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Digital Distance Learning and the Transformation of Vocational Schools From a Qualitative Perspective

Jan Delcker[1*†] *and Dirk Ifenthaler*[1,2†]

[1] *Learning, Design and Technology, University of Mannheim, Mannheim, Germany,* [2] *Learning Innovation and Teaching Excellence Centre, Curtin University, Perth, WA, Australia*

Digital distance learning has become one of the main modes of education at vocational schools during the COVID-19 pandemic. A large-scale survey with almost 4,000 stakeholders from 15 vocational schools in Germany was conducted to analyze the current state of digital distance learning, with the goal to identify the challenges teachers, students, school leaders, parents, and training companies face when digital distance learning processes are implemented. A total of N = 1,493 qualitative statements have been analyzed as part of the survey. The results of the deductive structuring content analysis suggest the influence of digital distance learning on eight categories within school development, namely teaching, feedback, organization, collaboration, personal resources, technical infrastructure, perceived learner success, and professionalization. The identification of challenges within these categories can help school leaders at vocational schools and policy makers to transform the experiences during the *ad hoc* implementation of digital distance practices into sustainable school development processes. The research work also proposes a transformation of existing theoretical frameworks of school development in the light of digitalization.

Keywords: distance learning, vocational school, school development, digitalization, digital transformation

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***Correspondence:**
Jan Delcker
jan.delcker@uni-mannheim.de

† These authors have contributed equally to this work and share first authorship

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INTRODUCTION

During the COVID-19 pandemic, distance learning became the primary form of education at vocational schools in Baden-Württemberg. Oftentimes, students nor teachers had the necessary competencies to learn and teach online (Howard et al., 2020; Huber and Helm, 2020). Many schools were not properly equipped with the technical or organizational infrastructure to implement such a rapid change from on-site to online classes (Delcker and Ifenthaler, 2020; Kerres, 2020). The project "*Distance Learning—Schul–und Unterrichtsentwicklung für Berufliche Schulen vor Ort*" (Distance Learning at Vocational Schools) was planned and conducted to evaluate the situation of stakeholders in vocational schools in Baden-Württemberg in cooperation with the Ministry of Culture Baden-Württemberg. For this purpose, an online evaluation instrument was designed to help decision makers at the school level to examine the perception of different stakeholder groups. The main goal of the research work was to provide decision makers and school leaders at vocational schools with a tool to evaluate their school, improve the distance learning situation at their schools, and engage in continuous school development.

In Germany, vocational training is traditionally based on the so called dual system (Protsch and Solga, 2016): The first part of the dual system consists of training companies which

take in apprentices for the 324 different qualifications programs (BIBB, 2021). The companies provide practical training through qualified instructors. Vocational schools are the second part of the dual system. They focus on the facilitation of theoretical general and subject-specific knowledge (Gessler, 2017). The two parts work closely together, and it is mandatory to attend a vocational school and to meet the requirements of the workplace to acquire the desired professional qualification (Deissinger, 2015). To ensure the close connection between the facilitation of practical and theoretical knowledge, working at the training company and attending a vocational school alternate on a weekly or monthly basis.

One of the most pressing challenges for vocational schools is the influence of digitalization on the theoretical and practical places of learning (Euler and Wilbers, 2018). On the one hand, digitalization requires the facilitation of new competencies, on the other hand, new digital educational tools and methods arise (Collins and Halverson, 2018). Amongst others, these competences include the ability to handle various digital technologies (Falloon, 2020), but also data literacy, information retrieval skills and the evaluation of digital data (Koltay, 2017; Henderson and Corry, 2021; Tsai and Wu, 2021). Future citizens are challenged with the protection of their personal data (Schüller, 2020; Horn and Otto, 2021) and digital collaboration (López-Meneses et al., 2020). The new digital competencies additionally include a sustainable perspective on digitalization (Luthra and Mangla, 2018; Chekanushkina et al., 2021) and the ability to use digital tools and methods to solve problems of the daily life and the workplace (Godhe, 2019). The competences for the workplace are of special importance for the vocational education trainings system, as digital processes and tools, such as 3D-printers (Chan et al., 2018), smart production systems (Hirsch-Kreinsen, 2016), digital marketing (Nadkarni and Prügl, 2021) or ERP systems (Spener et al., 2019), continuously change the workplace (Euler and Wilbers, 2018; Roll and Ifenthaler, 2020).

The tools to facilitate this competences might be computers (Patterson and Patterson, 2017; Falck et al., 2018), tablet PCs (Montrieux et al., 2015; Ifenthaler and Schweinbenz, 2016; Conrad and Schumann, 2021), smartphones (Lindberg et al., 2017; Hochberg et al., 2018), or interactive whiteboards (Tosuntaş et al., 2015; Mata et al., 2016; Hennessy, 2017). Flipped classroom settings (Mohamed and Lamia, 2018; Zainuddin et al., 2019; Strelan et al., 2020) and blended learning approaches (Dziuban et al., 2018; Hrastinski, 2019) are examples for teaching methods which combine digital and non-digital means. Both tools and methods can be used to present new forms of media, such as educational videos (Bateman and Schmidt-Borcherding, 2018; Carmichael et al., 2018), games (Hawlitschek and Joeckel, 2017; Lamb et al., 2018; Platz et al., 2021), apps (Cherner et al., 2014), and podcasts (O'Callaghan et al., 2017; König, 2021). Vocational schools can meet the challenge of a changing world through the consequent implementation of digitalization into school development processes, such as digital tools for the school's administration, modern technological infrastructure, or different teaching methods in conjunction with ongoing teacher education. The necessary changes on the school level have not been systematically implemented in the past. In many schools in Germany, the technical infrastructure remains insufficient (Fraillon et al., 2020) and information and communication technology (ICT) is only partially present in teacher education programs and curricula (Labusch et al., 2020).

