PhD-supervisors experiences during and after the COVID-19 pandemic: a case study

Rune J. Krumsvik[1]*, Fredrik Mørk Røkenes[1], Øystein O. Skaar[1,2],
Lise Jones[3], Stein H. Solstad[4], Øystein Salhus[4] and
Kjetil L. Høydal[4]

[1]Department of Education, University of Bergen, Bergen, Norway, [2]Department of Educational Studies
in Teacher Education, Faculty of Education, Inland Norway University of Applied Sciences, Hamar,
Norway, [3]Department of Psychosocial Science, University of Bergen, Bergen, Norway, [4]Faculty of Arts
and Physical Education, Volda University College, Volda, Norway

Introduction: The COVID-19 pandemic has significantly impacted the education sector, and this case study examined nearly three hundred PhD supervisors in Norway. The study was driven by the urgent need to better understand the professional, social, and existential conditions faced by doctoral supervisors during extended societal shutdowns. This explorative case study builds on a former study among PhD candidates and investigates the experiences of doctoral supervisors when remote work, digital teaching, and digital supervision suddenly replaced physical presence in the workplace, largely between March 12, 2020, and autumn 2022, due to the COVID-19 pandemic.

Methods: A mixed-methods research approach, incorporating formative dialog research and case study design, was employed to bridge the conceptual and contextual understanding of this phenomenon. The primary data sources were a survey (N = 298, 53.7% women, 46.3% men, response rate 80.54%) and semi-structured interviews (with nine PhD supervisors). Supplementary data collection was based on formative dialog research. It included field dialog (four PhD supervision seminars), open survey responses (n = 1,438), one focus group (n = 5), an additional survey (n = 85), and document analysis of PhD policy documents and doctoral supervision seminar evaluations (n = 7). The survey data, interview data, focus group data, and supplementary data focus also retrospectively on the first year of the pandemic and were collected from August 2022 until October 2023.

Results: The findings from the explorative case study revealed that the PhD supervisors faced numerous challenges during the pandemic, both professionally and personally. For PhD supervisors who extensively worked from home over a long period, the situation created new conditions that affected their job performance. These altered conditions hindered their research capacity, their ability to follow up with their PhD candidates, and their capacity to fulfill other job responsibilities. Although the PhD supervisors received some support during the pandemic, it seems that the incremental measures provided were insufficient.

Discussion: The case study results indicate that it is more important than ever to understand the gap between the formulation, transformation, and realization arenas when distinguishing between incremental, semi-structural changes and fundamental changes in PhD regulations and guidelines brought on by societal crises. This highlights the need for better crisis preparedness at the doctoral level in the years to come.

KEYWORDS

PhD-supervisors, experiences, COVID-19, supervision, PhD-fellows, frame factors

1 Introduction

Effective doctoral supervision is crucial for guiding PhD candidates through the complexities of their research, ensuring academic rigor and the successful completion of their dissertations (Bastalich, 2017; Wichmann-Hansen, 2021; Kálmán et al., 2022). The role of PhD supervisors during the pandemic and their impact on educational quality at various levels has been an under-researched area both nationally and internationally (Börgeson et al., 2021; Krumsvik et al., 2022). Supervisors who have varying experiences and work under diverse conditions are key players in the transformation arena where central policies are applied at the institutional level. Their interaction with PhD-candidates, whether in-person or remotely, shapes partly the quality of PhD-programs and candidates' learning experiences. The COVID-19 pandemic has influenced the education sector in numerous ways, and this case study examined nearly three hundred PhD-supervisors in Norway with a Mixed Method Research design and different methods and data. The impetus for the study was the urgent need for a better knowledge base to understand the professional, social, and existential conditions for doctoral supervisors when society is shut down for an extended period. This explorative case study builds on our former study among PhD-candidates (Krumsvik et al., 2022) and investigates the experiences of doctoral supervisors when remote work, digital teaching, and digital supervision suddenly replaced physical presence in the workplace (to varying extents).

First, the introduction contextualizes the study; second, the methodology is described; third, the main part presents the results from the survey part of the study; fourth, the data from the interviews and Supplementary data are presented; fifth, the discussion and conclusion are presented.

International policy documents underline the importance of PhD-supervision [European University Association (EUA), 2010, 2015] and, in Norway, it is crucial to view PhD supervision considering the specific frame factors for the PhD's and some general trends of changed frame factors in doctoral education over the last 10 years (Krumsvik, 2016a, 2017). It is therefore important to examine such frame factors in light of PhD-supervisors' experiences during the pandemic, but the current state of knowledge is still limited around this topic. However, "The United Kingdom Research Supervision Survey Report 2021″ found that among the 3,500 PhD supervisors in the United Kingdom, 65% felt that supervisory responsibilities have increased during the pandemic, 32% agreed that "concerns over supervision have kept me awake at night over the last 12 months" and 31% agreed that "supervising doctoral candidates makes me feel anxious over the last 12 months" (UK Council for Graduate Education, 2021). With these abovementioned issues in mind, this doctoral supervision study builds on our previous research on doctoral-level education (Krumsvik and Jones, 2016; Krumsvik and Røkenes, 2016; Krumsvik et al., 2016a,b, 2019, 2021; Krumsvik et al., 2022) and aims to examine the experiences of PhD supervisors in Norway during the pandemic to answer the research questions below:

1. To what extent has the COVID-19 pandemic impeded the PhD supervisors' frame factors on the micro-level, and how do they perceive this situation?
2. To what extent has the COVID-19 pandemic influenced PhD supervisors' frame factors on the meso-level, and how do they perceive this situation?

3. How do the PhD-supervisors experience the more general aspects of their supervision role during and after the pandemic?

1.1 The Norwegian context

To contextualize the research questions to the Norwegian context, one must remember that doctoral candidates in Norway are not students *per se* but are employees (on a 3–4 years contract) and more regarded as colleagues than students, and in this sense, the roles are more equal than in traditional supervisory relationships at a lower level (supervisor-student). Both by having PhD fellows being considered highly competent adult employees with state employment contracts, where they receive regular salaries, and have regular offices, they are initially part of the work community found within academia with its routines, duties, and rights. Another contextual aspect is that Norwegian PhD-candidates defend their theses relatively late in their careers. The average age for a candidate's defense is between 37 and 38 years and higher for many candidates within the humanities and social sciences. In comparison, the median age across OECD countries is 29 (Sarrico, 2022, p. 1304). Table 1 provides a generalized comparison of doctoral education across Nordic countries, the UK, and the US (Andres et al., 2015; Burner et al., 2020). While such broad overviews might exaggerate differences, they provide a framework for understanding doctoral education on a spectrum. This spectrum ranges from countries with significant government influence, where PhD candidates are employed (e.g., Nordic countries), to countries with moderate government influence, where PhD candidates are not employed (e.g., the UK), and finally to countries with minimal government influence, where PhD candidates are also not employed (e.g., the US). Despite these variations, the global trend indicates that doctoral education is becoming increasingly dependent on external funding (Bengtsen, 2023, p. 45).

In addition, women defend their theses on average 2 years later than men. Taking into account that the average age for first-time mothers in Norway is now 30.1 years, there is a lot that needs to happen within a few years, and this may sometimes affect the feasibility of their PhD-projects. This can, e.g., be related to the gender differences in Norway about parental leave days during the pandemic which is much higher for women than for men at the universities (Krumsvik et al., 2022)[1]. Another contextual factor that distinguishes doctoral supervision from other supervision (at lower levels) is that over 90% of the doctoral theses in Norway are article-based theses (Krumsvik, 2016b; Mason and Merga, 2018; Solli and Nygaard, 2022), which implies 3–4 published articles and an extended summary or synopsis (a "kappe" in Norwegian, ranging between 50 and 90 pages). This means that the PhD-candidates receive "supervision" and feedback from approximately 8–10 referees in scientific journals on their articles, in addition to feedback from their PhD supervisors. Because of this, many PhD-supervisors are

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1 Some of the Norwegian statistic from universities shows the following: about parental leave (day's work) (women 69%, men 31%), sick children (day's work) (women 69%, men 31%), self-certified sick leave (day's work) (women 65%, men 35%) and doctor-certified sick leave (day's work) (women 72%, men 28%) during one of the year in the pandemic (Krumsvik et al., 2022).

TABLE 1 Overview of the Nordic PhD model in comparison to UK and US models.

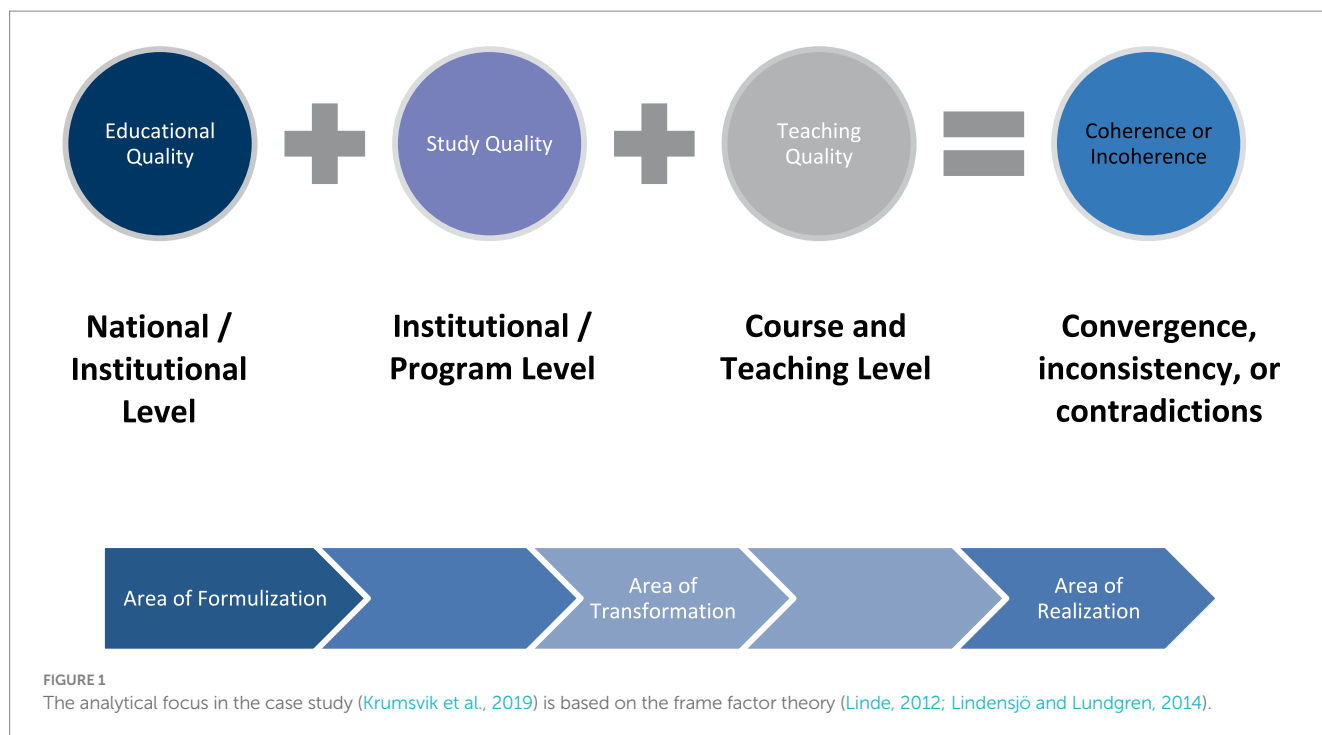| Aspect	Nordic Countries	UK	US
Admission Requirements	Master's degree, often high grade requirements	Master's degree, often high grade requirements	Varies widely, often research experience prioritized
Compulsory Training	Structured coursework	Coursework requirements vary	Coursework requirements vary
Supervision	Specific requirements for supervisor qualifications	Emphasis on supervisor training and competency	Supervision quality varies, no universal requirements
Funding	Substantial government support, structured funding	National funding through Doctoral Training Centres	Decentralized, varied funding landscape. Highly dependent on scholarships
Evaluation Process	Systematic evaluations, quality assurance through national policies	Systematic evaluations, quality assurance through national policies	Varied evaluation processes, institution-specific guidelines
Completion Timeframe	3–4 years full-time, with extensions possible	3–4 years full-time	5–6 years full-time
Employed by the institutions	Yes	No	No

