatgi et al., 2016). A more recent study revealed positive correlations between students' ICT self-efficacy and motivation, goal orientation, interest, and study success, but a negative correlation with anxiety (Pumptow and Brahm, 2020). This study also found that self-assessed e-learning skills, like application use and programming, are positively correlated with digital media self-efficacy. Hence, we hypothesized:

> H5: General self-efficacy (H5a) and ICT self-efficacy (H5b) are positively related to students' estimated probability of successful remote learning.

Learners' Current Emotional State

According to Liaw and Huang (2013), perceived e-learning satisfaction can be predicted by perceived self-efficacy and perceived anxiety. However, the authors pointed out that the negative relation between perceived anxiety and perceived satisfaction is relatively small and anxiety may not be the most significant predictor. Nevertheless, results of a longitudinal study showed that difficulties at university, like financial or relationship problems, can increase students' anxiety and depression levels (Andrews and Wilding, 2004). Because of the ongoing COVID-19 pandemic, perceived anxiety could have an even stronger impact. COVID-19 related research showed that there are major psychological health problems among university students during phases of lockdowns (Cao et al., 2020; Rodríguez-Hidalgo et al., 2020), including symptoms such as anxiety, stress, and depression. However, students also appear to be able to deal with anxiety during the pandemic (Baloran, 2020). Therefore, the current emotional state of students should be considered with respect to their estimated probability of successful remote learning. We hence hypothesized:

> H6: There is a relation between state anxiety (H6a), negative state affect (H6b), and positive state affect (H6c) on the one hand, and students' estimated probability of successful remote learning on the other.

Learners' Digital Literacy

In the context of universities and the ongoing digitization in higher education, digital literacy is an important factor for successful learning: Students are more and more required to navigate within the digital landscape, that is, being proficient in various software programs and in handling digital tools sufficiently (Koc and Bakir, 2010), but also being able to critically reflect digital technology (e.g., Rüth and Kaspar, 2020). According to Jimoyiannis (2015), digital literacy not only includes elements of ICT literacy, but also "a variety of knowledge, attitudes, and complex skills which people need to function effectively in contemporary digital environments" to be able to acquire, critically use, and create further knowledge (Hagel, 2015; p. 4). Digital literacy incorporates computer, internet, information, visual, and media literacy (Jimoyiannis, 2015). Therefore, digital literacy is a prerequisite for skill acquisition and successful learning (Tang and Chaw, 2016), in and beyond higher education (Littlejohn et al., 2012; Techataweewan and Prasertsin, 2018). Given the increasing digital and technological requirements within higher education and the importance of digital literacy for academic success, we hypothesized:

> H7: Digital literacy is positively related to students' estimated probability of successful remote learning.

MATERIALS AND METHODS

Participants

This study is the second part of a larger survey conducted in April and May 2020. Participants were recruited by a combination of

convenience and snowball sampling methods. The final sample used for statistical analyses included 584 university students (496 female, 82 male, and 6 diverse). Conditions of participation were a minimum age of 18 years and enrollment at a German university. Students enrolled at distance-learning universities were excluded. Age of the students ranged from 18 to 66 years with a mean of 24.07 years (SD = 4.88). Most of the students (n = 403) were in a bachelor's degree program, 181 were studying for a master's degree. The sample contained students of different study programs: 404 students participated in one of several teacher education programs covering a wide range of scientific disciplines, 71 were studying psychology, and 38 were studying a media-oriented program. Participation was voluntary and anonymous. Incentives to participate were not provided.

Measures

The survey started with demographic questions including age, gender, study program, number of semesters studied, and name of the university enrolled in. The questionnaire was administered in German language. Participants were informed in advance that they could terminate their participation at any time without giving reasons and that their data would then not be included in the study. Hence, the final data set contains only participants who provided a complete dataset.

Digital Literacy and Past Formal Learning Opportunities

The assessment of students' digital literacy and corresponding learning opportunities was based on the DigComp 2.1 (Carretero et al., 2017). This framework contains five competence areas and 21 competences, each described in a short statement. Based on these statements, we created 21 one-sentence-items to circumscribe each competence. A detailed overview of the used items is displayed in **Supplementary Table A**. Students reported the intensity with which they had learned these competences by means of past learning opportunities within their study program (1 = not at all, 5 = very intensively). Additionally, students were asked to rate their level of competence (1 = very low, 5 = very high). The first competence area deals with "information and data literacy" and contains three competences (e.g., "Analyze, compare, and critically evaluate data, information, and digital content and their sources."). We calculated a composite score for this competence area by averaging across the items for learning opportunities (α = 0.75) as well as for perceived competence (α = 0.75). The second competence area deals with "communication and collaboration" and contains six competences (e.g., "Collaborate with others using digital technologies and co-create resources and knowledge."). Cronbach's α was 0.87 for learning opportunities and 0.84 for perceived competence. The third competence area focuses on "digital content creation" and contains four competences (e.g., "Create and edit digital content and be able to express oneself through digital means"). Cronbach's α was 0.74 for learning opportunities as well as for perceived competence. The fourth competence area is about "safety" and contains four competences (e.g., "Protect technical devices and digital content and understand risks and threats in digital environments"). Cronbach's α was 0.83 for learning opportunities and 0.80 for perceived competence. The fifth competence area focuses on "problem solving" and contains four competences (e.g., "Identify and solve technical issues while operating devices and using digital environments"). Cronbach's α was 0.87 for learning opportunities and 0.82 for perceived competence.

Expected Changes in Key Study Characteristics

Students were asked to estimate how several study characteristics would change in light of the transition to remote teaching and learning. Specifically, we asked them to estimate the potential change in 12 study characteristics compared to their study experience before the pandemic (see "Results" Section). A response scale ranging from −2 (= deteriorating) over 0 (= no change) to +2 (= improving) was used.

Estimated Probability of Successful Remote Learning

To assess students' belief that they can successfully study in the new remote setting, we used the scale "probability of success" of the Questionnaire on Current Motivation (QCM; Rheinberg et al., 2001). This scale contains four items (α = 0.80) assessing learners' probability of success (e.g., "I believe to be up to the challenge of this task" and "I probably won't be able to successfully complete the task"). We slightly adapted the introduction so that the items refer to the new study situation of remote learning. The ratings were given on a five-point scale ranging from 1 (= does not apply) to 5 (= applies).

Quality of Technical Equipment and Availability of an Own Working Space at Home

To determine whether the students had the necessary spatial and technical resources to successfully take part in remote teaching and learning, the existence of four characteristics were rated: sufficiently fast and stable internet connection, required software, required hardware, and own permanent learning space. The answer options "No, I do not own" and "I do not know exactly" were coded as zero, the answer option "Yes, I do own" was coded as one. It should be noted that in order to achieve the highest possible test power in the later multiple regression model, we refrained from coding response "I do not know exactly" as missing data, as this would not affect the results regarding this variable. The first three items were aggregated to a sum score indicating the quality of students' technical equipment for remote learning, the last item served as dummy-coded variable indicating the availability of an own working place at home. The complete items and English translations can be found in the **Supplementary Table B**.

Students' Estimated Preparedness of Lecturers for Remote Teaching

The abrupt transition to remote teaching caused by the pandemic also poses unexpected challenges for lecturers. We asked the students to give an overall evaluation of the lecturers they have met so far in their study program. Specifically, the students assessed their lecturers' skills, motivation, and consideration of student needs with respect to remote teaching: "What percentage of your previous lecturers do you think, based on

your experience, are capable of realizing a good, entirely digital learning environment?", "What percentage of your previous lecturers do you think, based on your experience, are motivated to realize a good, entirely digital learning environment?", and "What percentage of your previous lecturers do you think, based on your experience, will consider students' interests and needs when realizing an entirely digital learning environment?". The original items in German language can be found in the **Supplementary Table B**. Ratings were given on a 11-point scale ranging from 0 (= 0%) to 10 (= 100%). We computed a composite score to assess the estimated preparedness of lecturers for remote teaching by averaging across the three items (α = 0.85).

General Self-Efficacy and ICT Self-Efficacy

We used a German short form of the Self-efficacy Scale to assess general self-efficacy (AKSU; Beierlein et al., 2012). The scale (α = 0.88) comprises three items (e.g., "In difficult situations I can rely on my skills") and uses a five-point Likert scale (1 = totally disagree, 5 = totally agree).

ICT self-efficacy refers to beliefs held while using information and communications technology for various learning purposes. A scale developed by Siddiq et al. (2017) was used to measure ICT self-efficacy. This scale (α = 0.83) comprises three items (e.g., "I am sure I know how to collaborate with other students by use of digital technology"), which were rated on a five-point Likert scale (1 = totally disagree, 5 = totally agree).

State Anxiety

To measure state anxiety, we used a German short scale (α = 0.87) of the State-Trait Anxiety Inventory (STAI-SKD, Englert et al., 2011). Students rated the items (e.g., "I am tense," and "I am concerned") according to their current emotional state with respect to the forthcoming remote learning semesters. Hence, the instruction was slightly adapted asking: "How do you feel with regard to the forthcoming online semester?". We used a five-point scale (1 = not at all, 5 = a lot).

Positive and Negative State Affect

State affect was measured by means of the German version of the Positive and Negative Affect Schedule (PANAS; Krohne et al., 1996). The students used a five-point scale (1 = not at all, 5 = extremely) to rate 20 adjectives describing different feelings and sensations (e.g., "active," "interested," "distressed," and "scared"). The students rated how they felt this way during the past few days. Cronbach's α for positive affect was 0.86, and it was 0.84 for negative affect.

RESULTS

Digital Literacy and Past Formal Learning Opportunities (RQ1)

We analyzed the *status quo* regarding digital learning in terms of self-rated digital competences and past learning opportunities experienced in the formal study program. As shown in **Table 1**, the intensity of past learning opportunities was rated as low overall. An ANOVA for repeated measures (Greenhouse–Geisser applied) was computed to compare the intensity ratings across competence areas (within-participant comparisons based on the identical measurement scale). We found a significant effect, $F(3.06, 1782.24) = 378.67$, $p < 0.001$, $\eta_p^2 = 0.39$. According to pairwise comparisons (Bonferroni-adjusted), the intensity of perceived learning opportunities in the area "information and data literacy" was higher than the intensity of all other learning opportunities. As shown in **Table 1**, most comparisons were significant, all ps < 0.001, except for "communication and collaboration" versus "digital content production," $p = 0.053$, and "safety" versus "problem solving," $p = 0.854$.

In contrast to learning opportunities, perceived competences were rated as moderate, that is, around the scale's midpoint. An ANOVA for repeated measures (Greenhouse–Geisser applied) compared the self-ratings across competence areas. Again, we found a significant effect, $F(3.66, 2133.43) = 353.99$, $p < 0.001$, $\eta_p^2 = 0.38$. As shown in **Table 1**, significant differences between all but one competence areas existed, all ps < 0.001 (Bonferroni-adjusted), except the contrast "information and data literacy" versus "communication and collaboration," $p > 0.999$.

Moreover, we found significant positive correlations between competence ratings and respective past learning opportunities for each competence area (**Table 1**). Thus, the more intensive the formal learning opportunities were, the more students felt competent in that particular area.

To better assess the generalizability of the results, we next examined possible differences at the level of selected subgroups. On the one hand, we focused on study stage by comparing bachelor and master students. As shown in **Table 2**, master students rated their learning opportunities and digital competences significantly higher with respect to competence area "information and data literacy." However, in all other competence areas, there was no difference in either the competence assessment or the prior learning opportunities. Importantly, these results still persisted when a homogenous group of bachelor students studying a specialized media-oriented program (called Intermedia) were excluded. Indeed, we exploratively compared this group (n = 36) with bachelor students (n = 33) and master students (n = 38) who study psychology. We selected these three groups as they were of similar size and can be considered as relatively homogenous regarding study content and course of study, in contrast to the strong heterogeneity in the rest of the sample. We found no group difference regarding perceived learning opportunities and self-rated competence in the area "information and data literacy." For all other competence areas, Intermedia students stated having more learning opportunities than bachelor and master psychology students. Group differences were less pronounced with respect to competences: Intermedia students (vs. psychology students) attributed higher competences to themselves in competence area "problem solving." For competence area "safety," Intermedia students considered their competence higher than master psychology students but not significantly higher than bachelor psychology students. Strikingly, no differences were found in learning opportunities and competences between bachelor and master psychology students. To sum up, in the case of perceived learning opportunities in particular, there were significant differences between the subgroups in favor of those students in whose study program media use and production

TABLE 1 | Descriptive statistics and bivariate correlations between perceived learning opportunities and self-rated digital literacy.

DigComp 2.1 competence area	Perceived learning opportunities		Perceived competence		Bivariate correlation	
	M	*SD*	*M*	*SD*	*r*	*p*
Information and data literacy	2.61[a]	0.87	3.41[a]	0.74	0.39	<0.001
Communication and collaboration	1.91[b]	0.77	3.42[a]	0.77	0.31	<0.001
Digital content creation	1.85[b]	0.69	2.53[b]	0.74	0.52	<0.001
Safety	1.58[c]	0.73	2.93[c]	0.84	0.37	<0.001
Problem solving	1.63[c]	0.75	2.68[d]	0.85	0.46	<0.001

Perceived competences were measured on a scale ranging from 1 (very low) to 5 (very high). Perceived learning opportunities were measured on a scale ranging from 1 (not at all) to 5 (very intensive). Mean values with different superscripts (a–d) indicate statistically significant differences between competence areas (Bonferroni-adjusted significance level, all ps ≤ 0.001).

occupies a central place, albeit at an overall low absolute level. Competences are rated as moderate on average, but only few group differences existed. Detailed results can be found in the **Supplementary Table C**.

Expected Changes in Key Study Characteristics (RQ2)

In the next step, we analyzed students' estimation of how twelve different study characteristics would change considering the transition to remote teaching and learning. The rating scale ranged from −2 (= deteriorating) to +2 (= improving). **Table 3** shows descriptive statistics, results of one-sample *t*-tests comparing the observed mean value with the scale's midpoint (0 = no change), and the frequency distribution of ratings. Results indicate that students did not expect deterioration in all areas of study. In numbers, four of the twelve characteristics were expected to significantly improve, namely the quantity and quality of learning materials provided online by lecturers, the possibility of a self-defined learn and time schedule, and temporal possibilities for undisturbed individual learning. In contrast, seven study characteristics were expected to worsen, namely students' access to relevant literature, the mutual supportiveness among students, the availability of lecturers, the quality of communication between students and lecturers, the general learning environment, students' personal identification with their studies, and their collaboration with other students in the context of lectures and seminars. The largest effect size ($d = -1.33$) was observed for the latter study characteristic. No change was expected regarding the spatial possibilities for undisturbed individual learning, due to the frequency of answers being distributed evenly across the possible answers. In general, the frequency distributions differed remarkably across study characteristics, but for each characteristic, there were both students who expected improvements and students who expected deterioration due to remote teaching and learning.

Explaining Students' Estimated Probability of Successful Remote Learning (H1 – H7)

The final analysis addressed students' belief about their ability to successfully master the new remote learning situation created by the abrupt transition to remote learning due to the pandemic, see **Figure 1**. Six participants reported their gender as "diverse" and were excluded because this was an insufficient subsample for the following blockwise regression analysis: Initially, context-related independent variables were considered as a first block in the regression model (Model 1, **Table 4**). Subsequently, person-related variables were added (Model 2). Students' estimated probability of successful remote learning served as the dependent variable.

The intercorrelations-matrix of all independent variables is presented in the **Supplementary Table D**. The correlations were rather low, with few exceptions. Ratings of different learning opportunities showed the most pronounced intercorrelations ($r_{max} = 0.70$). Besides, general self-efficacy and ICT self-efficacy ($r = 0.65$) as well as state anxiety and negative affect ($r = 0.61$) showed rather high correlations, indicating construct validity.

All statistical assumptions of the multiple regressions were checked (cf. Poole and O'Farrell, 1971), and most of them were met. Normality assumption was given by visual means, however, the Shapiro–Wilk test was significant. Additionally, because specific forms of heteroscedasticity can be hardly detected *via* visual inspection and statistical tests, we used bootstrapping (5,000 iterations) to ensure unbiased significance tests (Hayes and Cai, 2007).

Table 4 shows the results of the blockwise regression analysis. In the first model, limited to context-related variables, the estimated preparedness of lecturers, the availability of an own working space, the quality of technical equipment, and prior learning opportunities regarding information and data literacy showed a positive relation to the estimated probability of success. Learning opportunities in other competence areas did not show a significant relation. Overall, Model 1 explained 24% of the interindividual variance in the estimated probability of successful remote learning, $F(8, 569) = 22.60$, $p < 0.001$. Model 2 added person-related variables and increased the explanatory power of the model to 54% explained variance, $F(21, 556) = 31.00$, $p < 0.001$. In this complete model, the availability of an own working space (H1b) and the estimated preparedness of lecturers for remote teaching (H2) still showed significant positive relations, but quality of technical equipment (H1a) and learning opportunities for information and data literacy did not anymore. However, learning opportunities regarding digital content creation revealed a significant negative relation to the estimated probability of success: The more

TABLE 2 | Comparison between master and bachelor students regarding perceived learning opportunities and self-rated digital literacy.

DigComp 2.1 competence area	Perceived learning opportunities				*t*-test			Perceived competence				*t*-test		
	Master (*n* = 181)		Bachelor (*n* = 403)		*t*	*p*	*d*	Master (*n* = 181)		Bachelor (*n* = 403)		*t*(582)	*p*	*d*
	M	*SD*	*M*	*SD*				*M*	*SD*	*M*	*SD*			
Information and data literacy	2.75	0.88	2.55	0.86	2.56	0.011	0.23	3.62	0.66	3.32	0.76	4.54	<0.001	0.41
Communication and collaboration	1.84	0.70	1.95	0.80	−1.56	0.120	−0.13	3.44	0.75	3.42	0.78	0.33	0.738	0.03
Digital content creation	1.86	0.71	1.84	0.68	0.30	0.762	0.03	2.60	0.69	2.51	0.75	1.36	0.173	0.12
Safety	1.58	0.69	1.58	0.75	−0.05	0.958	−0.00	2.92	0.88	2.94	0.83	−0.26	0.798	−0.02
Problem solving	1.58	0.70	1.64	0.77	−0.97	0.331	−0.08	2.73	0.86	2.66	0.84	0.90	0.368	0.08

Perceived competences were measured on a scale ranging from 1 (very low) to 5 (very high). Perceived learning opportunities were measured on a scale ranging from 1 (not at all) to 5 (very intensive).

TABLE 3 | Descriptive statistics, one sample *t*-tests, and frequency distributions for expected changes in key study characteristics.