During the COVID-19 pandemic, vocational schools were forced to implement distance learning as a new principle for teaching and learning. The school buildings were closed down and on-site teaching was prohibited as a precaution against the pandemic. The rapid change from on-site teaching to digital distance learning can be described as a "digitalization shock" (Harderer et al., 2020, p. 14) for the mostly unprepared schools (Huber and Helm, 2020; Kerres, 2020; Freundl et al., 2021; Million, 2021; Zawacki-Richter, 2021). Distance learning is defined as a superior construct which is comprised of different forms of media-based learning with the geographical separation between teachers and learners being one of its main characteristics (Brindley et al., 2004; Moore and Kearsley, 2011). In regard to the vocational schools in Baden-Württemberg, most teachers used live video-classes, uploaded worksheets or educational videos as methods and tools for digital distance learning with varying perceived success (Delcker and Ifenthaler, 2020). While the schools were closed, stakeholders at the vocational schools, especially school leaders, did not have the tools and opportunities to evaluate the digital distance learning situation within their institutions. The goal of this study is to identify challenges for stakeholders at vocational schools through the analysis of qualitative evaluation data. The following research question emerges:

How do the stakeholders at vocational schools perceive the digital distance learning situation?

The data is used to discover opportunities from within the school to overcome the challenges of the implementation of digital distance learning. The study at hand shifts the perspective from a crisis-oriented view toward a future-oriented angle. It uses the experience of *ad hoc* distance learning situations to gain insights for sustainable school development.

At this point, an important distinction must be made between the terms school development and school reform (Muftić, 2012; Silcox and MacNeill, 2021). School reform should be used for top-approaches which originate from outside of a single school, such as from the federal state administration (Rolff, 2019). External influence factors might be state-wide curricula (Seleznyov and Czerniawksi, 2020), changes in public funding (Sugarman et al., 2016), or broadband Internet access (Fox and Jones, 2019). Based on the definition by Rolff (1995), school development describes the development of single schools. In contrast to school reforms, school development considers school specific factors, such as organizational, social, and infrastructural characteristics at school level from a bottom-up perspective (Rolff, 2019). Examples for these characteristics are school leadership (Mulford, 2003; Whitehead et al., 2013; Bellin-Mularski et al., 2016; Barblett and Kirk, 2018), on-going teacher training (Gudmundsdottir and Hatlevik, 2018; Wong, 2018; Roll and Ifenthaler, 2021), classroom activities (Dadds, 2020; Eickelmann et al., 2020; Spiteri and Chang Rundgren, 2020), cooperation (Jensvoll and Lekang, 2018; Jurkowski and Müller, 2018; Aprea et al., 2020;

Delcker and Ifenthaler, 2020), and technological infrastructure (Gil-Flores et al., 2017). The goal of the intentional and planned development process is the facilitation of students' inter- and intradisciplinary competencies (Rolff, 1995) and an improvement of students' educational environment (Hanberger et al., 2016). Factors which are beneficial for such an environment include academic rigor (Wang and Degol, 2016), the organizational structure of schools (Sebastian et al., 2014), school identification (Maxwell et al., 2017), and teacher qualification (Podolsky et al., 2019). A meta-analysis of whole-school development programs indicates very small to small effects ($0.09 < d < 0.15$) on students' achievements, with an increasing effect for schools with a financially disadvantaged student population (Borman et al., 2003). In school leadership effect studies, small direct and indirect effects of leadership on students' achievement can be found (Scheerens, 2012). Heck and Hallinger (2010) identify teachers' perception about school improvement capacity as an indicator for the educational achievement of students. Amongst other things, school improvement capacity contains continuous professional learning, open communication, and the implementation of state curricular standards. The perceived ability of teachers to shape their school in the form of collective leadership, teachers' motivation, and the work setting of teachers has a significant effect on students' achievements as well (Leithwood and Mascall, 2008). Teachers' well-being is strongly associated with the administrative skills of principals, as well as principals' time spent on instructional management and internal relations (Liebowitz and Porter, 2019). These findings are related to the research work of Sebastian et al. (2019), who identified a high correlation between the organizational management skills and the instructional leadership skills of principals: Principals who are able to support good classroom interaction are also capable of managing a school as an organization and vice versa (Sebastian et al., 2019). The quoted results of educational research underline the "interdependence between contextual factors, educational factors, and target group factors" (Ditton and Müller, 2011, p. 104) as a major characteristic of school development and school quality.

Although the terms school development' and school reform are differentiated and used to describe different approaches to influence and improve education, they cannot be interpreted as unconnected concepts. School curricula and teacher training programs are strongly connected to teaching practices and the educational content in the classroom. Vice versa, the desired outcomes of educational processes, such as the qualification of students and the facilitation of competencies, depend on adequate teaching methods and further teacher education. The distinction between school reform and school development forms the basis for the further considerations of Eickelmann and Gerick (2018), who identified five fields for the successful development of schools. Organizational Development (OD) includes a school's agenda, its mentality and beliefs toward communication and digitalization. The field of Personnel Development (PD) covers teacher training and the onboarding of new teachers. Education Development (ED) subsumes activities in the classroom, such as the usage of learning tools and methods. Technology Development (TD) consists of requirements regarding technological infrastructure and administration of systems. The final development field is called Cooperation Development (CD) and describes cooperation processes between the internal and external stakeholders of school development.

Studies show the influence of the different development fields on learner success, academic improvement, and staff satisfaction. The structure of a school has the potential to increase students participation in the classroom, enabling them to reach educational goals (Sebastian et al., 2014; Maxwell et al., 2017; Alinsunurin, 2020). If teachers cooperate in instructional processes, they support academic improvement (Bryk, 2010). Wang and Degol (2016) report a well-structured school as an important factor for high student performance. The learning experience of students is influenced by the tools and methods used for teaching (Stefanou et al., 2004), which in turn depends on the skills and competencies of teachers (Ifenthaler and Schweinbenz, 2016, 2013). Mulford (2003) describes effective school leadership as one of the biggest factors for teachers' satisfaction and performance. Teachers are less likely to leave a school, when teachers perceive the school leaders as effective (Nguyen, 2021). This includes the creation of learning opportunities for teachers as a major influence on teachers professional development (Huang et al., 2020).