Doctoral education is not entirely homogeneous within the Nordic countries. For instance, in Finland, PhD candidates are not automatically provided funding (Andres et al., 2015, p. 11). Additionally, there are differences between institutions within countries, such as in Norway (Burner et al., 2020).

co-authoring their doctoral candidates' publications. A final contextual aspect is the recent studies indicating a decrease in doctoral disputations nationwide in Norway over the past two years (Steine and Sarpebakken, 2023) – probably as a consequence of the pandemic. In a survey, Ramberg and Wendt (2023, p. 22) found that about 60 percent of PhD candidates and 50 percent of postdoctoral candidates (N = 300) were delayed during the autumn of 2022. The study showed that illness or leave, often due to caregiving responsibilities during the pandemic, was the most common reason for delays among PhD candidates and postdoctoral candidates, particularly impacting women more than men. Following illness, reduced access to supervisors, empirical data, research facilities, and external partners were significant factors contributing to delays in their research activities. Nearly a third of delayed candidates reported reduced access to supervisors, and about a fifth faced issues with external partner access, highlighting the critical role of these resources in completing research projects. When it comes to the PhD-supervisors, more specifically, the supervision differs from other types of supervision in that a formal PhD agreement is signed with a binding supervisor contract that lasts for 3–4 years (the PhD period) and is signed by both the supervisor and the candidate. The supervisor also has an overarching responsibility to avoid delays and ensure that the PhD program can be completed within the standard time frame. Supervisors are primarily responsible for guiding doctoral candidates on the specific, content-related aspects of their projects. This includes helping candidates identify the knowledge frontier in their field, position their study within the research field, develop clear and consistent research questions, choose appropriate scientific and methodological approaches, and provide expert guidance in discussing results and addressing ethical issues related to the thesis. This obviously places relatively high competence requirements on the supervisors, both in terms of their academic and research skills, and in relation to the doctoral supervision itself, as poor or inadequate supervision at this level can expose the candidate to a certain "drop-out risk" in the project.

Maintaining education quality during the COVID-19 pandemic has been challenging due to the widespread shift to digital teaching, supervision, and remote work. Many university teachers were unaccustomed to the online, digital learning environment, working with PhD candidates remotely for extended periods. Some taught in hybrid settings, with some PhD candidates quarantined at home while others attended in-person classes. Additionally, others navigated ordinary learning contexts with COVID-19 precautions like masks

and social distancing. This situation altered frame factors, adding complexity to the discussion of education quality.

Considering this, the case study seeks to understand if, and potentially how, external factors in pedagogical contexts over which institutions, academics, and teachers have no direct control play out. Lindensjö and Lundgren (2014) find that such external factors might have a significant impact on the outcomes of educational training, teaching, and supervision. Therefore, it is crucial to contextualize the pandemic experiences among PhD supervisors with respect to these factors, as they imply national and institutional frames for their PhD supervision. Though there exist several quantitative, survey-based studies on the impact of COVID-19 on PhD supervision (e.g., Pyhältö et al., 2023; Löfström et al., 2024), there is still a lack of in-depth qualitative understanding of the impact of COVID-19 on the supervisory relationship. The studies of Löfström et al. (2024) and Pyhältö et al. (2023) indicated that supervisors faced significant challenges in identifying when PhD candidates needed assistance and providing adequate support for their well-being during the shift to remote supervision. Supporting the progress and wellbeing of full-time candidates, who were more adversely affected by the pandemic than their part-time peers, became increasingly difficult. The increase in email communications could overwhelm supervisors, exceeding manageable levels and complicating their ability to offer timely and effective feedback. The lack of spontaneous, informal conversation, previously facilitated by in-person meetings, further hindered their ability to monitor and support the candidates effectively. These challenges were particularly pronounced for supervisors in scientific fields requiring lab work and practical training, which were severely disrupted by the pandemic, and supporting the progress and wellbeing of full-time candidates, who were more adversely affected by the pandemic than their part-time peers, became increasingly difficult. Furthermore, supervisors reported that their PhD candidates' lack of a scholarly community and inadequate supervision were significant challenges. This reflects the supervisors' view that the availability of a supportive research environment and adequate supervision are critical for candidates' success (Pyhältö et al., 2023). The study by Pyhältö et al. (2023) also found that supervisors generally estimated the impact on candidates' progress and well-being to be more negative than the candidates themselves did, which may imply that supervisors have a broader perspective on the long-term consequences of disruptions like the COVID-19 pandemic. Research prior to the pandemic (Pyhältö

FIGURE 1
The analytical focus in the case study (Krumsvik et al., 2019) is based on the frame factor theory (Linde, 2012; Lindensjö and Lundgren, 2014).

et al., 2012) has shown that apart from the importance of having clear and long-term financing, proper research facilities, and sufficient time to pursue a PhD, supervisors also stress the significance of PhD candidates' motivation, self-regulation, efficacy, and engagement as essential personal regulators for success in the PhD process.

1.2 Theoretical framework

This case study is exploratory and intrinsic (Stake, 1995, 2006), utilizing an abductive approach to theory with frame factor theory as our theoretical framework (Lundgren, 1999; Lindensjö and Lundgren, 2014). Frame factor theory suggests that society's influence on education manifests through a target system, an administrative system, and a legal system. This theory, used in educational sciences and pedagogy, acts as a lens for planning and analysis, positing that external factors, beyond the control of institutions and educators, significantly affect educational outcomes. We will further explain the contextual application of frame factor theory in this case study below.

Previous research highlights a gap in (doctoral) education between the formalization and realization arenas in frame factor theory (Lindensjö and Lundgren, 2014; Krumsvik et al., 2019). Linde (2012) introduces a transformation arena between these two, explaining the difficulty of implementing measures in complex organizations like universities. There is rarely a straightforward relationship between central decisions (formulation arena or macro-level) and their implementation (realization arena or micro-level). Policy documents require interpretation and application by faculty leaders, PhD program leaders, supervisors, and PhD candidates (transformation arena or meso-level) (Linde, 2012).

Given this context, a main focus of this case study was to evaluate how Norwegian PhD supervisors managed changed frame factors and education quality during the pandemic. The Norwegian Agency for

Quality Assurance in Education (NOKUT) defines education quality as "the quality of teaching classes, other learning facilities, and students' learning outcomes in terms of knowledge, skills, and general competence" (Skodvin, 2013, p. 2). It is important to differentiate between educational quality, study quality, and teaching quality.

Education quality is a broad concept encompassing everything from the subject/study program level to the government's education policy. In contrast, study quality is narrower, referring specifically to the educational institution (Skodvin, 2013, p. 3). Teaching quality goes further to the micro-level, focusing on course quality, teacher effectiveness, and PhD supervision. This study examined how PhD supervisors experienced COVID-19 restrictions at the micro- and meso-levels, considering two of the three levels. Figure 1 illustrates the analytical lenses in this mixed methods research (MMR) and formative dialog research case study:

2 Methodology

To understand and corroborate conditions faced by doctoral supervisors related to COVID-19 extended societal shutdowns, both in breadth and in depth, we employed a mixed-methods research design, combining quantitative data to show the strength of associations and qualitative data to explore their nature (Johnson et al., 2007; Creswell and Plano Clark, 2017). We utilized a three-stage design, QUAL-QUANT-QUAL (qualitative-driven sequential design, Schoonenboom and Johnson, 2017), making it a qualitative-dominant mixed-methods study (Johnson et al., 2007, p. 124). Using mixed methods research allowed us to explore the complex research problem more comprehensively compared to using either quantitative or qualitative data alone. Though the approach is less common in case studies (Tight, 2016, p. 380), the mixed methods are increasingly used (e.g., Ertesvåg et al., 2021; Hall and Mansfield, 2023; Peters and

Fàbregues, 2023). Advocates of such approaches consider mixed methods to "complement and extend one another and thus lead to better descriptions, clearer explanations and an enhanced understanding of phenomena, research aims and questions" (Ertesvåg et al., 2021, p. 655).

Specifically, an exploratory, sequential mixed-methods design was used to address the research questions (Fetters et al., 2013; Creswell and Plano Clark, 2017). This design involves collecting and analyzing qualitative data first (QUAL), using those findings to guide the quantitative data collection and analysis in the second phase (QUANT), and then using the quantitative results to inform further qualitative data collection and analysis in the third phase (QUAL). This method integrates through building, where results from one phase inform the next.

We conducted a cumulative data collection and analysis process (Creswell and Guetterman, 2021), basing survey questions on previously collected data from field dialogues, online observations, seminar evaluations, and document analysis. The questionnaire consisted of a general demographic questions (e.g., gender, educational background and what field(s) the supervisor supervised in), in addition to a range of multiple response items addressing four key themes: (1) important factors to complete a PhD, (2) supervisor challenges, (3) working from home experiences, and (4) perceived need for future competences as supervisors. Finally the questionnaire contained a range of statements measured on a Likert-scale from 1 to 5 where 3 was neutral (e.g., to what extent do you feel that your PhD-candidate(s) are on track with their doctoral project?). The qualitative interview guide (Kvale and Brinkmann, 2015) was developed from the prior quantitative data (survey), and the focus group guide was based on earlier survey and qualitative interview data (see Figure 2 below). We integrated research questions, methods, interpretation, and reporting at various points, using narratives where qualitative and quantitative results are presented in different sections of the same article through the contiguous approach (Fetters et al., 2013). This article primarily examines the coherence between qualitative and quantitative findings based on *confirmation*, *expansion*, or *discordance* (Fetters et al., 2013). The approach used in the study is similar to Hall and Mansfield (2023) and the coherence is derived from joint displays using visual means.