Variable	*M*	*SD*	One-sample *t*-test			Frequency distribution in %				
			t(583)	*p*	*d*	−2	−1	0	+1	+2
Quantity of learning materials provided by lecturers	0.71	1.11	15.37	<0.001	0.64	4.79	9.93	22.26	35.62	27.40
Quality of learning materials provided by lecturers	0.42	0.95	10.69	<0.001	0.44	2.74	10.62	42.47	30.31	13.87
Students' access to relevant literature	−0.50	1.27	−9.60	<0.001	−0.40	28.77	24.14	23.29	16.27	7.53
Collaboration with other students in the context of lectures and seminars	−1.18	0.89	−32.10	<0.001	−1.33	44.01	36.30	14.73	4.11	0.86
Mutual supportiveness among students	−0.20	1.11	−4.45	<0.001	−0.18	13.87	25.00	35.62	18.66	6.85
Availability of lecturers	−0.09	1.02	−2.07	0.039	−0.09	8.39	26.54	35.27	25.00	4.79
Quality of communication between students and lecturers	−0.51	1.03	−11.94	<0.001	−0.49	16.44	38.70	26.71	15.41	2.74
Possibility of a self-defined learn and time schedule	0.84	1.11	18.23	<0.001	0.75	3.42	11.13	17.29	34.25	33.90
Spatial possibilities for undisturbed, individual learning	−0.09	1.37	−1.57	0.117	−0.06	18.49	24.14	24.14	14.21	19.01
Temporal possibilities for undisturbed, individual learning	0.65	1.18	13.35	<0.001	0.55	6.85	9.93	21.75	34.42	27.05
General learning environment	−0.40	1.18	−8.25	<0.001	−0.34	17.98	36.13	22.43	15.24	8.22
Students' personal identification with their studies	−0.43	1.02	−10.19	<0.001	−0.42	15.92	29.79	40.58	8.73	4.97

One-sample t-tests were computed against the scale's midpoint of 0. The sum of the percentage values might differ from 100% due to rounding.

intensive the corresponding learning opportunities were, the lower was the estimated probability of successful remote learning. Remaining learning opportunities did not show a significant relation to probability of successful remote learning (H3). Moreover, age did show a negative relation to the probability of success (H4a), whereas gender (H4b) and study stage (H4c) did not. Interestingly, general self-efficacy (H5a), but not ICT self-efficacy (H5b), was positively related to the estimated probability of successful remote learning. Students' state anxiety, but not negative state affect (H6b), showed a significant negative relation to the estimated probability of successful remote learning. In contrast, positive state affect (H6c) was positively related to the probability of success. Importantly, and contradicting our expectations, none of the five domain-specific competence ratings showed a relation to the estimated probability of successful remote learning (H7). However, on the level of bivariate correlations, all competence ratings showed a significant positive relation to the estimated probability of successful remote learning. Hence, when competences were taken into account simultaneously and other variables were added, the multiple regression yielded a different picture. In general, all independent variables showed the expected significant bivariate correlation to the dependent variable (H1 – H7), except age, gender, and study stage (H4). However, these relationships only partially held in the multiple regression. The three most important independent variables were – according to standardized regression coefficients in Model 2 and in descending order – state anxiety, general self-efficacy, and the estimated preparedness of lecturers for remote teaching.

DISCUSSION

The early stages of the COVID-19 pandemic and the sudden transition to remote learning evoked a variety of challenges for university students in Germany. The present study was a timely response to this situation, and it pursued three objectives: We analyzed the *status quo* of students' digital literacy and corresponding (past) learning opportunities at the beginning of the transition to remote learning. Additionally, we examined the expectations of students regarding changes in study characteristics. Finally, we examined a set of context- and person-related variables that may determine students' estimated probability to master this new study situation of remote learning

TABLE 4 | Bivariate correlations and results of blockwise multiple regression analysis for students' estimated probability of successful remote learning as dependent variable.

	Bivariate correlation		Model 1			Model 2		
	r	*p*	*B*	ß	*p*	*B*	ß	*p*
Constant			1.86			2.29		
Quality of technical equipment	0.25	<0.001	0.17	0.15	0.001	0.04	0.04	0.243
Availability of own working space	0.25	<0.001	0.43	0.20	<0.001	0.28	0.13	<0.001
Preparedness of lecturers for remote learning	0.39	<0.001	0.13	0.33	<0.001	0.08	0.19	<0.001
Information and data literacy OTL	0.20	<0.001	0.10	0.11	0.009	0.06	0.06	0.094
Communication and collaboration OTL	0.15	<0.001	0.02	0.02	0.769	0.03	0.03	0.470
Digital content creation OTL	0.11	0.009	−0.10	−0.09	0.092	−0.19	−0.17	<0.001
Safety OTL	0.11	0.011	0.06	0.05	0.309	0.03	0.03	0.501
Problem solving OTL	0.12	0.004	0.03	0.03	0.655	0.07	0.07	0.176
Age	−0.03	0.459				−0.01	−0.07	0.014
Gender (0 = male, 1 = female)	0.03	0.532				0.13	0.06	0.076
Study stage (0 = bachelor, 1 = master)	0.07	0.086				0.08	0.05	0.165
General self-efficacy	0.50	<0.001				0.24	0.25	<0.001
ICT self-efficacy	0.49	<0.001				0.05	0.06	0.228
State anxiety	−0.56	<0.001				−0.25	−0.34	<0.001
Negative state affect	−0.43	<0.001				−0.01	−0.01	0.775
Positive state affect	0.37	<0.001				0.13	0.12	<0.001
Information and data literacy competence	0.33	<0.001				0.00	0.00	0.986
Communication and collaboration competence	0.39	<0.001				0.01	0.01	0.803
Digital content creation competence	0.30	<0.001				0.10	0.09	0.072
Safety competence	0.25	<0.001				−0.03	−0.03	0.530
Problem solving competence	0.30	<0.001				−0.03	−0.03	0.497
R^2/R^2_{adj}				0.24/0.23			0.54/0.52	

The analysis was based on n = 578 since participants how reported their gender as "diverse" (n = 6) were not included; Model 1 includes all context-related variables; Model 2 includes all context-related variables and all person-related variables. p-values are based on bootstrapping with 5,000 iterations; OTL = opportunities to learn.

successfully. We observed several important findings, which we will discuss in the next sections.

Digital Literacy and Past Formal Learning Opportunities

The results show that digital literacy in terms of self-rated competences and their respective past formal learning opportunities were positively correlated across competence areas. We also found that the extent of these competences differed among areas, with digital content production having the lowest self-rating. This result is noteworthy because the DigComp 2.1 (Carretero et al., 2017) treats these areas as five equal parts of one dimension. However, it should be taken into account that self-reports are sometimes biased and do not always reflect true competence levels (Aesaert et al., 2017). Similarly, the students' reported that formal learning opportunities to promote digital literacy had been rather sparse before the pandemic began, but their intensity also significantly varied across competence areas. Nevertheless, there appears to be a systematic lack of relevant learning opportunities in university courses. Indeed, earlier works have already highlighted that digital media were rarely part of teaching and learning in German universities before the pandemic (Persike and Friedrich, 2016) and that the *status quo* of digitalization was considered to be improvable (Gilch et al., 2019). Undoubtedly, forced remote teaching and learning during the pandemic has reinforced the need for a comprehensive digital transformation process.

Given the discrepancy between the self-assessment of moderate competences and the low intensity of corresponding learning opportunities in university courses, we may speculate that students acquire significant parts of digital competences outside the formal university context. However, it is important to note that students' general media use does not necessarily correlate with performance in digital learning (Persike and Friedrich, 2016). Nonetheless, these results may be a solid basis for universities and lecturers to implement measures and content to support underrepresented areas of learning opportunities to promote digital literacy. Also, these findings could serve as a basis for future research related to the COVID-19 pandemic and remote learning in general. A key question is whether the quantity and quality of formal learning opportunities has changed over the course of the pandemic and whether students rate their competences higher after going through a long period of enforced distance learning. It is important to observe whether formal learning opportunities to promote digital literacy and related skills have increased and whether any changes are only short-term or long-term.

Bachelor and master students only differed significantly in their perceived learning opportunities and digital competence

in the area of "information and data literacy." The effect sizes even for the significant differences are rather small. This result contradicts prior studies (Jäger-Biela et al., 2020) where master students reported more learning opportunities across all competence areas. However, it is noteworthy that Jäger-Biela et al. (2020) used a different competence framework and their sample only consisted of students enrolled in different teacher education programs. The role of individual study programs for learning opportunities is supported by our explorative analysis: Students of a media-oriented study program reported significantly more learning opportunities compared to bachelor and even master students in psychology. Interestingly, the differences in self-assessed competences were less pronounced, with students in the media-oriented program reporting higher competences in two of five competency areas, namely "safety" and "problem solving." Nevertheless, and similar to the overall sample, media students' mean scores for prior formal learning opportunities and perceived competences were at most in the middle range of the scale. This shows that there is basically still a lot of room for improvement for all students and that corresponding offers for competence trainings should be pushed across all study programs.

Expected Changes in Key Study Characteristics

The advantages and disadvantages of remote learning have been largely covered in research before (Arkorful and Abaidoo, 2015). Our results provide a novel perspective on the impact of the sudden transition to remote learning on study characteristics. While students expected seven out of twelve key study characteristics to worsen on average, they still believed that four study characteristics would improve. This distribution is in line with the perception of an overall more negative than positive impact of the pandemic (Petzold et al., 2020). Students felt an increase in anxiety and a fear of social isolation in the early stages of the pandemic (Benke et al., 2020; Cao et al., 2020). Especially the fear of social isolation is visible in our results. Collaboration with other students in lectures and seminars as well as the quality of communication between students and lecturers were the two aspects where students expected the most deterioration, indicating that communication and social interaction are perceived as being less likely in the digital sphere (cf. Masoumi and Lindström, 2012). These results underline that many students need social support and interaction in their studies, which should be addressed by adequate measures. The access to relevant literature was also expected to worsen, indicating an overdependence of German universities on presence services and operations, and thus indicating a lack of digitalization (Gilch et al., 2019). Moreover, from the perspective of personal and professional development, it is a warning signal that the students expected that their personal identification with their studies would deteriorate significantly.

However, our results also showed that the overall quality and quantity of learning materials provided online by lecturers was expected to improve. Furthermore, the possibility of a self-defined learning and time schedule as well as temporal possibilities for undisturbed individual learning were two further characteristic that were expected to improve. In this context, the central question is whether students actually possess the skills necessary to take advantage of increased flexibility and self-regulated learning. Consequently, universities should create specific measures that promote the necessary skills for self-regulated learning while maintaining students' personal identification with their studies. Noteworthy, the spatial possibilities for undisturbed, individual learning were not expected to change (on average). However, the expectations of students spread evenly across the range of possible answers, indicating substantial inter-individual variance in the quality of learning places at home.

Explaining Students' Estimated Probability of Successful Remote Learning

Given that individual optimism may play such a central role when dealing with remote learning under pandemic circumstances, we deepened the analyses in this respect. We focused on factors that might explain why students are more or less optimistic regarding the belief that one can nevertheless successfully master the new remote learning situation. For this purpose, we focused on context-related variables and person-related variables. Our model explained a substantial amount of 54% inter-individual variance. As expected, most of these factors were found to play a significant role. Importantly, we refer to the results of the regression model in the following section, instead of bivariate correlations. In order to assess the significance of the individual factors, their joint rather than separate contribution should be considered.

The Role of Context-Related Variables

Working Environment

Interestingly, the quality of students' own technical equipment in terms of internet connection, required software, and required hardware for remote learning only showed a significant relation to students' estimated probability of successful remote learning when limiting the analysis to context-related variables. When person-related variables were added, this relation changed to being non-significant. In developing countries, the lack of internet access and adequate technology poses a problem for remote learning during the COVID-19 pandemic (Adnan and Anwar, 2020). In Germany, where the present study took place, a vast majority of students are sufficiently equipped technologically, so this aspect seems to play a subordinate role for successful remote learning. In contrast, the availability of an own working space was positively related to the students' estimated probability of successful remote learning in both models. The relevance of an optimal environment at home that enables and stimulates remote learning has not really been the subject of research so far. In the situation of forced remote learning during the COVID-19 pandemic, the lack of a suitable workspace is especially problematic as it could further contribute to a spiral where already socially disadvantaged students might be disadvantaged even more. This has implications for policy makers and universities to help ensuring that certain students do not fall too far behind. Future research should focus more on the characteristics of home learning spaces.

Preparedness of Lecturers

One of the most important factors was students' perceived preparedness of lecturers for remote teaching. It seems to be a success factor from a student perspective if lecturers are capable and motivated to create remote teaching, while taking the interests of the students into account. Students who indicated that a greater percentage of their lecturers are able to meet these criteria reported a higher probability of successful remote learning. This finding is consistent with lecturer characteristics being a critical success factor for digital learning (Alhabeeb and Rowley, 2018). However, the lecturers are also put to the test by the sudden switch to remote teaching, as there was no time for the required training and to gain the necessary experiences and skills. A study by Krammer et al. (2020) investigated the perspective of university students on online courses and remote learning during the COVID-19 pandemic. Their results indicate that active involvement by lecturers, clearly structured tasks, and lecturers' feedback are positive factors for remote teaching and learning. What can be learned from the pandemic and the present results is that lecturers should be intensively trained in the adequate use of digital resources. Future research should consider the lecturers' perspective and characteristics accordingly.

Formal Learning Opportunities

Lastly, past learning opportunities to promote digital literacy were not a positive contributor to students' estimated probability of successful remote learning. The competence area of digital content creation showed a significant relation, but in negative direction. This result is surprising and a consequence of the simultaneous consideration of several factors and their (low to moderate) intercorrelations. Indeed, on the level of bivariate correlations, all learning opportunities showed positive relations to the probability of successful remote learning. However, it is not implausible that the more intensive the learning opportunities were in terms of digital content creation, the less likely success in remote learning was rated. Presumably, students who have experience with digital content creation are aware of the procedural and time-related problems related to the development and implementation of remote teaching and learning materials. They might be more aware of the challenges associated with the sudden transition elicited by the pandemic, and consequently think that their probability of successful remote learning is lower. In general, the topic of learning opportunities will become increasingly important during the pandemic and beyond. Our study was conducted at the beginning of the pandemic, and digital learning opportunities may have grown in the last four semesters since then. In addition, this could help identifying which learning opportunities are the most important and need to be implemented in a sustainable manner in different study programs. However, our results also indicate that besides formal learning opportunities, other variables need to be considered.

The Role of Person-Related Variables

The Role of Learners' Demographics

Previous research reported mixed results regarding the impact of gender and age on digital learning (e.g., González-Gómez et al., 2012; Lai and Hong, 2015; Ramírez-Correa et al., 2015; Adams et al., 2018). In the context of the COVID-19 pandemic, gender did not show an effect regarding the attitude to remote learning (Dikaya et al., 2021). In the present study, gender and study stage (bachelor versus master program) did not play a significant role, but age did. The older students were the lower was the estimated probability of success in remote learning. One possible explanation is that older students have developed more established learning routines over their previous lifespan that were disrupted by the COVID-19 pandemic, resulting in less flexibility in adapting to the new situation. The fact that these routines are less applicable in the new situation could have had a negative impact on their assessment of success. In general, it might be easier to create new strategies for remote learning than adapting prior established strategies from face-to-face settings. Indeed, Millar et al. (2021) stated that new learning strategies emerged among first semester university students. Other recent research on remote learning during the COVID-19 pandemic suggests that age and study stage, as well as gender, should not be considered alone and are only a few of a variety of potentially relevant sociodemographic variables (Vladova et al., 2021). More important variables might be the income of students, as it might influence the availability of specific technological infrastructure at home, and the individual family background, as this can take on a supporting or a burdening function in times of a pandemic. Indeed, studies showed that the pandemic has led to job losses or reduced income (Aucejo et al., 2020) as well as to new obligations and challenges in family life (Ayuso et al., 2020).

The Role of Learners' Self-Efficacy

Our results support the finding that self-efficacy is positively related to academic success (Zajacova et al., 2005). General self-efficacy was positively related to the probability of successful remote learning. However, we did not find a significant role of the more specific ICT self-efficacy. A current study found significant relations between internet self-efficacy and students' satisfaction with online education in times of the COVID-19 pandemic (Hamdan et al., 2021). One reason might be that the probability of successful remote learning in an online semester covers much more than dealing with technology-related study characteristics and was therefore related to the more global concept of general self-efficacy in the present study. Interestingly, Heo et al. (2021) recently examined the structural relationship between different domains of self-efficacy and online learning engagement. They found that self-efficacy in technology use itself did not increase learning engagement. Self-efficacy in an online learning environment, however, had an influential role. Therefore, it seems fruitful that future research should use more than one domain of self-efficacy and examine the relations between these domains. Furthermore, time management and self-regulation (Hamdan et al., 2021; Heo et al., 2021) seem to be relevant factors for remote learning and should be considered when examining remote learning in the future.

The Role of Learners' Current Emotional State

Besides self-efficacy as a general belief and demographic variables, we focused on students' current emotional states in this pandemic. Strikingly, the level of state anxiety was the

most influential independent variable regarding the estimated probability of successful remote learning. The more anxiety the students reported, the lower their scores were on the outcome variable. Importantly, negative state affect did not show a significant relation, suggesting that the more specific emotion of anxiety is a more suitable indicator here. Indeed, the whole situation elicited by the pandemic and the first nationwide lockdown have led to anxiety, distress, and uncertainty among German adults in general (Benke et al., 2020; Petzold et al., 2020). When we asked students about their state of anxiety regarding the upcoming remote learning semester, they had to consider an unpredictable long time in the future. As a consequence, students were dealing with uncertainty regarding their course of studies and the development of the pandemic in general. In contrast, state affect referred only to the past few days. Nonetheless, positive state affect was positively related to the students' estimated probability of successful remote learning. Overall, the results clearly show that the emotional sphere is an important factor, but one that is not typically addressed through targeted interventions within formal university teaching. A rethinking of this point, at least in times of an exceptional situation for society as a whole, should be considered.

The Role of Learners' Digital Literacy

Like learning opportunities, all areas of digital literacy showed a significant positive bivariate correlation with the probability of successful remote learning. However, combined with context-related variables and other person-related variables, competences did not play a significant role for the estimated probability of successful remote learning. While under normal circumstances digital literacy might be a prerequisite for successful learning (Tang and Chaw, 2016), the situation during the COVID-19 pandemic might be perceived as different. Although a majority of students seemed to be confident about their digital competences and skills during COVID-19 lockdowns (Tejedor et al., 2020), in a new and unknown situation characterized by anxiety and distress (Benke et al., 2020; Petzold et al., 2020) the level of anxiety and affect might overweight the existence of digital literacy. Moreover, it is also possible that the ability to efficiently and appropriately adapt existing competences to new situational conditions is more important than simply expanding competences. In any case, it is crucial that educational interventions to improve digital literacy in the university context are complemented by interventions to manage anxiety and stress and to improve adaptability in relation to new learning situations.

Limitations

This study provides a detailed analysis of the immediate perspective of German university students on remote learning during the COVID-19 pandemic. The data reflect the *status quo* during the initial phase of the pandemic but provides numerous implications for future action. Nevertheless, there are also limiting factors for the results and implications that should be considered:

First of all, the sample consists of mostly female university students enrolled in several teacher education programs with different scientific disciplines, psychology, or a media-oriented program. The vast majority studied at the same large German university. The sample was obtained through an unsystematic combination of convenience sampling and snowball sampling. Hence, this sample is not representative for all German university students. Relatedly, because the study started at the beginning of a new semester, it is completely unclear to what extent the participants had previously experienced the same learning opportunities and to what extent corresponding measurements might be characterized by some dependency. The immediacy of the national lockdown and transition to remote teaching and learning made it impossible to specify and trace appropriate subgroups. At least, a selected subgroup analysis indicated a limited variability of results and hence some generalizability across study programs. In principle, however, the mean differences between universities or study programs could be smaller than between some parallel courses within a study program if their lecturers implement distance learning in completely different ways or dramatically differ in their own digital literacy. Hence, future research should specifically focus on the variability of learning opportunities and competence distributions across different institutional levels.