From the development fields, the stakeholders of school development can be derived. They include students, their parents, teachers, school leaders and the school's administration (Harris, 2010; Ilomäki and Lakkala, 2018). In the case of vocational schools, the different training companies have to be added to the list of stakeholders (Delcker and Ifenthaler, 2020). In vocational schools in Baden-Württemberg, school management is placed in the hands of the school principals. In most cases, a single school principal is responsible for most managerial decisions at school level. The school principals are supported by department leaders, whose number depends on the size of the vocational schools. School leaders as a stakeholder group are therefore defined as the principal and the department leaders.

Furthermore, secondary stakeholders can be identified, such as the school administration on a federate state level and the cities the vocational schools are located in. Although the secondary level stakeholders influence school development processes at school level, the theoretical model used in this study focuses on the primary stakeholders and especially possible managerial decisions which can be based on the evaluation of these stakeholders (Eickelmann and Gerick, 2018; Rolff, 2019). The decision to emphasize the primary stakeholders is based on an initial important theoretical assumption presented in this paragraph: the development of schools has to focus on single schools as organizational units and their individual characteristics.

School evaluation has become an important tool for successful school development (OECD, 2013). Using thorough evaluations, decision makers can make purposeful changes to processes and guidelines within the individual school with regard to the characteristics of this school (Nevo, 2001). Additionally, school evaluation can be an important tool for school leaders to improve students' educational achievements (Blok et al., 2008).

The evaluation process can come from within the school itself (internal evaluation) or it can be based on an outside perspective (external evaluation) (Nevo, 2001; Vanhoof and Van Petegem, 2007). Some external evaluations focus on the performance of students and staff, such as the normative assessment of the PISA or the TIMMS studies (Hanberger, 2014; Hopfenbeck et al., 2018). In contrast, an internal evaluation targets processes inside a school, e.g., the cooperation between teachers, information flow or administrative procedures (Mutch, 2012). External evaluations are often conducted by professional evaluators. As a result, they are deemed to be more objective than internal evaluations. On the other hand, external evaluators are at risk to underestimate the influence of a single school's characteristics on evaluation results (Hopkins et al., 2016). These school characteristics, such as the location of the school, socio-economics of the student population, or staff profile, are more regularly considered during internal evaluations (Mutch, 2012; O'Brien et al., 2017). At the same time, internal evaluations are often considered as not being critical enough, because the evaluators assess themselves, their own colleagues, employers and workplace (Stoney, 2010).

The program "Distance Learning in Vocational Schools" aims to overcome the shortcomings of external and internal evaluation by combining elements of both approaches. A standardized instrument is used for the data collection, which allows to compare and combine the results of individual schools (Scheerens et al., 2003). The time consuming collection and reporting of data is conducted by external evaluators to adjust for time constraints of school leaders and teachers (Pont et al., 2008), in this case the researchers responsible for the study. At the same time, decision makers are able to decide which groups within their school they wanted to evaluate. The school specific data is being provided to each school. These two steps are important to strengthen the sense of ownership and transparency of the evaluation (Mutch, 2012). The survey process, including data collection, analysis and data management underwent the ethics approval process of the Ministry of Culture in accordance with the European data protection laws (GDPR).

MATERIALS AND METHODS

The evaluation instrument "Evaluation of Distance Learning" by Balzer and Schorn (2021) has been adapted for this study in regard to the vocational schools in Baden-Württemberg. The adaptation comprises the removal of irrelevant items, as the original tool contains items for high schools and primary schools, in addition to items for vocational schools. The instrument covers different dimensions for the evaluation of distance learning: school organization, class activity, teaching and learning, social interactions, and personal resources. These dimensions can be categorized into the development fields of the 5SD-model (Eickelmann and Gerick, 2018). Likert-scale items from 1 to 5 (totally disagree, partially disagree, neither nor, partially agree, completely agree) have been used for the separate stakeholder groups of students, teachers, school leaders, parents, and training companies. To ensure the correct wording for each stakeholder group, the items' phrasings differ between the stakeholder groups. Additionally, some items were removed if they were not relevant for specific stakeholder groups. A small number of items to collect demographic data has been added to the questionnaire, also depending on the specific stakeholder group. As a result, the instrument varies in length. The longest questionnaire (66 items) was provided to the teachers, the shortest one (23 items) to the parents. Only a few of the questions were mandatory to answer to decrease the likelihood of dropouts. The validity of the original instrument has been tested by Balzer and Schorn (2021).

In addition, a final two-part question has been added to the end of the questionnaire in an open answer format: "Which ideas for the improvement of distance learning in the current situation do you want to share with us? Is there anything else you want to share with us?" This final two-part question is the main data source for the empirical analysis of this survey.

School leaders could decide which stakeholder groups they wanted to provide with a link to the online questionnaire. While this added some individuality to the interests of the individual schools, providing the link to students, teachers, and school leadership was mandatory. School leaders also had the chance to choose single classes or types of vocational schools (in case of vocational school centers) for the data collection. School leaders could also decide at which point in time they wanted the data collection to happen, beginning from November 2020. The individual collection period at each school was planned out in a $2 + 2$ design: after 2 weeks of data collection, a reminder was sent to the participating stakeholder groups, resulting in a 1-month period of data collection per school. An invitation to the survey was sent to vocational schools in Baden-Württemberg through the ministry of culture in November of 2020. Initially, 19 schools decided to participate in the survey from October 2020 until March 2021. Data had been successfully collected from 15 schools by March 2021. Three schools dropped out as a consequence of the ongoing COVID-19 pandemic. At one school, not enough stakeholders participated in the data collection and the school was not considered for further analysis. Only two schools decided to limit the data collection by choosing the three mandatory stakeholder groups, while the other schools chose to include all five stakeholder groups.

