



Teacher Educators' Professional Digital Competence in Primary and Lower Secondary School Teacher Education

Fredrik Mørk Røkenes

Associate professor, Department of Teacher Education, Norwegian University of Science and Technology

Fredrik.rokenes@ntnu.no

Ruth Grütters

Associate professor, Department of Teacher Education, Norwegian University of Science and Technology

Cecilie Skaalvik

Assistant professor, Department of Teacher Education, Norwegian University of Science and Technology

Tove Grete Lie

Associate professor, Department of Teacher Education, Norwegian University of Science and Technology

Ove Østerlie

Associate professor, Department of Teacher Education, Norwegian University of Science and Technology

Anna Järnerot

Assistant professor, Department of Teacher Education, Norwegian University of Science and Technology

Kristoffer Humphrey

Assistant professor, Department of Teacher Education, Norwegian University of Science and Technology

Øistein Gjøvik

Assistant professor, Department of Teacher Education, Norwegian University of Science and Technology

Mari-Ann Letnes

Associate professor, Department of Teacher Education, Norwegian University of Science and Technology

Abstract

This study examines teacher educators' experiences with a professional development program—the Digitalization of Primary and Lower Secondary School Teacher Education (DigGiLU) project—offered at a Norwegian teacher education institution. A qualitative case study design was used, which incorporated semi-structured focus groups with 20 teacher educators ($N = 20$). The results show that teacher educators reported an increased awareness of the role of technology in teaching and learning. The participants underscored collegial knowledge-sharing activities involving the purposeful use of digital technology and collegial coaching with section coordinators as the most valuable aspects of professional development. The implications of these findings for teacher education are discussed.

Keywords

teacher education, professional digital competence, professional development, case study
focus groups

Introduction

Over the last decade, there has been significant growth in the research on information and communications technology (ICT) and digital competence in Norwegian schools (Fjørtoft et al., 2019; Krumsvik et al., 2013). The COVID-19 pandemic has further fueled the ongoing digitalization process in education, emphasizing the need for more research (Carrillo & Flores, 2020; Darling-Hammond & Hylar, 2020; Hodges et al., 2020). However, professional digital competence (PDC) in Norwegian teacher education remains an under-researched area (Daus et al., 2019; Hjukse et al., 2020; Lund & Aagaard, 2020). Currently, student teachers (STs) are expected to develop PDC through campus-based activities both during their school practicum and after graduating from their teacher education program (Instefjord & Munthe, 2017; Lund & Aagaard, 2020; Røkenes & Krumsvik, 2016). Hence, teacher educators (TEs) are expected to know how to use digital technology in their subject-disciplinary teaching; they are also expected to model for STs some sound pedagogical and didactical methods that these technologies can have for teaching and learning in schools (Carpenter et al., 2020; Lindfors et al., 2021). However, TEs have been largely overlooked in the research on the digitalization of teacher education, and little is known about how they develop PDC (Lund et al., 2014). To fill this knowledge gap, the current case study examines TEs' PDC development in a Norwegian teacher education institution. The purpose is to investigate and discuss TEs' experiences with the Digitalization of Primary and Lower Secondary School Teacher Education (DigGiLU) Online, a semester-long online PDC development program. The research question explored in the study is: *what experiences do teacher educators report having from a professional digital competence development program?*

Background

In an educational context, *digital competence* is often referred to as the knowledge, skills, creativity, and attitudes regarding how teachers, TEs, and STs can use digital technology for teaching and learning (Krumsvik, 2014). In Norway, *professional* has been added to the term to explicitly focus on the requirements of using digital technology in the teaching profession (Lund et al., 2014). In this sense, PDC can be understood as the “teacher/TE’s proficiency in using ICT in a professional context with good pedagogic-didactic judgment and his or her awareness of its implications for learning strategies and the digital Bildung of pupils and students” (Krumsvik, 2011, pp. 44-45). Lund et al. (2014) further elaborated on PDC in teacher education:

Move away from understanding digital competence as a set of generic skills suitable for all situations, both personal and professional, and toward an understanding of PDC that includes both generic and specific teaching profession skills. In the case of teacher education, PDC involves teachers not only appropriating technologies, but also making their learners appropriate them and put them to productive use. (pp. 283–284)