As a consequence of the mixed-methods design, this study combines two approaches in case study research. The first, proposed by Stake (1995, 2006) and Merriam (2009) and Merriam and Tisdell (2016), is situated in a social constructivist paradigm, and is attached to the qualitative part (connected to the second part of each research question). The second, based on Eisenhardt (1989), Flyvbjerg (2011), and Yin (2012), approaches the case study from a post-positivist perspective (Hyett et al., 2014, p. 1) (connected to the first part of each

research question). This intrinsic case study (Stake, 1995) aims to focus on ecological validity:

"Ecological validity is the degree of correspondence between the research conditions and the phenomenon being studied as it occurs naturally or outside of the research setting" (Gehrke, 2018, p. 563). Informant selection was based on a purposeful method (Maxwell, 2013), in which we recruited PhD supervisors from Norway.

Next, all interviews were analyzed using reflexive thematic analysis (Braun and Clarke 2019, 2021) where themes were constructed and presented in this paper (see section 4). In addition, we also conducted a sentiment analysis (Dake and Gyimah, 2023) of the nine interviews (see Supplementary file).

To answer the research question, we combined formative dialog research (Baklien, 2004) and case study research (Stake, 2006). Data collection consisted of fieldwork (see Supplementary file), a survey $N = 298$, 53.7% women, 46.3% men, response rate 80.54%, nine semi-structured interviews (with PhD supervisors), and one focus group ($N = 5$). Supplementary data consisted of an additional survey ($N = 85$), PhD-policy document analysis ($N = 6$), field dialogues (4 PhD supervision seminars), open survey data (1,438 responses), seminar observations ($N = 4$), and reviews of relevant documents such as evaluations of doctoral supervisor seminars. We also used policy documents and regulations concerning PhD education in Norway as supplementary sources.

We focused on how PhD supervisors experienced changing frame factors, such as university lockdowns, remote work, digital teaching, digital supervision, doctoral progression, and others, with an emphasis on illuminating the micro-level (course and teaching level) from the PhD supervisors' perspective. This focus is twofold: the program's structure and quality directly affected the PhD- supervisors during the pandemic. The second is simply that they conducted several evaluations about matters related to the structure and quality compared with the others. However, PhD- candidates' opinions are also important, and their views are also interwoven because some of them have been present during field dialogs and participated in the PhD-supervision seminars.

When focusing on how PhD-supervisors experience their supervision, PhD's research progression, psychosocial aspects, their nearest superior, and the main focus are on illuminating the meso-level (institutional and program level).

2.1 Cumulative research process

In our case study, we brought the experiences and our study among PhD's (Krumsvik et al., 2022) from the period March 12, 2020, to November 30, 2021, into our design of this study.

FIGURE 2
The research process. The yellow arrows show the main data sources, and the blue arrows show the Supplementary data in this article. In addition, we have conducted focus group interviews and an extra survey, which will be published in another article (since they mainly focus on academic writing with the large language models).

TABLE 2 Distribution of supervisors by academic background and PhD supervision in various fields.

Factor	Academic Background		Supervising Fields		
	n	Percent	*n*	Percent	*Percent of cases
Education and Teacher Training	43	17.92	81	28.32	35.06
Natural Science	49	20.42	44	15.38	19.05
Health Science	23	9.58	39	13.64	16.88
Humanities	43	17.92	36	12.59	15.58
Psychology	16	6.67	17	5.94	7.36
Sociology	17	7.08	16	5.59	6.93
Medicine	5	2.08	12	4.20	5.19
Other	44	18.33	41	14.34	17.75

*Indicates that this is a multiple response question, and percentages of cases do not sum to 100% because respondents could select more than one option.

TABLE 3 Challenges faced by supervisors during the pandemic in terms of supervision.

Factor	*n*	Percent	*Percent of cases
Balancing work and family life	76	14.5	34.7
Working from home	76	14.5	34.7
Psycho-social aspects (loneliness, etc.)	74	14.1	33.8
Canceling conference participation, etc.	71	13.6	32.4
Canceling stays abroad	61	11.7	27.9
Supervision Quality	59	11.3	26.9
I have not had any challenges	50	9.6	22.8
Delayed peer review process in journals	29	5.5	13.2
Publishing	24	4.6	11
Research ethics	3	0.6	1.4

*Indicates that this is a multiple response question, and percentages of cases do not sum to 100% because respondents could select more than one option.

We executed an excessive cumulative data collection process (including a part during the pandemic) and analysis, especially from August 2022 – October 2023. The relatively long time period allowed the researchers to test their interpretations along the way and detect contrary evidence, e.g., reach saturation during the coding and analysis of the qualitative data (Creswell and Guetterman, 2021).

3 Results

3.1 Quantitative part (survey)

Above and below are the results of the quantitative part of the study, based on the survey data. This analysis is tentative and covers only the survey results. The interview data and Supplementary data will be presented later in the paper. Two hundred and forty respondents completed the survey (*N* = 298, 80.54% response rate). The academic backgrounds of the supervisors were diverse, with the three largest groups coming from natural sciences, humanities, education and teacher training. The largest group of supervisors (41.75%) supervised PhD candidates in education and teacher training (see Table 2).

A narrow majority (58.08%) of the supervisors had submitted an article-based dissertation (see more in attachment 5 in the Supplementary file), in the Supplementary file meaning that approximately four out of ten supervisors have not "hands on"

experience with article-based thesis as their thesis in their own doctoral degree. A large majority (81.67%) had supervised PhD candidates before and after the pandemic, while 11.67% had only supervised during and after. 41.27% of the supervisors stated that the coronavirus pandemic (from March 12, 2020 - January 2022) had impeded their candidate(s) progress in their doctoral project. 21.12% agreed (to a large or very large extent) that the PhDs' publication process of articles to scientific journals has been delayed because of the journal's peer review process during the pandemic (i.e., journal processing times seemed to increase due to several factors including a lack of available peer reviewers because of heavy workloads, health issues, more teaching, etc.).

3.1.1 Challenges in supervision

Results in Table 3 indicate that the most commonly reported challenges faced by supervisors during the pandemic were balancing work and family life and working from home, each affecting more than a third of the supervisors. Psycho-social aspects, such as loneliness, also emerged as a notable challenge. The cancelation of conference participation and stays abroad were significant issues, reflecting the broader impact on professional development opportunities. Concerns about supervision quality were also prominent. Some supervisors reported no challenges, highlighting a degree of variability in experiences. Other challenges included delays in the peer review process for journals, difficulties with publishing,

TABLE 4 Challenges faced by supervisors during the pandemic working from home.

Factor	*n*	*Percent	Percent of cases
Little contact with colleagues	144	18.44	60.76
Little contact with my PhD-candidate(s)	99	12.68	41.77
Distractions in everyday life from others at home	96	12.29	40.51
More workload with digital teaching from the home office	78	9.99	32.91
Lack of office equipment (e.g., desk. Office chair. Etc.)	70	8.96	29.54
Psycho-social aspects (loneliness etc.)	68	8.71	28.69
Lack of space	58	7.43	24.47
More home responsibilities (e.g., childcare.)	54	6.91	22.78
Lack of necessary computer equipment	34	4.35	14.35
I have not had any challenges	33	4.23	13.92
Less access to library services	22	2.82	9.28
Poor internet access	18	2.3	7.59

*Indicates that this is a multiple response question, and percentages of cases do not sum to 100% because respondents could select more than one option.

and issues related to research ethics, though these were less commonly reported.

3.1.2 Challenges in working from home

Results in Table 4 indicated that supervisors faced multiple challenges while working from home during the pandemic. The most common issue was having little contact with colleagues, which affected more than six in ten supervisors. Supervisors also frequently reported having little contact with their PhD candidates. Distractions from others at home were another prevalent challenge. Many supervisors experienced an increased workload due to digital teaching from home, and lacking office equipment, such as desks and office chairs, was also commonly reported. Psycho-social aspects, such as loneliness, were significant issues as well. The lack of space and increased home responsibilities, such as childcare, were notable challenges. A smaller number of supervisors reported having no challenges at all. Other less commonly reported issues included limited access to library services and poor internet access.

3.1.3 Factors PhD candidates need to complete their doctorate

We find that there is a high degree of consistency between what supervisors (Table 5) and PhD candidates (Table 6) consider to be the most important factors for completing the doctorate. In particular, it is persistence, resilience, and the ability to work independently are the most important factors, in addition to supervision and co-writing with supervisors.

Thus, there is considerable agreement between what the supervisors and the PhD candidates report, which may indicate that within the academic tradition, the doctoral journey is primarily seen as an individual endeavor (feat of strength) where the supervisor is the closest supporter.

3.1.4 Appreciation of supervision

The supervisors mostly agreed that both they and the PhD candidates value supervision. 89.91% responded they agree or strongly agree to this question for themselves, and 92.47% responded they agree or strongly agree on behalf of the PhD candidates. In comparison, 61.25% responded similarly to whether the department values supervision, while 24.17% were neutral, and

14.59% responded they disagree or strongly disagree. This may suggest that the supervisory relationship is primarily between the PhD candidate and the supervisor, with less firm ties to the institution.

When it comes to what extent the supervisors think that their institution has been accommodating regarding compensating the loss of progress due to the coronavirus pandemic for their own PhDs, 27.2% stated that this had been done to a small extent or very small extent and 29.39% stated that this had been done to a large extent or very large extent. 30.1% agreed (large extent and very large extent) that supervisory responsibilities have increased during the pandemic. 13.3% expressed (to a large or very large extent) that supervising doctoral candidates makes them feel anxious' over the last 24 months" (pandemic), but the majority (64.3%) experienced this to a small and very small extent. 9.3% expressed (to a large and a very large extent) that concerns over doctoral supervision have kept them awake at night over the last 24 months (pandemic), but the majority (69.3%) experienced this to a small and very small extent. 56.1% of the supervisors have not discussed any challenges with the progress of their doctoral candidate(s) project due to the coronavirus pandemic with the department's human resources manager/head.

When asked how many hours they have enshrined in their working plan per semester as the main supervisor per PhD candidate, supervisors state this varies from zero to above 80 h, but for the majority, it is between 20 and 40 h per semester (40.46%). 23.1% state they do not think that their PhD-candidate(s) are on track with their doctoral project, while 50.2% state that their PhD-candidate(s) are on track with their doctoral project. Some PhDs publish their articles in their thesis based on pre-collected data (e.g., as a part of bigger projects), while others publish their articles in their thesis based on data collections done by themselves. 58.77% of the supervisors think this affects the completion time for the last group of PhDs (large and very large extent). 53.4% of the supervisors have been co-authoring their doctoral candidates' publications.