Also, one limitation is the fact that all measurements were self-reports. While these are necessary for some constructs (e.g., state anxiety and self-efficacy), more objective measurements for learning opportunities and real competence levels would be desirable. However, instruments that allow objective measurement of digital literacy are very sparse and do not cover the wide range of competences outlined in the DigComp 2.1 Framework. Moreover, an objective analysis of formal learning opportunities is very difficult (cf. Jäger-Biela et al., 2020), because the mention of certain contents in official course descriptions does not provide any information about whether the intended curriculum was actually implemented and realized in this way.

Another possible limitation might be that the present study design was cross-sectional and only covered the perspective of students on remote learning. Therefore, no causal relations can be drawn and the perspective of teachers on remote teaching remains unclear. More measuring points or a post-course evaluation of student's actual success were not part of this study. At the beginning of the study, it was unknown how long the lockdown and associated measures would last, which is why a longitudinal approach was (unfortunately) not taken into account. Lastly, another limitation is the explorative approach of our study. Our regression model was solely based on previous empirical evidence and a simple distinction between context- and person-related variables, as existing and more elaborated models usually did not fit well to the specific situational demands of the pandemic situation. It must also be kept in mind that at the early time of the study, no pandemic-related educational research had been published, and many of the papers cited here were occurring concurrently. Since then, more and more literature addressing the students' perspective on remote learning was published (e.g., Krammer et al., 2020; Tejedor et al., 2020; Hamdan et al., 2021. Hawley et al., 2021). Thus, there are generally few references to relevant (i.e., pandemic-related) prior work in the current literature, but all of this work, taken together, provides a valuable resource for planning future research and practical measures. In this regard, this study also contributes an important complementary piece to the literature.

Conclusion

Overall, this study shows that students lacked formal learning opportunities to promote digital literacy at the early stages of the pandemic. It also revealed that formal learning opportunities are positively related to students' digital literacy, which was rated as moderate. Differences between bachelor and master student were only found in one competence area. Although learning opportunities seem to vary significantly across selected study programs, there is basically still a lot of room for improvement, both in terms of learning opportunities and related competences. The sudden transition to remote learning led to specific expectations regarding changes of key study characteristics, in negative and positive directions. We found that both context- and person-related variables are relevant in explaining students' estimated probability of success in remote learning. The proposed model showed remarkable explanatory power and provides a solid foundation for future research and further elaborated models. General self-efficacy, an own working space, current anxiety, positive state affect, students' age, and the estimated preparedness of lecturers for remote learning were identified as relevant variables explaining the perceived probability of success. Importantly, perceived digital literacy and four out of five corresponding learning opportunities did not show a significant relation to this key outcome variable when considered simultaneously with all other contextual and personal variables. In summary, these results show possible starting points for measures to improve digital learning and teaching in the long term.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. In Germany, as stated by the German Research Association (DFG, https://www.dfg.de/foerderung/faq/geistes_sozialwissenschaften/index.html), the present survey study did not require the approval of an ethics committee, because the research did not pose any threats or risks to the respondents, it was not associated with high physical or emotional stress, and the respondents were informed about the objectives of the survey in advance. At the beginning of the study, participants were informed that the data of this study will be used for research purposes only and that all data are collected anonymously. Thus, no identifying information was collected. Participants who prematurely abandoned the survey were not included in the analyses and all of their data were deleted from the dataset. The patients/participants provided their written informed consent to participate in this study. Informed consent to participate in this study was provided by clicking a corresponding box, and participation was voluntary in all cases.

AUTHOR CONTRIBUTIONS

TH, AA, and KK designed the study, performed the analyses, interpreted the results, and wrote the manuscript. TH and AA collected the data. KK organized and supervised data collection and acquired funding. All authors contributed to the article and approved the submitted version.

FUNDING

This research reported in this article was partly supported by the Federal Ministry of Education and Research of Germany (BMBF) under grant number 01JA2003 (DiSK). This project is part of the "Qualitätsoffensive Lehrerbildung," a joint initiative of the Federal Government and the Länder which aims to improve the quality of teacher training. The program was funded by the Federal Ministry of Education and Research. The authors are responsible for the content of this publication.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.734160/full#supplementary-material

REFERENCES

Adams, D., Sumintono, B., Mohamed, A., and Noor, N. S. M. (2018). E-learning readiness among students of diverse backgrounds in a leading Malaysian higher education institution. *Malays. J. Learn. Instr.* 15, 227–256.

Adnan, M., and Anwar, K. (2020). Online learning amid the Covid-19 pandemic: students' perspectives. *J. Pedagog. Sociol. Psychol.* 2, 45–51. doi: 10.33902/JPSP.2020261309

Aesaert, K., Voogt, J., Kuiper, E., and van Braak, J. (2017). Accuracy and bias of ICT self-efficacy: an empirical study into students' over-and underestimation of their ICT competences. *Comput. Hum. Behav.* 75, 92–102. doi: 10.1016/j.chb.2017.05.010

Alemany-Arrebola, I., Rojas-Ruiz, G., Granda-Vera, J., and Mingorance-Estrada, Á. C. (2020). Influence of COVID-19 on the perception of academic self-efficacy, state anxiety, and trait anxiety in college students. *Front. Psychol.* 11:570017. doi: 10.3389/fpsyg.2020.570017

Alhabeeb, A., and Rowley, J. (2018). E-learning critical success factors: comparing perspectives from academic staff and students. *Comput. Educ.* 127, 1–12. doi: 10.1016/j.compedu.2018.08.007

Andrews, B., and Wilding, J. M. (2004). The relation of depression and anxiety to life-stress and achievement in students. *Br. J. Psychol.* 95, 509–521. doi: 10.1348/0007126042369802

Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., and Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education

students: a global perspective. *Sustainability* 12:8438. doi: 10.3390/su12208438

Arkorful, V., and Abaidoo, N. (2015). The role of e-learning, advantages and disadvantages of its adoption in higher education. *Int. J. Instr. Technol. Distance Learn.* 12, 29–42.

Aucejo, E. M., French, J., Araya, M. P. U., and Zafar, B. (2020). The impact of COVID-19 on student experiences and expectations: evidence from a survey. *J. Public Econ.* 191:104271. doi: 10.1016/j.jpubeco.2020.104271

Ayuso, L., Requena, F., Jiménez-Rodriguez, O., and Khamis, N. (2020). The effects of COVID-19 confinement on the Spanish family: adaptation or change? *J. Comp. Fam. Stud.* 51, 274–287. doi: 10.3138/jcfs.51.3-4.004

Baloran, E. T. (2020). Knowledge, attitudes, anxiety, and coping strategies of students during COVID-19 pandemic. *J. Loss Trauma* 25, 635–642. doi: 10.1080/15325024.2020.1769300

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychol. Rev.* 84, 191–215.

Beierlein, C., Kovaleva, A., Kemper, C. J., and Rammstedt, B. (2012). *Ein Messinstrument zur Erfassung Subjektiver Kompetenzerwartungen: Allgemeine Selbstwirksamkeit Kurzskala (ASKU). [Short Scale for Measuring General Self-efficacy Beliefs (ASKU)] (GESIS-Working Papers, 2012/17)*. Mannheim: GESIS – Leibniz-Institut für Sozialwissenschaften.

Benke, C., Autenrieth, L. K., Asselmann, E., and Pané-Farré, C. A. (2020). Lockdown, quarantine measures, and social distancing: associations with depression, anxiety and distress at the beginning of the COVID-19 pandemic among adults from Germany. *Psychiatry Res.* 293:113462. doi: 10.1016/j.psychres.2020.113462

Branquinho, C., Kelly, C., Arevalo, L. C., Santos, A., and Gaspar de Matos, M. (2020). "Hey, we also have something to say": a qualitative study of Portuguese adolescents' and young people's experiences under COVID-19. *J. Community Psychol.* 48, 2740–2752. doi: 10.1002/jcop.22453

Brown, N., Te Riele, K., Shelley, B., and Woodroffe, J. (2020). *Learning at Home During COVID-19: Effects on Vulnerable Young AUSTRALIANS. Independent Rapid Response Report*. Hobart, Tas: University of Tasmania, Peter Underwood Centre for Educational Attainment.

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., et al. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* 287:112934. doi: 10.1016/j.psychres.2020.112934

Carretero, S., Vuorikari, R., and Punie, Y. (2017). *DigComp 2.1. The Digital Competence Framework for Citizens with Eight Proficiency Levels and Examples of Use*. Luxembourg: Publications Office of the European Union. doi: 10.2760/38842

Coccoli, M., Guercio, A., Maresca, P., and Stanganelli, L. (2014). Smarter universities: a vision for the fast changing digital era. *J. Vis. Lang. Comput.* 25, 1003–1011. doi: 10.1016/j.jvlc.2014.09.007

Daymont, T., Blau, G., and Campbell, D. (2011). Deciding between traditional and online formats: exploring the role of learning advantages, flexibility, and compensatory adaptation. *J. Behav. Appl. Manage.* 12, 156–175.

Dikaya, L. A., Avanesyan, G. A., Dikiy, I. S., Kirik, V. A., and Egorova, V. A. (2021). How personality traits are related to the attitudes toward forced remote learning during COVID-19: predictive analysis using generalized additive modelling. *Front. Educ.* 6:629213. doi: 10.3389/feduc.2021.629213

ElSaheli-Elhage, R. (2021). Access to students and parents and levels of preparedness of educators during the COVID-19 emergency transition to e-learning. *Int. J. Stud. Educ.* 3, 61–69. doi: 10.46328/ijonse.35

Englert, C., Bertrams, A., and Dickhäuser, O. (2011). Entwicklung der fünf-item-kurzskala STAI-SKD zur messung von zustandsangst [Development of the five-item short scale STAI-SKD for the assessment of state anxiety]. *Z. Gesundheitspsychol.* 19, 173–180. doi: 10.1026/0943-8149/a000049

Gilch, H., Beise, A. S., Krempkow, R., Müller, M., Stratmann, F., and Wannemacher, K. (2019). *Digitalisierung der Hochschulen: Ergebnisse einer Schwerpunktstudie für die Expertenkommission Forschung und Innovation [Digitalization of Universities: Results of a Focus Study for the Expert Comission of Research and Innovation.](No. 14-2019)*. Berlin: Expertenkommission Forschung und Innovation (EFI).

González-Gómez, F., Guardiola, J., Rodríguez, Ó. M., and Alonso, M. Á. M. (2012). Gender differences in e-learning satisfaction. *Comput. Educ.* 58, 283–290. doi: 10.1016/j.compedu.2011.08.017

Gross, M., and Latham, D. (2012). What's skill got to do with it: Information literacy skills and self-views of ability among first-year college students. *J. Am. Soc. Inf. Sci. Technol.* 63, 574–583. doi: 10.1002/asi.21681

Hagel, P. (2015). *Towards an Understanding of 'Digital Literacy(ies)'. Discourse: Deakin University Library Research & Practice*. Geelong, Vic: Deakin University Library, 1–13. doi: 10.21153/dsc2015no1art1

Hamdan, K. M., Al-Bashaireh, A. M., Zahran, Z., Al-Daghestani, A., Samira, A. H., and Shaheen, A. M. (2021). University students' interaction, internet self-efficacy, self-regulation and satisfaction with online education during pandemic crises of COVID-19 (SARS-CoV-2). *Int. J. Educ. Manage.* 35, 713–725. doi: 10.1108/IJEM-11-2020-0513

Hawley, S. R., Thrivikraman, J. K., Noveck, N., Romain, T. S., Ludy, M. J., Barnhart, L., et al. (2021). Concerns of college students during the COVID-19 pandemic: thematic perspectives from the United States, Asia, and Europe. *J. Appl. Learn. Teach.* 4, 11–20. doi: 10.37074/jalt.2021.4.1.10

Hayes, A. F., and Cai, L. (2007). Using heteroskedasticity-consistent standard error estimators in OLS regression: an introduction and software implementation. *Behav. Res. Methods* 39, 709–722.

Heo, H., Bonk, C. J., and Doo, M. Y. (2021). Enhancing learning engagement during COVID-19 pandemic: self-efficacy in time management, technology use, and online learning environments. *J. Comput. Assist. Learn.* 37, 1640–1652. doi: 10.1111/jcal.12603

Jäger-Biela, D. J., Kaspar, K., and König, J. (2020). "Lerngelegenheiten zum erwerb von digitalisierungsbezogenen medienkompetenzen: analysen des studienangebots und des nutzungsverhaltens von lehramtsstudierenden am fallbeispiel der Universität zu Köln [Learning opportunities for the acquisition of digitalization-related media competencies: analyses of the study offer and the usage behavior of student teachers at the University of Cologne]," in *Bildung, Schule, Digitalisierung [Education, School, Digitalization]*, eds K. Kaspar, M. Becker-Mrotzek, S. Hofhues, J. König, and D. Schmeinck (Münster: Waxmann), 64–70.

Jimoyiannis, A. (2015). "Digital literacy and adult learners," in *The SAGE Encyclopedia of Educational Technology*, ed. M. J. Spector (Thousand Oaks, CA: SAGE Publications), 213–216. doi: 10.4135/9781483346397.n94

Joo, Y. J., Lim, K. Y., and Kim, E. K. (2011). Online university students' satisfaction and persistence: examining perceived level of presence, usefulness and ease of use as predictors in a structural model. *Comput. Educ.* 57, 1654–1664. doi: 10.1016/j.compedu.2011.02.008

Joo, Y. J., Lim, K. Y., and Kim, J. (2013). Locus of control, self-efficacy, and task value as predictors of learning outcome in an online university context. *Comput. Educ.* 62, 149–158. doi: 10.1016/j.compedu.2012.10.027

Kapasia, N., Paul, P., Roy, A., Saha, J., Zaveri, A., Mallick, R., et al. (2020). Impact of lockdown on learning status of undergraduate and postgraduate students during COVID-19 pandemic in West Bengal, India. *Child. Youth Serv. Rev.* 116:105194. doi: 10.1016/j.childyouth.2020.105194

Khan, F., and Vuopala, E. (2019). Digital competence assessment across generations: a finnish sample using the Digcomp framework. *Int. J. Digit. Lit. Digit. Competence* 10, 15–28. doi: 10.4018/IJDLDC.2019040102

Klassen, R. M., and Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction: teacher gender, years of experience, and job stress. *J. Educ. Psychol.* 102, 741–756. doi: 10.1037/a0019237

Koc, M., and Bakir, N. (2010). A needs assessment survey to investigate pre-service teachers' knowledge, experiences and perceptions about preparation to using educational technologies. *Turk. Online J. Educ. Technol.* 9, 13–22.

König, J., Doll, J., Buchholtz, N., Förster, S., Kaspar, K., Rühl, A.-M., et al. (2018). Pädagogisches wissen versus fachdidaktisches wissen? [General pedagogical knowledge versus pedagogical content knowledge?]. *Z. Erziehungswiss.* 21, 1–38. doi: 10.1007/s11618-017-0765-z

Krammer, G., Pflanzl, B., and Matischek-Jauk, M. (2020). Aspekte der online-lehre und deren zusammenhang mit positivem erleben und motivation bei lehramtsstudierenden: mixed-method befunde zu beginn von COVID-19 [Aspects of online teaching and their relation to positive experience and motivation among teacher education students: mixed-method findings at the beginning of COVID-19]. *Z. Bildungsforschung* 10, 337–375. doi: 10.1007/s35834-020-00283-2

Krohne, H. W., Egloff, B., Kohlmann, C. W., and Tausch, A. (1996). Untersuchungen mit einer deutschen version der "Positive and Negative Affect

Schedule" (PANAS) [Investigations with a German version of the Positive and Negative Affect Schedule]. *Diagnostica* 42, 139–158.

Kuzminska, O., Mazorchuk, M., Morze, N., Pavlenko, V., and Prokhorov, A. (2018). "Study of digital competence of the students and teachers in Ukraine," in *International Conference on Information and Communication Technologies in Education, Research, and Industrial Applications*, eds V. Ermolayev, M. Suárez-Figueroa, V. Yakovyna, H. Mayr, M. Nikitchenko, and A. Spivakovsky (Cham: Springer), 148–169. doi: 10.1007/978-3-030-13929-2_8

Lai, K. W., and Hong, K. S. (2015). Technology use and learning characteristics of students in higher education: do generational differences exist? *Br. J. Educ. Technol.* 46, 725–738. doi: 10.1111/bjet.12161

Liaw, S. S., and Huang, H. M. (2013). Perceived satisfaction, perceived usefulness and interactive learning environments as predictors to self-regulation in e-learning environments. *Comput. Educ.* 60, 14–24. doi: 10.1016/j.compedu.2012.07.015

Lin, M. H., Chen, H. G., and Liu, K. S. (2017). A study of the effects of digital learning on learning motivation and learning outcome. *Eurasia J. Math. Sci. Technol. Educ.* 13, 3553–3564. doi: 10.12973/eurasia.2017.00744a

Littlejohn, A., Beetham, H., and McGill, L. (2012). Learning at the digital frontier: a review of digital literacies in theory and practice. *J. Comput. Assist. Learn.* 28, 547–556. doi: 10.1111/j.1365-2729.2011.00474.x

López-Meneses, E., Sirignano, F. M., Vázquez-Cano, E., and Ramírez-Hurtado, J. M. (2020). University students' digital competence in three areas of the DigCom 2.1 model: a comparative study at three European universities. *Australas. J. Educ. Technol.* 36, 69–88. doi: 10.14742/ajet.5583

Masoumi, D., and Lindström, B. (2012). Quality in e-learning: a framework for promoting and assuring quality in virtual institutions. *J. Comput. Assist. Learn.* 28, 27–41. doi: 10.1111/j.1365-2729.2011.00440.x

McPherson, M. A., and Nunes, J. M. (2008). Critical issues for e-learning delivery: what may seem obvious is not always put into practice. *J. Comput. Assist. Learn.* 24, 433–445. doi: 10.1111/j.1365-2729.2008.00281.x

Millar, S. K., Spencer, K., Stewart, T., and Dong, M. (2021). Learning curves in COVID-19: student strategies in the 'new normal'? *Front. Educ.* 6:641262. doi: 10.3389/feduc.2021.641262

Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., et al. (2020). The socio-economic implications of the coronavirus and COVID-19 pandemic: a review. *Int. J. Surg.* 75, 185–193. doi: 10.1016/j.ijsu.2020.04.018

Paechter, M., Maier, B., and Macher, D. (2010). Students' expectations of, and experiences in e-learning: their relation to learning achievements and course satisfaction. *Comput. Educ.* 54, 222–229. doi: 10.1016/j.compedu.2009.08.005

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Rev. Educ. Res.* 66, 543–578.

Persike, M., and Friedrich, J.-D. (2016). *Lernen mit Digitalen Medien aus Studierendenperspektive [Learning with Digital Media from a Student Perspective]. Arbeitspapier Nr. 17*. Berlin: Hochschulforum Digitalisierung.