With the *Professional Digital Competence Framework for Teachers* (Kelentrić et al., 2017), more attention has been paid to the possibilities, challenges, and consequences that digital technology can have for teaching and learning in schools. Here, the concept of the added pedagogical value and purposeful use of digital technology is often referred to by educators. According to Holmberg et al. (2018), this entails using ICT “to support learning in ways that would not be possible without it” (Holmberg et al., 2018, p. 131). As a result, the focus has also been directed at TEs, who are responsible for preparing future teachers to

teach in today's technology-rich schools (Lund et al., 2014). However, several evaluations of Norwegian teacher education have noted the lack of focus on the purposeful use of digital technology; these studies have concluded that TEs should model how digital tools can add pedagogical value in subject-disciplinary learning (Daus et al., 2019; Tømte et al., 2013). Furthermore, few studies have focused on developing STs' and TEs' PDC in Norwegian teacher education (Instefjord & Munthe, 2017; Lund & Aagaard, 2020; Røkenes & Krumsvik, 2016). Thus, there is a knowledge gap in the literature regarding the activities, models, and structures that can promote PDC in TE.

Internationally, increased attention has been paid to what TEs should know relating to the purposeful use of digital technology for teaching and learning (Baek et al., 2018; Carpenter et al., 2020; Foulger et al., 2017). In the US, Foulger et al. (2017) developed the 12 teacher educator technology competencies (TECTs) "that comprise the knowledge, skills, and attitudes *all* teacher educators need in order to best support teacher candidates as they become technology-using teachers" (Foulger et al., 2017, p. 418). The TECTs include TE modeling approaches that prepare STs to effectively use technologies, online tools to support teaching and learning, and appropriate assessment technologies. Studies on Norwegian TEs have focused on reducing the barriers to digital technology uptake in teaching or understanding TEs' beliefs, motivation, and attitudes toward technology integration and PDC (Instefjord & Munthe, 2017; Madsen et al., 2018). However, the development of TEs' PDC has been mainly overlooked in the literature among the Nordic countries, despite research acknowledging their role in modeling ICT and developing STs' PDC (Lindfors et al., 2021; Lund et al., 2014; Røkenes & Krumsvik, 2016).

Although the content and foci of professional development programs focusing in technology might differ, a common trait is that they are usually organized as massive open online courses (MOOCs), physical seminars and workshops, or blended courses (Langseth et al., 2018). Here, instruction is given by local experts and enthusiasts, EdTech consultants, or campus support personnel or teams dealing specifically with supporting teaching in higher education, such as how to make the move to online teaching (Hodges et al., 2020). Although local experts and enthusiasts might offer practical instructions and relevant experience that can build on local knowledge, relying on them in the long term is, however, often unsustainable. Moreover, EdTech consultants and higher education support units are often focused on providing technical rather than pedagogical support and are not usually adapted to the needs of teacher education. An alternative approach to providing instruction in professional development is to train faculty members to act as collegial coaches and facilitators of the learning activity. Terry et al. (2019) examined the UK National Institute for Health and Care Excellence's (NICE) student champion scheme (NICE SCS), the strategy of which aimed to "train health care students to deliver digital literacy sessions on using the NICE Evidence Search engine to peers" (Terry et al., 2019, p. 192). The findings show that the student champions experienced personal and professional development benefits in their digital literacy including knowledge transfer and designing and leading peer-teaching sessions on using the NICE search engine. Likewise, Grant et al. (2015, p. 39) argued that for a technology integration effort to be successful, there is a need for "key individuals and administrators to champion" the initiative. In the development of PDC, the TEs could act as administrators or coordinators to lead and tailor professional development based on colleagues' experiences, beliefs, and immediate needs (Baek et al., 2018). Similarly, our study builds on and contributes to the literature on the use of collegial coaching for technology professional development in teacher education.

Methodology

Study context

The present study focuses on the three-year research and development project DigGiLU at the Department of Teacher Education (2018–2020) at the Norwegian University of Science and Technology (NTNU). The overall aim was to provide professional development in PDC for the TEs. In turn, the TEs could prepare the STs for the demands of the Norwegian National Curricula for Knowledge Promotion 2020 (LK20). In LK20, the use of digital technologies is expected in the ways teachers intend to operationalize competence aims, deep learning, cross-curricular topics, and assessments (Norwegian Directorate for Education and Training, 2020).