Analysis

In total, 3,872 persons participated in the survey. A total of 1,493 (38.6%) participants gave an answer to the open question at the end of the instrument. The answers of 1,172 students, 177 teachers, 57 parents, 56 training companies, and 26 school leaders were used for the analysis. The length of the statements varies between single words and long paragraphs. The mean number of words per statement is 49. A first step, all stakeholder statements have been organized into these five categories, following the deductive structuring content approach (Mayring, 2015, 2004). The approach is based on the determinations of inductive categories out of the theoretical considerations. Throughout the process, categories might have to be revised and changes. Afterward, the statements are being organized into the final categories, followed by an interpretation of the results. The analysis method is based on the following five categories: school organization, class activity, teaching and

learning, social interactions, and personal resources. In the process, the five dimensions turned out to be too broad for a lot of the statements, especially if multiple aspects of distance learning where mentioned. Consequently, three categories have been added to improve the structuring process. The following categories emerged:

(1) Organization: statements regarding organization processes within the school, such as the flow of information, introduction of schedules, formalized regulations, unified implementation of tools.
(2) Technical Infrastructure: statements regarding available software, hardware or internet connection in the school or at home, missing licenses, tools, or functionalities.
(3) Teaching: statements regarding teaching practices, quality of teaching tools, and methods.
(4) Feedback: statements regarding rules and processes concerning feedback between the different stakeholders.
(5) Motivation and learning success: statements regarding stakeholders' motivation to work online.
(6) Social interaction and support: statements regarding the relationship between and within stakeholder groups, support systems for the different stakeholder groups.
(7) Personal resources and stress factors: statements regarding the impact on day-to-day life, workload, and relevant coping strategies.
(8) Further education and training: statements regarding the content, organization, and availability of further training programs.

The statements were structured into multiple categories, if the statements contained topics for multiple categories, resulting in a total of 1,825 assignments after the second categorization. In the third phase of the analysis, the categories were further examined to determine how the stakeholders evaluate the distance learning situation at vocational schools. Some statements contain practical propositions to enhance the current situation. Two independent researchers analyzed the data based on the eight given categories with the help of a coding manual. This procedure was chosen to reduce interpretation bias from the authors. The results of the categorization by the different researchers are consistent overall, with a limited number of exceptions.

RESULTS

The most prominent statements in the specific categories are summarized to answer the research question. The presentation order of the categories is defined by the number of statements assigned to each category, starting with the category with the most assignments. The evaluation results are further partitioned into the different stakeholder groups, also sorted by seize. Exemplary statements are being used to underline the results at selected passages (S = student, T = teacher, TC = training company). These statements have been translated by the authors.

Category 1: Organization

An insufficient structure and organization is the most common criticism of participating students (429 of all statements). While some of the statements are very general, specific organizational problems can be identified from the perspective of the students. The first problem is the heterogenous implementation of digital tools and platforms by the teachers. Heterogeneity refers to the type of tool that is being used, but also to the way teachers integrate these tools into their teaching. While some teachers deliver lessons through video conference tools, other teachers limit their teaching to the distribution of worksheets:

"Teachers should consistently use platforms (max 3. different ones). There should be live teaching in each subject, e.g., on Teams (not just exercises per mail). [*sic*]" (S, ID 279)

The different teaching techniques are linked to students' fear of not being able to achieve the learning goals for the school year. This fear is further enhanced by the lack of transparency regarding grading formalities and requirements which are perceived as maladjusted. Statements regarding grading and requirements are mentioned 41 times by the students. The third important topic for students is the irregularity of lessons. Out of all student statements, 31 students stated that class schedules should be used to organize distance learning.

The teachers share the students' perception about the structure and organization within the school as one of the main weaknesses of the current distance learning situation. They advocate clear rules and standards for the use of different programs. The second most mentioned topic is the flow of information from the federal school administration. The information regarding the implementation of specific tools and data privacy is deemed insufficient:

> "[. . .] The federal state should provide clear recommendations for collaborative tools and supply the schools with these tools (licenses). [. . .]" (T, ID 2300)

> "necessary: [. . .] a single tool for video conferences, for the whole school and the whole federal state, e.g., Webex or Zoom" (T, ID 1803)

In total, 34 teachers state that they want to keep some form of distance learning. Especially online conferences with colleagues and further implementation of learning management systems are mentioned. School leaders evaluate the organizational situation similar to the teachers. They credit their staff and teachers for the positive developments at their schools, while criticizing the lack of support from state officials. This includes the provision of financial funding as well as clear rules and recommendations.

Only very few of the parents' statements can be categorized into organization, containing the need for more information about students' tasks and necessary infrastructure. The topic of information and transparency is the biggest part of training company statements. The training companies want to know what their apprentices are doing and how the situation at the school is organized.

"Information for the training companies about the online classes was completely missing. In general, there was little information for the training companies, this has to be improved."

Category 2: Technical Infrastructure

Almost a third of all statements (29.2%) refer to the technical infrastructure within the school or at home. While the statements of the different stakeholders in this category are very similar, students express conflicting views toward digital platforms and software. While some state that they have access to the necessary software, almost the same number of students state the opposite. In 31 cases, students mention the lack of necessary hardware, such as tablets, printers and laptops, for the successful participation in distance learning processes at their respective schools. A slightly more prominent problem (43 statements) for students is internet access at home. This includes insufficient stability, speed, and data volume, especially when students have to use their mobile data plans to participate in classes as a result of missing computers.

> "I only have an internet connection half of the time. It comes and goes and is not available a lot of the time." (S, ID 3888)

The teachers' statements assess the situation in the same way. In addition to their own infrastructure, they express worries about their students' equipment. They extend the lack of infrastructure to the circumstances in the school, including servers and the internet connection in the school building(s). School leaders, parents, and training companies make statements about deficient hardware. In regard to software, data security is a common topic for them, stating the need for tools that are especially built for the educational sector and vocational schools.

Category 3: Teaching

Roughly the same amount of statements as in category 2 can be allocated to category 3 (340 statements). The students emphasize the implementation of live video conferences as a helpful teaching method, with almost 20% of students' statements in this category. A typical statement is the wish for more live interaction and less autonomous learning in the form of worksheets or exercises. The students stress the importance of explanations and structures when teachers hand out work assignments. Students report an increased workload in comparison to on-site teaching, criticizing unrealistic teacher expectations in the form of deadlines and volume of work, which is intensified through the perceived lack of communication between the teachers. The increase of self-regulated learning practices is rated positively in 10% of students' statements in this category.