Petzold, M. B., Bendau, A., Plag, J., Pyrkosch, L., Mascarell Maricic, L., Betzler, F., et al. (2020). Risk, resilience, psychological distress, and anxiety at the beginning of the COVID-19 pandemic in Germany. *Brain Behav.* 10:e01745. doi: 10.1002/brb3.1745

Poole, M. A., and O'Farrell, P. N. (1971). The assumptions of the linear regression model. *Trans. Inst. Br. Geogr.* 52, 145–158. doi: 10.2307/621706

Prior, D. D., Mazanov, J., Meacheam, D., Heaslip, G., and Hanson, J. (2016). Attitude, digital literacy and self efficancy: flow-on effects for online learning behavior. *Internet High. Educ.* 29, 91–97. doi: 10.1016/j.iheduc.2016.01.001

Pumptow, M., and Brahm, T. (2020). Students' digital media self-efficacy and its importance for higher education institutions: development and validation of a survey instrument. *Technol. Knowl. Learn.* 26, 555–575. doi: 10.1007/s10758-020-09463-5

Ramírez-Correa, P. E., Arenas-Gaitán, J., and Rondán-Cataluña, F. J. (2015). Gender and acceptance of e-learning: a multi-group analysis based on a structural equation model among college students in Chile and Spain. *PLoS One* 10:e0140460. doi: 10.1371/journal.pone.0140460

Rheinberg, F., Vollmeyer, R., and Burns, B. D. (2001). FAM: ein fragebogen zur erfassung aktueller motivation in lern-und leistungssituationen [QCM: a questionnaire to assess current motivation in learning situations]. *Diagnostica* 47, 57–66. doi: 10.1026//0012-1924.47.2.57

Rodríguez-Hidalgo, A. J., Pantaleón, Y., Dios, I., and Falla, D. (2020). Fear of COVID-19, stress, and anxiety in university undergraduate students: a predictive model for depression. *Front. Psychol.* 11:591797. doi: 10.3389/fpsyg.2020.591797

Rohatgi, A., Scherer, R., and Hatlevik, O. E. (2016). The role of ICT self-efficacy for students' ICT use and their achievement in a computer and information literacy test. *Comput. Educ.* 102, 103–116. doi: 10.1016/j.compedu.2016.08.001

Rüth, M., Breuer, J., Zimmermann, D., and Kaspar, K. (2021). The effects of different feedback types on learning with mobile quiz apps. *Front. Psychol.* 12:665144. doi: 10.3389/fpsyg.2021.665144

Rüth, M., and Kaspar, K. (2017). The E-learning setting circle: first steps toward theory development in E-learning research. *Electron. J. Elearn.* 15, 92–101.

Rüth, M., and Kaspar, K. (2020). Commercial video games in school teaching: two mixed methods case studies on students' reflection processes. *Front. Psychol.* 11:594013. doi: 10.3389/fpsyg.2020.594013

Selwyn, N. (2008). An investigation of differences in undergraduates' academic use of the internet. *Act. Learn. High. Educ.* 9, 11–22. doi: 10.1177/1469787407086744

Shapiro, M., Solano, D. M., Bergkamp, J. J., Gebauer, A., Gillian, E., Lopez, K. M., et al. (2020). Impacts of converting courses to virtual instruction midsemester at a hispanic-serving institution. *J. Chem. Educ.* 97, 2526–2533. doi: 10.1021/acs.jchemed.0c00788

Shopova, T. (2014). Digital literacy of students and its improvement at the university. *J. Effic. Responsibil. Educ. Sci.* 7, 26–32. doi: 10.7160/eriesj.2014.070201

Siddiq, F., Gochyyev, P., and Wilson, M. (2017). Learning in digital networks–ICT literacy: a novel assessment of students' 21st century skills. *Comput. Educ.* 109, 11–37. doi: 10.1016/j.compedu.2017.01.014

Tang, C. M., and Chaw, L. Y. (2016). Digital literacy: a prerequisite for effective learning in a blended learning environment? *Electron. J. Elearn.* 14, 54–65.

Techataweewan, W., and Prasertsin, U. (2018). Development of digital literacy indicators for Thai undergraduate students using mixed method research. *Kasetsart J. Soc. Sci.* 39, 215–221. doi: 10.1016/j.kjss.2017.07.001

Tejedor, S., Cervi, L., Pérez-Escoda, A., and Jumbo, F. T. (2020). Digital literacy and higher education during COVID-19 lockdown: Spain, Italy, and Ecuador. *Publications* 8:48. doi: 10.3390/publications8040048

Tinker, R. (2001). E-learning quality: the concord model for learning from a distance. *NASSP Bull.* 85, 36–46. doi: 10.1177/019263650108562804

Vladova, G., Ullrich, A., Bender, B., and Gronau, N. (2021). Students' acceptance of technology-mediated teaching–how it was influenced during the COVID-19 pandemic in 2020: a study from Germany. *Front. Psychol.* 12:636086. doi: 10.3389/fpsyg.2021.636086

Zajacova, A., Lynch, S. M., and Espenshade, T. J. (2005). Self-efficacy, stress, and academic success in college. *Res. High. Educ.* 46, 677–706. doi: 10.1007/s11162-004-4139-z

Zander, S., and Heidig, S. (2020). "Motivationsdesign bei der konzeption multimedialer lernumgebungen [Motivation design during the conception of multimedia learning environments]," in *Handbuch Bildungstechnologie*, eds H. Niegemann and A. Weinberger (Berlin: Springer-Verlag GmbH), 393–415.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Education

ORIGINAL RESEARCH
published: 24 February 2022
doi: 10.3389/feduc.2021.724112

Did the Communication Barriers During the Lockdown Reduce Students' Satisfaction?

Juan Li[1], *Sitan Li*[2], *Jianbo Hu*[3], *Caixia Zhong*[4] *and Pan Liu*[5,6]*

[1]School of Health Care Security, Shandong First Medical University & Shandong Academy of Medical Sciences, Jinan, China, [2]Moody College of Communication, The University of Texas at Austin, Austin, TX, United States, [3]State Grid Shandong Electric Power Company, Jinan, China, [4]Shandong Luneng Taishan Football School, Weifang, China, [5]School of Economics and Management, Beijing Institute of Petrochemical Technology, Beijing, China, [6]Beijing Academy of Safety Engineering and Technology, Beijing, China

The lockdown control measures implemented against the pandemic of COVID-19 have had a global effect on various aspects of our lives as a society. Considering the impact of the lockdown caused by COVID-19 on adolescents, we conducted practical longitudinal research on the changes in adolescent satisfaction before and after lockdown. A total of 221 students aged 13–19 years from a professional adolescent football school in China participated in a self-report satisfaction questionnaire before and after the lockdown. The results showed that the satisfaction of adolescents improved significantly after the lockdown. There were significant differences based on age in the improvement rate, but the correlation between the students' home regions (and how they were affected by COVID-19) and satisfaction improvement was not significant. To examine the possible reasons behind the improvement in adolescent satisfaction, we then analyzed in detail the online teaching and training methods implemented by the school during the lockdown. Based on this investigation, we outlined recommendations to guide future practice. This research is expected to deepen the theory and practice associated with the development of Chinese adolescent teaching, which may be applied to other training institutions.

Keywords: adolescent satisfaction, Chinese football school, COVID-19, lockdown, online teaching, training institutions

OPEN ACCESS

Edited by:
Meryem Yilmaz Soylu, Georgia Institute of Technology, United States

Reviewed by:
Pasquale La Malva, University of Studies G. d'Annunzio Chieti and Pescara, Italy
Prathamesh Churi, SVKM's Narsee Monjee Institute of Management Studies, India

***Correspondence:**
Pan Liu
lpositive@qq.com

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *08 August 2021*
Accepted: *11 November 2021*
Published: *24 February 2022*

Citation:
Li J, Li S, Hu J, Zhong C and Liu P (2022) Did the Communication Barriers During the Lockdown Reduce Students' Satisfaction? Front. Educ. 6:724112. doi: 10.3389/feduc.2021.724112

1 INTRODUCTION

As of October 24, 2021, there have been 243 million confirmed cases of COVID-19, including 4.9 million deaths, the coronavirus disease 2019 (COVID-19) globally (World Health Organization, 2021), with the virus continuing to spread. Following the example of Wuhan, China, many countries implemented lockdown measures to alleviate the spread of the infection and contain the outbreak (Lau et al., 2020). The latter, have not only affected human lives and the economy on a global level, but are also expected to affect micro-personal psychology, cognition, and interrelationships (Chang et al., 2020; Chen et al., 2020; Zhao et al., 2020; Zhu et al., 2020).

Among them, Di Crosta et al. (2021) conducted research on consumer behavior and its psychological antecedents during the pandemic showed that consumer behavior was affected by the new coronavirus. Cannito et al. (2021) also researched consumer behavior preferences during the epidemic and proved the impact of COVID-19 on consumer behavior. The study of Ceccato et al. (2021) verified the impact of COVID-19 on the future life expectations of tested adults. Related studies have also confirmed the impact of COVID-19 on different age groups (Ceccato et al., 2021;

Rosi et al., 2021). Ceccato et al. (2021) conducted research on age-related differences in crisis emotions, cognitive attitudes, and behavioral responses showed that in the COVID-19 epidemic, the elderly as high-risk groups had lower negative emotions than young people and middle-aged people. The results of Rosi et al. (2021) showed that the older the age, the lower the susceptibility to Covid-19, but the higher the perceived severity. Different predictors explained the perception of risk severity and vulnerability in different age groups. In COVID-19 related research, youth should also be a group of concern.

In most countries, including China, during the lockdown period, schools and educational institutions, most factories, non-emergency supplies stores, and institutions were closed, while the people were required to stay at home, and not go out unless necessitated by an emergency (British Broadcasting Corporation, 2020; DW News, 2020). At this time, many people were separated from their close ones while their homes acted as offices and schools, following the implementation of remote work and online distance learning (Prospects, 2020; Science Focus, 2020). Therefore, many families and individuals had to adapt to these changes (Adjust, 2020).

For students of one football school in China, the lockdown of 3 months meant foregoing face-to-face teaching and coaching with their teachers and coaches, group collaboration with teammates, and outdoor sports training, which may have been associated with some physical and psychological effects.

Satisfaction is an important indicator for sports teams (Burns et al., 2012). Numerous studies have shown that athlete satisfaction and sports performance are closely related (Sriboon, 2002; Bebetsos and Theodorakis, 2003; Cunningham and Dixon, 2003; Reinboth and Duda, 2006). Moreover, team cohesion and leadership are related to athlete satisfaction (Aoyagi et al., 2008; Karreman et al., 2009; Chen et al., 2015). During the lockdown period, we were unable to fully evaluate the team performance of sports teams and the individual performance of the student-athletes due to the lockdown conditions, however, we were able to assess the self-reported satisfaction of the student-athletes.

Therefore, the purpose of this study was to examine the changes in the satisfaction of students after going through a COVID-19 imposed lockdown in a football school and to analyze the online teaching and training methods that might have affected these changes.

2 THEORETICAL HYPOTHESIS

Communication theory believed that communication was a process of expression, interaction, and influence. In this process, individuals interacted with other individuals through similar expressions to affect their cognition, emotions, and behaviors (Craig, 1999, p143). There were barriers to the communication environment caused by changes in the communication space and time of communication. There were also communication barriers due to changes in understanding and expression, and levels. Changes in mentality and communication media also created communication barriers (Eisenberg, 2010).

During the lockdown, coaches had to rely on online education and video methods to teach. This allowed students and coaches to switch from face-to-face communication to video communication, which was a change in the communication medium. Online education did not limit the time and space of video communication between students and coaches, which made the communication space and communication time between them change. For the coach to express communication content through video more clearly, the way of expression also changed. At the same time, due to the prolonged lockdown, the mentality of coaches and students changed. These were theoretically possible barriers to communication. From an intuitive understanding, this barrier may affect student satisfaction.

Studies have found that the existence of communication barriers will reduce the effectiveness of communication (Lunenburg, 2010; Guttman et al., 2018). Park and Song (2005) investigated the communication barriers experienced by patients and nurses in their research, and believed that it is necessary for nurses to understand patients' perceptions of communication barriers and obtain better communication skills and attitudes. Norouzinia et al. (2016) found in a study that communication barriers affect the relationship between nurses and patients, but these obstacles can be eliminated by raising the awareness of nurses and patients and creating an ideal environment. They recommend effective communication between nurses skills training and encourage nurses through continuous monitoring of acquired skills. The research of Norouzinia et al. (2016) inspired us, perhaps through a more detailed online education implementation process to reduce the negative impact of communication barriers on student satisfaction with coaches. More importantly, Li et al. (2020) found in a study that online teaching during the lockdown period improved the coach-athlete relationship. Regarding student satisfaction, the online teaching project of this research has been implemented as rigorously and meticulously as possible, and various methods have been adopted to avoid communication barriers. Therefore, we tried to make the following assumptions.

Hypothesis. During the period of the epidemic, online teaching under meticulous promotion will increase the satisfaction of students.

TABLE 1 | Age distribution of test participants.

Age	Test participants number	
	Before lockdown	After lockdown
13	30	45
14	49	19
15	35	40
16	24	33
17	24	27
18	0	13
19	19	20

3 METHODS

3.1 Participants

We conducted a longitudinal study of the impact of COVID-19 lockdown on 221 students (male, average age 15.33) aged

13–19 years (See **Table 1**), attendees of a professional adolescent football school in China. During the lockdown, the players who normally attend boarding school returned to their family homes located in different provinces in China for 3 months between January 4–17 and April 17, 2020. The students who participated in the survey were unable to meet their teammates and coaches during the 3-month lockdown. Every day, from Monday to Friday, they participated in online learning and training; the school teachers broadcasted live video lessons, arranged assignments and corrective assignments, and conducted daily teaching activities following the school's regular schedule. Coaches and students had daily video meetings, during which they conducted ball-free and confrontation-free training.

3.2 Measure

In this study, the Chinese version (Yang, 2019) of the subscale of the Athlete Satisfaction Questionnaire (Riemer and Chelladurai, 1998) was used to measure student athletes' satisfaction: the subscale of individual satisfaction contains three items on individual performance satisfaction (e. g. the improvement in my skill level thus far), while the subscale of satisfaction with the team contains three items on team performance satisfaction (e. g. the extent to which the team has met its goals for the season thus far). Riemer and Chelladurai (1998) reported the two subscales to originally have Cronbach's alpha levels of 0.85 and 0.95, respectively. The Cronbach's alpha values of the two subscales obtained for the Chinese version in Yang's study were 0.79 and 0.80, respectively. The Cronbach's alpha levels of the two subscales we obtained in the study were 0.81 and 0.87, respectively. The items were measured using a five-point Likert scale, with answers ranging from 1 (never) to 5 (always).

3.3 Data Collection Procedure

This research was conducted with the consent of the Ethics Committee of Beijing Jiaotong University. The second cross-sectional data collection in this study was approved by the Shandong Luneng Taishan Football School Ethics Committee. The student-athletes participating in the survey were informed that participation in the study was voluntary and anonymous, and that they would be allowed to withdraw at any time. They were not compensated for participating in the survey in any way. Their questionnaire completion process was completed independently.

The data were collected at two time points using the same questionnaire: before the full outbreak of the COVID-19 pandemic in December 2019, and then on April 17, 2020, when China's pandemic was fully controlled and the lockdown was lifted in various places. During the first data collection, we used a paper questionnaire. Student-athletes completed the questionnaires in a classroom at their school (approximately 30 players at a time) before the time of their evening self-study after dinner. They filled out the questionnaires in the classroom or the technical and tactical rooms.

Before the questionnaire survey began, the investigators explained to the students that the purpose of the questionnaire was to conduct scientific research and asked them to complete it independently without consulting each other. After all the student athletes completed the survey, the investigator collected the questionnaires. The entire process of data collection was conducted by the researchers, and neither the teachers nor the coaches were present. After the paper questionnaires were collected, the researchers coded the questionnaires and entered the data into the computer. After the data entry was completed, another researcher conducted a second check to validate and confirm the data from the first questionnaire survey.

For the second data collection, we used an electronic questionnaire. The student-athletes completed the electronic questionnaire at home. Similar to the procedure followed during the first data collection, the investigators introduced the purpose of the questionnaire and communicated the precautions before the student-athletes began filling out the questionnaire. The questionnaires were sent to the student-athletes through a WeChat group. Then, they were asked to choose a time of their convenience to complete the questionnaire within 1 day of receiving it.

A team of 28 student-athletes did not participate in the first questionnaire because they had gone out to participate in a competition. After deleting the questionnaires with missing data, 171 datasets were obtained in the first survey (the data validity rate was 77%). After the second, online, data collection, the questionnaires that were filled out within 40 or fewer seconds were deleted. We obtained 213 completed questionnaires in the second survey (the data validity rate was 96%).

3.4.1 Teaching Plan

Under the unified coordination of the head of the department, the teacher arranged every week of online teaching for a given student unit or grade 1 week in advance (before 4:00 pm on a Friday, from February 10 to May 15, 2020), and arranged the curriculum. A week of online teaching involved five study days a week and 20 lessons per week, including four to six lessons in Chinese, mathematics, and English, and one to three lessons in other subjects. The number of political sciences, language, mathematics, and English classes in high school grades remained the same as it was during classroom teaching (see Supplementary Materials 1 to 3 for course examples).

The teachers prepared the lesson plans. The teaching plan had to include, at least, the content of the teaching materials. The teachers had to provide a brief analysis of the teaching materials, teaching objectives, major and difficult points, preparation of teaching resources (coursework, lesson plans, online courses), and teaching methods (online courses, live lectures, smart classrooms, self-learning by publishing tasks). There were also teaching procedures, homework design (including tutorials), and homework feedback forms (see Supplementary Material 1 to 3 for course examples and Supplementary Material 4 for the online learning plan).

3.4.2 Teaching Resources

According to the teaching guidelines set for the new semester in response to COVID-19, teachers are to use the online cloud classroom resources. Teaching resources and technical support provided by the cloud platform were announced by the Ministry

of Education of China to enable the teachers to carefully prepare the lessons during the pandemic. Teachers prepared lesson plans or coursework, uploaded them for the students for the latter's learning, and matched appropriate exercises to consolidate the learning objectives. Teachers could upload the teaching resource links for the new textbook content, electronic versions of teaching materials, or forward images to students for learning. The learning resources or learning requirements sent by the teachers had to be integrated before they were published so that parents and students could understand the requirements instantly.

Furthermore, a variety of applications were used together during the online course. The advantages of various types of software were integrated. For example, in addition to the commonly used "Xiao Rui homework", the "onion math" micro-learning and classroom quiz functions were used to guide students to turn pre-emptive learning into reality for the subject of mathematics. The English course made full use of the assessment and display function of the "Middle School Together" online platform to guide students to practice spoken language and perform animation (video) dubbing. With the help of the platform, all the functions of regular English teaching were realized, from word pronunciation to reading comprehension, and from word dictation to oral training. Some teachers also explored the "little butler" function in the WeChat mini-program to upload and give feedback for homework, and used the "Solitaire" mini-program to reduce screen swipes, perform recitation, and check-in. In short, the teachers adhered to the concept of "everything for the children" and "everything to optimize the teaching effect," and continued to practice and explore.