To meet the project goals, 146 TEs (N = 146) out of the approximately 400 TEs working at the department were offered a semester-long online PDC development program: DigGiLU Online. The project funds from DigGiLU were used to buy out the TEs' time from regular teaching, which was estimated at 155 hours' worth of teaching (equivalent to teaching a 7.5-credit course). The section leaders, representing nine different subject-disciplinary sections, and who were in control of the faculty's work-related tasks, were tasked with selecting TEs eligible to reduce their teaching load to take professional development.

The online course platform edX was used by the TEs. Using edX, the TEs had to individually study five modules (in Norwegian) that included research articles, text-based lessons, video lectures, and tutorials of various applications:

1. Teaching profession in times of digitalization: The first module addresses teacher education as a profession in a digital age, where the concept of PDC is introduced and discussed. The module brings up relevant pedagogical theories of teaching and learning, leading up to activities that are linked to recommended readings on the topic, from which the participants must critically reflect on their own role as TEs and digital role models.
2. Subject-disciplinary use of ICT: The second module discusses both general and subject-related aspects and theories related to teaching and learning with ICT, followed by the practical activities tied to each subject discipline that the participants need to try out in their own teaching practice.
3. Leadership of learning in digital environments: The third module relates to research on classroom management in technology-rich environments to the school practicum component in teacher education. The module ends with the reflection activities tied to mentoring the STs during their field experience.
4. Pupils' digital world: The fourth module examines pupils' in- and out-of-school practices with digital technologies, linking these practices to contemporary learning theories. In the module, the participants are required to interview pupils about their digital lifeworld and connect what the students said to how these digital practices might be relevant for the STs.
5. Future learning environments: The fifth module explores current trends in alternative learning environments beyond the traditional physical classroom, where the participants are tasked with imagining and designing a future classroom or learning lab for use in their own teaching.

Each module included an activity requiring the TEs to meet up with other participants, physically or virtually, to share their experiences and reflect on using digital technologies in their teaching. The activities were led by section coordinators, and conducted through

Microsoft Teams and physical meetings. The participants were asked to use about 80 hours for reviewing the content of the online resource, and the remaining 75 hours on completing the module tasks, participating in seminars, and applying what they had learned to their own teaching practice. At the end of the program, a final seminar was arranged between two different sections to share their experiences and reflections across subject disciplines. To be approved as professional development, the TEs had to participate in all the knowledge-sharing seminars. In addition, the TEs had to post an entry on a wiki platform—Confluence—where they described and reflected on a technology-enhanced lesson plan. A course diploma was issued after completing DigGiLU Online.

Research design

A case study was used as the research design. Yin (2014) argued that a case study is “an empirical inquiry that investigates a contemporary phenomenon (the ‘case’) in depth and within its real-world context, especially when the boundaries between the phenomenon and context may not be clearly evident” (Yin, 2014, p. 16). The case in the current qualitative study, that is, the boundaries, focus, and extent of the research, was on the TEs’ experiences with the activities in DigGiLU Online at NTNU. As the current study’s authors also participated in developing DigGiLU Online, we chose the case because the professional digital competence development activities are unique in a Norwegian TE context. TEs from all four cohorts who had participated in DigGiLU Online were invited to participate in the study (Table 1). The study was approved by the Norwegian Centre for Research Data (NSD). Participation was voluntary, and the participants could withdraw their consent at any point and have their data anonymized.

Table 1 Overview of the TEs participating in DigGiLU Online (N = 146)

Participants (<i>n</i>)	Semester			
	Spring 2019	Fall 2019	Spring 2020*	Fall 2020*
	52	53	34	7

* Because of COVID-19 during the spring of 2020, several participants who participated in DigGiLU Online Spring 2020 chose to delay their participation to the fall 2020 semester.

Focus groups

Out of the 146 TEs who had taken DigGiLU Online, 20 TEs ($N = 20$, female = 14, male = 6) from various subject-disciplinary sections were recruited (Table 2). Recruitment was based on a purposeful sample, here utilizing qualifications (i.e., subject discipline, teaching experience, gender) and an accessibility sample based on written consent to participate in the study and availability (Patton, 2015).