> "In my opinion, distance learning is a good opportunity to become more independent and to acquire new competencies. [. . .] the downside is the amount of material teachers want us to go through. In my opinion, that amount of material would not and could not be handled in on-site classes." (S, ID 3809)

The teachers' evaluation of live video conferences as a teaching tool is very mixed. Some teachers made good experiences and want to keep teaching online, while others are opposed to the idea, mainly because of the increased workload and subject-specific barriers. They underline the challenge to implement practical training in an online format. Learning management systems, on the other hand, are rated as a useful asset for digital teaching at vocational schools. Especially the possibility to centrally save files and the ease of distribution of learning material and exercises get mentioned. The statements of the other stakeholders are similar to the ones mentioned above.

Category 4: Feedback

The category "Feedback" has been included as a single category, because it is a very prominent topic within the statements. Around 5% of all statements mention feedback directly. Students report a lack of feedback from the teachers in regard to tasks and exercises.

> "[. . .] If tasks have a deadline, students should also receive feedback [. . .]" (S, ID 3904)

> "Tasks which have been uploaded should be assessed with proper feedback" (S, ID 3968)

> "It would be nice to send finished work to the teachers more often and to receive individual feedback" (S, ID 2635)

The criticism goes beyond feedback on tasks and refers to the general communication with teachers. Students state their perception of teachers reacting very late or not at all to questions outside of the class room setting from time to time. Parents and training companies share this evaluation. The teachers on the other hand rarely mention feedback in their statements. In the few cases that can be found in the dataset, teachers express difficulties regarding the time requirements and workload of individual feedback.

Category 5: Motivation and Learning Success

The statements regarding the motivation to use distance learning are ambivalent. Throughout the 179 students' statements regarding distance learning, around 60% can be identified a positive, while the other third prefers on-site teaching practices. This ratio is reversed for the teachers: the teachers prefer on-site teaching and often refer to subject-specific requirements as a reason against distance learning.

> "language teaching with a class of 30 students is not possible online. Language input is much lower than while on-site teaching. [. . .] gymnastic instruction is almost not feasible" (T, ID 1878)

> "practical occupational education is almost impossible in an online format" (T, ID 48)

Many students report problems around their ability to stay motivated during online classes and when working from a distance. Their statements include the lack of digital infrastructure, insufficient space, or having to simultaneously work at their respective training companies as reasons for their diminishing motivation. Other students value the opportunity to plan their learning process more independently as well as the safe learning space they can create at home. These students report an increase in motivation when distance learning. Students' self-assessment corresponds to the evaluation of teachers. Many teachers experience the students as less motivated during distance learning practices. From the teachers' perspective, the motivation of students is influenced by two factors: students who have been

motivated during on-site teaching are still motivated to work from a distance, whereas students who already struggled with motivation before the pandemic had even more motivational problems when taught from a distance. In addition, the type of vocational school influences students' motivation. On the higher ISCED levels, motivation and self-regulated learning skills are reported higher by the teachers, compared to the lower ISCED levels:

> "[. . .] Even if the technical infrastructure is there, the motivation to participate—depending on the type of school – is generally low." (T, ID 3611)

> "[. . .] Learning delay and demotivation are very high at the vocational college. Even the majority of students in graduation classes just pretend to register in the morning. In contrast, it works very well in classes in which students generally have a higher level of education (e.g., industrial clerks) [. . .]" (T, ID 2377)

Category 6: Social Interaction and Social Support

Around 100 statements contain information about social interaction and social support. The majority of these statements focuses on missing or insufficient communication between teachers and students. This includes communication in video conferences, but also communication processes outside of the classroom, which have partially been reported in the category "Feedback." Many teachers underline the importance of real-life social interaction as an integral part of on-site classes.

> "[. . .] On-site teaching can't be replaced through online teaching. Teaching lives through direct communication, interaction, and social experience. [. . .]" (T, ID 1720)

Some students mention communication problems in the classroom with their peers, especially during online group projects. A more prominent topic for students is the insufficient communication they attribute to the teacher-teacher relationship. Students perceive their excessive workload as a direct consequence of non-existing agreements between their teachers.

> "[we need] communication between the teachers regarding tasks in the class, big tasks often overlap" [S, ID 3379]

Category 7: Personal Resources and Stress Factors

Almost 15% of the statements can be filed into this category. A majority of the students' statements refers to the perceived increase of workload when working from a distance. From their perspective, teachers hand out more assignments and those assignments also take more time to complete. Apart from assignment specific workload, students mention a generally higher number of tasks when working online.

> "The hand-in assignments should fit the classes, [. . .] the assignments take much longer than an actual school lesson." (S ID 2873)

> "I think it's just too many assignments. And the teachers can't teach all the competences we need [. . .]" (S ID 3210)

Teachers and other stakeholders share the opinion of students regarding the volume of assignments, time constraints, and general workload.

> "The knowledge gap of the apprentices is big and as a consequence they are stressed and are scared that they will graduate with a bad grade" (TC ID 4008)

> "The school schedules have to be adapted so that students do not sit in front of the computer the whole day" (T 240)

Only a few of the statements mention personal stress factors, such as problems caused by living conditions or the general situation. Although the number of these statements is low, they show severe problems:

> "Distance classes are very tempting for me. It is easy for me to skip classes. I can simply sleep in and let myself go. I hope I can get back to school soon" (S ID 1836)

> "We should take more breaks, because we are sitting in front of the PC for such a long time [. . .]. The concentration is gone, your eyes hurt [. . .]" (S ID 2209)

> "[. . .] During the first lockdown, apprentices had to be in their training companies. It is impossible to stay focused there and we didn't have the time to do all assignments. [. . .]" (S ID 430)

Category 8: Further Education and Training

The final category contains around 10% of all statements. The most important issue for students is the perceived lack of teachers' digital competences. They mainly refer to the usage of digital tools, especially when conducting live video classes or uploading content to a LMS.

> "[. . .] Teachers should be taught how to use modern media [. . .]" (S ID 1525)

> "The structure within Moodle differs between the teachers (depending on their knowledge and skills)." (S ID 1606)

The teachers themselves acknowledge the need for further education and training. They mention specific IT support, but also further training for digital tools and didactical methods.

