



From digital competence to Professional Digital Competence: Student teachers' experiences of and reflections on how teacher education prepares them for working life

Aslaug Grov Almås¹

Western Norway University of Applied Sciences

Agnete Andersen Bueie

University of South-Eastern Norway

Toril Aagaard

University of South-Eastern Norway

Copyright the authors

Received 28 February 2021; accepted 06 September 2021

Abstract

The authors of this article have collaborated as part of a steering group for Norwegian state-funded research and development project designed to enhance the professional digital competence (PDC) of both teacher educators, practising, and student teachers. In this article, we give voice to students' experiences of their PDC development during teacher education (TE). We investigate their ideas on how TE might be developed to prepare them better for professional careers in a digital context. The participants are studying at a Norwegian university where, from 2018 to 2021, PDC has become a major area of focus as part of the aforementioned project. The data consist of four group interviews with 17 students from different campuses. We find that student teachers employ a broad range of digital technologies during TE. They experience a diversity of digital didactical practices and engage in thematic discussions concerning digitalization. They also utilise many technologies and apply the digital knowledge they have acquired in their personal lives. While some of them request more technical support during TE, most want to see TE engaging them in more critical discussions about the educational opportunities and challenges that digitalization offers. We discuss some of the dilemmas that TE must address to respond to these findings. In particular, we elaborate on how students' digital experiences can be used as a resource when preparing for their professional roles as teachers.

Keywords: student teachers, teacher education, professional digital competence

¹ Corresponding author: aslaug.almas@hvl.no

Introduction

This article focuses on how student teachers develop their professional digital competence (PDC). Norwegian students are expected to have attained a certain level of relevant digital competency on entering teacher education (TE), not least because they have grown up in a digital society with a school system that encourages the use of digital tools as part of the learning process. As early as 2006, digital skills were defined as a basic area of competence in all schools in Norway, together with skills in reading, writing, oral communication, and mathematics. It has thus been clear that subject teachers at all school grade levels share responsibility for teaching digital skills to their students (NOU 2014:7). We also know that digitalization influences the lives of young people outside school. According to the Norwegian Media Authority, 97% of 9- to 18-year-olds in Norway have their own mobile phone, 70% have their own PC, and 90% use social media platforms such as Snapchat, TikTok, Instagram, and Facebook (The Norwegian Media Authority, 2020). In addition to being entertained, some will probably also be familiar with the more disturbing aspects of digitalization. In 2020, almost 50% of Norwegian girls aged 17 to 18 reported regretting sharing posts on social media, while approximately 30% of 13 to 18 year-olds had viewed posts related to being very thin, fights or fight plans, or instructions on self-harm (The Norwegian Media Authority, 2020). These statistics indicate that student teachers will also have developed digital competencies that are relevant to their future careers as teachers.

However, researchers such as Kirschner and Bruyckere (2017) are eager to warn against overestimating the relevance of young people's digital skills in preparation for higher education (HE) and question the assertion that they are tech-savvy and multitasking experts simply because they have grown up in a digital world. They are critical of the concept of digital natives and argue that what young people learn before entering HE is insufficient to meet the digital challenges they face as students. For example, student teachers will need to learn how digital technologies can be used to enhance school pupils' learning experiences, and in safe ways. They must also learn to exploit digital technologies in a variety of didactic practices, some of which are highly subject-specific. This calls for teachers who can engage in what Lund and Aagaard (2020, p. 68) describe as a "transformative digital agency—that is, agency to identify educationally challenging situations and turn to relevant digital resources (and other resources) to transform the problem situation into a constructive and teachable event". Globally, efforts such as TPACK and DigCompEdu are being implemented to conceptualize and operationalize the competencies required. In 2017, the Norwegian Directorate for Education and Training launched its 'Professional Digital Competence Framework for Teachers' (PDC).

We will elaborate on the PDC concept later, but first, we wish to present our reasoning behind this study, in which our main aim is to give voice to students' experiences of, and reflections on, how their PDC develops during TE. We shall accomplish this by addressing two research questions:

- How do student teachers characterize their PDC and the development of such competence during TE?
- How do student teachers suggest that TE could be enhanced to better prepare them for professional careers as teachers in a digital context?

To answer these questions, we have analysed a series of group interviews with students studying at a multi-campus university in Norway.

Context of the study

The study was carried out at a university that received NOK 20 million from the Norwegian Ministry of Education and Research to ensure that its TE programme is preparing students for a career in digitalized classrooms within a digitalized society. The project was carried out between 2018 and 2021, with data gathering taking place in October 2019. In 2017, the Norwegian TE programme was converted from a BA programme to an MA programme. The MA programme for primary schools involves three mandatory subjects: Norwegian (L1), mathematics, and pedagogy, while that for lower secondary schools involves only one (pedagogy). This structure makes it difficult to address interdisciplinary issues such as PDC coherently.