Table 2 Participants in the focus group interviews (N = 20)

Name	Gender	Subject discipline
Ulrika	F	Science
John	M	Pedagogy
Mona	F	English
Katie	F	Mathematics
Audrey	F	Norwegian
Hans	M	Norwegian
Madeline	F	Norwegian
Amy	F	English
Arthur	M	Science
Olga	F	Social science
Alexa	F	Mathematics
Maddison	F	Pedagogy
Ethan	M	Norwegian
Holly	F	Pedagogy
Ally	F	Arts and crafts
Megan	F	Norwegian
Olivia	F	Social science
Kasper	M	Pedagogy
Mya	F	Science
Jack	M	Social Science

Semi-structured focus groups were used to collect the data (Brinkmann & Kvale, 2014). An interview guide (Appendix 1) was developed for use in the focus groups and was based on previous teaching experiences, past research, and researcher participation as developers and instructors in DigGiLU. Using semi-structured focus groups allowed for a somewhat standardized but flexible interview approach where the TEs could elaborate on topics they felt were important.

Concepts from research on, for example, digitalization in education, were operationalized into understandable questions for the participants, who were generally not familiar with the research field. Some examples of the questions are as follows: In what ways have the use of digital technologies affected, changed, or facilitated added pedagogical value to your teaching? In what ways do you think participating in DigGiLU Online has developed your PDC? In what ways can TEs develop STs' PDC?

The participants ($N = 20$) were organized into five focus groups, with four TEs and two researchers participating in each interview. All the interviews were conducted in Norwegian in the fall semester of 2020 after ending DigGiLU Online. Interviews were held using the virtual platform Zoom, and each interview lasted about 90 minutes. Afterward, the interviews were transcribed verbatim and translated into English by the researchers. The translations were verified by a native speaker (Brinkmann & Kvale, 2014). The participants' names were anonymized and replaced with pseudonyms. Investigator triangulation ensured the validity and reliability of the results (Denzin, 2009). Member checking was used to increase the trustworthiness of the focus group data. The participants received the transcripts for

verification, confirmation, and “establishing credibility” (Lincoln & Guba, 1985, p. 314). Generalization was tied to naturalistic (Lincoln & Guba, 1985), reader, and/or user generalizations (Lund, 2013) through rich descriptions.

Data analysis

The focus group data, which consist of the TEs’ conversations about their experiences from DigGiLU Online, were analyzed using a thematic analysis (Braun & Clarke, 2006; Braun et al., 2019). A thematic analysis is “a method for identifying, analysing and reporting patterns (themes) within data” (Braun & Clarke, 2006, p. 79), where themes capture “something important about the data in relation to the research question” (Braun & Clarke, 2006, p. 82). We followed a six-step process, as proposed by Braun and Clark (2006, pp. 87-93). First, we familiarized ourselves with the data by carefully examining the interview transcripts and recordings. Second, we created initial codes by systematically color coding the dataset in Microsoft Word for unique features, here by using the research question as a guide; we used two orientations when it came to the coding: a deductive approach, which we generated from theory, ideas, and concepts, and an inductive approach, which generated codes “bottom-up” from the data (Braun et al., 2019, p. 853). To exemplify the deductive approach, the code *getting an overview of digital tools for use in the teaching profession in a digital school* was developed based on the project aims and reported needs in previous research, while the inductive approach can be illustrated through the code *sharing tips about useful digital teaching tools*. In the third step, we searched the list of codes for themes by sorting, collating, and refocusing the analysis of codes into constructing broad themes. The themes were constructed on a semantic level, that is, close to the TEs’ language and explicit language, and on a latent level that can help “focus on a deeper, more implicit or conceptual level of meaning, sometimes quite abstracted from the explicit content of the data” (Braun et al., 2019, p. 853). Fourth, we reviewed and refined the themes by collapsing overlapping themes and removing those that lacked enough data. For example, the codes *sharing teaching experiences with ICT* and *the value of community* were merged into the theme *knowledge-sharing practices*. Next, in the fifth step, the names and definitions of the themes were further refined to capture the essence of what each theme is about. Finally, the final analysis resulted in two main themes: *digital technology in the teaching profession* and *knowledge-sharing practices*.

Results and Discussion

Digital technology in the teaching profession

The main aim of DigGiLU Online was to develop the TEs’ PDC, that is, to help them be able to use digital technology purposefully and critically in their own teaching, in turn developing the STs’ PDC. Starting with Module 1 in the online resource, the participants critically reflected on PDC in relation to the teaching profession and their role as TEs. From the interviews, the TEs expressed a clear and reflective view of digital technology’s role in their teaching. An underlying theme here was the purposeful use of digital tools, as described by one of the participants: “Digitalization does not solve everything for us, but where we find it purposeful, we would seek out solutions all the time” (Audrey). Similarly, another TE supported the notion of the pedagogical added value of digital technology as “[a]n addition to promote learning and to promote different ways of collaboration” (Mona). The findings echo those presented in Holmberg et al. (2018), where collaborative learning, authentic tasks, and supporting student’s metacognitive reflection are mentioned as ways ICT can add pedagogical value (Holmberg et al., 2018, pp. 136-137). However, other TEs were more critical and