> "Support from external IT specialists is urgently needed! Many teachers are no computer specialists." (T ID 1438)

> "It is not just the handling of digital tools that is import, but also the creation of good didactical concepts within the specific subjects." (T ID 175)

DISCUSSION

Practical Implications

The organization of digital distance learning at school and classroom level is a major concern of students, especially in regard to the heterogeneous implementation of tools and methods, unclear grading processes as well as the lack of classroom schedules. The implementation of tools and methods is problematic in two ways. Firstly, teachers use different didactical

methods for digital distance learning. While some stick to more traditional forms, such as live video classes, other teachers prefer problem sets which are being provided over an LMS or distributed *via* email. It is important to notice that the choice of teaching methods does not generally deviate from an on-site setting. Designing instructions in a way the teachers deem the most effective is one of the most important principles in Germans education system, considering the "constitutional freedom of teachers" (Kerres, 2020). Hence, students at vocational schools should be familiar with different didactical practices. However, they state clear preferences for teacher centered live video classes, most likely because that method does deviate the least from the methods the students are used to. The student-centered learning approach requires much more self-learning competencies on the students' side. The extensive workload that the student perceive might be a result of an imbalance between their competencies and the requirements.

On the other hand, digital distance learning can make it very difficult for the teachers to notice and recognize how students deal with a specific method, while on-site teaching methods are characterized by the possibility to immediately react to students' needs. Educators at vocational schools have to carefully balance different methods of distance learning to take these two aspects into account. Most importantly, teachers should not rely on the provision of problem sets as the sole teaching method. In accordance with the principle of method diversity, it is recommended to include self-centered learning practices (worksheets, online tests) as well as strategies which focus on the teacher (live video classes) to foster students' competencies (Dole et al., 2015; Cidral et al., 2018; Maass et al., 2019; Tawbush et al., 2020).

A second problem occurs from the heterogenous implementation of tools. In practice, the teachers chose various software solutions for similar tasks. For example, some teachers use a LMS to store learning materials, while other teachers use software like Microsoft Teams or Apple Classroom for the provision of similar learning materials. In many cases, the basic functionality of the tools does not differ significantly. As a result, the teachers' decision for a specific tool seems to be based on personal preference rather than function or didactical value. Therefore, it seems less relevant whether Zoom, WebEx or BigBlueButton is being used for video classes, or if worksheets are provided through a cloud service or *via* email. While each teacher uses one digital tool for each task, students are required to deal with a multitude of different tools for similar tasks. At worst, students might have to use three or more different video tools throughout video classes in the morning and then get learning materials from other various tools and platforms in the afternoon. This situation has been pointed out as stressful and overwhelming in the students' statements. At school level, stakeholders should come to an agreement on which tools and methods they want to use for specific tasks. Although such an agreement contradicts the freedom of teaching to a certain degree, it seems to be an important step for the introduction of digital distance learning at vocational schools. Once all stakeholders have had the opportunity to acquire competences for the chosen tools, the number of tools can slowly be increased, if stakeholders miss specific functionalities or if new tools prove to be more suited for educational processes.

This argument is additionally backed by teachers' and school leaders' wishes for clearer rules at federal state level. Many of their statements refer to uncertainty regarding the compliance with data protection and privacy laws when working with digital tools. A public whitelist for schools could be an adequate tool to dispel such concerns, because the stakeholders at schools could then make their statements on specific digital tool selection more transparent. More transparency is also necessary in regard to changing regulations when it comes to grading and assessment. During the switch from on-site to digital online teaching, the federal administration quickly announced that grading was suspended. While teachers perceived that decision as a motivational setback for students, many students were unsure whether and how they could achieve their qualifications. A successful integration of digital learning practices therefore requires thorough regulations on how digital assignments can be designed and how grading is arranged.

Technological infrastructure is one of the most mentioned topics in the stakeholders' statements. In accordance with previous research work (Gil-Flores et al., 2017; Hennessy, 2017; Chua and Chai, 2019; Falloon, 2020; Fraillon et al., 2020), the effective provision of technological infrastructure can be identified as an import pillar of digital distance learning. The results of the data analysis in regard to technological infrastructure can be categorized into different components, namely hardware and software, each on the school and the personal level. From a school level perspective, the server infrastructure within a school has to be capable of supporting digital distance learning. Some of the shortcomings mentioned in the results can be traced back to inadequate hardware, for example when teachers state that they cannot provide hybrid lessons due to the fact that there is no wireless connection in some classrooms. Investments into creating an adequate infrastructure within the school buildings therefore has to be one of the most pressing topics for stakeholders at vocational schools. It is crucial to develop solutions that are specific to individual schools, because the actual structural conditions have a big influence on how wireless networks have to be set up (Gil-Flores et al., 2017; Hernandez et al., 2019). Even with the specific conditions in mind, decision makers at schools can benefit from the experience of comparable schools. To that end, the school administration on the state level has to further support vocational schools through the comprehensive collection of ongoing and finished infrastructural development projects. Accessing such information can help businesses and craftsmen to come up with sustainable on-site solutions.

Even if wireless network coverage is given, some schools cannot provide sufficient internet bandwidth, due to the general condition of the internet grid in Germany (Gürtzgen et al., 2018; Stockinger, 2019; forsa, 2020). Although efforts have been made recently to improve this situation, especially rural areas and schools within these areas have to be described as isolated and underdeveloped in regard to internet access. This includes the internet connection of students and teachers working from their homes. These findings might be located outside of

school development in terms of responsibility, but they have to be factored in when planning digital distance learning. One possibility is the provision of digital workplaces within the school. Although this contradicts the idea of digital distance learning, such digital workplaces allow students to participate in learning processes, rather than leaving those students to themselves. These considerations follow the findings regarding students' access to adequate software and hardware. The question on the provision of devices is still not fully clarified. In comparison to other forms of schools, vocational schools have the advantage of collaborating training companies, which they can include in the provision process. Instead of counting on student-owned devices, schools could use company-owned devices. An additional benefit of this approach is the connection of learning places, meaning that students learn to use the same devices in schools and at their workplaces. The training companies therefore directly benefit from their investment into apprentice devices.