3.4.3 Evaluation of the Teaching Process

Course preparation, teaching, assignment submission, review, and feedback were accomplished by the requirements of conventional teaching and were effective. Teachers were familiar with the teaching content; the teaching process was smooth; and the explanation was clear and concise, easy to understand, reflected the teachers' personal style, and could attract the students. Teachers strengthened the control of the students' learning process through effective methods. Students who failed to enter the classroom in time were promptly reminded, noted, and timely feedback was sent to students and parents.

Another important aspect was moral education during the pandemic. According to the relevant requirements for pandemic prevention and control, combined with the current long-term separation of school students from their parents and the need for multi-element cultivation, the teachers organized homework experiences and activities encouraging the students to raise the national flag on the internet, thank their parents by helping the latter with housework and cooking. Teachers also organized online donations to support initiatives such as "the most beautiful retrogrades" (telling the story of the doctors who fight against the pandemic around them), "talking on the weekends" (players discussed how they felt after reading a biography of a famous football player), "tree-planting festival knowing green and protecting the green" (student-athletes shared photos or videos of what they planted in their gardens), and other practice activities for moral education. Through these activities, teachers guided the students to care about their family, their country and the world, while learning to be grateful and responsible.

Furthermore, due to time and equipment limitations during regular school hours, students had few opportunities to share their work. The teachers utilized the display function of the online platform (School's WeChat official public platform) to carry out subject competition display activities. Some of these activities organized by the teachers included handwritten newspaper displays, speaking or Oral English competition in front of the camera, and hard pen calligraphy competition, according to the different characteristics of a given subject. The opportunities presented to each student aimed to allow them to fully exercise their diverse abilities.

3.4.4 Control of the Teaching Outcomes

To ensure the effectiveness of online learning, the teaching outcomes were timely monitored, feedback on the students' learning status was provided in time, and necessary adjustments were made. The teacher evaluated and gave feedback to the students according to the students' participation in lectures, homework completion, and discussions. In response to problems in learning attitude, teachers communicated with the relevant department leaders and coaches, and received strong support from the leaders. The effect of this joint education by coaches and teachers was immediate.

Each department counted the number of teaching plans and evaluated them once a week on an important basis for teacher performance evaluation (see Supplementary Material 5 for details). Based on the evaluation of the Faculty of Education, the Teaching Department evaluated the teachers' distance teaching work based on the quality of the teaching plans (including coursework), resources, and platform usage. Recommend outstanding cases were shared with all the teachers.

Teachers provided face-to-face feedback to the parents on the students' learning process and the deficiencies in the learning process, as well as the areas where parents need to cooperate with them, during online parent-teacher meetings through the "Live Streaming Cloud" or "Tencent Meeting". The meetings helped achieve good parent-teacher communication. To understand the effect of the online classroom and obtain reasonable suggestions from parents, a questionnaire survey was completed by the parents. A few of the questions this questionnaire survey covered were related to the students' study time, homework methods, amount of work, and activity development. The questionnaire showed the parents' satisfaction to have reached 98.2%.

3.5 Statistical Analysis

Analyses were performed with SPSSAU and Microsoft Excel. Distribution normality was assessed using the Kolmogorov-Smirnov test. Normally distributed data were analyzed with a *t*-test, while non-normally distributed data were analyzed with a rank-sum test.

TABLE 2 | Normality test of data.

Variable	Group	N	Normality		Extreme difference			Kolmogorov–Smirnov Z	Sig.
			Mean	SD	Absolute	Plus	Minus		
Individual Performance	Before	171	3.883	0.844	0.157	0.093	−0.157	0.157	*0.000*
	After	213	4.186	0.738	0.161	0.135	−0.161	0.161	*0.000*
Team Performance	Before	171	3.877	0.937	0.125	0.115	−0.125	0.125	*0.000*
	After	213	4.357	0.804	0.248	0.212	−0.248	0.248	*0.000*

N, number of samples; SD, standard deviation.

TABLE 3 | Testing of significant differences.

Variable	Group	N	Mean ranks	Sum of ranks	Mann-whitney U	Wilcoxon W	Z	Sig.
Individual Performance	Before	171	170.82	29,209.50	14,503.500	29,209.500	−3.482	*0.000*
	After	213	209.91	44,710.50				
Team Performance	Before	171	158.73	27,142.50	12,436.500	27,142.500	−5.492	*0.000*
	After	213	219.61	46,777.50				

N, number of samples.

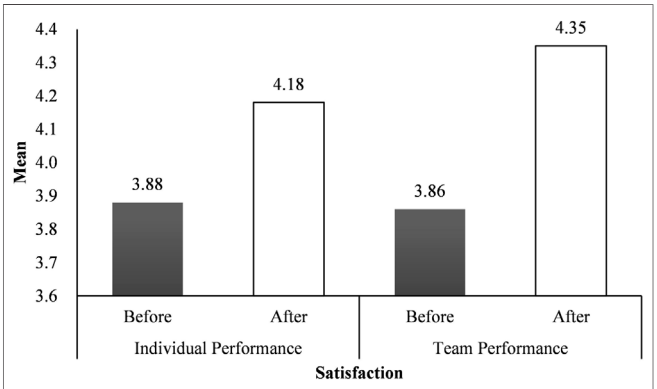

FIGURE 1 | Satisfaction comparison chart of individual performance and team performance.

4 RESULTS

4.1 Normality Test

We conducted a Kolmogorov–Smirnov normality test as the sample size was greater than 50 (Lilliefors, 1967; Drezner et al., 2010). Specifically, for all the data collected before and after the COVID-19 lockdown, the results were significant ($p < 0.05$), suggesting that the data were not normally distributed (**Table 2**).

4.2 Average Value Difference Examination

4.2.1 Difference Examination

Since the samples did not conform to a normal distribution, the rank-sum test was used to verify the differences. The Mann-Whitney U test was thus employed to verify the differences collected before and after the lockdown. As **Table 3** shown, the results indicated that the students' satisfaction on individual performance before the COVID-19 lockdown was significantly different from that after the COVID-19 lockdown (Z = -3.482, $p < 0.001$). Athletes' satisfaction with team performance also had the same characteristics (Z = -5.492, $p < 0.001$).

Next, we compared the differences between the two groups. As **Figure 1** shown, the mean value of individual performance after the COVID-19 lockdown was higher than that before (4.18 > 3.88). Thus, the COVID-19 lockdown was beneficial for the athlete's individual performance. The mean value of team performance after the COVID-19 lockdown was also higher than that before (4.35 > 3.86). Thus, the COVID-19 lockdown was beneficial for the athlete's team performance.

4.4.2 Analysis by Age

We next compared and analyzed the data of the two dimensions of satisfaction before and after the COVID-19 lockdown according to age (see **Figures 2**, **3**). As shown by the figures, in the 13-, 14-, 15-, 16-, 17-, and 19 year-old groups, the values of individual performance satisfaction significantly increased after the lockdown. The post-lockdown and pre-lockdown data were 14 years old (4.36 > 3.87), 15 years old (4.05 > 3.59), 16 years old (4.18 > 3.78), 17 years old (3.91 > 3.73), and 19 years old (4.30 > 3.82). As for team performance, the satisfaction increased after the lockdown in the 13-, 15-, 16-, and 17 year-old groups. The post-lockdown and pre-lockdown data were 13 years old (4.37 > 4.21), 15 years old (4.40 > 3.80), 16 years old (4.75 > 3.45), and 17 years old (4.01 > 3.05). However, the figures for 14- and 19 year-olds did not improve significantly. The post-lockdown and pre lockdown data were 14 years old (4.18 < 4.23), and 19 years old (4.02 < 4.07).

4.4.3 Geographical Analysis

We used SPSSAU to analyze the correlation between the two sets of data. As shown in **Table 4**, we used correlation analysis to study the correlation between Individual Performance and Team

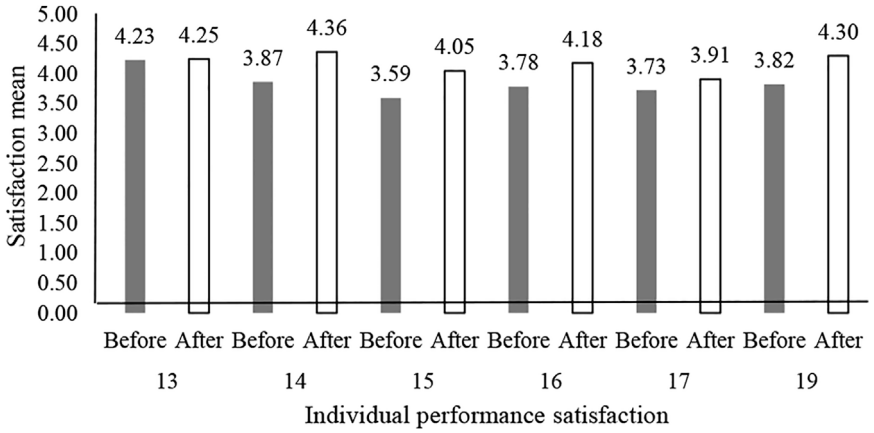

FIGURE 2 | Satisfaction of individual performance chart by age.

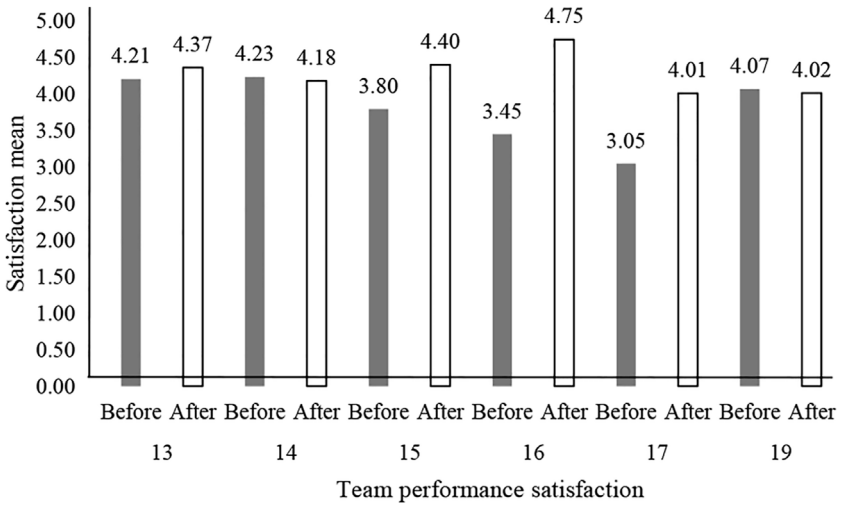

FIGURE 3 | Satisfaction of team performance chart by age.

TABLE 4 | Analysis of the correlation between student satisfaction and regions.

Variable	Mean	SD	Individual performance	Team performance	Regions
Individual Performance	4.100	0.374	1		
Team Performance	4.347	0.567	0.485*	1	
home regions	0.568	0.439	-0.186	-0.081	1

* $p < 0.05$.

Performance, Regions and used the Pearson correlation coefficient to express the correlation. Specific analysis showed that: the correlation coefficient between Individual Performance and Team Performance was 0.485, and it showed a significance of 0.05 level, which showed that there was a significant positive correlation between Individual Performance and Team Performance. The correlation coefficient value between Individual Performance and Regions was -0.186, which was close to 0, and the *p*-value was 0.431 > 0.05, which showed that there was no correlation between Individual Performance and Regions.

As shown in **Figure 4**, we compared the average scores of individual performance satisfaction in each of the students' home regions, while also looking at the extent to which these regions

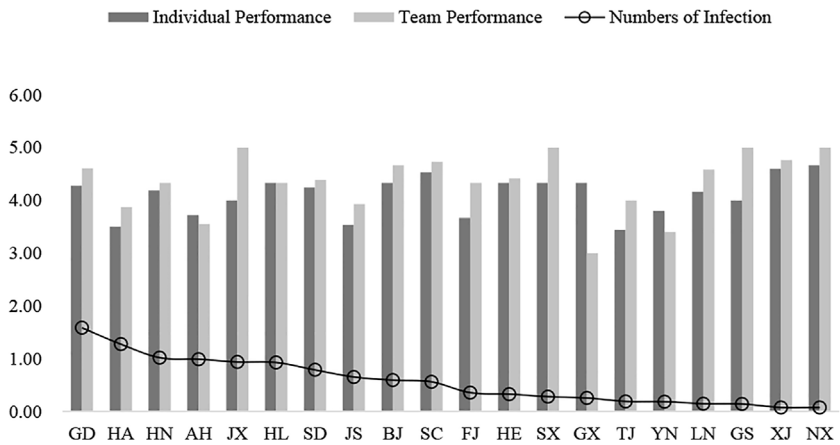

FIGURE 4 | Satisfaction and the number of confirmed COVID-19 infections in each province.
English abbreviations of Chinese provinces: Ningxia NX, Xinjiang XJ, Gansu GS, Liaoning LN, Yunnan YN, Tianjin TJ, Guangxi GX, Shanxi SX, Hebei HE, Fujian FJ, Sichuan SC, Beijing BJ, Jiangsu JS, Shandong SD, Heilongjiang HL, Jiangxi JX, Anhui AN, Hunan HN, Henan HA, Guangdong GD.

were affected by the COVID-19 pandemic, and found no relationship. Similarly, satisfaction with team performance and the spread of the pandemic per region were not found to be related. Therefore, neither of the two dimensions of satisfaction, individual performance and team performance, related to the geographical distribution of the pandemic.

4.4.4 Results of the Online Teaching and Training Program

At present, the teachers of the school are 100% proficient at using the live broadcast cloud application technology. As of May 14, 2020, Shandong Luneng Taishan Football School had conducted more than 3,000 live courses, providing more than 150,000 min of live broadcasting for more than 300 students. In addition to the improvement of factors such as student satisfaction, we were able to extract some recommendations to guide future practice.

Previously, in regular teaching, there used to be only one teacher per class. Online teaching was conducted in grades, which greatly saves the time spent by teachers in preparing for and attending classes. Especially when there were two teachers in two parallel classes, the lecture plan was discussed and formulated, and the teaching was implemented in turn. The teachers listened to and learned from each other.

The teachers were initially troubled with the tracking of homework via online teaching. As the teachers explored the functions of various applications, they were able to exchange solutions to problems and learn from each other. The difficulties were, thus, solved.

Due to the effective use of smart classroom functions, it was found that in addition to teaching, smart classrooms can also be used for video-assisted training. Smart classrooms serve both online courses and online training, increasing the value of equipment input and output.

In the past, it was difficult for the teachers and teams to go out to participate in competitions and learning activities. In particular, a teacher was responsible for the guidance of seven or eight subjects. In the future, with the help of online teaching, the learning organization and learning effect during competition outings and training sessions could be easily solved, thereby ensuring the achievement of the two goals of learning and training.

The school held a meeting with the parents online. In particular, the school had a large number of students, of whom more than half come from other provinces, which caused great trouble for the in-person parent-teacher meetings. The live broadcast method too was unstable at times, and not always conducive to the interaction between teachers and parents; nevertheless, the successful practice of such online parent-teacher meetings would effectively solve the problem of parents not being able to participate in the meetings because of their residing far away from school, and laid the foundation for the regular holding of online parent-teacher meetings in the future.

Combining the results of the empirical analysis and the practical results of this project, the hypothesis of this research has been verified. In other words: during the period of the epidemic, online teaching under meticulous promotion increased the satisfaction of students.

5 DISCUSSION

The purpose of this study was to test whether the satisfaction of students had changed after the COVID-19 lockdown compared to that before the lockdown. The research results showed that the two dimensions of athlete satisfaction (satisfaction with individual performance and satisfaction with team performance) improved significantly after the lockdown. The results also showed that the satisfaction with individual performance improved for all age groups except 13-year-olds. As for satisfaction with team performance, it improved significantly among 13-, 15-, 16-, and 17-year-old student-athletes,

and declined significantly among 14- and 19-year-olds, after the lockdown. The study also showed that satisfaction before and after the lockdown was not significantly related to the home region of the student-athletes and the spread of the COVID-19 pandemic in each region.

Because of the differences in research objects and research content, our conclusions are not the same as those of Di Crosta et al. (2021) and Cannito et al. (2021) on consumer behavior. We have also not done research on the impact of expectations on the future life. But our research has similarities. We have all discovered the impact of COVID-19 on the behavior or cognition of the research subjects, which may involve the past, present and future (Ceccato et al., 2021). In addition, similar to the findings of (Ceccato et al., 2021) and Rosi et al. (2021) on the elderly, in the study of different populations, we found that during the COVID-19 lockdown period, the satisfaction of students improved. One possibility for this improvement may be that some students were more satisfied because they underestimated the risk of COVID-19 (perhaps because they belong to the least vulnerable age group). Or it may be because they saved money by staying at home and believed that the lockdown was a special school holiday. For the deep-seated reasons for this improvement, the following discussion may be able to answer.

After the lockdown, many of the schools in China and worldwide had to implement online teaching. Shandong Luneng Taishan Football School decided to base their online teaching on the Plan, Execution, Check, and Processing (PDCA) cycle originally proposed by Dr. Hugh Hart, an American quality management expert (Tague, 2005; pp. 390–392). It was later adopted and publicized by Deming and gained popularity; thus, it is also called the Deming cycle (Mauléon and Bergman, 2009). The purpose of the PDCA cycle is to divide quality management into four stages, namely Plan (Plan), Execution (Do), Check (Check), and Processing (Act) (Tague, 2005; pp. 390–392). In quality management activities, it is required to make plans, implement plans, check the implementation results according to various tasks, and then incorporate successful tasks into the standard operating procedure, leaving the unsuccessfully implemented tasks to be resolved in the next cycle (Moen and Norman, 2006). Based on this approach, a "large cycle" (3 months) and 12 "small cycles" (12 weeks) of online teaching were completed.

Our assumption that the improvement in student satisfaction was, to an extent, driven by the change in teaching methods, cannot be empirically proved as upon implementing the online teaching program the school did not expect it to be the subject of research (Beijing Jiaotong University and Shandong Luneng Taishan Football School). Nevertheless, our findings are consistent with previous research confirming the benefits of online teaching in relation to student outcomes. The change in overall satisfaction before and after the pandemic in this study could be attributed to the teaching methods.

Social presence was previously found to have a positive effect on online learning satisfaction, which means that students tend to be most satisfied when their social status in online learning is high (Horzum, 2017). According to this research, we can assume that in online live classrooms, student-athletes are in a relatively equal position when compared to their teachers and coaches. We can also anticipate that learning knowledge with a relatively equal social status may increase the satisfaction of young student-athletes.

Online teaching was also found to adhere better to both student autonomy and interactivity. Although our research found that the degree of satisfaction improvement was slightly different according to age, it may have been impacted by the fact that a 28-person team did not fill in the first questionnaire because of their being engaged with participating in a competition.

Nevertheless, the overall trend was that of satisfaction improvement, which warrants consideration of the fact that online education is different from traditional teaching, and that online teaching can contribute more effectively to building the learning autonomy and interactivity of students (Peng et al., 2005). The online live teaching implemented in this study was an indirect "person-computer-person" interaction; this is different from the direct interaction process between teachers and students in traditional teaching as it forces the students to learn independently. Online learning resources for students included text, images, animation, audio, video, and other information carriers, each of which can stimulate students' learning interest and exploration spirit, especially when the students are adolescents (Peng et al., 2005). In addition, in the actual online teaching practice, the interaction between students and teachers, the interaction among the students, and the interaction between students and teaching materials have all been previously found to be related to satisfaction with online learning (Gray and DiLoreto, 2016; Xu et al., 2017; Bervell et al., 2019; Zhang and Lin, 2020).