To contextualize our findings, we present some of the key strategies that were applied during the project. Firstly, the institution added learning outcomes to its programme plans to clarify subject teachers' responsibility for promoting PDC. Since PDC is a relatively new concept, it was not possible to implement it using 'top-down' strategies alone. The institution needed to develop a shared conceptual understanding and to ensure that the benefits of existing and relevant knowledge about teaching and learning were fully exploited. For this reason, members of the project group incentivised both their colleagues and student teachers to engage in re-designing educational practices and better aligning themselves to the needs of a digitalized society. From a student perspective, this broader involvement and bottom-up approach explain why some of the students attended classes in which teachers conducted smaller research and development projects designed to promote PDC, while others attended more traditional classes. The students also participated in up to seven interdisciplinary PDC seminars, often attended by teachers from the relevant field of practice. These seminars differed in number and focus area across the four TE campuses.

In September 2019 we surveyed with the dual aim of assessing the students' perceived understanding of PDC and gathering reports of their experiences of the PDC seminars. We also wanted to elicit suggestions as to how TE should develop to better promote student teachers' PDC development. The results of the survey are analysed in detail elsewhere (Lund & Aagaard, 2020), but we take this opportunity briefly to summarize the findings that are most relevant to this article. Of the 182 students who responded, 69% stated that they knew what PDC entailed. This finding surprised us somewhat because even though PDC was defined very briefly in the survey's introductory text, it is a com-

plex, dynamic term about which even teacher educators appear to lack a common understanding. The survey also indicated that students as a group had the experience of using a wide range of digital technologies as part of their education.

The interviews analysed in this article were conducted to look in greater depth into the students' experiences with the various PDC initiatives that were implemented across the four campuses. The findings will facilitate a discussion on how a complex phenomenon such as PDC can be implemented in a TE programme with few interdisciplinary structures.

Conceptual clarification

The university that the survey participants attend employs the PDC framework developed by the Norwegian Directorate for Education and Training (Kelentrić et al., 2017). It utilises the framework actively, but also critically. The framework offers seven competence areas that student teachers need to develop: 1) an awareness of how digitalization influences schools and school subjects; 2) competency as a means of initiating and engaging in educational change processes; 3) knowledge about ethical dilemmas and how these should be addressed; 4) skills that enable them to design educational practices relevant to the digital society in which we live; 5) pedagogical and didactic knowledge; 6) familiarity with how to lead learning processes, and 7) the facilitation of interaction and communication. Learning outcomes were specifically linked to each of the competence areas, but no guidelines were provided for how student teachers should achieve them.

PDC is a complex concept that is still 'in the making'. Hacking (1999) has argued that such concepts are both socially constructed and interactive. In our case, the PDC concept has been co-constructed by researchers, policymakers, teacher educators, and student teachers as part of their respective efforts to identify the competencies that a teacher needs to be well-prepared for teaching in a digital environment. The conceptual understanding of PDC will shape the practices of teacher educators, and operationalisation through action over time will enhance conceptual understanding within TE.

What do we know about PDC development in teacher education?

Several studies conducted both in Norway (Gudmundsdottir et al., 2014; Krumsvik, 2016; Tømte et al., 2013) and internationally (Arstorp, 2015; Tondeur et al., 2016; Foulger et al., 2017; Nelson et al., 2019), have indicated that TE has systematically enhanced student teachers' PDC to a limited degree. Tømte (2015) has previously concluded, in agreement with Kirschner and Bruyckere (2017), that even technically proficient students did not necessarily know how to use ICT for learning purposes, and that even if teacher educators demonstrated innovative ways of using ICT in pursuit of pedagogical objectives, students often failed to recognize and learn from them.

In 2018, Gudmundsdottir and Hatlevik demonstrated that newly qualified teachers' PDC self-efficacy depended on how they perceived the quality of their PDC development

during TE. However, most of the respondents considered this development to be fairly poor. Later, they found that students' search strategies were often restricted to the use of Google. They also revealed that students were aware of the risks of finding inappropriate content online but that they had only limited competence in dealing with privacy and copyright issues (Gudmundsdottir & Hatlevik, 2020).

Hjukse et al. (2020) indicated that PDC development varied from subject to subject, and that teacher educators tended, in general, to focus more on how digital technology should be applied in education, rather than addressing the various issues that users encounter in digital educational contexts, such as digital bullying and adapted learning (Hjukse et al., 2020). Lund and Aagaard (2020) have questioned the idea that TE, in its efforts to foster student teachers' PDC, tends to focus too much on the use of digital technologies at the expense of addressing deeper and more epistemological issues. This is the case even if digitalization has fundamental consequences for how both students and school pupils obtain their knowledge.

Studies into PDC development in TE are increasing but, as highlighted by Gudmundsdottir and Hatlevik (2018), there remains a need for more research. Existing work has been based mainly on surveys, and more qualitative approaches have been lacking. Our contribution towards filling this 'gap' involves an interview-based investigation of students' experiences of PDC development in an institution that has received public funding to prepare them for a professional career in a digital context.