The development and provisioning of educational software should be standardized at federal state level. This way, stakeholders can be certain that they are using software solutions which adhere to data security laws and didactic standards. The tender procedures for the specific software developers have to be based on development processes which include educational researchers and stakeholders at vocational schools. Most importantly, the federal government has to provide sufficient funding to make the production of educational software attractive for software companies.

From the students' perspective, digital distance learning is perceived as more work-intensive than on-site teaching. In addition, students prefer live video classes over problem sets. Both results might be traced back to an argument that has been stated in the context of school organization in a previous paragraph. Live video classes can focus on the teacher as the main provider of knowledge and information, whereas problem sets require more self-learning competencies. The responsibility for a successful learning process shifts toward the students to a certain degree (McCabe and O'Connor, 2014). This can cause students to feel positively challenged, something that is mentioned in some of the students' statements. Other students might feel overwhelmed or unprepared if the learning process lacks the guidance of a teacher. The potential of challenges can quickly turn into excessive demands in situations where too much at once is required from the learners. Students specifically underline these situations when they report a lack of teacher-teacher communication, resulting in too many or too difficult tasks within a short amount of time. The potentials of self-centered learning strategies can be harnessed through transparent learning goals and close communication with other teachers (Guggemos and Seufert, 2021). Digital tools can support teachers and students to stake out realistic expectations. One example is the implementation of a class schedule which is accessible by all responsible teachers and the students. Here, the educators can present tasks on a weekly basis, preferably with an envisaged time frame. Such a tool allows the teachers to collaborate and consider students workload more precisely when planning their own tasks. In light of the students' criticism, the lack of experience with digital distance learning has to be emphasized. While teachers can hardly estimate the workload of students beforehand, students can only use their former experience with on-site teaching as a reference point. In digital distance learning situations, students are required to be more self-reliant. Consequently, teachers have to find out which amount of work and which types of problem sets are feasible for their students. The problematic situation for teachers is reflected in their statement regarding difficulties when trying to use digital distance teaching for specific subjects. It seems apparent that some subjects might be less suitable for video classes or other forms of digital teaching methods. This conclusion might be rooted in a possible misconception of digital distance learning. The overall goal should not be the transmission of on-site teaching practices into a digital format, but rather the possibility to expand the existing teaching methods with the help of digital tools. As an example, language classes have been rated as inadequate for digital distance learning, because they "require face to face interaction" (T ID 1337). But language classes are not limited to face to face interaction. Language teachers could design learning scenarios which include online video platforms such as YouTube and task students with providing subtitles for their favorite German songs or movie scenes. Such a scenario enhances more traditional learning settings, rather than trying to force existing practices into digital distance teaching. This argument holds for the facilitation of practical competencies. Simulations might be helpful to support teachers' efforts in regard to practical tasks, but it will not and should not make learning at the workplace obsolete (Jossberger et al., 2018; Lamb et al., 2018).

The challenging teaching situation is further underlined by students' extensive references toward feedback and feedback culture. Students require guidance and feedback from their teachers, especially when learning practices focus on self-centered learning competencies, for example when teachers use problem sets as teaching tools (Hattie and Timperley, 2007; Metcalfe, 2017). Many of the statements describe the didactical process as one dimensional when teachers do not provide solutions or individual feedback for assignments. In those situations, students are unable to complete the learning process, because they do not know whether their solution was right or wrong. Consequently, they are unable to learn from their mistakes (Brookhart, 2017) and reach the planned learning goals. In return, the students get frustrated, which reduces their motivation. The loss of motivation influences their ability to further participate in the learning process, because it affects their sense of competence and self-efficacy (Hattie et al., 2020). Teachers can break this downward spiral through purposefully implemented feedback. In their statements, the teachers acknowledge the students' need for feedback, but they also mention their workload as a limiting factor on their ability to give feedback. The results show that it is necessary to build an adequate feedback culture which bridges the students' needs and the possibilities of the teachers. Both groups have to agree on specific forms of feedback which meet their requirements. These forms of feedback might be the provision of sample solutions or individual feedback for single students in a rotating process. Additionally, digital tools can help teachers to enhance feedback culture in the classroom with positive implications for their workload. Digital quizzes can be implemented to give direct feedback to the students

(George, 2020), as well as automated scoring for longer texts (Ludwig et al., 2021). On the other hand, students have to be aware of the fact that they might not receive individual feedback for each assignment and they have to further develop competencies to evaluate their learning process. Given the high relevance of feedback for the students, the negotiation process between students and teachers has to be embedded in a school-wide feedback culture. In practice, each teacher should be able to provide comparable forms of feedback to their students. Consequently, school leaders have to provide the digital tools to teachers and students alike.

The ability to implement new tools and methods into teaching is linked to the competencies of teachers (Villalobos, 2016; Hennessy, 2017; Mishra, 2019; Falloon, 2020). The results of the analysis show that many students do not perceive their teachers as competent in regard to ICT. More importantly, teachers themselves voice the need for further education and training. Such training programs might focus on specific methods, such as flipped classroom (Strelan et al., 2020) or blended learning approaches (Graham et al., 2019; Hrastinski, 2019). Additionally, specific digital tools might be the content of further teacher education, including the usage of interactive whiteboards (Hennessy, 2017), tablet computers (Ifenthaler and Schweinbenz, 2013; Montrieux et al., 2015; Otterborn et al., 2019), or educational software (Jossberger et al., 2018; George, 2020). In the context of vocational schools, teachers should further enhance their ability to bridge theoretical and practical learning places, by educating themselves about simulations (Jossberger et al., 2018; Rausch et al., 2021) and learning factories (Faßhauer et al., 2021; Roll and Ifenthaler, 2021). The training programs have to be specifically adapted to the abilities of teachers, such as their prior knowledge and preferred style of teaching (Darling-Hammond et al., 2017; Terhart, 2019; van Ackeren et al., 2019). In addition to formal education programs, teachers can benefit from each other's experience in collaborative processes within a single school or within a professional network (Romeu et al., 2016; García-Martínez et al., 2020). Advancements in teacher education should not be limited to in-service teachers. In the future, digital tools, methods and content has to be further implemented into pre-service teachers training programs at the university level (van Ackeren et al., 2019). Digitally competent young professionals might function as multiplicators at school level, where they can profit from the work experience of expert educators (Scantlebury et al., 2008).