The study also found no differences in satisfaction between students belonging to different regions. Research has found that online live broadcast teaching is not geographically restricted, and can integrate existing teachers, teaching materials, and equipment to improve resource utilization efficiency, achieve resource sharing, and eliminate the impact of regional differences (Peng et al., 2005); this is consistent with our findings.

Although online live education, at least partially, achieved the results of improving student satisfaction, we must clearly understand that the premise behind this study's investigation of online live education was that teachers, coaches, and young student-athletes already had a long-term foundation of traditional education. Traditional education is multi-faceted and includes emotional exchange between teachers and students, the friendly relationship between students, and the environment and atmosphere during the growth process. Online live teaching can truly simulate all these aspects of traditional education, but it cannot completely replace these (Peng et al., 2005). In this sense, online live teaching will not replace traditional school education. Therefore, online live teaching and traditional education are most beneficial when they coexist in a complementary relationship (Peng et al., 2005).

The above analysis may merely serve as guidance for practical experience, and practical research will probably reveal many differences. The most important test of distance learning is the

conscious self-discipline of the students. As some parents have already returned to work, children's learning is often unsupervised during the day, and in some families, parent-child communication may be poor. Therefore, distance learning mainly poses three major problems. The first problem is that of student self-discipline (self-disciplined children learn better than non-disciplined children). Second, the interactivity that can be achieved in distance teaching is not as high as what can be achieved in offline teaching, and some students' understanding and acceptance of knowledge need to be strengthened. Third, although the teachers organize check-ins from time to time during class, it is difficult to monitor whether students are playing games during the class. This quality problem cannot be solved by technology.

In response to the above problems, the following approaches could be implemented. We can strengthen the guidance education of students' self-discipline awareness with the cooperation of coaches. Moreover, teachers can slow down the pace of teaching, repeat and consolidate key knowledge, and cover only one subject per lesson. With the consent of the parents and students, teachers may try to use two learning tools-one for listening and the other for monitoring the learning process at the same time to supervise the individual students who are inactive or cannot be supervised by the parents.

It cannot be said for certain that the change in satisfaction was due to the change in teaching methods because the environment is also an important factor. School effectiveness research has always shown that the quality of the learning environment is the most important policy factor for achieving positive student outcomes and learning efficiency (Organisation for Economic Co-operation and Development, 2009). During the lockdown, the students' learning environment had to be converted to their family homes. However, the students were still interacting with the same group of students, so it can be inferred that changes in teaching methods may be the main factor that brought about changes in satisfaction.

The Shandong Luneng Taishan Football School did not expect their methods to be a part of scientific research, and therefore, the effectiveness of the method could not be tested empirically, which is a limitation of this study. The lockdown period of 3 months forced us to choose the method of online live education. The future development and use of advanced internet technologies such as 5G will provide traditional education with even more opportunities for development. We can expect that the combination of online live broadcast teaching and traditional education can form a perfect network-based teaching system. This new network-teaching model can adopt the advantages of both online and traditional teaching while discarding their respective shortcomings. Therefore, we assume that, to a certain extent, the online teaching and training done by the school was effective. We also hope that our research and practice can provide a reference for other schools during the lockdown period.

6 CONCLUSION

Without the lockdown associated with the COVID-19 pandemic, such teaching and training management methods may not have been implemented for more than 300 students over a long period. However, in the face of the lockdown, remote teaching and training methods had to be adopted. The data we obtained through the authoritative scale showed that the satisfaction of students improved significantly after the lockdown. Furthermore, the results showed that while there were significant differences in the improvement rate among various age groups, there was no correlation with the students' geographical home region. Through a thorough analysis of the online teaching methods, we further outlined aspects in which the change from traditional teaching to online teaching may have affected the increase in student satisfaction. The present results show that in the face of lockdowns caused by sudden emergencies, schools and other organizations can achieve the results of improving the satisfaction of students and parents through strict organizational and process control. To evaluate the improvement of academic or athletic performance, further follow-up research is needed.

DATA AVAILABILITY STATEMENT

The studies involving human participants were reviewed and approved by Beijing Jiaotong University (JG201905017). The participants and, where necessary, the participants' legal guardian/next of kin provided written informed consent to participate in this data are available upon request.

AUTHOR CONTRIBUTIONS

JL designed the research and completed the manuscript, SL and JH designed the research with Juan Li and proposed the discussion, CZ completed the data collection, and PL completed most of the data analysis.

FUNDING

The first author's research received funding support from the Fundamental Research Funds for the Central Universities 2021YJS052.

REFERENCES

Adjust (2020). 7 Tips on Adjusting to Work from home. Available at: https://www.adjust.com/blog/adjust-working-from-home-tips/ (Accessed March 25, 2020).

Aoyagi, M. W., Cox, R. H., and McGuire, R. T. (2008). Organizational Citizenship Behavior in Sport: Relationships with Leadership, Team Cohesion, and Athlete Satisfaction. *J. Appl. Sport Psychol.* 20 (1), 25–41. doi:10.1080/10413200701784858

Bebetsos, E., and Theodorakis, N. (2003). Athletes' Satisfaction Among Team Handball Players in Greece. *Percept Mot. Skills* 97 (3_Suppl. l), 1203–1208. doi:10.2466/pms.2003.97.3f.1203

Bervell, B., Umar, I. N., and Kamilin, M. H. (2019). Towards a Model for Online Learning Satisfaction (MOLS): Re-considering Non-linear Relationships Among Personal Innovativeness and Modes of Online Interaction. *Open Learn. J. Open, Distance e-Learning* 35, 236–259. doi:10.1080/02680513.2019.1662776

British Broadcasting Corporation (2020). Coronavirus: Italy Extends Emergency Measures Nationwide. Available at: https://www.bbc.co.uk/news/world-europe-51810673 (Accessed March 10, 2020).

Burns, G. N., Jasinski, D., Dunn, S. C., and Fletcher, D. (2012). Athlete Identity and Athlete Satisfaction: The Nonconformity of Exclusivity. *Personal. Individual Differences* 52 (3), 280–284. doi:10.1016/j.paid.2011.10.020

Cannito, L., Anzani, S., Bortolotti, A., Palumbo, R., Ceccato, I., Di Crosta, A., et al. (2021). Temporal Discounting of Money and Face Masks during the COVID-19 Pandemic: The Role of Hoarding Level. *Front. Psychol.* 12, 642102. doi:10.3389/fpsyg.2021.642102

Ceccato, I., Palumbo, R., Di Crosta, A., La Malva, P., Marchetti, D., Maiella, R., et al. (2021). Age-related Differences in the Perception of COVID-19 Emergency during the Italian Outbreak. *Aging Ment. Health* 25 (7), 1305–1313. doi:10.1080/13607863.2020.1856781

Ceccato, I., Palumbo, R., Di Crosta, A., Marchetti, D., La Malva, P., Maiella, R., et al. (2021). "What's Next?" Individual Differences in Expected Repercussions of the COVID-19 Pandemic. *Personal. Individual Differences* 174, 110674. doi:10.1016/j.paid.2021.110674

Chang, J., Yuan, Y., and Wang, D. (2020). Analysis of Mental Health Status and Influencing Factors of College Students under the New Coronavirus Pneumonia Epidemic. *J. South. Med. Univ. (Nan Fang Yi Ke Da Xue Xue Bao)* 40 (2), 171.

Chen, L. H., Kee, Y. H., and Chen, M.-Y. (2015). Why Grateful Adolescent Athletes Are More Satisfied with Their Life: The Mediating Role of Perceived Team Cohesion. *Soc. Indic. Res.* 124 (2), 463–476. doi:10.1007/s11205-014-0798-0

Chen, X., Yang, C., Bao, Q., Zhu, K., Wang, H., Jiang, Q., et al. (2020). Analysis of the Impact of the New Coronary Pneumonia Epidemic on the Chinese Economy and Countermeasures. *Bull. Chin. Acad. Sci.* 35, 1–5.

Craig, R. T. (1999). Communication Theory as a Field. *Commun. Theor.* 9 (2), 119–161. doi:10.1111/j.1468-2885.1999.tb00355.x

Cunningham, G. B., and Dixon, M. A. (2003). New Perspectives Concerning Performance Appraisals of Intercollegiate Coaches. *Quest* 55 (2), 177–192. doi:10.1080/00336297.2003.10491798

Di Crosta, A., Ceccato, I., Marchetti, D., La Malva, P., Maiella, R., Cannito, L., et al. (2021). Psychological Factors and Consumer Behavior during the COVID-19 Pandemic. *PLoS one* 16 (8), e0256095. doi:10.1371/journal.pone.0256095

Drezner, Z., Turel, O., and Zerom, D. (2010). A Modified Kolmogorov-Smirnov Test for Normality. *Commun. Stat. - Simulation Comput.* 39 (4), 693–704. doi:10.1080/03610911003615816

DW News (2020). Coronavirus: What Are the Lockdown Measures across Europe? Available at: https://www.dw.com/en/coronavirus-what-are-the-lockdown-measures-across-europe/a-52905137 (Accessed April 14, 2020).

Eisenberg, E. M. (2010). *Organizational Communication: Balancing Creativity and Constraint*. New York, NY: Saint Martin's.

Gray, J. A., and DiLoreto, M. (2016). The Effects of Student Engagement, Student Satisfaction, and Perceived Learning in Online Learning Environments. *Int. J. Educ. Leadersh. Preparation* 11 (1), n1, 2016 . Available at: https://eric.ed.gov/?id=EJ1103654.

Guttman, O. T., Lazzara, E. H., Keebler, J. R., Webster, K. L. W., Gisick, L. M., and Baker, A. L. (2018). Dissecting Communication Barriers in Healthcare. *J. Patient Saf.* Publish Ahead of Print. 2018 Nov. doi:10.1097/pts.0000000000000541

Horzum, M. B. (2017). Interaction, Structure, Social Presence, and Satisfaction in Online Learning. *Eurasia J. Math. Sci. T* 11 (3), 505–512. doi:10.12973/eurasia.2014.1324a

Karreman, E., Dorsch, K., and Riemer, H. (2009). Athlete Satisfaction and Leadership: Assessing Group-Level Effects. *Small Group Res.* 40 (6), 720–737. doi:10.1177/1046496409346450

Lau, H., Khosrawipour, V., Kocbach, P., Mikolajczyk, A., Schubert, J., Bania, J., et al. (2020). The Positive Impact of Lockdown in Wuhan on Containing the COVID-19 Outbreak in China. *J. Trav. Med.* 27 (3), 037. doi:10.1093/jtm/taaa037

Li, J., Gao, H., Liu, P., and Zhong, C. (2020). Does Distance Produce Beauty? the Influence of COVID-19 Lockdown on the Coach-Athlete Relationship in a Chinese Football School. *Front. Psychol.* 11, 560638. doi:10.3389/fpsyg.2020.560638

Lilliefors, H. W. (1967). On the Kolmogorov-Smirnov Test for Normality with Mean and Variance Unknown. *J. Am. Stat. Assoc.* 62 (318), 399–402. doi:10.1080/01621459.1967.10482916

Lunenburg, F. C. (2010). Communication: The Process, Barriers, and Improving Effectiveness. *Schooling* 1 (1), 1–10. Available at: https://www.mcgill.ca/engage/files/engage/communication_lunenburg_2010.pdf.

Mauléon, C., and Bergman, B. (2009). Exploring the Epistemological Origins of Shewhart's and Deming's Theory of Quality. *Int. J. Qual. Serv. Sci.* 1 (2), 160–171. doi:10.1108/17566690910971436

Moen, R., and Norman, C. (2006). *Evolution of the PDCA Cycle*. Asian Network for Quality Conference in Tokyo. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.470.5465&rep=rep1&type=pdf (Accessed Aug 8, 2018).

Norouzinia, R., Aghabarari, M., Shiri, M., Karimi, M., and Samami, E. (2016). Communication Barriers Perceived by Nurses and Patients. *Glob. J. Health Sci.* 8 (6), 65–74. doi:10.5539/gjhs.v8n6p65

Organisation for Economic Co-operation and Development (2009). *Creating Effective Teaching and Learning Environments: First Results from TALIS*. Paris: OECD. Available at: http://www.oecd.org/dataoecd/17/51/43023606.pdf (Accessed July 21, 2009).

Park, E. K., and Song, M. (2005). Communication Barriers Perceived by Older Patients and Nurses. *Int. J. Nurs. Stud.* 42 (2), 159–166. doi:10.1016/j.ijnurstu.2004.06.006

Peng, H., Chen, X., Yang, J., and Zhu, L. (2005). *Complementary Research on the Advantages of Online Education and Traditional Education Teaching Methods [Basic Medical Education Edition]*. Taiyuan, China: Journal of Shanxi Medical University, 45–47. Available at: http://www.cnki.com.cn/Article/CJFDTotal-SXYD200502021.htm.

Prospects (2020). *5 Tips for Studying at home*. Available at: https://www.prospects.ac.uk/applying-for-university/university-life/5-tips-for-studying-at-home (Accessed April, 2020).

Reinboth, M., and Duda, J. L. (2006). Perceived Motivational Climate, Need Satisfaction and Indices of Well-Being in Team Sports: A Longitudinal Perspective. *Psychol. Sport Exerc.* 7 (3), 269–286. doi:10.1016/j.psychsport.2005.06.002

Riemer, H. A., and Chelladurai, P. (1998). Development of the Athlete Satisfaction Questionnaire (ASQ). *J. Sport Exerc. Psychol.* 20 (2), 127–156. doi:10.1123/jsep.20.2.127

Rosi, A., van Vugt, F. T., Lecce, S., Ceccato, I., Vallarino, M., Rapisarda, F., et al. (2021). Risk Perception in a Real-World Situation (COVID-19): How it Changes from 18 to 87 Years Old. *Front. Psychol.* 12, 646558. doi:10.3389/fpsyg.2021.646558

Science Focus (2020). 10 Science-Backed Tips to Help You Work from home Successfully. Available at: https://www.sciencefocus.com/the-human-body/wfh-sos-how-to-work-from-home-successfully-during-lockdown/ (Accessed April 14, 2020).

Sriboon, N. (2002). *Coach Leadership Behaviors, Team Cohesion, and Athlete Satisfaction in Relation to the Performance of Athletes in the 1999 Rajabhat Games*. Tallahassee, United States: Doctoral dissertation, Florida State University. Available at: https://elibrary.ru/item.asp?id=5344902.

Tague, N. R. (20051995). "Plan–Do–Study–Act Cycle," in *The Quality Toolbox*. 2nd ed. (Milwaukee: ASQ Quality Press), 390–392.

World Health Organization (2021). Weekly Epidemiological Update on COVID-19 - 26 October 2021. Available at: https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19—26-october-2021 (Accessed November 2, 2021).

Xu, X., Zhao, W., and Liu, H. (2017). Factors Influencing College Students' Satisfaction in Online Learning. *Distance Edu. China* 5 (5). Available at: Available at: http://www.cnki.com.cn/Article/CJFDTotal-DDJY201705005.htm.

Yang, S. (2019). Revision of Athletes' Organizational Citizenship Behavior Scale Based on Item Response Theory and its Mediating Role in Cohesion and Satisfaction. *J. Shenyang Inst. P. E.* 38 (2), 52–57. Available at: http://xb.syty.edu.cn/CN/abstract/abstract8961.shtml.

Zhang, Y., and Lin, C.-H. (2020). Student Interaction and the Role of the Teacher in a State Virtual High School: what Predicts Online Learning Satisfaction? *Technol. Pedagogy Edu.* 29 (1), 57–71. doi:10.1080/1475939X.2019.1694061

Zhao, N., Wang, Y., Li, S., Liu, X., Wu, P., and Zhu, T. (2020). Wuhan's "closing the City" on People's Psychological Behavior and Countermeasures. *Proc. Chin. Acad. Sci.* 35 (3), 264–272.

Zhu, L., Chen, M., Zhang, T., Zhang, T., Jiang, C., and Gao, D. (2020). Research on the Status and Influencing Factors of Sleep and Emotion during the Outbreak of New Coronary Pneumonia. *J. Stroke Nervous Dis.* 37 (3), 196–200.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

frontiers in Psychology

ORIGINAL RESEARCH
published: 16 March 2022
doi: 10.3389/fpsyg.2022.779217

The Influence of Teacher–Student Interaction on the Effects of Online Learning: Based on a Serial Mediating Model

Hai-Long Sun, Ting Sun, Feng-Yi Sha, Xiao-Yu Gu, Xin-Ru Hou, Fei-Yan Zhu and Pei-Tao Fang*

School of Business, Guangdong University of Foreign Studies, Guangzhou, China

During the COVID-19 pandemic, online education has become an important approach to learning in the information era and an important research topic in the field of educational technology as well as that of education in general. Teacher–student interaction in online education is an important factor affecting students' learning performance. This study employed a questionnaire survey to explore the influence of teacher–student interaction on learning effects in online education as well as the mediating role of psychological atmosphere and learning engagement. The study involved 398 college students studying at Chinese universities as the research object. Participants filled out a self-report questionnaire. The study found that (1) the level of teacher–student interaction positively affected students' learning effects ($r = 0.649$, $p < 0.01$). (2) The psychological atmosphere mediated the positive effect of the level of teacher–student interaction on learning effects with mediating effect value of 0.1248. (3) Learning engagement mediated the positive effect of teacher–student interaction on learning effects with a mediating effect value of 0.1539. (4) The psychological atmosphere and learning engagement play a chain-mediating role in the mechanism of teacher–student interaction affecting students' learning effects; that is, teacher–student interaction promotes students' learning engagement by creating a good psychological atmosphere, which, in turn, influences learning effects. The mediating effect value was 0.0403. The results indicate that teacher–student interaction not only directly affects students' learning effects but also influences students' learning effects through the mediating effect of the psychological atmosphere and learning engagement.

Keywords: online education, teacher–student interaction, learning engagement, learning effect, chain-mediating effect

OPEN ACCESS

Edited by:
Ariel Mariah Lindorff, University of Oxford, United Kingdom

Reviewed by:
Araz Ramazan Ahmad, University of Raparin, Iraq
Xun Yan, University of Illinois at Urbana-Champaign, United States

****Correspondence:***
Hai-Long Sun
shl428@163.com

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Psychology

Received: *18 September 2021*
Accepted: *14 February 2022*
Published: *16 March 2022*

Citation:
Sun H-L, Sun T, Sha F-Y, Gu X-Y, Hou X-R, Zhu F-Y and Fang P-T (2022) The Influence of Teacher–Student Interaction on the Effects of Online Learning: Based on a Serial Mediating Model. Front. Psychol. 13:779217. doi: 10.3389/fpsyg.2022.779217

INTRODUCTION

The global spread of COVID-19 has resulted in the suspension of classes for more than 850 million students worldwide, disrupting schools' original teaching plans in these countries and regions (Chen et al., 2020). Meanwhile, the update and development of network information technology has accelerated the digitalization process of traditional education, promoted the

deep integration of subject courses and information technology, and promoted the practice and exploration of online education (Paudel, 2021). Many countries began offering online teaching to students *via* platforms, such as Zoom, Skype, and FaceTime. Today, online education has become a common form of learning that is affected by COVID-19. Based on the current situation of global epidemic prevention and control, online education is expected to be a long-standing teaching method (Moore et al., 2010; Chen et al., 2020).