Reflection and PDC development

Professional development starts long before student teachers enter their TE programmes. Their prior experiences and memories will have laid the foundations for their attitudes and beliefs (Körrkö et al., 2016). The importance of reflection in TE and development is well documented (Schön, 1987, Calderhead, 1989, LaBosky, 1994, Korthagen & Vasalos, 2005), and reflection on experience obtained during practice, as highlighted by theoretical perspectives, tend to be highly influential for learning (Darling-Hammond, 2006, Zeichner, 2010). Körrkö et al. (2016) investigated primary school student teachers' practicum-related reflections and found that while such reflections gradually broadened and deepened, they remained primarily descriptive. However, it was also found that reflection combined with feedback concerning their professional actions in the classroom enhanced the students' understanding of practical theories. The authors concluded that supporting student teachers' reflective skills can impact positively their professional development.

We have already briefly defined PDC, and in the following, we intend to link reflection with PDC development. In the context of recent research, we feel that TE needs to address deeper and more epistemological issues and to reflect on how technologies not only expose students to the use of digital tools but also disrupt existing practices (Lund & Aagaard, 2020). It is a major and complex challenge to prepare students for such professional actions (Helleve et al., 2013; Illeris, 2009) and to handle such tasks in correct and qualified ways (Molander & Terum, 2008). Helleve et al. (2019), argue that student teachers

need to develop a repertoire of techniques for their conduct during TE, combined with a sense of self-awareness as digitally competent professionals, and to prepare to deal largely non-prescriptively with challenging professional issues and situations.

This has been confirmed by other researchers (Aagaard & Lund, 2020; Brevik et al., 2019; Lund et al., 2019), who suggest that engaging in transformative digital agency promotes educational designs that are both relevant and aligned to the digital world in which we live. This involves identifying challenging situations combined with an ability to envisage alternative possible futures and solutions to the challenges. A recent empirical study (Aagaard et al., in review) has indicated that reflection, combined with the reading of academic literature and a critical attitude to subject-specific traditions in learning communities, can support transformative agency and the development of PDC. Gravett et al. (2017) have suggested that experience from teaching practice can act as a springboard for reflection linking theoretical and practical knowledge. Klemp (2013, p. 56) has shown that engaging in dialogue with professionals can reinforce students' reflective forward-thinking and challenge their prejudices.

Method

The study we present here is a case study, carried out using an empirical method suitable for the in-depth investigation of contemporary phenomena within a real-world context (Yin, 2018). Busch (2013) has stated that a phenomenon can only be studied and fully understood in the holistic context within which it is taking place. Our study involves a selection of 17 students (12 female and 5 male) studying at four different campuses at a university in Norway. The data comprise four group interviews with the 17 students. One of the groups is taken from a TE programme with a blended learning design in which the students undergo mainly online face-to-face teaching, combined with a few weeks of campus residencies each year. These students are significantly older than the others participating in the study and many cases have established family lives.

A purposeful sampling approach (Creswell, 2015) was adopted, selecting student teachers who had completed at least one year in TE, two periods of school placement, as well as participation in subject specific PDC initiatives and seminars. The leaders of the TE programmes at each of the campuses assisted us in recruiting the participants. Participation was based on informed consent, and the study was reported to the Norwegian Centre for Research Data. An overview of the participants is given in Table 1.

Table 1. Overview of participants

	Campus A	Campus B	Campus C	Campus D
Participants	5	2	6	4
Age	21, 23, 24, 25, 28	22, 26	20, 20, 22, 22, 23, 27	42, 39, 33, 30

The interviews were semi-structured and based on an interview guide using three themes:

1) the student teachers' understanding of PDC, 2) their experiences with PDC during TE so far, and 3) their thoughts on how TE can help to develop and improve their PDC. The interviews lasted for approximately 60 minutes and were carried out face-to-face on the students' respective campuses. The interviews were conducted by the main author, who also carried out the first review, with partial transcriptions, of the data. Subsequently, all three authors listened to the recordings and jointly selected sections for transcription. All three authors contributed to the data analysis. We chose to transcribe those excerpts that were relevant to our research questions.

The interview data were analysed using thematic content analysis (Creswell, 2015). Analysis was initiated by sorting according to interview themes 1, 2, and 3 above. During the process, some new categories evolved. Our analysis of students' experiences in developing PDC showed that these could be subdivided into three 'experience categories': 2a) the use of specific digital technologies; 2b) digital didactical experiences, and 2c) thematic PDC issues addressed in TE. We also found that the students had acquired their PDC both in and outside TE.

Findings

In the following, we will attempt to answer our research questions under three main headings: 1) how student teachers describe their PDC; 2) how they develop PDC during teacher education and 3) how they propose that teacher education might prepare them for professional careers as teachers in a digital context.

How do student teachers describe their PDC?

As noted previously in the context section, 69% of student teachers responding to a survey used to evaluate PDC seminars either agreed or very much agreed that they knew what PDC entailed. The interviews, however, painted a very different picture.