While the majority of statements was made by students and teachers, the other stakeholders share many of their opinions. In the context of vocational schools, some statements of the training companies have to be singled out. The educators at the training companies underline the fact that the schools often do not provide information about the current situation at the schools. An effective flow of information is necessary to foster collaborative processes between the theoretical and practical places of learning (Aprea et al., 2020). Several approaches can help to improve the collaboration between schools and training companies. Firstly, schools could open their LMS to the training companies. With this approach, trainers have the opportunity to coordinate workplace practice with current topics at the school and vice versa. Trainers could inform the teachers about new tools and methods that are currently being implemented on the work floor. Consequently, teachers could use those new tools as real-life examples for specific subjects. Oftentimes, companies have access to machines and software which the vocational schools cannot provide. Through collaborative teaching designs, trainers can showcase these machines, for example by creating explanatory videos together with their apprentices. In this way, all students of a class can learn about new techniques and practices of the workplace. Teachers can also use simulations to connect theory to practice (Rausch et al., 2021). Effective simulations require scenarios which are close to the real tasks on the work floor. Trainers at the training companies can help to create such scenarios.

The analysis of the stakeholder statements helps to identify increasing issues and difficulties of a relatively small number of students. Although their number seems to be small, they require special considerations from decision makers at vocational schools. Firstly, the problems which are described by those students seem to considerably affect their ability to follow the classes, successfully hand in problem sets and reach their learning goals. Digital distance learning must not exclude these students from the vocational educational training system. A solution could be the setup of learning places within the school building, although such rooms are partially opposed to the concept of digital distance learning. If these learning places are accompanied by teachers on-site, struggling students might be able to develop the specific competencies to successfully participate in digital distance learning. Secondly, it is unclear whether the described challenges and the number of the struggling students within the sample accurately represent the situation of all vocational students. This limitation is further presented in the following chapter.

Limitations and Further Research

Several limitations influence the interpretation of this study. The online questionnaire resulted in a comprehensive collection of data from the respective vocational schools. The high number of qualitative statements underlines the value of the evaluation process for the stakeholders at vocational schools. Miller and Dumford (2014) as well as Adams (2015) critically reflect on open questions: they state that respondents tend to answer those questions when their experience has been more negative. This might skew the results of the survey. In addition, stakeholders without access to the questionnaire did not have the possibility to state their opinion. Nevertheless, the various participating schools and the high number of responses indicate a good representativeness of the data, especially in regard to students and teachers. In many cases, the different categories are presented from multiple perspectives, allowing for a complex examination. The stakeholders within the training companies have to be better linked to school evaluation in the future. Although their statements contain valuable information, especially in regard to information flow, their attitudes and perceptions have to be further examined. One way could be the definition of contact persons within the companies. Such contact persons might be the

instructors at the workspace or relevant management personal. This way, the response rate from the companies might be increased and new cooperation processes between the vocational schools and the training companies can be initiated.

The interpretative characteristic of the qualitative research approach should be strengthened through quantitative research, as the numerous considerations regarding the different identified categories require the examination of verifiable relationships. The category feedback can serve as an example for such a research approach. An experimental design can provide the necessary data to identify measurable effects of different feedback methods on the learner' success of students and their motivation. Consequently, the success of learners should be assessed as a combination of perceived success and formal assessment, for example graded exams. As a result, the stakeholders at the vocational schools can implement feasible, sustainable and beneficial tools and methods into the daily practice within their institutions. The analysis of evaluation data.

The necessity to increase the numbers of categories for the interpretation process is a hint toward the limitations of the chosen theoretical framework. In its current form, the five development dimensions (Eickelmann and Gerick, 2018) contain important fields of school development and distance learning. On the other hand, the results of the analysis show an imbalance between the theoretical framework and real-life practice. Evidence for this disparity can most notably be found in the category of feedback and regulations. While both categories can be found as subdimensions of the theoretical framework, they might play a much more important role than the framework suggest, especially when a school starts to implement digital distance practices. It becomes apparent that the weight and the importance of the individual development fields shift during school development processes. The stakeholders at schools are especially challenged by those development fields in which they have the least experience or which are mostly affected by the change: while teachers and students are able to give and receive feedback in traditional classroom settings, the paradigm of feedback changes in digital distance scenarios. The same can be said about guidelines and regulations, which exist for almost all parts of traditional vocational training. As new tools and methods for digital distance learning are implemented, many of the traditional rules cannot by applied. The resulting competence vacuum can lead to insecurity and frustration, often putting development processes to a halt. While the theoretical framework focuses on the development of single schools rather than a school system, it is important to notice, that similar schools face comparable challenges in the light of the implementation of digital distance learning. These challenges might be overcome by a stronger cooperation between the different stakeholders within and outside of the school. As of now, the connection between the different parts of this network mainly exists in the form of workgroups, cooperation projects or as part of research processes. The vocational schools in Germany are by design part of an extensive network, based on the structure of the dual system. This network can be enhanced through digital technology and digital forms of cooperation, especially through the conjunction of the different digital systems in use. This would create collaborations on an additional level, enabling stakeholders to profit from the experiences and resources from other parts of the vocational school network. While current frameworks emphasize the importance of a single schools characteristics' (Eickelmann and Gerick, 2018; Ilomäki and Lakkala, 2018; Zylka, 2018; Rolff and Thünken, 2020), the disruption of school development in the context of digitalization has to be met with a model which implements the new technological capabilities to shape collaborative networks.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data is protected under EU/German data protection laws. Requests to access the datasets should be directed to JD, jan.delcker@uni-mannheim.de.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ministry of Culture, Baden-Württemberg, Germany. Written informed consent from the participants to their 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

Both authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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