distant from the supposedly optimistic views surrounding the way in which digital technologies were discussed in the professional development program: “[T]hen I remember that I, in a way, was a bit provoked regarding the techno-optimistic views, that the technological tools were good just because they were digital” (Ulrika). This skepticism toward the use of technology was experienced by several TEs taking DigGiLU Online and can be seen as part of a more extensive debate about technology’s role as a premise provider in creating knowledge (Grüters, 2020; Krumsvik et al., 2013). During the interviews, however, knowledge about the opportunities and challenges that technology can afford was nuanced, encompassing the entire teaching situation and not just the digital dimension, as illustrated by a quote from one of the participants:

I do not want my teaching to only exist on Blackboard [learning management system]. I want it to exist in the community that we have in a classroom, in our discussions when we meet, first and foremost. And then, the other aspects can be a support of or additions to but can never replace it. (Katie)

As illustrated above, the TE expressed her experiences with moving their teaching online, here fearing a loss of social presence through limited physical interactions with the STs (Carrillo & Flores, 2020). However, because schools and universities had to switch to emergency remote teaching because of COVID-19, the TEs did not have a choice regarding the use of digital technologies in their teaching: “OK, I do not have a choice. We just have to try to swim through it” (Mya). Hodges et al. (2020) argued that the move to emergency remote teaching cannot be compared with high-quality online teaching, where a careful instructional design process would be present in the latter. The swimming metaphor underlines experiencing a loss of choice or agency during the pandemic in teaching (or not) with digital technologies, where integrating digital technologies into teaching became an absolute necessity. Thus, the pandemic made apparent the need to adapt for continuous professional development to “match emerging needs” (Darling-Hammond & Hyster, 2020, p. 460). However, improvising quick solutions might make TEs feel like “instructional MacGyvers” (Hodges et al., 2020). Therefore, to carefully plan for high-quality online (or physical) teaching, TEs need to know about the technology so that they can use it purposefully (Carpenter et al., 2020; Foulger et al., 2017): “How you use the technical knowledge that is needed, the skills that are needed, and how you assess what fits and works particularly well to teach that particular topic” (Mya). Mya’s reflections indicate that using digital tools as a teacher is more than just generic skills: it also involves both generic and specific teaching profession skills including how to locate, critically evaluate, choose, and seamlessly integrate digital tools that are appropriate for the subject’s content and methods (Lund & Aagaard, 2020; Lund et al., 2014; Røkenes & Krumsvik, 2016). Mya mentions using computer simulations in natural sciences to explore the universe, weather systems, and quarks. Although she never used the term PDC, her reflections can be related to several main areas and aims in the *PDC framework* such as “pedagogy and subject didactics” (Kelentrić et al., 2017).

Regarding preparing STs to teach with digital technologies and developing their PDC as promoted in DigGiLU Online Modules 1 and 2—as well as in the knowledge-sharing seminars—the TEs’ responses seemed to diverge. Some TEs expressed a strong sense of responsibility when it came to preparing the STs, here by exposing them to relevant digital technologies and modeling purposeful technology integration in their subject-disciplinary teaching, such as programming and coding in STEM:

I believe that if there are digital tools that are used in schools, at least if there is a classification of digital tools that are used in schools, then we have to expose the students to these because if they have never used digital tools, if they do not have a normalized relationship to digital tools, then there is a huge barrier to familiarizing themselves with it on their own when they enter the schools. (Arthur)

However, others expressed little to no sense of responsibility toward developing the STs' PDC. For example, one TE openly rejected the notion that she should prepare STs to use digital technologies in her teaching:

If it is so that we are supposed to teach students how to use digital tools in practice, then I strongly disagree. It is not my job as a TE to do so. There should instead be courses. If teacher education is supposed to do so, then there should be specific courses that address it. It is not my job as a subject professional. (Alexa)

Despite these contrasting experiences and views expressed by the TEs in the focus groups, previous research has shown that modeling exemplary teaching with ICT is vital for STs' technology preparation (Guðmundsdóttir & Hatlevik, 2018; Røkenes & Krumsvik, 2016). The issue related to the TEs' experiences can be connected to different views of what STs are supposed to learn on campus and during the school practicum. In other words, there seems to be no clear agreement on the responsibilities of TEs versus mentor teachers in developing STs' PDC. Closer collaboration between the TEs and mentor teachers might be a highly relevant area because mentor teachers might be more updated on current practices with ICT and have "better knowledge and skills concerning how to use digital tools to enhance learning in schools" (Instefjord & Munthe, 2017, p. 44).