The quotation "We are the digital generation, we are doing well" is characteristic of how the students described their PDC. A review of the data as a whole indicates that most students initially expressed confidence when it came to using digital technologies and argued that they had good digital skills. "I grew up with the Internet", as one student put it. Most students also expected that the development of their PDC was a process that would continue after TE and throughout their teaching careers in response both to evolution in digital technologies and how knowledge work is conducted. Many expected that there would be no problem in finding out about how to use new types of digital technologies. One student claimed that "if there is something I don't know about technology, it will be easy for me to learn how to use it". However, there was a minority that felt less confident, one of whom said, while laughing: "I know how to use HDMI and Power-Point". Even if many of the students believe that they will find out how digital technologies work, some also expressed an awareness that they needed to learn more about how such tools can be applied for teaching and learning in different subjects and across their

pupils' age groups. The material as a whole indicated that few of the students interviewed were familiar with the concept and the Norwegian PDC framework. When describing their own PDC, they talked mostly about mastering digital tools.

However, there were some exceptions. The students from the campus with the blended learning programme were very familiar with the PDC framework. PDC was often addressed as part of their TE programme, which included seven dedicated interdisciplinary PDC seminars. The other campuses had between only one and three such seminars. These students were older, which might explain why the thoughts they expressed in interviews about PDC were more mature and knowledgeable. Their discussions indicated that participation in online teaching, combined with digital collaboration, also generated PDC.

On being introduced to the PDC framework during the interviews, all the students showed an interest in many of the PDC categories and subsequently revealed a deeper understanding of PDC than they had expressed initially. The framework generated critical reflections and discussion on topics such as safe internet use, social media and digital identity, digital bullying, and the potential inherent in learning through gaming. Here, it was common for the students to refer to their personal experiences and reflections. Some related stories about their children or younger siblings who were gamers, while others reflected on their grandparents' struggles to cope in a digitalized society.

In summary, our thematic analysis has revealed that most of the student teachers tended initially to describe their PDC as good. Most of them exhibited high levels of self-confidence when it came to using established digital technologies and to learn to use new ones. While some appeared to be developing somewhat robust PDC traits during TE, others demonstrated a less aware and more experience-based PDC development.

How do student teachers describe their PDC development during teacher education?

Table 2 provides a concise overview of the students' experiences of their PDC development, sorted according to the three categories that emerged during the analysis (2a, 2b, and 2c). The students' responses to open questions simply give us an insight into what they as groups associated and spontaneously remembered in an interview setting. As a result, the lists in Table 2 are not exhaustive. While some students referred to their experiences from teaching practice, such as the use of VR, most are drawn from experiences on campus.

Table 2. Student teachers' experiences with developing PDC in TE

Use of specific <u>digital</u> technologies		Didactical digital experiences	Thematic PDC issues addressed
PowerPoint	Word	Video assessment	Source awareness
OneNote	Teams	Video reflection	GDPR
Endnote	Zoom	Digital collage	Copyright
Flipgrid	Padlet	production	Safe internet use
<u>Mentimeter</u>	Canvas	Digital storytelling	Class leadership in a
GeoGebra	VR	Coding	digital context
Sphero	Multi	Written	Social media use
Google Earth	<u>Salaby</u>	<u>feedback practices</u>	Learning
Book creator	Smartboard	Presentations	through gaming
Greenscreen	iPad	Pecha Kutcha	
Facebook	<u>Omnioin</u>	Flipped Classroom	
Screencast- o- <u>matic</u>	Socrative	Online learning	
	<u>Wikispaces</u>	Podcast production	
	Smartboard	Video production	
		Online group work	

The first two columns show that the participants had experienced exposure to a broad range of digital technologies, and our overall impression is that most of them were quite content with their use of technology during TE. Even though a few students said that they would like to work with a larger digital toolbox after TE, only one called for more training in the use of specific tools. Another complained that her experience was limited primarily to PowerPoint. However, the general tendency was that the students greatly appreciated being introduced to the various digital tools and as previously mentioned, most seemed confident in learning to use such tools on their own. Some felt that spending time learning specific digital technologies during TE was problematic. As one participant put it: “They (TE) sort of treated us as if we were at ‘ground zero’, starting with zero knowledge, while most students in the classroom have basic digital skills.”

Several students argued that digital technologies and their usage change over time, making it difficult, and perhaps even irrelevant, to learn the details of specific digital technologies during TE. Some were amused by a PDC seminar dedicated to social issues on Facebook, claiming that Facebook is irrelevant to young people of today. The following student reflected upon his group examination, saying:

We had a group exam based on ‘Wikispaces’, which now no longer exist. This is quite ironic... The outcome was restricted as it was a bit outdated. Nevertheless, it was presented as “very good”, and “this is digital”, and “you will need it in the future”.