3.1.5 What competencies supervisors need

As seen from Table 7, nearly half of the supervisors believed they needed more pedagogical and methodological competence related to supervision. Additionally, about one-third felt they lacked knowledge

TABLE 5 Most important factors in completing a PhD as reported by PhD supervisors.

Factor	n	Percent	*Percent of Cases
Their own persistence	188	19.18	78.33
Their ability to work independently	169	17.24	70.42
Supervision	168	17.14	70.00
Their own resilience	115	11.73	47.92
Co-publishing with supervisors	89	9.08	37.08
Family support	55	5.61	22.92
Doctoral courses	51	5.20	21.25
Co-publication with other researchers	45	4.59	18.75
Less workload related to teaching	42	4.29	17.50
More time for the actual dissertation work	42	4.29	17.50
Working from the office	12	1.22	5.00
Working from home	4	0.41	1.67

*Indicates that this is a multiple response question, and percentages of cases do not sum to 100% because respondents could select more than one option.

TABLE 6 Most important factors in completing a PhD as reported by PhD Candidates.

Factor	n	Percent	*Percent of Cases
My own persistence	40	15.60	66.70
Supervision	37	14.50	61.70
My ability to work independently	33	12.90	55.00
My own resilience	24	9.40	40.00
Co-publishing with supervisors	20	7.80	33.30
Ending the corona pandemic	17	6.60	28.30
Working from the office	16	6.30	26.70
Family support	15	5.90	25.00
More time for the actual dissertation work	14	5.50	23.30
Doctoral courses in the PhD program	12	4.70	20.00
Doctoral courses in WNGER II	10	3.90	16.70
Less workload related to teaching	7	2.70	11.70
Working from home	6	2.30	10.00
Co-publication with other researchers	5	2.00	8.30

*Indicates that this is a multiple response question, and percentages of cases do not sum to 100% because respondents could select more than one option.

TABLE 7 Competencies PhD supervisors believe they need to increase.

Factor	n	Percent	*Percent of Cases
Increase my competence in the pedagogy of supervision	100	20.6	47.6
Methodology (quantitative, qualitative and mixed methods)	92	19	43.8
Knowledge about guidelines and regulations for doctoral education	68	14	32.4
Literature review on a doctoral level	65	13.4	31
Academic writing: Writing the synopsis in a doctoral thesis	52	10.7	24.8
Academic writing: Writing scientific articles	41	8.5	19.5
Philosophy of science	40	8.2	19
Research ethics	27	5.6	12.9

*Indicates that this is a multiple response question, and percentages of cases do not sum to 100% because respondents could select more than one option.

about formal aspects, such as guidelines, related to the PhD program. The supervisors reported that the guidelines for the doctoral program were somewhat clear, particularly those for article-based dissertations.

This perceived clarity was positively correlated ($r = 0.23$, $p = 0.002$) with the extent to which the institution offered "continuing professional development" (CPD), and 39.88% of the supervisors

stated that their institution did not provide supervisors with CPD. Thus, while many supervisors recognized the need for enhanced pedagogical and methodological skills, as well as a better understanding of formal guidelines, the availability of CPD programs was associated with clearer doctoral program guidelines. This suggests that increasing access to professional development opportunities could improve supervisors' competence and clarity regarding program requirements, ultimately benefiting the supervision process.

3.1.6 Female academics with children

About four out of ten supervisors (41.07%) agreed (to a large or very large extent) that female PhDs with children seem to have more home responsibilities than men (e.g., for childcare, household, homeschooling, own children in quarantines, etc.) during the pandemic. About three out of ten (27.77%) agreed (to a large or very large extent) that female PhDs' (with own children) submission rates to scientific journals have been delayed as a consequence of COVID-19, considering that women seem to have more home responsibilities (e.g., for childcare, household, homeschooling, own children in quarantine, etc.) during the pandemic. About two out of ten (23.64%) agreed (to a large or very large extent) that female supervisors' (with their own children) submission rates to scientific journals have been delayed as a consequence of COVID-19, considering that women seem to have more home responsibilities (e.g., for childcare, household, homeschooling, own children in quarantine, etc.) during the pandemic.

Cronbach's alpha ($\alpha = 0.87$) indicated a high level of consistency among three statements concerning the increased home responsibilities faced by female researchers with children compared to their male counterparts during the pandemic. These statements highlighted that female researchers with children appeared to bear more responsibilities at home, such as childcare, household tasks, and homeschooling, and as a result, their submission rates to scientific journals had been adversely affected by COVID-19. The average response (mean $= 3.18$, standard deviation $= 0.88$) indicated that the supervisors were generally neutral toward these statements. However, closer inspection revealed that female supervisors (mean $= 3.29$, standard deviation $= 0.92$) agreed with these statements more than male supervisors (mean $= 3.03$, standard deviation $= 0.79$), a difference that was statistically significant ($p = 0.017$) but with a small effect size (Cohen's $d = 0.30$). There was a positive correlation ($r = 0.23$, $p = 0.002$) between whether the PhD candidate had considered quitting the PhD program and the three statements, which suggests that supervisors who reported that PhD candidates had considered quitting also agreed more with the statements. Conversely, a negative correlation ($r = -0.21$, $p = 0.002$) was found between considering quitting the PhD program and the belief that the institution made sufficient efforts to compensate for the lack of progress during the pandemic, indicating that better institutional support might have reduced the likelihood of candidates considering quitting.

3.2 Qualitative part (interview data and other types of qualitative data)

We conducted a cumulative data collection process where the qualitative interview guide questions were built upon previously collected quantitative data (survey). Based on a snowballing sample (Patton, 2015), we recruited nine doctoral supervisors from the humanities, social-, and educational sciences with diverse experience and approaches to supervising PhD candidates during the pandemic. Using semi-structured interviews (Brinkmann, 2022), each supervisor was interviewed online using Zoom with interviews lasting from 30 to 60 min. All interviews were conducted in Norwegian and later transcribed verbatim. We followed Braun and Clarke's, (2019, 2021) approach to reflexive thematic analysis to analyse the interview data. The themes constructed from the analysis of the interview data focus issues, such as "The Impact of the Pandemic on Supervision," "Home Office Experience," Workload and Employer Support," "PhD Candidate Preparation for Article-Based Theses," "Competence in Supervising Article-Based Theses," and "Guidelines and Structuring the PhD Process."

3.2.1 Analyzing the interview with Kyle

Introduction: Kyle, aged 47, specializes in professional ethics. He completed his doctoral degree through a monographic thesis and is relatively new to supervising PhD candidates, currently guiding three, two of whom he is the main supervisor.

Impact of the Pandemic: Kyle wore two hats during the pandemic: as a PhD supervisor and as a leader of a doctoral program. He noted that the pandemic did not significantly impact his supervisees due to well-planned data collection that adapted to digital formats when necessary. His role as the program leader gave him broader insights into how other candidates fared, with some experiencing difficulties in recruiting interviewees and needing to adjust their research plans accordingly.

PhD Supervision During the Pandemic: Kyle's supervision was largely unaffected by the pandemic as most of it was conducted digitally, catering to students located in different parts of the country. He emphasized the importance of maintaining frequent contact, especially when usual social and professional gatherings were suspended. The pivot to online platforms like Zoom and increased digital communication tools helped maintain the continuity and quality of supervision.

Home Office Experience: Working from home was generally positive for Kyle, who appreciated the reduced distractions and the ability to maintain productivity with a well-equipped home office. However, he missed informal interactions with colleagues, which were hard to replicate through digital means.

Workload and Employer Support: Kyle experienced a slight increase in workload as more effort was required to monitor and support students remotely. His interactions with his Head of Department/direct manager were supportive, helping him navigate the challenges of remote supervision.

PhD Candidate Preparation for Article-Based Theses: Kyle observed that many PhD candidates were unprepared for the intricacies of article writing, including the lengthy processes of submission and peer review. He attributed this to their educational background, which primarily focused on monographic work at the bachelor's and master's levels.

Competence in Supervising Article-Based Theses: Although Kyle has not written a synopsis ('kappe', i.e., a synthesis chapter for article-based theses) himself, he feels prepared due to his involvement in supervisor training programs that include synopsis writing. He believes in collaborative supervision where co-supervisors with more experience in specific areas can complement his guidance.

Guidelines and Structuring the PhD Process: Kyle praised the clarity of guidelines regarding the synopsis writing at his program, highlighting proactive efforts to discuss and understand these guidelines among candidates and supervisors. He supports the idea of starting the synopsis early in the PhD journey, allowing candidates to develop a clear perspective on how their articles will integrate into their larger thesis narrative.

Summary: Kyle's approach to PhD supervision during the pandemic was proactive and adapted to the challenges of remote interactions. He emphasizes the importance of clear guidelines, structured support from the academic program, and the benefits of collaborative supervision. His perspective offers valuable insights into managing PhD supervision under crisis conditions and highlights areas for potential improvement in preparing candidates for the demands of article-based theses.

3.2.2 Analyzing the interview with Sally

Introduction: Sally, aged 46, is experienced in the field of educational sciences and professional research, having supervised 15 PhD candidates to completion. She conducted her doctoral research through an article-based thesis.

Impact of the Pandemic on PhD Candidates: Sally observed that the pandemic had a limited impact on most of her PhD candidates, except for 2–3 individuals who experienced delays, partially due to the pandemic. Disputations were delayed for some candidates who preferred physical attendance, affecting their completion timeline.

Adaptations in Supervision Methods: The pandemic made Sally diversify her supervision methods, including more frequent digital meetings with Zoom or Teams and asynchronous communications like email. She shifted from paper-based to digital comments on drafts, which enhanced the efficiency and immediacy of feedback. This change is something she intends to continue using beyond the pandemic.

Home Office Experience: Sally found working from home manageable and returned to the office as soon as feasible, particularly because she needed to balance work with family responsibilities. The transition to the home office did not significantly disrupt her supervision activities, though it introduced minor challenges like occasional distractions from family.

Increased Workload During the Pandemic: Sally reported a slight increase in her workload during the pandemic due to a need for more frequent communication to ensure the continuity and quality of supervision. This was compounded by the timing of her candidates being in critical phases of their thesis work.

Support from Employer: She felt that the focus of her institution's support during the pandemic was more on ensuring that PhD candidates were well-supported rather than directly supporting the supervisors themselves.

Preparedness of PhD Candidates: Sally noted that while the PhD candidates were generally well-prepared academically, they often lacked specific training in writing article-based theses, a significant adjustment from writing monographic theses typical at the bachelor's and master's levels.

Competence in Supervising Article-Based Theses: Sally felt confident in her ability to supervise article-based theses despite recognizing the ongoing need to adapt and learn, particularly in managing the synthesis chapter or "kappen."

Clarity of Guidelines for the Synopsis: She found the guidelines for writing the synopsis at her institution clear and involved in educational efforts to help candidates understand these guidelines better. However, she questioned whether standardization would improve understanding or unnecessarily restrict academic freedom.