In addition, past studies have primarily focused on traditional classroom contexts and merely extended the characteristics and regularity findings of traditional classrooms to online classroom studies. However, whether their findings can be applied to higher education in general or even higher education in online classrooms needs to be explored in depth. For instance, Carter and Rukholm (2008) speculated that, compared to traditional education, teacher–student interaction in online education is an important factor influencing students' learning effects. How, then, do teachers and students interact effectively in online education in the era of COVID-19? How can learning effects be improved through teacher–student interaction? This is an important scientific and practical problem that must be solved urgently in online education. Based on this need, this study constructs a chain mediation model to explore the influence of teacher–student interaction on learning effects in online classrooms and determine what mediating factors of teacher–student interaction impact learning effects. Moreover, it provides a theoretical basis for relevant research and online teaching practice and has academic research and practical value.

THEORETICAL REVIEW AND RESEARCH HYPOTHESIS

In teaching, teacher–student interaction behaviors, which refer to the process of interaction between teachers and students during classroom teaching through a variety of situations, forms, and contents, are diverse, giving full play to the parties' personal characteristics (Van de Pol et al., 2010). From the perspective of interaction theory, Zhou (2003) defined teacher–student interaction behaviors it as a multiform, multi-content, and multi-latitude interaction process between teachers and students in a common situation. Accordingly, the essence of teacher–student interaction is a system of interaction that is multiform and multi-content. Based on the concept of teacher–student interaction, we think that teacher–student interaction in online education refers to the process that contributes to teaching and learning in the context of online teaching, in which teachers and students play their roles and use Internet tools.

The Level of Teacher–Student Interaction Affects Students' Learning Effect

The level of teacher–student interaction improves students' learning effects on two levels: interactive form and interactive content. In the form of teacher–student interaction, Moore (1989) proposed that online learning interaction includes three types of interactions: "learners and learning content," "learners and teachers," and "learners and learners." On this basis, Li et al. (2020) further clarified that "Internet + teaching" is the "information interaction between teachers and students and teaching elements" in a specific environment, reflecting the change from one-way to multi-directional interaction. They also pointed out that the level of interaction is positive. This level is reflected in the quality of classroom questions. Studies have shown that the proportion of high-level questions that can bring better learning effects to classroom questions has increased significantly (Graesser and Olde, 2003).

At the level of teacher–student interactive content, multiple indicators, such as knowledge acquisition, ability training, emotional edification, and value establishment, constitute an interactive content system. Yang (2002) noted that effective learning activities are one of the basic conditions for learning to occur. Through the design and implementation of effective learning activities, an active learning process will occur, and better learning results will be achieved. Furthermore, some researchers have pointed out that effective teacher–student interaction is a necessary condition for deep learning in the context of online education (Mu and Wang, 2019); it is the strongest factor in the online learning experience (Jiang et al., 2019), and it is people who play a decisive role in the interaction between teachers and students. The effect of various interactive strategies in distance education is based on the joint efforts of teachers and students (Liu, 2006). As a result, this research proposes Hypothesis 1:

> *H1: The level of teacher–student interaction is positively correlated with learning effects in online education.*

The Mediating Role of Psychological Atmosphere

Social interaction theory refers to the process by which individuals take social actions toward others and each other and engage in reactive social actions; it emphasizes interactive behaviors that take place in specific contexts that have an impact on the psychology and behavior of both parties (Bandura, 1967). Furthermore, the influence of social interaction often needs to be realized through environmental changes (Seabi, 2012). Focusing on the teacher–student interaction perspective, we inferred that the degree of teacher–student interaction in online education *via* a good learning atmosphere improves the level of students' participation in learning (i.e., the degree of learning investment), so as to promote learning effects. According to constructivism, the learner's knowledge is obtained in a certain context with the help of others, using necessary information, as well as through the construction of meaning; the ideal psychological atmosphere should include context, collaboration, conversation, and meaning construction (He, 1997). Class atmosphere is a factor that affects individual achievement goals. The learning environment may focus on mastery,

effort, or performance and ability, which affects the goal positioning of different individuals (Ames and Archer, 1988). Successful teaching is the result of the combined effect of variables, such as teachers, students, content, family, school, society, region, history, and culture (Pham et al., 2012). This research groups the selection of multiple variables into the "psychological atmosphere" as an important mediating variable in the influence mechanism of teacher–student interaction. Good two-way communication between teachers and students can shorten the psychological distance between the two as well as among students and encourage students to form a positive collective atmosphere (Tang and Zhong, 2013). Specific to live teaching courses, a teacher's live streaming investment significantly affects the online psychological atmosphere (Yuan and Qi, 2020).

Furthermore, Zhang et al. (2020) found that a good classroom atmosphere is conducive to improving the teaching effect when studying classroom delivery. The classroom atmosphere affects students' subjective environmental cognition, and students' perception of the learning environment has an important impact on their academic performance (Yu et al., 2013). Combined with the findings of the above research, this research suggests that a good psychological atmosphere can enable students who are not directly supervised and are receiving online education to participate more actively in interaction with teachers and insert themselves into class learning, which helps students quickly enter a learning state in the classroom, and ultimately achieve a high-level learning effect. Therefore, Hypothesis 2 is further proposed:

H2: The psychological atmosphere has a mediating effect between teacher–student interaction level and learning effects in online education.

The Mediating Role of Learning Engagement

Wilson (2006) summarized the conceptual model of three-dimensional learning engagement: behavior input, learning emotional input, and learning cognitive input. In addition, Shi (2010) suggested two important characteristics of students' learning engagement: the effectiveness of the input and the student's satisfaction with their learning status and school conditions. Effectiveness can be observed through GPA in the short term, and teacher–student interaction affects students' satisfaction with online classrooms. Therefore, we believe that to achieve learning goals, teachers need to play a variety of roles in the classroom. The dialog between teachers and students, student feedback, and teacher evaluation are concrete manifestations of this process (Zhang, 2015). Thus, this study proposes Hypothesis 3:

H3: The level of engagement has a mediating effect between teacher–student interaction level and learning effects in online education.

Combining the previous assumptions, this study considered that the psychological atmosphere and learning engagement may have a chain-mediating effect between teacher–student interaction and learning effect. In other words, teacher–student interaction → psychological atmosphere → learning engagement → learning effect. Research of Allen and Griffeth (2001) shows that multiple mediators exhibit sequential effects that form a chain of mediators, which is referred to as the chain-mediating model. Therefore, Hypothesis 4 is proposed as follows:

H4: Psychological atmosphere and learning engagement have a chain-mediating effect between teacher–student interaction and learning effects in online education.

Based on the above analysis, a hypothetical model is proposed (see **Figure 1**).

MATERIALS AND METHODS

Participants

In this study, a random sample of students of different grades, majors, places of origin, and types of schools who had participated in online education at the undergraduate level or above was included as participants. The investigated sample was recruited online *via* Wenjuanxing,[1] an online platform similar to Mechanical Turk or Qualtrics, which is used to launch nationwide e-surveys in China and is widely employed in behavioral and psychological studies. Participants gave their informed consent after being provided with information explicitly stating the research purpose as well as the nature and procedure of the study. A total of 508 questionnaires were returned. As the quality of online questionnaires is difficult to guarantee, some cases chose the same response for the entire questionnaire. Questionnaires with more than three standard deviations were excluded. An effective total of 398 participants was obtained (180 males, 218 females; **Table 1**). When the target population increases, researchers must gradually increase the sample size. Existing studies suggest that when the target population reaches 5,000 or above, the sample size can be increased to approximately 350–500, which indicates that our sample size of 398 is sufficient.

Measurement

Teacher–Student Interaction Scale

The Teacher–Student Interaction Scale was revised according to Xu (2016) and used to measure the level of teacher–student interaction using a 5-point Likert scale. Each item was rated from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating higher teacher–student interaction. The scale includes six dimensions—interaction quantity, interaction form, interaction distance, interaction content, interaction time, and

[1]http://www.wjx.com

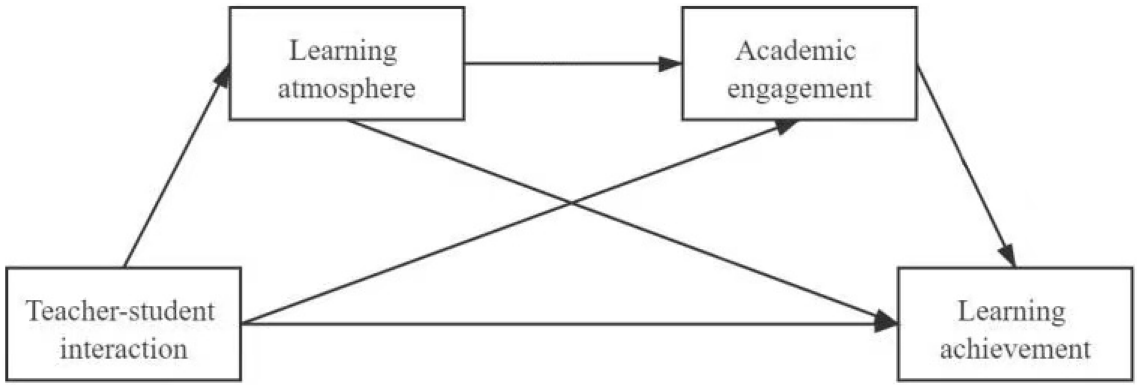

FIGURE 1 | Hypothetical model of the effect of teacher–student interaction on learning effect in online education.

TABLE 1 | Demographic characteristics of the sample.

Variable	Category	Frequency (n)	Percentage
Gender	Male	180	45.2
	Female	218	54.8
Course type	Skill	198	49.7
	Theory	200	50.3
Grade	Freshman	29	7.3
	Sophomore	156	39.2
	Junior	205	51.5
	Senior	8	2.0
University type	"985" university	33	8.3
	"211" university	27	6.8
	Ordinary university	338	84.9

985 universities are universities at the first level on the Chinese mainland. 211 universities refer to better universities in China (100 key universities in the 21st century: 211).

interaction motivation—with a total of six items, such as "In online education, I can speak freely in class." *Cronbach's alpha* was 0.830.

Learning Engagement Scale

The Learning Engagement Scale was revised from the classroom engagement scale developed by Wang et al. (2014) to measure students' engagement in the classroom using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). This scale has three items, including "I can solve problems using multiple solutions in online education." Cronbach's alpha coefficient was 0.785 in this study.

College Student Classroom Psychological Atmosphere Scale

Learning atmosphere was measured using the Psychological Atmosphere Scale developed by Li (2006, unplubished) to measure the atmosphere of college classes. It uses a 5-point Likert scale and consists of five items, each rated from 1 to 5 (1 = strongly disagree, 5 = strongly agree). Higher scores indicate a higher-quality psychological atmosphere. In this study, we used the learning and collaboration dimensions of scale of Li and additionally developed a psychological atmosphere subscale with five questions, taking into account the characteristics of online education, for example, "the teacher is highly concerned with classmates." In this study, Cronbach's alpha coefficient for the Psychological Atmosphere Scale was 0.795.

Learning Effect Scale

The learning evaluation system under the mixed education model was developed by Zhou (2018) for multidimensional dynamic learning evaluation using a five-point Likert scale. This study's learning effect scale adopted the three dimensions of online independent learning, offline collaborative learning, and classroom interactive learning in the "learning evaluation system under mixed education model" and additionally developed a subscale that combined the actual evaluation criteria of university courses, which contains seven keywords: concentration, duration, initiative, cooperation, satisfaction, communication, and application. For example, "I discovered that my interest in learning has improved significantly." Cronbach's α coefficient for the Learning Engagement Scale was 0.910 in this study.

Control Variables

To control for the influence of other factors, we also measured the participants' gender and grade and the types of courses as control variables.

Study Procedure

In this study, data were collected using a time-lag design to avoid common method bias. Specifically, the data collection in this study was divided into three time points with a 1-week interval. Data were collected *via* participants' self-reporting. Materials were prepared in Chinese and presented in a questionnaire form. At the first time point, we collected independent variables (degree of interaction) and control variables; at the second time point, we collected intermediary variables (psychological atmosphere, learning engagement); finally, at the third time point, we collected dependent variables (learning effects in online education).

RESULTS

Compared to other statistical methods (e.g., regression analysis or structural equation modeling), the bootstrap method is suitable for small samples and does not assume a data distribution morphology. Therefore, for the purpose of this study, the bootstrap method proposed by Preacher and Hayes (2004, 2008) was used to examine mediation effects.

In this study, SPSS24.0 and AMOS software were employed to test common method bias as well as the reliability of the analysis results. Additionally, SPSS24.0 was used to perform a descriptive statistical analysis of the variables, including calculating their mean, the standard deviation, the measured reliability coefficient, and the correlation coefficients between the variables. Then, for the unstandardized scale means, we performed the chain mediation effect test using the PROCESS macro test in SPSS 24.0.

Common Method Biases

Based on the completion of the exploratory factor analysis, this study continued the validation factor analysis using the common method bias analysis method: all items of the four variables of psychological atmosphere, interaction level, engagement level, and learning effect were evaluated using exploratory factor analysis. A common method factor was then added, and a one-way validating factor analysis was performed with all the scale items as those involved in the hypothesis testing. The results showed that $\Delta RMSEA = 0.011$, $\Delta SRMR = 0.0147 < 0.05$, $\Delta CFI = 0.035$, and $\Delta TLI = 0.032 < 0.1$. This shows that after the common method factor is added, there is no significant common method deviation, and the model has good discriminative validity.

Correlation Analysis

The descriptive statistics and correlation matrix for each variable are listed in **Table 2**. The results showed that psychological atmosphere, degree of interaction, learning engagement, and learning effect are significantly positively correlated at the 1% level, indicating that further mediation effects can be tested. There was a positive correlation between psychological atmosphere and degree of interaction ($r = 0.606$, $p < 0.01$), learning engagement and learning effects ($r = 0.640$, $p < 0.01$), and degree of interaction and learning effects ($r = 0.649$, $p < 0.01$). Psychological atmosphere and learning engagement ($r = 0.406$, $p < 0.01$), psychological atmosphere and learning effects ($r = 0.566$, $p < 0.01$), and degree of interaction and learning engagement were positively correlated ($r = 0.493$, $p < 0.01$).

TABLE 2 | Correlation coefficient table of research variables.

Variables	*M*	*SD*	1	2	3
1. Psychological atmosphere	3.366	0.658	1		
2. Degree of interaction	3.349	0.641	0.606**	1	
3. Learning engagement	3.456	0.654	0.406**	0.493**	1
4. Learning effects	3.526	0.641	0.566**	0.649**	0.640**

*M (Mean), Arithmetic mean; SD, standard error of the mean. **p < 0.01.*

Analysis of Control Variables

First, we discuss the factors that may influence the findings (grade and course type). Due to the large difference in numbers, we combined the freshman and sophomore numbers as the lower-grade group and the junior and senior grades as the senior group. Independent sample *t*-test results showed that compared to the higher grades (3.38 ± 0.65), the degree of learning engagement in the lower grades (3.51 ± 0.65) was significantly higher [$t(396) = 1.95$, $p = 0.05$]. However, there was no significant difference in the psychological atmosphere, degree of interaction, or learning effects between the higher and lower grades. Similarly, we analyzed the differences between the different types of courses. The results showed that there was no significant difference in the psychological atmosphere, degree of interaction, learning effects, or learning engagement between skill courses and theory courses. In addition, there was no significant correlation between the type of course and the variables (psychological atmosphere, degree of interaction, learning engagement, and learning effects).

Analysis of Chain Mediating Effect

Mediation analyses were performed using the bootstrapping method with bias-corrected confidence estimates for the mediating effect of teacher–student interaction and student learning effects after controlling for gender, grade, and major as covariate variables (Preacher and Hayes, 2004).

First, based on the results in **Table 3**, teacher–student interaction has a significant impact on the learning effect ($\beta = 0.331$, $t = 7.53$, $p < 0.001$). After the mediating variables are included, learning engagement has a significant positive impact on the learning effect ($\beta = 0.390$, $t = 10.47$, $p < 0.01$), and psychological atmosphere not only has a significant positive impact on the learning effect of students ($\beta = 0.201$, $t = 4.97$, $p < 0.001$) but also has a moderately significant impact on learning engagement ($\beta = 0.168$, $t = 3.10$, $p < 0.005$). The level of teacher–student interaction not only positively affects the psychological atmosphere of students ($\beta = 0.623$, $t = 15.01$, $p < 0.001$) and learning engagement ($\beta = 0.402$, $t = 7.18$, $p < 0.001$) but also has a positive effect on learning effects. Significant positive effects were observed ($\beta = 0.331$, $t = 7.53$, $p < 0.001$). Gender, grade, and major as controlled variables all had *p*-values greater than 0.1 (specified $^*p < 0.05$, $^{**}p < 0.01$), indicating that all three had a small effect on all four dimensions, with negligible effects in terms of the chain-mediating effect.

DISCUSSION

This research explores the impact of teacher–student interaction on learning effects in online education as well as the mediating effect of psychological atmosphere and learning engagement. The results show that teacher–student interaction not only

TABLE 3 | Regression analysis of the mediation model.

	Model 1: Learning effect		Model 2: Psychological atmosphere		Model 3: Learning engagement		Model 4: Learning effect	
Variable	***β***	***t***	***β***	***t***	***β***	***t***	***β***	***t***
Gender	0.001	0.01	−0.076	−1.11	−0.065	−0.88	0.046	0.85
Grade	0.033	0.96	−0.003	−0.09	−0.014	−0.35	0.040	1.34
Course	−0.003	−0.19	−0.021	−1.20	0.017	0.91	−0.004	−0.30
Interactive	0.654	16.87	0.623	15.01	0.402	7.18	0.331	7.53
Atmosphere					0.168	3.10	0.201	4.97
Engagement							0.390	10.47
R^2	0.423		0.371		0.266		0.59	
F	72.07		57.85		28.36		92.33	

*β: Regression coefficient; T: The result of the t-test on the regression coefficient. The mediating effect analysis (see **Table 4**) shows that the Bootstrap 95% confidence interval of the mediating effect of psychological atmosphere and learning engagement does not contain 0, indicating that psychological atmosphere and learning engagement are due to teacher–student interaction affecting student learning. Regarding the mediating variable of effect, the total mediating effect value was 0.319. Specifically, the mediating effect of teacher–student interaction on student learning is primarily achieved through the following three paths: (1) indirect effect 1 (0.1248): teacher–student interaction level → psychological atmosphere → student learning effect; (2) indirect effect 2 (0.1539): teacher–student interaction level → learning engagement level → learning effect; and (3) indirect effect 3 (0.0403): teacher–student interaction → psychological atmosphere → learning engagement level → learning effect. Indirect effect 1, indirect effect 2, and indirect effect 3 accounted for 19.20, 23.68, and 6.20% of the total effect, respectively. Indirect effect 2 was more significant than indirect effect 1, and indirect effect 1 was more significant than indirect effect 3, while other differences did not reach a significant level.*

positively influences learning effects but also has a positive impact on learning effects through the mediating effect of psychological atmosphere and learning engagement. In addition, psychological atmosphere and learning engagement have a chain-mediating effect on the influence mechanism of teacher–student interaction that affects learning effects for students. That is, teacher–student interaction promotes students' learning engagement by creating a positive psychological atmosphere, which, in turn, affects the learning effects experienced by students. Therefore, this study concludes that the level of teacher–student interaction not only directly affects learning effects but also influences them through the mediating effect of psychological atmosphere and learning engagement and the chain-mediating effect of psychological atmosphere–learning engagement. Three research implications are drawn as follows: enhancing the level of teacher–student interaction can improve learning effects, enhancing online classroom atmosphere and learning engagement can strengthen student learning effects, and building a new type of teacher–student relationship can better promote student learning effects.