The same student highlighted the possible risks inherent in providing students with in-depth experience in technologies that might become outdated by the time they graduated. Such feelings reveal that students acknowledge that PDC development involves being prepared to deal with a constantly fluctuating digital future.

Table 2 also reveals that the students were exposed to a range of didactical digital experiences during TE and that, in general, they found these to be very positive. They were particularly appreciative when teacher educators invited them to reflect on experiences with technology use in knowledge work and shared their pedagogical reasoning for using technology during lessons. One student said:

In this subject, the teachers have been good at justifying their choice of methods, which makes it easier for us to use them later in practice. (...) There is no point in using digital technologies without justifying why.

However, it is also clear that there was some variation in the students' experience of the value of didactical digital experiences. Some groups had attended a learning lab, where they were introduced to different types of digital tools. Some students stated that they experienced these didactical digital experiences simply as playful activities. And even if they did not describe the tools as worthless, some expressed a need for more in-depth learning to gain a better understanding of their purpose. Some wanted to learn more about programming and how to use tools such as Sphero balls in school.

The interviews also revealed student teachers' concerns about some of the thematic PDC issues that are addressed during TE. As noted previously, they referred to several topics such as learning about source criticism, GDPR, copyright, safe internet use, class leadership in a digital context, social media use, and learning through gaming. Most of them considered themselves to be well prepared to deal with such issues in a school setting, even if some of this knowledge was experience-based and developed outside TE.

In a nutshell, our thematic analysis has revealed that student teachers develop their PDC through the use of specific digital technologies, didactical digital experiences, and by working with PDC issues addressed during TE. There is some variation in terms of what they learn most of, as is the case for their perceived needs and expectations regarding TE. The material also reveals that the experiences of student teachers in terms of their PDC development, even at the same university, vary depending on both their teachers and the institutional priorities of their campus.

How do student teachers propose that teacher education might prepare them for professional careers as teachers in a digital context?

The interviews revealed that students felt that some PDC issues were given too little attention during TE. These included digitalization and democracy, digital bullying, digital identity, how digitalization changes subjects in school, and the epistemic consequences of digitalization. When the interviewer introduced these issues, which are also included in the national PDC framework, most of the students appeared to be somewhat insecure. However, raising such issues also spontaneously triggered professional reflections that indicated a readiness and an interest in reflecting on experiences both from practice and life in general, as well as a desire to relate these to theoretical perspectives and, in this case, to PDC as a concept. Many students called explicitly for an opportunity to engage

in more such reflections. As one put it: “They (TE) could have introduced us to this model before (...) and the kind of conversation we have now.”

Even if many of the students interviewed described the PDC seminars as useful, there was a general feeling that more focus should be given to PDC during subject teaching. Most indicated that they would like to spend more time discussing the reasons for didactical digital practices during TE. One stated that “some of the teachers use the same tools in different settings, just to reveal how they can be used”. She then added that these teachers had in fact included them in reflections about didactical choices and their relevance for learning in schools.

In summary, students tended not to complain about how TE prepared them for careers as professional teachers in a digitalised society. After initially presenting themselves as being highly knowledgeable, they later acknowledged that there were important PDC issues that they wished to learn more about during TE. Many proposed that PDC development could be intensified both within and across school subjects, as well as through didactical reflections.

Discussion

The purpose of this study is to give voice to students’ experiences of their PDC development during TE, and their ideas about how TE could be developed to better prepare them for professional careers as teachers in a digital context. Our discussion is structured around two particular topics. Firstly, we address the finding that student teachers’ conceptual understanding of PDC is vague. Secondly, we discuss the students’ proposals for how to improve the TE programme.

PDC ‘in the making’

At the university where this study was conducted, PDC as a concept was understood in terms of how it was described in the aforementioned framework. Nevertheless, we found that students from only one of the four interview groups had no knowledge of the framework. Students from the other groups were familiar with some of the content but needed help from the interviewer to engage in conceptual reflections. This indicates that the term PDC was only rarely mentioned as part of these students’ TE.

The PDC framework provides us with seven competence areas and a great many topics that have to be addressed. The students continued to speak about digital competence in terms of a set of generic skills, and the use of technology was a key issue. However, they were also aware of the differences between the digital competence that teachers need and that required by other professions, and that the acquisition of knowledge within the PDC framework requires different approaches. Students’ stories from this study support previous research that has concluded that TE is better at using digital technology than it is working with topics that are relevant in the digital age (Hjukse et al. 2020, Tømte et al, 2013; Gudmundsdottir & Hatlevik, 2018).

We must keep in mind that the students interviewed as part of this study had not yet graduated. The interviews were snapshots, representative of the stage at which they found themselves in their education. Their understanding of PDC is likely to develop during their subsequent years in TE. Even so, the descriptions given in this study indicate that a large number of concurrent activities offer students a vast number of different experiences, as illustrated in Table 2. PDC is operationalized and integrated into different ways both in the PDC seminars and during subject teaching. This variation, combined with the fact that focus during TE is mainly directed towards the use of tools, indicates that PDC is a field that is still ‘in the making’. The practical use of technology is a tangible, and perhaps thus an easier, way of working with PDC than focusing on its epistemological consequences.