The TEs' reflections during the interviews show that they had significant knowledge about PDC, despite not knowing about the actual term, which seemed somewhat unclear in the professional development program: "When it comes to that term, professional digital something, I remember that it was a part of DigGiLU Online and that it was very unclear to me what it meant" (Arthur). Despite the fact that PDC was introduced in Module 1, the confusion raised by the participant might relate to the responsibility of the subject disciplines in the *PDC framework* (Kelentrić et al., 2017), which addresses the overall teaching profession and not just teacher education (Hjukse et al., 2020, p. 22). In turn, the participants had to relate PDC to their own subject discipline throughout DigGiLU Online. Most of the TEs seemed to have developed a critical and conscious relationship with the term and were able to integrate it into their teaching practice: "I have become more aware of the possibilities of how and why I can use it" (Ethan). A critical relationship with PDC can also be traced when the TEs chose not to use digital technologies: "Something has made me more aware of when I want to use digital technologies and when I do not want to use them, that is, more aware of when I choose not to use them" (Audrey). These quotes reflect the complexity in the participants' understanding and application of PDC, where tacit practical knowledge is foregrounded rather than theoretical knowledge. This could be because of a weak theoretical foundation for using ICT to support teaching and learning in teacher education, because digital technologies are often used in instrumental ways and the justification for their integration is based on practical needs rather than being evidence based (Røkenes & Krumsvik, 2016). In other words, our findings confirm those from the literature (Hjukse et al., 2020; Lund & Aagaard, 2020), while also contributing new knowledge about the complexity of introducing and implementing new concepts such as PDC.

Knowledge-sharing practices

Another central theme that stood out across the data was the TEs' practices of sharing experiences and knowledge about how digital technologies could be used for teaching and learning in teacher education; these included online discussions facilitated by the section coordinators in Teams and through physical campus-based seminars. During these interactions, the TEs shared, modeled, and discussed teaching practices involving digital technologies. The participants presented entries posted on the online wiki Confluence, where they described and critically reflected on technology-supported teaching activities. In the focus group interviews, all the TEs mentioned that the face-to-face knowledge-sharing seminars were perceived as the most valuable aspect of DigGiLU Online, even though every module included discussions in Teams: "The community was great, and the final seminar we had in August...where the section of Norwegian and Arts and Crafts met up, that was incredibly inspirational!" (Audrey). Another TE also gave a similar statement: "I clearly remember the final summary that we had at the end where we were with colleagues from the Norwegian section. It was really nice to meet up and listen to what the others had been doing and to get some input and be inspired by others" (Amy). Cross-disciplinary knowledge-sharing seminars can function as arenas for ongoing professional development and networking (cf. TECT 10 in Carpenter et al., 2020; Foulger et al., 2017, p. 433). In these arenas, the TEs not only observed how digital technologies are used in other subjects, but they also learned how to use these themselves to develop a sense of awareness surrounding their possibilities and limitations, which might inspire them to use ICT in their own teaching (Lund & Aagaard, 2020; Uerz et al., 2018). A feature that was strongly emphasized in the interviews was using section coordinators as organizers and facilitators in professional development:

In our section, we were seven or eight from pedagogy that took DigGiLU at the same time, but it was our coordinator that organized us into one group so that we had regular gatherings, which I thought was OK...before we had even started, she had organized us into a community, so that was very nice. (Kasper)

In addition to administrative support, the section coordinators also acted as collegial coaches and supported the TEs in writing entries in Confluence. The wiki was meant as a safe space for sharing lesson plans, ideas, or methods involving the integration of digital technologies in subject-disciplinary teaching at the department: "Confluence, a sort of lexicon, our documentation portal where everything was stored. I found it fascinating" (John). Another participant expressed similar attitudes toward using a wiki for documentation and knowledge sharing: "For me, it was a source of inspiration for when I was designing my lessons...I learned a lot from reading what the others had written" (Mya). Others had a more distant relationship with the wiki: "I have not even accessed my wiki account, not read what is there, and not seen it as a wiki" (Megan). In sum, the section coordinators were a key factor in supporting departmental professional development. Using colleagues as section coordinators for collegial coaching helped successfully connect the professional development to the TEs' actual needs and establish legitimacy for the professional development program. These findings are in line with those of Terry et al. (2019), who showed that student champions can help develop digital literacy in peers. As underlined by Baek et al. (2018, p. 175): "Technology experiences must be dynamic, authentic, and tailored for individuals at different stages of technology adoption".