Timing for Writing the Synopsis: Reflecting on her experience and current practices, Sally advocated for thinking about the synopsis early in the doctoral process but cautioned against producing extensive texts prematurely. She emphasized the importance of adapting the scope of the synopsis as the research evolves.

Use of Doctoral Committees' Guidelines: Sally observed that adherence to guidelines varies depending on whether committee members are national or international, with international members often impressed by the candidate's ability to publish in high-ranking journals.

Overall, Sally's experiences and insights provide a nuanced view of PhD supervision during the pandemic, highlighting flexibility, adaptation, and the importance of maintaining high standards of communication and support. Her approach demonstrates a balance between structured guidance and allowing academic independence, aiming to foster resilience and adaptability among her PhD candidates.

3.2.3 Analyzing the interview with Gabbie

Introduction: Gabbie, aged 54, specializes in school and teacher education. She has supervised two PhD candidates to completion and is currently guiding four others. Her doctoral thesis was article-based.

Impact of the Pandemic on PhD Candidates: Gabbie observed varied impacts of the pandemic on her PhD candidates. While two of her students were minimally affected, one faced significant challenges in data collection due to difficulties in recruiting informants. This disparity seems to have been influenced by the candidates' approaches or perhaps their personal rapport with potential informants.

Changes in Supervision Practices: The pandemic shifted Gabbie's supervision to entirely online formats using Zoom, Teams, or phone apps. While she was accustomed to digital interaction, the lack of informal, face-to-face interactions led to a more formal and structured supervision style. The spontaneous "corridor conversations" that often enhance relational aspects of supervision were missing, which she felt detracted from the personal connection in the supervisor-supervisee relationship.

Home Office Experience: Gabbie had a positive experience working from home, finding it efficient and beneficial due to eliminating commute times and the conducive environment at home for focused work. Her family setup supported this arrangement well, allowing her to balance work and home life effectively during the pandemic.

Workload Changes During the Pandemic: Her workload in terms of PhD supervision remained roughly the same, though the nature of interactions changed. Instead of impromptu office drop-ins, there were more scheduled meetings, primarily online via Zoom or Teams, which required a different kind of preparation and possibly led to more structured discussions.

Support from Employer: Gabbie noted a lack of specific support for supervisors from her employer during the pandemic; the focus was more on ensuring that she, like other staff, was generally coping with the pandemic's challenges. There was an emphasis on looking out for the PhD candidates' well-being, translating into a directive for supervisors to maintain close contact and support.

Preparedness of PhD Candidates for Article-Based Theses: Similar to Kyle and Sally, Gabbie agreed with the survey findings that many candidates are not well-prepared for writing article-based theses. She attributes this to their academic background, which primarily focuses

on monograph writing. She advocates for collaborative writing for the first article to help familiarize candidates with the process of scholarly writing and peer review.

Evaluation of Own Competence in Supervising Article-Based Theses: She feels confident in her supervisory skills but acknowledges that continuous learning and discussion with peers are essential for handling complex or unfamiliar issues that arise during supervision. Gabbie appreciates the collaborative nature of the supervisory teams at her institution, which helps in managing any gaps in her experience or knowledge.

Clarity of Guidelines for the Synopsis: Gabbie finds the guidelines for writing the synopsis to be somewhat unclear and open to interpretation, suggesting that more explicit guidelines could help, especially for those new to supervising or external committee members who evaluate the theses.

When to Start Writing the Synopsis: She recommends that PhD candidates consider the synopsis throughout their doctoral journey but compile it towards the end. Gabbie advises keeping a file of potential content for the synopsis from the start of the doctoral process, which can include discarded sections from articles or ideas that do not fit into the articles but are valuable for the overarching thesis narrative.

Overall, Gabbie's experience reflects a pragmatic and flexible approach to PhD supervision. She adapts to the demands of the pandemic while trying to maintain the quality of academic mentorship. Her strategies for managing remote supervision and her positive attitude toward the enforced changes highlight a successful adaptation to the challenges posed by the pandemic.

3.2.4 Analyzing the interview with Henrik

Introduction: Henrik, aged 46, specializes in school and educational research. He has successfully guided three PhD candidates as a primary supervisor and is supervising four more. His doctoral thesis was a monograph.

Impact of the Pandemic on PhD Candidates: Henrik noted that the pandemic affected his PhD candidates differently based on the nature of their research. Those engaged in classroom interventions faced significant challenges due to pandemic-related restrictions, particularly in accessing schools and conducting fieldwork. Conversely, candidates focused on desk-based research, such as literature reviews, experienced fewer disruptions. One of his candidates, involved in empirical research, had to receive an eight-month extension due to difficulties in data collection, exacerbated by strikes in the secondary education sector.

Changes in Supervision Practices: The transition to online supervision did not significantly affect Henrik, as he was already accustomed to conducting supervision via video conferencing tools like Teams and Zoom. However, he missed the informal, face-to-face interactions that often enrich the supervisory relationship. He noted that the absence of casual corridor conversations led to a more formal and structured online interaction.

Home Office Experience: Henrik found the exclusive home office setup challenging and detrimental to his well-being. He prefers a balance between working at the office and from home. The lack of physical interaction with colleagues and the continuous remote work environment negatively impacted his mental health, requiring him to seek professional health support.

Workload Changes During the Pandemic: Henrik reported that his workload related to PhD supervision did not increase significantly during the pandemic. However, other responsibilities became more demanding, and the overall context of working from home without the usual workplace interactions made certain tasks more difficult.

Support from Employer: There was no specific support provided by his employer concerning his role as a PhD supervisor during the pandemic. Support efforts were more generalized and not tailored to the unique challenges faced by supervisors.

Concerns for PhD Candidates: Henrik was particularly concerned about the mental health of his candidates, noting that the isolation and disruption caused by the pandemic were significant stressors. He proactively discussed these issues with his candidates, acknowledging the challenges faced by those with families and those who were isolated without a support network.

Personal Health Concerns: The pandemic had a substantial impact on Henrik's mental health, highlighting the importance of considering the well-being of supervisors along with their candidates during such crises.

Effect on Completion Times: Henrik observed that the pandemic inevitably led to delays in the completion times of his PhD candidates, with some requiring extensions. He noted a disparity in how extensions were granted, suggesting a need for more consistent criteria.

Preparation for Article-Based Theses: Henrik believes that most PhD candidates are not well-prepared to write article-based theses, as their previous academic training typically does not include writing journal articles. He spends significant time discussing the publication process with his candidates to demystify it and help them understand the expectations of journal editors and peer reviewers.

Overall Reflection: Henrik's experience reflects the diverse impacts of the pandemic on different types of research activities and highlights the importance of flexibility and support in PhD supervision. His proactive approach to discussing mental health and the structural changes in supervision practices illustrate adaptive strategies that can be beneficial in navigating future disruptions in academic settings.

3.2.5 Analyzing the interview with Luna

Introduction: Luna, aged 55, specializes in English as an Additional Language didactics. She completed her doctoral degree with an article-based thesis and has supervised a total of 11 PhD candidates, two of whom have completed their dissertations under her primary supervision.

Impact of the Pandemic on PhD Candidates: Luna discussed the varying impacts of the pandemic on her supervisees. One candidate, who was already far along in her research when the pandemic hit, was less affected in terms of supervision but faced uncertainty and stress related to her digital dissertation defense using Zoom. For two new candidates who started during the pandemic, the experience was particularly challenging. They struggled with integrating into the academic community and adapting to remote work, significantly affecting their progress and emotional well-being.

Changes in Supervision Practices: The pandemic required Luna to adapt her supervision methods, emphasizing digital communication tools and frequent check-ins via Teams, Zoom, or phone apps. She noted that these changes allowed for maintaining close communication but shifted many supervision interactions to support coping with the emotional and logistical challenges posed by the pandemic.

Home Office Experience: Luna had a positive experience working from home, which was facilitated by having enough space and a family structure that supported a conducive work environment. She did not face significant challenges balancing work and family life, which helped maintain her productivity and well-being.

Workload Changes During the Pandemic: While her direct supervision workload remained stable, Luna's role as a researcher education coordinator significantly increased her overall responsibilities. She was deeply involved in supporting a broader range of PhD candidates beyond her direct supervisees, which included mediating between candidates and their supervisors and helping navigate the challenges posed by the pandemic.

Support from Employer: Luna felt well-supported by her employer, particularly in terms of responsiveness to her needs and concerns as she navigated her roles during the pandemic. This support was crucial in managing the increased demands on her time and ensuring the well-being of the candidates for whom she was responsible.

Concerns for PhD Candidates: Luna expressed significant concern for the mental well-being of her candidates, noting that the pandemic exacerbated feelings of isolation and stress. She was particularly worried about those who could not integrate into the academic community or faced severe disruptions in their personal lives.

Personal Health Concerns: Despite managing her workload and maintaining her health, Luna acknowledged the intense pressures of her role during the pandemic, which were compounded by the high demands of her coordinator position.

Effect on Completion Times: Luna observed that the pandemic delayed completion times for many PhD candidates, with extensions being necessary but variably granted. She emphasized the importance of transparent and equitable handling of extension requests to ensure fairness.

Preparation for Article-Based Theses: Luna believes that PhD candidates are generally underprepared for writing article-based theses, attributing this to the educational focus on monographic rather than article-based work before the PhD level. She highlighted the importance of guidance in academic writing and understanding publication processes as essential components of PhD education.

Overall Reflection: Luna's experience during the pandemic underscores the critical role of adaptability in supervision, the importance of mental health support for PhD candidates, and the need for clear communication and guidelines in managing extended impacts on doctoral education. Her proactive approach to addressing these challenges reflects a comprehensive and empathetic supervision style aimed at supporting candidates through unprecedented times.

3.2.6 Analyzing the interview with Lydia

Introduction: Lydia, aged 52, specializes in educational research, focusing on professional development, assessment, and teacher education. She completed her doctoral degree through a monographic thesis and has supervised three PhD candidates to completion, with six currently under her guidance.

Impact of the Pandemic on PhD Candidates: Lydia noted that the pandemic affected the progress of her PhD candidates, especially those with young children or those who started their projects around the onset of the pandemic. The challenges of remote work and caring for family members led to minor delays in their research timelines.

Changes in Supervision Practices: For candidates who had already started their projects, Lydia managed to continue effective supervision by meeting them on campus when possible. However, starting a supervisory relationship entirely online via Zoom or Teams with new candidates presented difficulties, particularly in building rapport and trust.

Home Office Experience: Lydia found working from home to be somewhat liberating and enjoyed the quiet environment, which contrasted with the often-hectic campus life. Her home setup, which included adult family members who managed their responsibilities independently, provided a conducive environment for work without significant distractions.

Workload Changes During the Pandemic: While the actual supervision tasks did not significantly increase in time, Lydia spent more effort on providing emotional support to her candidates. Discussions often veered from academic topics to personal well-being, reflecting the heightened anxieties and social isolation experienced by the candidates.