Consequently, and during the interviews, a knowledge of the PDC framework seemed to expand the students’ conceptual understanding and generated several critical reflections and discussions. In so doing it seemed to act as a tool for thought. Körrkö et al. (2016) have stated that reflection, combined with feedback on professional actions in classrooms, acts to enhance student teachers’ development of practical theories. As teacher educators, our task is to support student teachers’ reflective skills because this will impact positively their professional development.

In this respect, the emergence of the PDC concept and our understanding of it is very interesting. Moreover, the students’ understanding does not have to agree with their teachers’. Concepts are social and dynamic phenomena, and some voices have already suggested that the current PDC framework lacks some key and highly relevant competencies. In reflecting on this, we can refer to Hacking (1999) and his definition of concepts as being both socially constructed and interactive. Our conceptual understanding of PDC will shape TE practices, and its operationalisation through action will in turn help to advance our understanding. This presents a major challenge for TE, and in the following section, we will discuss student teachers’ suggestions for how TE programmes can be improved in the context of PDC.

Improvements in teacher education that will promote student teachers’ PDC development

As we demonstrated in our review, previous studies have shown that TE has failed to adequately prepare student teachers in the field of PDC. Our study has introduced some nuances to this picture. The students interviewed tended not to complain about how TE was preparing them for professional careers as teachers in a digitalized society. They claimed that they were skilled in the use of digital technologies, although this expertise was mainly the result of their education. They typically referred to their personal experiences when they talked on this issue and their reflections tended to focus on the relevance of these experiences to the school context. All the participants talked about their digital experiences during TE. They said that they felt quite well prepared for their professional careers and demonstrated an understanding that the field required continuous development.

Based on our findings, the students did not expect TE to prepare them fully to deal with the PDC challenges they would encounter in their teaching careers. However, we believe that it is not unreasonable to question whether the students know what their needs are. Our study has shown that their understanding of PDC was focused more on how to use tools than on issues related to digitalization. This represents a limited level of understanding of PDC when we compare it to how the concept is operationalized in the PDC framework. In the light of this, we believe that there is reason to argue that an important task of TE is to assist students in moving from being digitally competent to becoming professionally digitally competent. This implies that TE must focus on more than simply the use of digital tools. It must encourage more reflective perspectives on the use of technology and promote a critical consideration of what technology can offer to students' learning processes. It must also address what digitalization means for knowledge work in the various school subjects.

A quotation from one of the students interviewed was that “we are the ones who know this field”. This is partly true, but even though students may feel that they are digitally competent, they also need TE to help them frame this competence within a professional context. Today's student teachers all enter TE with a certain level of digital competence. Our job in TE is to work together with our students to develop their ‘just out of school’ competencies into a rounded professional competence. Körrkö et al. (2016) argue that students' digital professional competence starts to develop before they enter TE. As professional educators within a professional community, we have to promote our students' capacity for reflective forward-thinking and challenge their prejudices (Klemp, 2013).

It is not surprising that the students when talking about PDC, focused primarily on the use of technology. A survey looking into teacher educators' PDC (Daus et al., 2019) demonstrated that this is also the case for their teachers. Findings from this survey showed that teacher educators agree that digitalization is changing TE. However, they also believe that these changes are related most closely to the way TE is carried out in terms of facilitating access to knowledge. They are less in agreement with the idea that digitalization changes academic content (Daus et al., 2019, p. 23). Aagaard and Lund (2020) have pointed out that digitalization has epistemological consequences that have important impacts on educational practices. The authors argue that student teachers have to “identify educationally challenging situations and turn to relevant digital (and other) resources to transform the problem situation into a constructive and teachable event” (p. 68). The discussions that emerged after the students interviewed in this study were introduced to the PDC framework indicate that knowledge of the concept expands their previous skill-focused and limited conceptual understanding, based on experiences both during and outside TE, compared with their understanding before the interviews.

TE has an obligation to assist student teachers to develop the qualifications, PDC included, that they need to conduct themselves as professionals (Illeris, 2009) and to be able to complete tasks in a qualified, correct, and ideal manner (Molander & Terum, 2008). One way to start is by promoting student teachers' self-understanding as digitally competent professionals because as future teachers they will get little instruction in how to

conduct themselves (Helleve et al., 2019). The issues addressed in the PDC framework will thus be handled differently, depending on the relevant context.

Conclusion

In conclusion, our study has shown that PDC is a concept ‘in the making’ and that this may explain why student teachers have yet to become fully familiar with it. Moreover, it may be difficult for them to recognise the complexity of the concept when they are asked to talk about their understanding and development of PDC. We note that the students were in the middle of their education when they were being interviewed.