The Level of Teacher–Student Interaction Affects the Learning Effects of Students Engaged in Online Education

Debourgh (2003) believed that teacher–student interaction is an important factor affecting the learning effects of students in online education. Lin et al. (2017) found that the interaction between learners and teachers has a significant positive impact on online learners' learning satisfaction as well as on learning effects. The analysis in this research shows that the level of teacher–student interaction has a positive impact on learning engagement and psychological atmosphere. Therefore, this further demonstrates that the level of teacher–student interaction will affect the learning effects of students in online education from another perspective, which is consistent with existing research. However, the previous analysis shows that the level of teacher–student interaction has different degrees of influence on different mediators, in which teacher–student interaction has a greater impact on the academic atmosphere and students' learning engagement as a whole, followed by learning effects. Teacher–student interaction has a significant positive effect on the above three mediators. Existing research shows that interaction in online learning is closely related to learners' learning experience, learning engagement, learning satisfaction, and learning effects. For example, Zhang et al. (2017) found that in online learning, the multi-level interaction between students, teachers, and among students is beneficial for improving students' learning effects. Therefore, how to improve the interaction level between teachers and students in online education to facilitate its impact on students' learning effects should receive attention in the field of online education.

The Chain Mediating Effect of Learning Engagement and Psychological Atmosphere

This research further reveals how teacher–student interaction level affects the learning effects of students through the mediators by dividing different dimensions of the mediators of the teacher–student interaction influence mechanism. Although they all have an impact, different mediators have different degrees of influence on students' learning effects. Among them, the level of learning engagement as a mediator has the greatest impact on the learning effects of students, followed by psychological atmosphere. Tang (2018) also began by building teacher–student relationships to enhance students' perceptions of good teacher–student relationships, improve the perceived school atmosphere, and promote students' learning engagement. Our results of study not only expand the previous theoretical research of the teacher–student interaction level–student learning effect and demonstrate the positive influence of the mediators of students' psychological

TABLE 4 | Bootstrap results for the mediation effect.

Mediating path	Indirect effect	Boot standard error	95% confidence interval		Relative mediation effect	Total mediation effect
			Lower limit	Upper limit		
Total indirect effect	0.319	0.0464	0.2311	0.4134	100.00%	49.08%
Indirect effect 1	0.1248	0.0343	0.0622	0.1949	39.12%	19.20%
Indirect effect 2	0.1539	0.0382	0.083	0.2347	48.24%	23.68%
Indirect effect 3	0.0403	0.0186	0.0064	0.0795	12.63%	6.20%

*The above results further support that the psychological atmosphere plays a mediating role between teacher–student interaction level and the effects of online learning, and learning engagement plays a mediating role between teacher–student interaction level and the effects of online learning for students. The level of teacher–student interaction and the effect of students' online learning play a chain-mediating role (see **Figure 2**).*

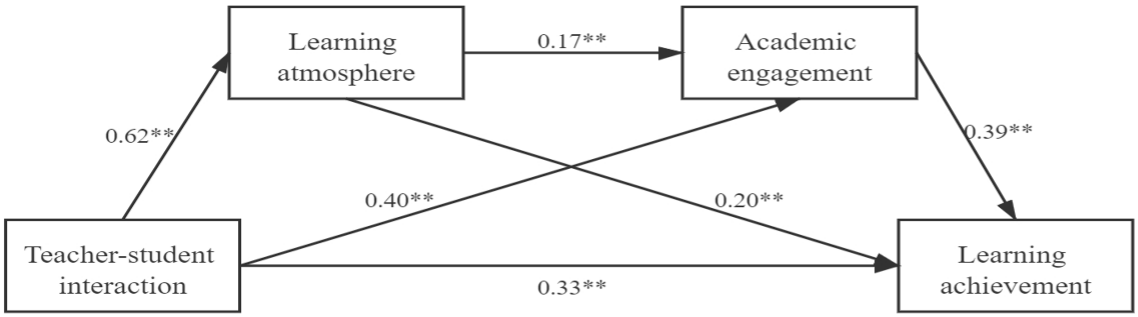

FIGURE 2 | The chain mediation model of the influence of teacher–student interaction level on student learning effects in online education $^{**}p < 0.01$.

atmosphere and learning engagement level but also supplement and perfect the existing research on the influence mechanism of the existing teacher–student interaction level on the students' learning effects. This is of great significance for improving students' learning performance in online education by designing teacher–student interaction in the future.

Practical Implications

Enhancing teacher–student interaction level can improve students' learning effects. Teacher–student interaction plays a positive role in mobilizing the classroom atmosphere, guiding students to form correct learning attitudes, and improving learning effects (Van de Pol et al., 2010). In higher education, teacher–student interaction enhanced. For example, teachers should add more interactive sessions and release classroom learning evaluation results in a timely manner to improve the synchronous interaction between teachers and students, which can help students reflect on their performance in class discussion, improve their learning attitude and methods, and enhance their learning performance.

Research has found that improving the psychological atmosphere and increasing the level of student engagement in online education can help enhance the learning effects of online education. Based on this mechanism, in the online education learning process, the design of teacher–student interaction achieves the purpose of improving students' learning performance and maximizing students' learning effects by improving the psychological atmosphere, thereby increasing students' learning enthusiasm and learning engagement.

In addition, it has been found that spiritual communication and the exchange of ideas between teachers and students are needed to foster harmonious development for both parties so as to achieve better teaching results (Pennings et al., 2018). Teacher–student interaction is also a reflection of the relationship between teachers and students. Teachers and students must communicate emotionally to form spiritual interactions and build a new type of interactive teacher–student relationship. By adopting cooperative teaching, teachers and students can establish a sharing mechanism to better promote the improvement of students' learning effects.

Research Limitations and Prospects

This research provides a theoretical contribution and practical value in regard to research on the influence mechanism of teacher–student interaction level on students' online learning effect. However, has several limitations.

First, in terms of questionnaire design, due to the lack of control questions in the questionnaire, there is no question specifically used to identify whether the respondent answered the questionnaire seriously and truthfully. Therefore, there may be invalid questionnaires and data deviations. In the analysis portion of the questionnaire, there may be objective factors that have not been accounted for, which must be addressed in the future. In terms of research methods, the questionnaire survey method is a sample survey; thus, there may be individual differences in reality.

Second, although this study examines the effects of two types of intermediary variables, learning atmosphere and

learning engagement, on the level of teacher–student interaction and student learning effects, the relationship between the two may also be affected by other factors. Therefore, future research should explore the boundary conditions that impact the effect of teacher–student interaction on students' learning effects.

Third, there may be other factors that influence the results. Although factors, such as gender, grade, and type of course, were measured and treated as control variables in our study, the potential influences of other factors, such as the learner's initial level of competence in the subject studied, cannot be ruled out. Future research should conduct separate analyses for different disciplines.

Fourth, the variety of university courses is rich, and course teaching is often not cohesive. For example, the students involved in this research were taking online education courses, and they will not be studied again before or after the semester of the study period. Therefore, considering the number of research samples and the rich variety of courses, we chose individual self-evaluations to measure learning effects. We believe that third-party evaluation is also a useful indicator for providing more objective data. Therefore, the matching samples can be adopted in future studies, in which teachers can evaluate learning effects or the interaction degree of their students to increase the objectivity and accuracy of the results.

Regarding future research, as people have continually paid attention to interaction, and interactive media with strong interaction capabilities prompts people to seek solutions to problems from a technical level, deep and effective interaction cannot be guaranteed.

With the continuous development of online education, teaching, and learning conditions will continue to change. Therefore, we should identify and pay close attention to these changing conditions over time and further restrict the research scope based on the new conditions. Moreover, future research should divide teacher–student interaction into different dimensions, focus more on the construction of teachers' dialog ability in online education, avoid technicism, focus on inducing deeper learning for higher-level progress, and deeply explore the level of teacher–student interaction in a universal interaction framework. Finally, the specific influencing factors of students' online learning effects should be examined, ineffective or inefficient teacher–student interactions should be explored from multiple perspectives, and feasible countermeasures and suggestions should be identified to improve the quality of teacher–student interaction and the effects of students' online learning to further promote "teaching and learning" and fundamentally improve the quality of online education.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, and further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the ethical standards of institutional review board at Guangdong University of Foreign Studies. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

H-LS and TS: conceptualization, writing— review, and editing. H-LS, TS, and F-YS: methodology. X-RH, F-YZ, and X-YG: formal analysis. H-LS, F-YZ, F-YS, and P-TF: writing—original draft preparation. H-LS: supervision. All authors contributed to the article and approved the submitted version.

FUNDING

This research was partially supported by the National Natural Science of China (No.72101062), Guangdong Basic and Applied Basic Research Foundation (No. 2020A1515110429), Youth Foundation of Social Science and Humanity, China, Ministry of Education (No. 20YJCZH135), Youth Project of Social Science Foundation of Guangdong Province (No. GD19YGL07), and Education reform project of Guangdong University of Foreign Studies (GUDFS (2019), No. 55).

REFERENCES

Allen, D. G., and Griffeth, R. W. (2001). Test of a mediated performance-turnover relationship highlighting the moderating roles of visibility and reward contingency. *J. Appl. Psychol.* 86, 1014–1021. doi: 10.1037/0021-9010.86.5.1014

Ames, C., and Archer, J. (1988). Achievement goals in the classroom: students' learning strategies and motivation processes. *J. Educ. Psychol.* 80, 260–267. doi: 10.1037/0022-0663.80.3.260

Bandura, A. (1967). *Social Learning Theory*. Englewood Cliffs, NJ: Prentice Hall.

Carter, L. M., and Rukholm, E. (2008). A study of critical thinking, teacher-student interaction, and discipline-specific writing in an online educational setting for registered nurses. *J. Contin. Educ. Nurs.* 39, 133–138. doi: 10.3928/00220124-20080301-03

Chen, T., Peng, L., Yin, X., Rong, J., Yang, J., and Cong, G. (2020). Analysis of user satisfaction with online education platforms in China during the COVID-19 pandemic. *Healthcare* 8:200. doi: 10.3390/healthcare8030200

Debourgh, G. A. (2003). Predictors of student satisfaction in distance-delivered graduate nursing courses: what matters most? *J. Prof. Nurs.* 19, 149–163. doi: 10.1016/S8755-7223(03)00072-3

Graesser, A. C., and Olde, B. A. (2003). How does one know whether a person understands a device? The quality of the questions the person asks when the device breaks down. *J. Educ. Psychol.* 95, 524–536. doi: 10.1037/0022-0663.95.3.524

He, K. K. (1997). The teaching mode, teaching method, and teaching design of constructivism. *J. Beijing Nor. Uni.* 5, 74–81.

Jiang, Y. J., Bai, X. M., Wu, W. C., and Luo, X. J. (2019). Analysis of the structural relationship of influencing factors of the online learning

experience. *Mod. Distance Educ.* 1, 27–36. doi: 10.13927/j.cnki.yuan.2019.0004

Li, X. W., Ye, W. J., and Zhang, Q. H. (2020). Research on the index model of teacher-student interaction behavior in the environment of "internet+teaching". *Res. High. Educ. Eng.* 3, 157–162.

Lin, C. H., Zheng, B., and Zhang, Y. (2017). Interactions and learning outcomes in online language courses. *Br. J. Educ. Technol.* 48, 730–748. doi: 10.1111/bjet.12457

Liu, X. (2006). On the principles of teacher-student interaction in distance education from the perspective of dialogue theory. *Distance Educ. China* 3, 37–39.

Moore, M. G. (1989). Three types of interaction. *Am. J. Dist. Educ.* 2, 1–6. doi: 10.1080/08923648909526659

Moore, J. L., Dickson-Deane, C., and Galyen, K. (2010). Designing for E-learning, online learning, and distance learning environments: are they the same? *Internet High. Educ.* 2, 129–135.

Mu, S., and Wang, X. J. (2019). Research on deep learning strategies in online learning. *Distance Educ. China* 10, 29–39+93.

Paudel, P. (2021). Online education: benefits, challenges, and strategies during and after COVID-19 in higher education. *Int. J. Stud. Educ.* 3, 70–85. doi: 10.46328/ijonse.32

Pennings, H. J., Brekelmans, M., Sadler, P., Claessens, L. C., van der Want, A. C., and van Tartwijk, J. (2018). Interpersonal adaptation in teacher-student interaction. *Learn. Instr.* 55, 41–57. doi: 10.1016/j.learninstruc.2017.09.005

Pham, G., Koch, T., Helmke, A., Schrader, F., Helmke, T., and Eid, M. (2012). Do teachers know how their teaching is perceived by their pupils? *Procedia Soc. Behav. Sci.* 46, 3368–3374. doi: 10.1016/j.sbspro.2012.06.068

Preacher, K. J., and Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation model. *Behav. Res. Methods Instrum. Comput.* 36, 717–731. doi: 10.3758/BF03206553

Preacher, K. J., and Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav. Res. Methods* 40, 879–891. doi: 10.3758/BRM.40.3.879

Seabi, J. (2012). Feuerstein's mediated learning experience as a vehicle for enhancing cognitive functioning of remedial school learners. *Aust. J. Educ. Dev. Psychol.* 12, 35–45.

Shi, F. H. (2010). A new perspective on quality evaluation reform of undergraduate education: learning engagement. *Mod. Educ. Manag.* 5, 51–54. [in Chinese]. doi: 10.3969/j.issn.1674-5485.2010.05.015

Tang, C. L. (2018). The relationship between perceived school climate and learning engagement in junior middle school students and intervention study. Doctoral dissertation. Central China Normal University. [in Chinese].

Tang, S. G., and Zhong, W. L. (2013). Research on the construction of interactive teaching model. *Theory Pract. Educ.* 18, 42–43.

Van de Pol, J., Volman, M., and Beishuizen, J. (2010). Scaffolding in teacher-student interaction: a decade of research. *Educ. Psychol. Rev.* 22, 271–296. doi: 10.1007/s10648-010-9127-6

Wang, Z., Bergin, C., and Bergin, D. A. (2014). Measuring engagement in fourth to twelfth grade classrooms: the classroom engagement inventory. *Sch. Psychol. Q.* 29, 517–535. doi: 10.1037/spq0000050

Wilson, T. D. (2006). On user studies and information needs. *J. Doc.* 62, 658–670. doi: 10.1108/00220410610714895

Xu, E. Q. (2016). An empirical study on the impact of teacher-students interaction on online learning performance. *Res. Audio-Vis. Educ.* 37, 61–68. doi: 10.13811/j.cnki.eer.2016.09.010

Yang, K. C. (2002). Several issues concerning the development of instructional design theory in the internet age. *Mod. Educ. Technol.* 1, 20–23+76.

Yu, H. Q., Li, C., and Shi, M. M. (2013). The influence of learning environment on college students' learning style and academic achievement: an empirical study based on the cultivation of undergraduate top innovative talents. *J. High. Educ.* 8, 62–70.

Yuan, Y. R., and Qi, S. J. (2020). A study on the influencing factors of college students' learning ability in online teaching environment. *Educ. Rev.* 8, 61–64.

Zhang, Z. P. (2015). Research on teacher-student interaction in foreign classrooms: hot issues and future trends. *Pri. Seco. Sch. Abr.* 4, 42–48+41.

Zhang, W. P., Chen, M. T., Zhao, X. N., and Bai, X. (2020). Influence of teacher-student interaction on classroom learning in special delivery classroom: a case of art delivery class in chongyang primary school. *Res. Audio-Vis. Educ.* 41, 90–96. doi: 10.13811/j.cnki.eer.2020.08.012

Zhang, X. L., Huang, Z. Z., and Li, M. L. (2017). An empirical study of online learners' "interactive learning" experience and its impact on learning outcomes. *Tsinghua J. Educ.* 2, 117–124.

Zhou, Q. F. (2003). Constructing a language classroom of "teacher-student interaction". Doctoral dissertation. East China Normal University.

Zhou, X. C. (2018). Exploration of assessment system and rating scales based on the blended learning mode. *J. Chengdu Nor. Uni.* 37, 163–167.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX

1. Teacher–student Interaction Scale

1. I can speak freely in class in online education.
2. Teacher–student interaction is getting longer in online education.
3. In online education, I prefer to interact with the teacher synchronously.
4. In online education, I will take the initiative to raise my hand to answer when I have an idea.
5. My classmate has become more interested in online education.
6. In online education, students in our class actively participate in classroom interaction.

2. Learning Engagement Scale

1. In online education, I can complete basic exercises and do extended exercises.
2. In online education, I can solve many problems with divergent and comprehensive thinking abilities.
3. In online education, I can solve problems through multiple solutions.

3. College Student Classroom Psychological Atmosphere Scale

1. In online education, many students are participating in the interaction in class.
2. I have participated in many teacher–student interaction courses in online education.
3. Teachers in online education provide many opportunities for interaction.
4. The forms of teacher–student interaction in online education have become diverse.
5. The timeliness of teacher–student interaction in online education has been improved.

4. Learning Effect Scale

1. Good teacher–student interaction in online education can improve my interest in learning.
2. Good teacher–student interaction in online education keeps me from getting distracted in class.
3. Good teacher–student interaction in online education can improve my learning hours after class.
4. In online education, I can listen carefully in class, do homework seriously, and actively participate in discussions.
5. I am good at cooperating with others in online education, not only having an opinion, but also listening to others' opinions with an open mind.
6. Good teacher–student interaction in online education can improve my satisfaction with the course.
7. Good teacher–student interaction in online education can improve my professional communication skills.
8. Good teacher–student interaction in online education enables me to better use the knowledge of the major.

Advantages of publishing in Frontiers

OPEN ACCESS
Articles are free to read for greatest visibility and readership

FAST PUBLICATION
Around 90 days from submission to decision

HIGH QUALITY PEER-REVIEW
Rigorous, collaborative, and constructive peer-review

TRANSPARENT PEER-REVIEW
Editors and reviewers acknowledged by name on published articles

Frontiers
Avenue du Tribunal-Fédéral 34
1005 Lausanne | Switzerland

Visit us: www.frontiersin.org
Contact us: frontiersin.org/about/contact

REPRODUCIBILITY OF RESEARCH
Support open data and methods to enhance research reproducibility

DIGITAL PUBLISHING
Articles designed for optimal readership across devices

FOLLOW US
@frontiersin

IMPACT METRICS
Advanced article metrics track visibility across digital media

EXTENSIVE PROMOTION
Marketing and promotion of impactful research

LOOP RESEARCH NETWORK
Our network increases your article's readership