Support from Employer: Lydia expressed disappointment with her institution's lack of direct support during the pandemic. The focus remained on expecting faculty to adapt and manage without specific interventions aimed at easing the transition to remote supervision or addressing the unique challenges posed by the pandemic.

Concerns for PhD Candidates: She was particularly concerned about the psychological well-being of her candidates, as many were navigating difficult life stages compounded by the pandemic. Lydia felt a strong responsibility to reassure them and help them maintain confidence in their ability to progress in their research.

Personal Health Concerns: Lydia did not report significant concerns about her own health, feeling relatively privileged and well-adapted to the circumstances. She maintained a positive outlook, supported by stable family dynamics and the ability to engage in outdoor activities, which helped preserve her mental well-being.

Effect on Completion Times: Acknowledging the inevitable delays caused by the pandemic, Lydia noted that extensions were likely necessary for most PhD candidates during this period. She appreciated that post-pandemic policies allowed for extensions to address disruptions, especially those related to family responsibilities.

Preparation for Article-Based Theses: Despite not having written a synopsis herself, Lydia observed that candidates often lack preparedness for writing article-based theses, a gap she attributes to the traditional focus on monographic work at earlier academic stages. She advocates for enhanced training and support for candidates transitioning to this format.

Overall Reflection: Lydia's reflections reveal a nuanced understanding of the challenges faced by PhD candidates and supervisors during the pandemic. Her approach highlights the importance of flexibility, emotional support, and the need for institutions to provide clearer guidelines and more robust support systems to adapt to such unprecedented circumstances effectively. Her experience underscores the critical role of empathy and adaptability in academic leadership during crises.

3.2.7 Analyzing the interview with Michelle

Introduction: Michelle, 41, specializes in educational science, teacher education, and language didactics. She has previously supervised five PhD students to completion and is currently the main and co-supervisor for ten PhD candidates.

Impact of the Pandemic on PhD Candidates: Michelle reported varied impacts of the pandemic on her PhD candidates. Those who were in the final stages of their research before the pandemic began experienced minimal disruptions, benefiting from the shift to remote work which allowed them more focused time for writing. However, candidates in earlier stages of their projects or those with young children faced significant challenges due to reduced childcare hours and the need to juggle multiple responsibilities.

Changes in Supervision Practices: The pandemic greatly affected Michelle's ability to provide regular supervision. With the demands of her own childcare responsibilities and the limitations of remote work, the frequency and quality of her interactions with her PhD candidates suffered. Supervision sessions were delayed, and Michelle had to adjust her practices, often conducting meetings via phone, online with Zoom or Teams, or in socially distanced outdoor settings.

Home Office Experience: Michelle found working from home to be extremely challenging, particularly due to the presence of young children and the constant interruptions that blurred the lines between work and home life. She experienced a persistent sense of being unable to adequately meet all her responsibilities as a supervisor and a parent.

Workload Changes During the Pandemic: Her workload related to PhD supervision became more demanding due to the difficulties in maintaining regular and effective communication. Michelle had to find creative ways to support her students, which often meant extended work hours and adapting to less conventional interaction methods.

Support from Employer: Michelle expressed significant disappointment with the lack of support from her employer during the pandemic. She felt that the institutions did not provide clear guidelines or additional support for managing the unique challenges brought on by the pandemic, leaving supervisors to manage as best they could under difficult circumstances.

Concerns for PhD Candidates: Michelle was particularly concerned about the psychological well-being of her candidates, noting that the isolation and disruptions affected different groups in varied ways. She observed that while parents were stressed and overextended, single young men often felt isolated and unproductive, which sometimes led to detrimental lifestyle changes.

Personal Health Concerns: Michelle mentioned that, like many in academia, she was accustomed to working excessively and did not have time to focus on her own health due to the demands of the pandemic situation.

Effect on Completion Times: Michelle anticipated that the pandemic would likely extend the completion times for many PhD candidates due to delays in data collection and the general disruption of academic schedules. She noted that while some extensions were granted, many were not, which added to the stress and uncertainty for the candidates.

Preparation for Article-Based Theses: Michelle believes that PhD candidates are generally not well-prepared to write article-based theses, which is often not addressed until during the PhD program itself. She emphasized the importance of structuring doctoral education to prepare better candidates for the realities of academic publishing and the peer review process.

Overall Reflection: Michelle's experience during the pandemic highlights the complex challenges faced by PhD supervisors. Her insights underscore the need for better institutional support and clearer guidelines to navigate such unprecedented situations. Her

commitment to adapting her supervisory practices despite personal and professional challenges demonstrates her dedication to her role and the success of her students.

3.2.8 Analyzing the interview with Ollie

Introduction: Ollie, aged 55, specializes in educational science and has completed his doctoral degree with a monograph. He has guided one PhD candidate to completion and is currently supervising three, with one about to defend their thesis.

Impact of the Pandemic on PhD Candidates: Ollie noted significant disruptions for his PhD candidates due to the pandemic. One candidate was fortunate to have completed major data collection just before lockdowns, which somewhat insulated their progress. However, others struggled as their research depended heavily on data collection in schools, which became nearly impossible due to access restrictions and subsequent strikes affecting the school system.

Changes in Supervision Practices: While the physical data collection was hindered, Ollie found digital supervision effective, especially for discussing and editing texts. He appreciated the direct focus on the text that digital platforms such as Teams or Zoom facilitated, contrasting with the sometimes-awkward setups of physical meetings. Nonetheless, the lack of access to schools for his candidates meant there was less content to supervise, which altered the dynamics of his guidance.

Home Office Experience: Ollie had a relatively positive experience working from home, appreciating the convenience and reduced commute time. He noted that being at home allowed for a more relaxed dress code and flexible work hours, although he acknowledged a potential for decreased social interaction and the blurring of work-life boundaries.

Workload Changes During the Pandemic: Ollie's workload in terms of PhD supervision remained largely the same, but the nature of the supervision changed. He spent more time helping candidates pivot their projects to adapt to the new realities, which included more discussions and finding alternative approaches to research obstacles.

Support from Employer: Ollie felt that there was a lack of specific support for PhD supervisors from his employer during the pandemic. The focus seemed to be more on undergraduate and master's students, with little attention paid to the challenges faced by PhD candidates and their supervisors.

Concerns for PhD Candidates: He was concerned about the delays and the psychological impact on his students, noting the challenges of maintaining motivation and morale under such uncertain and stressful conditions.

Personal Health Concerns: Ollie was proactive about maintaining his physical health during the pandemic, investing in ergonomic furniture to ensure comfort while working from home. He did not express concerns about his psychological health, suggesting a pragmatic approach to dealing with the pandemic's challenges.

Effect on Completion Times: He anticipated that the pandemic would significantly delay his PhD candidates' completion times, mainly due to disrupted data collection processes. Ollie stressed the importance of data quality and how difficulties in data collection could impact the overall quality of doctoral research and subsequent publication opportunities.

Overall Reflection: Ollie's insights reflect a nuanced understanding of the diverse challenges posed by the pandemic to doctoral education. His adaptation to online supervision using videoconferencing

platforms such as Zoom or Teams highlights the potential benefits of digital platforms for focused academic work, even as he recognizes the significant disruptions to traditional research pathways. His experience underscores the need for institutions to provide more robust support systems for doctoral candidates and supervisors, ensuring that doctoral training quality and integrity are maintained even in adverse circumstances.

3.2.9 Analyzing the interview with Tyler

Introduction: Tyler, aged 60, specializes in the philosophy of science, organization, and educational leadership. He completed his doctorate with a monograph and has guided two PhD candidates to completion, with four currently under his supervision.

Impact of the Pandemic on PhD Candidates: The pandemic significantly disrupted the plans of Tyler's PhD candidates, particularly affecting those involved in international collaborations and empirical research. One candidate missed a crucial research stay in Italy, impacting their opportunity to engage with an international academic community. Another had to revise their empirical approach due to restricted access to schools, which was a common issue during the pandemic.

Changes in Supervision Practices: Tyler's supervision was heavily affected by the pandemic, with all interactions moving to digital platforms, including Teams and Zoom. This shift resulted in less frequent and less personal guidance, which he felt was less effective than the planned intensive seminars abroad. Like Ollie, however, Tyler noted some benefits to digital supervision using videoconferencing platforms, such as the ability to engage with text during sessions directly.

Home Office Experience: Initially, Tyler took on additional teaching responsibilities to compensate for colleagues struggling with digital formats, which increased his workload. Over time, he found a rhythm of working from home and even appreciated the focused time that allowed him to complete a book. He alternated working from home and the office, leveraging the strengths of both environments to maintain productivity.

Workload Changes During the Pandemic: Tyler's workload in terms of PhD supervision did not increase significantly. Digital Teams or Zoom meetings tended to be shorter and more focused, which somewhat compensated for the increased preparatory work required for effective digital instruction.

Support from Employer: Tyler expressed frustration with his institution's management during the pandemic, particularly concerning doctoral courses and the increased bureaucratic oversight that he felt stifled academic freedom. He noted a lack of focus on the needs of PhD supervisors and candidates compared to other groups within the university.

Concerns for PhD Candidates: While not overly concerned about the mental and physical health of his candidates, Tyler was worried about the practical aspects of their research, especially those needing to conduct fieldwork, which was severely impacted by the pandemic restrictions.

Personal Health Concerns: Tyler did not express particular concerns about his health; however, he took proactive measures to ensure a comfortable working environment by investing in ergonomic office equipment.

Effect on Completion Times: Tyler anticipated that the pandemic would extend the completion times for his PhD candidates, especially due to disruptions in data collection and the broader impact on academic research activities.

Overall Reflection: Tyler's experiences reflect the complex challenges faced by academic supervisors during the pandemic, balancing the shift to digital platforms with maintaining academic rigor and support for their candidates. His story highlights the need for institutions to provide better support and flexibility for supervisors and PhD candidates during crises, ensuring that academic standards and well-being are maintained. Tyler's ability to adapt and find personal benefits during the pandemic, such as completing a book, also underscores the potential for finding opportunities in the face of challenges.

3.2.10 Comprehensive analysis of the Main findings across nine interviews of doctoral supervisors in Norway

3.2.10.1 Overview

This analysis integrates the findings from interviews with nine doctoral supervisors in Norway, structured by the interview guide (based on the main findings from the survey) and analyzed using Braun and Clarke's (2021) approach to reflexive thematic analysis. The analysis focuses on how the COVID-19 pandemic affected the progression of PhD candidates and the corresponding changes in supervision practices.