Our project was not finished when the interviews were conducted, but our findings indicate that contemporary student teachers enter TE with a well-developed digital competence, and that TE sometimes tends to bring them back to ‘ground zero’. TE needs to meet student teachers where they are and to recognize and exploit the digital competence that students bring to TE. It has to support and advance their digital competence into fully-fledged PDC. The majority of students are seeking a deeper understanding of, and an opportunity to reflect on, how, when, and why digital tools should be used in teaching.

A related issue concerns the position of teacher educators in response to their students’ needs. To what extent are teacher educators ready to engage with their students in reflections concerning technology use as part of didactical practices, and to draw on their students’ established insights? This issue requires further research and is currently being addressed by Info-TED (the International Forum for Teacher Educator Development) and TETCs (Teacher Educator Technology Competencies).

Our findings are based on a limited number (17) of participants, and the study was carried out in the context of a TE programme that has received NOK 20 million as part of a project to prepare student teachers for professional careers in a digital society. This background introduces a potential constraint in terms of being able to generalise our results across all TE programmes. However, our qualitative approach has provided an in-depth insight into how a small sample of student teachers experience their PDC development. TE in the west faces the challenge of implementing a competence area that is complex and fairly new, and we believe that the results of our study are of relevance beyond its present context. However, we strongly recommend that future research should seek to investigate the same phenomenon at different institutions.

References

- Arstorp, A.-T. (2015). *Teknologi på læreruddannelsen – en forestillet eller en realiseret praksis? En virksomhedsteoretisk analyse af objekter, motiver og rettetheder på samfunds-, institutions- og undervisningsniveau*. Doktorafhandling. Aarhus Universitet. <https://pure.au.dk/portal/files/87307660/AfhandlingArstorp.pdf>
- Brevik, L. M., Gudmundsdottir, G. B., Lund, A., & Aanesland, T. S. (2019). Transformative agency in teacher education: Fostering professional digital competence. *Teaching and Teacher Education*, 86, 1-15. <https://doi.org/10.1016/j.tate.2019.07.005>
- Busch, T. (2013). *Akademisk skrivning for bachelor- og masterstudenter*. Fagbokforlaget.

- Calderhead, J., (1989). Reflective teaching and teacher education. *Teaching and Teacher Education*, 5(1), 43–51. [https://doi.org/10.1016/0742-051X\(89\)90018-8](https://doi.org/10.1016/0742-051X(89)90018-8)
- Creswell, J. W. (2015). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. Pearson Education, Inc.
- Darling-Hammond, L. (2006). Constructing 21st-Century Teacher Education. *Journal of Teacher Education*, 57(3), 300–314. <https://doi.org/10.1177/0022487105285962>
- Daus, S., Aamodt, P. O., & Tømte, C. (2019). *Profesjonsfaglig digital kompetanse i lærerutdanningene. Undersøkelse av tilstand, holdninger og ferdigheter ved fem grunnskolelærerutdanninger*. NIFU. <http://hdl.handle.net/11250/2602702>
- Foulger, T. S., Graziano, K. J., Schmidt-Crawford, D., & Slykhuis, D. A. (2017). Teacher educator technology competencies. *Journal of Technology and Teacher Education*, 25(4), 413–448. <https://www.learntechlib.org/p/181966/>
- Gravett, S., de Beer, J., Odendaal-Kroon, R., & Merseth, K. (2017). The affordance of case-based teaching for the professional learning of student-teachers. *Journal of Curriculum Studies*, 49(3), 369–390. <https://doi.org/10.1080/00220272.2016.1149224>
- Gudmundsdottir, G. B., Loftsgarden, M., & Ottestad, G. (2014). *Nyutdanna lærarar: Profesjonsfagleg digital kompetanse og røynsler med IKT i lærerutdanninga*. Senter for IKT i utdanninga. https://www.udir.no/contentassets/fb484acf74dc4eb3bea0f16bf9995641/nul-rapport_nynorsk.pdf
- Gudmundsdottir, G. B., & Hatlevik, O. E. (2018). Newly qualified teachers' professional digital competence: implications for teacher education. *European Journal of Teacher Education*, 41(2), 214–231. <https://doi.org/10.1080/02619768.2017.1416085>
- Gudmundsdottir, G. B., & Hatlevik, O. E. (2020). “I just Google it”- Developing professional digital competence and preparing student teachers to exercise responsible ICT use. *Nordic Journal of Comparative and International Education (NJCIE)*, 4(3), 39-55. <https://doi.org/10.7577/njcie.3752>
- Hacking, I. (1999). *The social construction of what?* Harvard University Press.
- Helleve, I., Almås, A.G., & Bjørkelo, B. (2013). Use of social networking sites in education: governmental recommendations and actual use. *Nordic Journal of Digital Literacy*, 8(4), 191–207. <https://doi.org/10.18261/ISSN1891-943X-2013-04-02>
- Helleve, I., Almås, A. G., & Bjørkelo, B. (2019). Becoming a professional digital competent teacher. *Professional Development in Education*, 46(2), 324-336. <https://doi.org/10.1080/19415257.2019.1585381>
- Hjukse, H., Aagaard, T., Bueie, A. A., Moser, T., & Vika, K. S. (2020). Digitalisering i grunnskolelærerutdanningen: Om faglige forskjeller i arbeidet med profesjonsfaglig digital kompetanse. *Acta Didactica Norden*, 14(1), 1-27. <https://doi.org/10.5617/adno.8023>
- Illeris, K. (2009). Kompetanse, læring og utdanning. *Nordisk Pedagogik*, 2(29), 194–209. <https://doi.org/10.18261/ISSN1891-5949-2009-02-03>
- Kelentrić, M., Helland, K., & Arstorp, A-T. (2017). *Rammeverk for læreres profesjonsfaglige kompetanseutvikling*. <https://www.udir.no/kvalitet-og-kompetanse/profesjonsfaglig-digital-kompetanse/rammeverk-larerens-profesjonsfaglige-digitale-komp/>
- Kirschner, A., & De Bruyckere, P. (2017). The myths of the digital native and the multitasker. *Teaching and Teacher Education*, 67, 135-142. <https://doi.org/10.1016/j.tate.2017.06.001>
- Klemp, T. (2013). Refleksjon – hva er det, og hvilken betydning har den i utdanning til profesjonell lærerpraksis? *Uniped*, 36(1), 52-58. <https://doi.org/10.3402/uniped.v36i1.20957>
- Körrkö, M., Kyrö-Ämmälä, O., & Turunen, T. (2016). Professional development through reflection in teacher education. *Teaching and Teacher Education*, 55(1), 198–206. <https://doi.org/10.1016/j.tate.2016.01.014>
- Korthagen, F., & Vasalos, A. (2005). Levels in reflection: core reflection as a means to enhance professional growth. *Teacher and Teaching*, 11(1), 47–71. <https://doi.org/10.1080/1354060042000337093>
- Krumsvik, R. J. (red.) (2016). *Digital læring i skole og lærerutdanning* (2. utg.). Universitetsforlaget.
- LaBosky, V. K., (1994). *Development of reflective practice: A study of preservice teachers*. Teachers College Press.
- Lund, A., Furberg, A., & Gudmundsdottir, G. (2019). Expanding and embedding digital literacies: Transformative agency in education. *Media & Communication*, 7(2), 47–58. <https://doi.org/10.17645/mac.v7i2.1880>
- Lund, A., & Aagaard, T. (2020). Digitalization of teacher education: Are we prepared for epistemic change? *Nordic Journal of Comparative and International Education (NJCIE)*, 4(3), 56–71. <https://doi.org/10.7577/njcie.3751>