From the focus groups, an underlying topic was that the knowledge-sharing seminars were organized and led differently based on the different sections' meeting cultures and par-

ticipants' availability. Although some sections gathered only one or two times throughout the semester, other sections met as frequently as once every two weeks for lunch seminars. In some sections, the TEs mentioned that bringing up the use of digital technologies for teaching and learning was even met with resistance: "In our section, I feel that in a way, there is no room for that and that it is never received well when you want to discuss these kinds of things" (Ulrika). Regarding this difference, one of the participants highlighted the importance of leadership in professional development, regardless of the topic or discipline, to identify the common challenges in teaching practices: "If there is going to be any form of development, then there has to be some sort of leadership of this. That is, it rarely happens by itself, unfortunately. Someone must lead the process, and by that, I do not mean the one who is the most proficient ICT user" (Hans). Previous research has pointed out that management development support for technology training in teacher education tends to be weak (Instefjord & Munthe, 2017, p. 44). However, technical, pedagogical, and administrative support are important components in reducing some of the frustrations that TEs might experience in integrating digital technologies in their teaching and when anchoring PDC in course plans and assessments (Hjukse et al., 2020). In our study, these processes require anchoring in faculty leadership to legitimize professional development and collegial coaching among the TEs.

The last cohort of TEs were delayed in their professional development because of the COVID-19 lockdown (Table 1). Consequently, many of them prioritized what one TE labeled as "matters of necessity" (Olivia), such as shifting their physical teaching to a fully online environment, writing grant proposals, and conducting research instead of focusing on other commitments, such as finishing their professional development program. However, the COVID-19 pandemic raised the issue of using digital technologies in teacher education, and seemed to have affected the TEs' perspectives toward digitalization and DigGiLU Online. One participant stated that "COVID-19 marks a paradigm shift" where the TEs' tasks must "involve more than highlighting the possibilities of using digital tools in teaching" (Katie). Overall, the pandemic can certainly be considered a "moment of disruption" for teacher education that has "created the opportunity for rethinking and reinventing preparation" (Darling-Hammond & Hyler, 2020, p. 463). For the time being, TEs still need to be supported in developing PDC so that they can become critical, reflective, and confident users of digital technology in their teaching.

Conclusion

The study explored: *What experiences do teacher educators report having from a professional digital competence development program?* The implications of our study support and expand on previous research, showing TEs' experiences regarding PDC development in teacher education. First, the study adds to the field new knowledge about the complexities of implementing new concepts such as PDC in teacher education. The TEs' reflections on digital technology in their teaching seem to mirror a somewhat reserved and pragmatic approach toward the term PDC. Although participants noted they were unfamiliar with the term, the data show that PDC permeates how the TEs discussed and reflected on their teaching practices. Yet the divergent perceptions among the TEs about who is responsible for developing the STs' PDC shows the complexity regarding the roles and responsibilities of TEs in digitalization. Second, we found that systematic collegial support and arenas for knowledge sharing were important factors in online professional PDC development. The participants emphasized the value of knowledge sharing within and between subject-disciplinary sec-

tions, with section coordinators being emphasized as central figures. Third, the results show that creating a foundation within faculty leadership is essential for supporting participants to complete professional development. Distributing leadership using section coordinators is crucial in leading professional development processes and facilitating knowledge sharing.

As a catalyst for digitalization, the COVID-19 pandemic seemed to increase the TEs' awareness surrounding the possibilities and limitations of digital technologies, here in a context where they had been forced into a remote teaching scenario. Even though the COVID-19 lockdown only affected the last cohort of participants following PDC development, the pandemic represented a crossroads for teacher education, presenting the opportunities and challenges of teaching in fully online environments. Creating safe spaces for knowledge sharing and developing a community needs to be prioritized, so that TEs can discuss and critically reflect on their teaching practices, with or without technology. However, facilitating professional development, knowledge sharing, and driving innovation forward requires leadership and resources at multiple organizational levels.