Main Themes Identified:

1. Impact of the Pandemic on PhD Progression:
- **Disruptions in Data Collection**: Most supervisors reported significant disruptions in their candidates' ability to collect data, especially those requiring access to external facilities like schools or international institutions. This was primarily due to lockdowns and restrictions imposed to curb the spread of the virus. As one supervisor noted: "One of my candidates had to delay their project significantly due to the inability to collect data as schools were not accessible." (Ollie)
- **Adaptations in Research Plans**: Many candidates had to alter their research methodologies or adjust their empirical scopes to suit the new constraints, highlighting the flexibility required under crisis conditions. However, one of the supervisors mentioned that: "It affected them very differently. I had three candidates before the pandemic, and two of them were barely affected. However, the third struggled significantly with data collection due to difficulties in recruiting informants." (Gabbie)

2. Changes in Supervision Practices:
- **Shift to Digital Supervision**: All supervisors transitioned to online platforms for conducting supervision, such as Zoom, Teams, or phone apps (e.g., Facebook Messenger, WhatsApp). While some found digital tools effective for sharing and reviewing written work, others felt the lack of physical presence reduced the quality of interaction and guidance they could provide. As one supervisor noted: "Digital supervision worked very well because it allowed sharing and discussing texts more effectively than in-person meetings. This actually enhanced the focus on the text during sessions" (Ollie).
- **Increased Need for Emotional Support**: Supervisors noted an increased need to support the psychological well-being of their

candidates, as many struggled with isolation and stress due to the pandemic. As one supervisor noted: "I was particularly attentive to the mental health of my candidates, especially those without local family support. Regular check-ins were crucial during this period" (Gabbie).

3. Work Environment and Work-Life Balance:

- **Home Office Challenges**: Responses about working from home were mixed; some supervisors appreciated the flexibility and reduced commute times, while others struggled with distractions and the blending of personal and professional spaces. As one supervisor mentioned: "I actually enjoyed working from home as it provided a peaceful environment, but I missed the informal interactions with colleagues." (Lydia)
- **Institutional Support**: There was a notable lack of targeted support for supervisors from their institutions. This often left supervisors and their candidates feeling overlooked in broader university responses to the pandemic. As one supervisor noted: "There was no specific support for me as a PhD supervisor during the pandemic. The general support was the same as for all staff members" (Lydia).

4. Professional Development and Academic Output:

- **Delays in Academic Milestones**: The pandemic delayed key academic milestones, including thesis submissions and defenses, primarily due to halted data collection and extended research timelines.
- **Publication Challenges**: The disruption also impacted candidates' abilities to publish their research, a crucial component of their academic careers, due to delays and changes in their research projects.

Integration of Findings with Saldaña's Coding Framework and Interview Guide:

- Using Saldaña's coding method allowed for identifying recurring challenges and adaptations among the supervisors' experiences. The thematic analysis revealed a consistent need for increased flexibility in research planning and supervision methods.
- The interview guide helped maintain a focus on how the pandemic specifically impacted various aspects of PhD supervision and candidate progression. It ensured that all relevant areas, such as changes in work routines, supervision adjustments, and overall impacts on PhD timelines, were systematically explored.

Comprehensive Assessment: The interviews collectively underscore the resilience and adaptability required by PhD candidates and their supervisors during the pandemic. They highlight several areas for improvement:

- **Enhanced Institutional Support**: Institutions clearly need to provide more structured support tailored to the needs of PhD candidates and supervisors during crises.
- **Flexibility in Research and Supervision Plans**: Adapting research plans and supervision methods to accommodate unexpected disruptions is crucial for maintaining the integrity and continuity of PhD education.

- **Focus on Mental Health**: The increased emotional and psychological support needed by candidates suggests that institutions should integrate mental health resources more fully into their doctoral training programs.
- **Preparedness and Training**: The experience has shown the importance of preparing PhD candidates for unexpected changes in their research environment, including training in digital tools and remote research methodologies.

In conclusion, the pandemic has not only disrupted traditional PhD education paths but also provided insights into how flexibility, digital preparedness, and institutional support can be enhanced to better prepare for future crises. These insights are vital for shaping resilient and adaptive academic environments that can withstand global challenges while supporting doctoral candidates' academic and personal well-being.

From the analysis of the nine interviews, a few aspects stood out as particularly notable, offering deeper insights (expansion) into the unique challenges and responses within the context of PhD supervision during the pandemic:

1. Resilience and Innovation in Supervision:

- Some supervisors noted that despite the significant challenges, the shift to digital platforms allowed them to explore new forms of engagement with texts and supervision methods. For example, one supervisor highlighted the effectiveness of digital tools for collaborative work on documents, suggesting that these might even surpass traditional face-to-face interactions in certain aspects. This adaptation was a positive takeaway that some found surprising and worth integrating into their post-pandemic practices.

2. Diverse Impacts on Different Research Types:

- The differential impact of the pandemic on empirical versus theoretical research was striking. Supervisors of candidates who needed to conduct fieldwork, especially in schools or abroad, faced severe disruptions. As one supervisor noted: "We had to adjust research plans significantly, shifting to alternative data sources and methods where possible." (Kyle). In contrast, those whose work was more theoretical or could be conducted remotely experienced fewer setbacks. This variance highlighted certain types of research vulnerability to external disruptions, which was a notable point of concern.

3. Underestimation of Emotional Challenges:

- Another well known, but still important aspect was the depth of emotional and psychological impacts on PhD candidates as noted by their supervisors. The extent to which these challenges affected the candidates' productivity and well-being was significant and perhaps underappreciated by the institutions themselves. This underscores a critical area for future academic support systems to address more robustly.

4. Lack of Institutional Support:

- The widespread sentiment of insufficient institutional support was particularly striking. Several supervisors felt that there was a lack of targeted strategies to support PhD supervision during the pandemic. This lack of support was not just in terms of

transitioning to online modes but also in addressing the specific needs of PhD candidates and their projects during such a disruptive period.

5. The Positive Impact of Forced Adaptation:

- Interestingly, some supervisors pointed out that the forced adaptation to new circumstances led to unexpected benefits, such as enhanced focus and productivity in certain cases, and even opportunities for personal and professional growth, such as writing a book or developing new teaching methods. These outcomes, while not universal, were surprising positives that emerged from a generally challenging time.

The sentiment analysis of the 9 interviews (see attachment 4 in the Supplementary file) showed some individual variations, but that resilience and adaptability among doctoral supervisors during the pandemic were quite common. Supervisors recognized the challenges but overall maintained a positive and proactive stance, focusing on solutions and effective management of their supervisory roles. The objective nature of their responses indicates a practical approach to dealing with the pandemic's impact, emphasizing the importance of communication, adaptation to remote supervision, and institutional support.

These insights not only highlight the varied experiences of PhD supervisors during the pandemic but also suggest areas for improvement in how institutions support doctoral education in times of crisis. The resilience and innovative approaches developed during this period could inform future policies and practices to better support PhD candidates and supervisors alike.

3.2.11 Integrated analysis: the main findings from the interviews and the open survey responses

To integrate and analyze the findings from the interviews (see attachment 1) and the 1,483 open survey responses (see attachment 2) from the survey among 293 doctoral supervisors, we can draw on several key themes and concerns that emerge consistently across these data sources. This approach will help us understand the broader implications of the insights gathered from different perspectives within the same study.

1. Adaptation to Digital Tools and Platforms:

- **Interviews**: The interviews highlighted how supervisors adapted to using digital tools for communication and supervision. This was generally seen as effective but lacking in certain qualitative aspects, particularly in building deeper relationships and managing more nuanced discussions.
- **Open Survey Responses**: The survey also reflected a reliance on digital tools, with many supervisors recognizing their utility in maintaining continuity. However, there was also an acknowledgment of the challenges in fully replicating face-to-face interactions.

2. Ethical and Practical Concerns with Digital Supervision:

- **Interviews**: Concerns were raised about the relational and ethical implications of the lack of physical presence and interaction, and the extensive use of digital tools in academic settings during the pandemic.

- **Open Survey Responses**: Similar concerns were noted, with supervisors emphasizing the importance of ensuring academic integrity and the genuine intellectual development of PhD candidates.

3. Impact of the Pandemic on Supervisory Practices:

- **Interviews**: The pandemic's impact was a significant theme, affecting the logistical aspects of supervision and the mental well-being of both supervisors and their candidates.
- **Open Survey Responses**: Responses indicated varied impacts of the pandemic, with some supervisors noting increased stress and difficulty in maintaining research productivity and supervisory quality.

4. Institutional Support and Professional Development:

- **Interviews**: There was a noted lack of sufficient institutional support for adapting to new modes of supervision and research during the pandemic.
- **Open Survey Responses**: This theme was echoed in the survey responses, with mixed reports about the availability and effectiveness of continuing professional development (CPD) related to research supervision. Some respondents felt unsupported, particularly in navigating the challenges posed by remote supervision and digital tools.

5. Preparedness of PhD Candidates:

- **Interviews**: Discussions highlighted concerns about the varying levels of preparedness among PhD candidates, especially in writing the synopsis and adapting to new research methodologies that include digital tools and remote data collection.
- **Open Survey Responses**: Supervisors expressed a range of experiences regarding candidate preparedness. While some noted their candidates were well-equipped, others pointed out significant gaps, especially in writing the synopsis and article-based theses and handling the referee process, the timeline and complex research independently.

6. Valuation of Supervision:

- **Interviews**: Supervisors discussed feeling that their efforts were not adequately valued by institutions, with a need for greater recognition and support for their roles.
- **Open Survey Responses**: This sentiment was reinforced by survey data, where some supervisors felt that their contributions to doctoral training were undervalued by their institutions, particularly when compared to other academic duties.

7. Suggestions for Institutional Changes:

- **Interviews**: There were calls for institutions to adapt more proactively to the changing landscape of doctoral education, including better training for using digital tools and more robust support systems for both supervisors and candidates.
- **Open Survey Responses**: Supervisors suggested various improvements, such as more structured professional development opportunities, better guidelines for remote supervision, and enhanced support for mental health and well-being.

3.2.12 Summary

The integrated analysis across interviews and open survey responses suggests a complex landscape of doctoral supervision during and potentially beyond the pandemic era. Key themes highlight both challenges and potential areas for policy and practice enhancements:

- **Digital Adaptation and Ethical Concerns**: While digital tools have provided necessary solutions for continuity in supervision, they bring up ethical concerns that institutions need to address more thoroughly, particularly concerning academic integrity and the quality of student learning.
- **Support and Development Needs**: There is a clear need for institutions to offer more targeted support and development opportunities for supervisors, addressing both the technical aspects of digital supervision and the broader pedagogical skills required in a changing academic environment.
- **Recognition and Valuation of Supervision**: Supervisors feel that their work is not sufficiently valued, suggesting that institutions should reevaluate how they recognize and support supervisory roles within the academic career framework.
- **Candidate Preparedness**: There is variability in how prepared PhD candidates are for the demands of modern doctoral research, indicating the need for more robust preparatory programs and entry assessments.

These insights call for a strategic reassessment of doctoral training programs, supervisory support mechanisms, and institutional policies to better align with the evolving needs of both supervisors and their candidates.