- Ministry of Education and Research (2014). Knowledge Promotion. <http://www.regjeringen.no/en/dep/kd/Selected-topics/compulsoryeducation/Knowledge-Promotion.html?id=1411>
- Molander, A., & Terum, L.I. (2008). *Profesjonsstudier*. Universitetsforlaget.
- Nelson, M. J., Voithofer, R., & Cheng, S.-L. (2019). Mediating factors that influence the technology integration practices of teacher educators. *Computers & Education*, 128, 330–344. <https://doi.org/10.1016/j.compedu.2018.09.023>
- NOU 2014:7 (2014). *Elevenes læring i fremtidens skole*. Kunnskapsdepartementet. <https://www.regjeringen.no/contentassets/e22a715fa374474581a8c58288edc161/no/pdfs/nou201420140007000ddd-pdfs.pdf>
- Schön, D. (1987). *Educating the reflective practitioner*. Jossey-Bass.
- The Norwegian Media Authority (2020). *Barn og medier 2020. En kartlegging av 9–18-åringers digitale medievaner*. Medietilsynet.
- Tondeur, J., van Braak, J., Siddiq, F., & Scherer, R. (2016). Time for a new approach to prepare future teachers for educational technology use: Its meaning and measurement. *Computers & Education*, 94, 134–150. <https://doi.org/10.1016/j.compedu.2015.11.009>
- Tømte, C., Kårstein, A., & Olsen, D. S. (2013). *IKT i lærerutdanningen: På vei mot profesjonsfaglig digital kompetanse?* NIFU. <https://nifu.brage.unit.no/nifuxmlui/handle/11250/280429>
- Yin, R. K. (2018). *Case study research and applications: design and methods* (6th ed.). SAGE.
- Zeichner, K. (2010). Rethinking the connections between campus courses and field experiences in college- and university-based education. *Journal of Teacher Education*, 61(1–2), 89–99. <https://doi.org/10.1177/0022487109347671>
- Aagaard, T., & Lund, A. (2020). *Digital Agency in Higher Education: Transforming Teaching and Learning*. Routledge. <https://doi.org/10.4324/9780429020629>
- Aagaard, T., Bueie, A. A., & Hjukse, H. (in review). Teacher educator in a digital age: A study of transformative agency. *Journal of Digital Literacy*.