The current study has some limitations. A qualitative case study design allowed us to explore the TEs' opportunities and challenges with online PDC development in depth, but not in breadth. A mixed methods research design would have allowed us to explore the phenomenon both on a broad and a deep scale. Furthermore, to measure the long-term impact of PDC development on TEs' technology-related beliefs and STs' achievements, pre- and post-tests could have been implemented. Moreover, the study could not control for the impact that the lockdown had on the TEs' PDC. Further longitudinal research is needed to address whether the preparedness of STs when it comes to teaching with digital technologies during and after graduating from teacher education has an impact on pupils' academic achievements in school subjects. Such research should include how teacher education can prepare STs for future scenarios with lockdowns, online teaching, and home schooling.

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Appendix 1: Interview guide for the focus group interviews

In relation to the development project Digitalization of Primary and Lower Secondary School Teacher Education, as a teacher educator at the Department of Teacher Education, you are hereby invited to participate and contribute to a research project on the professional development program DigGiLU Online. The purpose of the DigGiLU project has been to promote professional digital competence (PDC) in the department's teacher educators and student teachers and to create a change in pedagogical and didactical teaching practices. The research project focusing on DigGiLU Online is anchored in the New Technologies and Educational Design Research Group (NTED). The overarching aim of the project has been to develop new teaching practices with (or without) digital technologies that can help enhance the overall quality of education in teacher education and to develop teacher educators' and student teachers' PDC. The research question that we have examined in the research project has been the following: what experiences do teacher educators report having from participating in the DigGiLU Online professional digital competence development program?

You are a part of this focus group interview because you have marked “yes” on the informed consent form for the research study, stating that you wish to participate in a focus group interview and that you consent that audio and video is recorded. In advance of the focus group interview, most of you have answered an electronic survey about DigGiLU Online, and some of the survey questions will be followed up on in the interview.

Table 3 Interview guide

Overarching research questions	Interview questions
<p>Dimension I. Competence development In what ways have DigGiLU Online promoted the development of PDC for the department's teacher educators?</p>	<p>How did you experience professional development of PDC through DigGiLU Online? Please mention some of the opportunities and challenges that you encountered. How did you experience being able to contact a section coordinator before starting the professional development program? How did you experience the need for professional development in pedagogical and didactical use of digital technologies at the department? In what ways do you think participating in DigGiLU Online has developed your PDC?</p>
<p>Dimension II. Implementation In what ways have DigGiLU Online promoted teacher educators' implementation of digital technologies as a learning resource across subject disciplines?</p>	<p>In what ways have the use of digital technologies affected, changed, or facilitated in adding pedagogical value to your teaching? In what ways have the use of digital technologies negatively influenced, restrained, or been a disruptive element to your teaching? In what ways have your participation in DigGiLU Online affected your teaching practice? In what ways have participation in DigGiLU Online affected the ways you reflect on the use of digital technology for teaching and learning in teacher education? In what ways can student teachers benefit from your participation in DigGiLU Online? In what ways can teacher educators develop student teachers' PDC? Alternatively, why should we/why should we not facilitate this development?</p>
<p>Dimension III. Knowledge-sharing In what ways have DigGiLU Online promoted teacher educators' knowledge-sharing practices regarding trying out digital technologies in their teaching?</p>	<p>How did you experience the DigGiLU Online knowledge-sharing seminars that were organized and facilitated by the section coordinator? How did you experience working with the final project assignment where you had to post an entry to the DigGiLU Online project wiki, Confluence? What previous arenas have you used for sharing knowledge and experiences about the use of digital technologies in teaching and learning?</p>
<p>Dimension IV. School practicum In what ways have DigGiLU Online facilitated the use of digital technologies for the administration and completion of the school practicum?</p>	<p>In what ways can your experiences from DigGiLU Online be used with the student teachers' school practicum component and the praxis field? What is the role distribution with teacher educators and mentor teachers in terms of developing student teachers' PDC?</p>
<p>Any other business What other dimensions surrounding DigGiLU Online do the participants want to address?</p>	<p>Are there any questions that have been discussed earlier that you wish to bring up again and elaborate on further? Are there any dimensions or questions that have not been addressed in the focus group interview that you wish to bring up? Do you have any direct questions to the project and/or research group leaders related to the DigGiLU Online research project?</p>

Thank you for participating in the focus group interview! You will be sent an anonymized written transcription of the interview that we want you to check, and confirm that the information is correct.