4 Limitations and future research

The present study provides in-depths insights into PhD supervision during the pandemic; however, the study also has several limitations apart from inherited limitations of self-reports and interview data. Firstly, the findings might be context-specific to the educational setting in Norway. The unique characteristics of the Norwegian educational system, cultural aspects, and institutional structures may not be entirely generalizable to other countries. However, the globalization of doctoral education, with increasing international collaborations, international publishing, and standardization of academic practices, might mitigate this issue to some extent, making the findings relevant beyond the Norwegian context. Secondly, the study lacks data on PhD supervisors' experiences prior to the pandemic. This absence of baseline data means we cannot directly compare the pre-pandemic and pandemic periods. Nonetheless, the experiences reported in this study correspond well with prior research on academic supervision (Pyhältö et al., 2012, 2023; Löfström et al., 2024), indicating that the challenges and adaptations observed are not entirely unprecedented, even if intensified by the pandemic context.

Future research should aim to explore the long-lasting impacts of COVID-19 on doctoral education. It is necessary to investigate whether the changes observed in supervisory practices during the pandemic are fleeting or have led to a permanent shift in how supervision is approached. Specifically, studies should examine if new models of remote supervision, increased flexibility, and the use of digital tools will continue to be integrated into doctoral education

post-pandemic, or if traditional methods will resume dominance. This is of special interest in cases where PhD supervisors and PhD candidates are located at different institutions. By addressing these questions, future research can contribute to a deeper understanding of the pandemic's legacy on doctoral education.

5 Conclusion

In this article we examined the experiences of PhD supervisors in Norway during the pandemic to answer the research questions:

1. To what extent has the COVID-19 pandemic impeded the PhD supervisors' frame factors on the micro- level, and how do they perceive this situation?
2. To what extent has the COVID-19 pandemic influenced PhD supervisors' frame factors on the meso- level, and how do they perceive this situation?
3. How do the PhD-supervisors experience the more general aspects of their supervision role during and after the pandemic?

We conducted a cumulative data collection process and analysis, where survey questions were based on previously collected field dialog data, online observation data, seminar evaluation data, and document analysis data. The qualitative interview guide questions were built upon previously collected quantitative data (survey), and the Supplementary data was based on previously collected quantitative data (survey) and qualitative interview data.

The coherence between qualitative and quantitative findings is mainly examined based on *confirmation*, *expansion*, or *discordance* in this article (Fetters et al., 2013).

The findings from the explorative case study revealed that the PhD supervisors faced numerous challenges during the pandemic, both professionally and personally. They found digital supervision with their PhD fellows via platforms like Teams and Zoom to be convenient and efficient but occasionally lacking in quality. They also encountered difficulties in addressing the psychosocial aspects of their PhD candidates' experiences and faced various research-related challenges with their PhD-candidates during the pandemic. For PhD supervisors who extensively worked from home over a long period, the situation created new conditions that affected their job performance. These altered conditions hindered their research capacity, their ability to follow up with their PhD candidates and their capacity to fulfill other job responsibilities. Although the PhD supervisors received support during the pandemic, it seems that the incremental measures provided were insufficient. The PhD regulations were established before the pandemic under normal conditions and for normal circumstances. However, it appears that no significant adjustments have been made to accommodate the extraordinary pandemic conditions, which have altered some aspects of their professional roles as academics and PhD supervisors. This was particularly critical for PhD supervisors with young children, especially female supervisors, who had to deal with lockdowns, social distancing, remote work, homeschooling, quarantine for themselves and their children, and COVID-19 illness, since the data showed that they seemed to have more home responsibilities than men during the pandemic. We also found that some supervisors thought that female PhDs' (with own children) submission rates to scientific journals have been delayed as a

consequence of COVID-19, considering that women seem to have more home responsibilities. In addition, the supervisors thought that female supervisors (with own children) submission rates to scientific journals have been delayed as a consequence of COVID-19, considering that female supervisors seem also to have more home responsibilities (e.g., for childcare, household etc.).

This slow-motion disaster lasted up to 20 months and can be perceived as an "external intervention" or a naturalistic experiment which was impossible to predict for universities and society. The case study results indicate that it is more important than ever to plan for the unforeseen in order to be better prepared for the next societal crisis. Therefore, it is important to be vigilant and understand the gap between the formulation, transformation, and realization arenas when it comes to the distinction between incremental, semi-structural changes and fundamental changes in PhD regulations and guidelines brought on by societal crises. Although some support from employers has been offered, the overall PhD guidelines, regulations, and supervision norms remained unchanged in the transformation arena (meso- level) during the pandemic. On a general level, this highlights the need for better crisis preparedness at the doctoral level in the years to come.

A common finding related to RQ1 and RQ2 and across the different data sources was that the COVID-19 pandemic has significantly impacted some of the PhD supervisors in different ways on both micro- and meso-levels, and some of them perceive this long-lasting pandemic challenging and difficult, while others have experienced this to a lesser degree. This reveals a confirmation across the quantitative and qualitative data in the study. Also, these findings mostly confirmed and expanded on the understanding of the impact of the pandemic on PhD candidates (Krumsvik et al., 2022), with some minor discordance.

More specifically, the PhD supervisors in the study were somewhat satisfied with the educational quality regarding digital teaching but experienced various supervision, research-related and psycho-social challenges. Although some of the supervisors received support during the pandemic, it seems like the majority did not receive sufficient support and their workload increased significantly during the pandemic. This is due to the high complexity of frame factors that have changed the underlying premises for doctoral education during the pandemic, affecting both the PhD- supervision and the PhD candidates' feasibility on several levels. The regulations for PhD scholarships and PhD regulations, implemented before the pandemic in 2018, were designed under *normal* educational and social conditions and may not fully address the challenges faced during the pandemic. Therefore, this study shows that to reduce this gap and strengthen the feasibility of the PhDs and the frame factors for PhD-supervision, the institutions must significantly enhance their preparedness to effectively manage demanding situations at both micro- and meso-levels, ensuring they are fully equipped to address future societal crises of a similar nature.

When it comes to RQ3 we find both confirmation, expansion, and discordance across the quantitative and qualitative data. We find confirmation across the quantitative and qualitative data when it comes to the variability in preparedness of PhD candidates for writing the article-based thesis. Article-based theses present unique challenges compared to traditional monograph-based dissertations, particularly in terms of integration and the breadth of skills required. One of the primary challenges with article-based theses is integrating articles that may cover slightly different aspects of a research topic into a coherent

overall thesis. This integration is critical, it requires a high level of academic writing skills and ability to secure the coherence of the synopsis. Candidates often come into PhD programs with varying levels of experience in academic writing and publication. The survey and interviews, as well as Supplementary data, indicate that many candidates are not well-prepared for writing article-based theses, highlighting a need for more targeted training in academic writing and publishing early in the doctoral process. The need for robust supervisory support is acutely felt in guiding article-based theses, where candidates must navigate the complexities of publishing in peer-reviewed journals alongside synthesizing their research in the synopsis. This implies that PhD-candidates both are taking a doctoral degree in the Norwegian context and at the same time are publishing articles for the international research context, which can be challenging.

We find expansion when it comes to the need to have guidelines for the synopsis. Supervisors reported significant variation in the guidelines for the synopsis across institutions, both in the qualitative and quantitative part, which can lead to confusion and inconsistency in expectations for candidates and supervisors. Some respondents found these guidelines sufficient, while others find them unclear or obscure, complicating their task of effectively guiding PhD candidates. Clear, comprehensible guidelines are essential for ensuring that the synopsis effectively synthesizes the research in a manner that meets academic standards (Wollenschläger et al., 2016).

And we find some discordance regarding variability in candidate preparedness where both strands of the data indicated a significant variability in how prepared PhD candidates are when they enroll in doctoral programs. Candidates' preparedness often depends on their previous educational experiences, which can vary widely regarding exposure to research methods, academic writing, and critical thinking skills. The variability in preparedness suggests a need for more robust preparatory programs to equip all incoming doctoral candidates with the necessary skills and knowledge to succeed in their research endeavors. Implementing comprehensive entry assessments could help identify specific areas where candidates might need additional support, allowing programs to tailor preparatory courses or early doctoral training to address these gaps.

These findings collectively point to a need for doctoral programs to clarify guidelines, particularly for the synopsis in article-based theses, to enhance support for supervisory roles, and to develop preparatory programs that address the broad variability in candidate preparedness. This is also based on research on the need for *rubrics* (Wollenschläger et al., 2016), which shows that transparency around requirements and guidelines is important for students learning. By tackling these issues, institutions can better prepare PhD candidates for the demands of modern doctoral research, ultimately leading to more consistent and successful outcomes in doctoral education. And despite that only 20 (8.3%) of the supervisors agreed or strongly agreed that they were supervising a PhD candidate who had considered quitting the PhD program during the pandemic, it is important to be vigilant around the (complex) reasons that causes this, since this is in many ways a drastic decision, first of all for the candidate themselves, but also for the supervisors, as well as for the society in general who has invested almost 5 million Norwegian kroner in each PhD-scholarship. Dropping out can partly be related to the observed findings that many PhD candidates were unprepared for the intricacies of article writing, including the lengthy processes of submission and peer review, attached to their educational background, which primarily

focused on monographic work at the bachelor's and master's levels. This also implies that while PhD's are perceived, assessed and evaluated as student/candidates when they are completing assignments in a doctoral program, there might be a quite new situation for them when they submit their articles to scientific journals with blind review, where they are evaluated as other researchers (and not only as students/candidates). Such findings (and similar findings) seem to go "under the radar" in doctoral programs in Norway and by taking into account such "tacit knowledge" we might be better prepared to bridge the formulation arena and realization arena within doctoral education in the years to come. This development also demands a vigilance within doctoral education of the importance of theory development within doctoral education since international research shows that doctoral supervision is under-theorized and lacks a solid knowledge base (Halse and Malfroy, 2010; Halse, 2011) where also eclectic use of theories (Dalland et al., 2023) can improve this area.

Author note

GPT-4o (OpenAI, 2024) was employed in this article to translate interview findings to English after a general thematic analysis conducted in Norwegian and as one of several validity communities for the open survey responses. The GPT-4's output was manually examined, edited, and reviewed by the authors. The sentiment analysis of the 9 interviews was done by the first author and by using the GPT-4o. Then it was carried out a validation of this sentiment analysis by SurveyMonkey (SurveyMonkey, 2024), Claude (Anthropic, 2024) and Gemini Advanced (Google, 2024).

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.

Author contributions

RK: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. FR: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing – review & editing, Writing – original draft. ØSk: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing. LJ: Conceptualization, Data curation, Methodology, Validation, Writing – original draft, Writing – review & editing. SS: Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. ØSa: Data curation, Validation, Writing – original draft, Writing – review & editing. KH: Methodology, Validation, Writing – original draft, Writing – review & editing.

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 author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1436521/full#supplementary-material

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