



Extended editorial

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Teacher professional digital competence

There is a global challenge to educate future generations for workplace practices and jobs that do not yet exist (OECD, 2017). According to the Organisation for Economic Co-operation and Development (OECD, 2017) and the European Commission (European Commission, 2007, 2018), globalization and deindustrialization on the global stage change the skills and competencies we need for the future. Thus, preparing for future skills and competencies must be addressed in initial education (ibid). Digital competencies or literacies are considered an important way to prepare for an increasingly digital global job market and society, but also as a way to transform society and learning. Development of such competencies cannot be reserved just for a select group of people, but for all citizens, taking a lifelong perspective. The focus on competency development for lifelong learning is a dominant perspective in Norway (Ludvigsen, 2015; Ministry of Children and Education, 2018), and in all of the Nordic countries (Bocconi, Chiocciariello, & Earp, 2018). Digital competence has also been an area of research attention for quite some time, in an effort to further develop the understanding of what it is and could be in TE (Dwyer et al., 1991; Erstad, 2005; Gilster, 1997; Hooper & Rieber, 1995; Krumsvik, 2006a; Krumsvik, 2012a; Lankshear & Knobel, 2003). An example which has had a high impact in the field is the TPACK (Technological pedagogical and content knowledge) framework (Mishra & Koehler, 2006) which delivered a conceptualization of teachers' digital competence. The current special issue addresses professional digital competence (PDC) in teacher education (TE) in Norway from the perspective of a large government funded project with five TE institutions, initiated to meet some of the challenges of a global society and fast paced technological development.

Professional digital competence development in a global perspective

Over the last two decades, there has been a global focus on educators' professional digital competence development, that is, promoting critical and creative use of digital technologies for teaching and learning in education. Most of these initiatives have focused on teachers in schools such as the Second International Technology in Education Study (SITES) Module 2 (M2), where innovative pedagogical practices in 15 (SITES-M1 1998-1999) and 28 (SITES-M2 2001) participating countries that used technology were identified and described (Kozma, 2003). Others have focused on technology-supported professional development for teachers in so-called developing countries such as Pakistan, Nigeria, Bangladesh, India, Kenya, and Sub-Saharan Africa (McAleavy, Hall-Chen, Horrocks, & Riggall, 2018). However, more initiatives have also been directed at teacher educators (e.g., Krumsvik, 2012b) who, in this sense, have been an overlooked and underexplored group of professionals acting as second-order teachers, or teachers of teachers (Arstorp, 2015; Uerz et al., 2018). In the Preparing Tomorrow's Teachers to Use Technology (PT3 1999-2002) grant program, the US Department of Education provided funding to universities, schools, state departments of education, and other educational agencies to better prepare pre-service and in-service teachers to integrate technology in school settings (Polly et al., 2010). Although not related to PT3, Mishra and Koehler's (2006) TPACK (Technological pedagogical and content knowledge) framework was also an important innovation from the US that put emphasis on the role of technology in the teaching profession. In New Zealand, the project Professional Development for e-Learning: A Framework for the New Zealand tertiary education sector (Shepherd et al., 2008) drew from research, and the perspectives and experiences of lecturers, to develop a framework for supporting professional development in higher education including practices of teacher educators (Madsen, Archard, & Thorvaldsen, 2018).

In a Norwegian educational context, three large-scale digitalization projects are worth mentioning here, including PILOT, PLUTO, and DIGGLU. The PILOT project (Project Innovation, Learning, Organization, and Technology 1999-2003) (Krumsvik, 2006b) and Learning Networks (Ottestad, Skaug, & Synnevåg, 2009) were to this date the largest and most comprehensive innovation projects related to pedagogical use of ICT in schools, spanning over four years and including 120 schools, three universities, and four university colleges (Erstad, 2004; Erstad & Hauge, 2011; Krumsvik, 2006b). One of the outputs from PILOT was Krumsvik's (2006) doctoral thesis on ICT-initiated school development in the Norwegian secondary school, which laid the foundation for thinking differently about teachers' digital competence, as opposed to a general view of digital competence (Erstad et al., 2005; Krumsvik, 2007). Another project, PLUTO (Program for Teacher Education, Technology and Change 2000-2004), involved seven Norwegian teacher education institutions and schools at different levels (Hauge, 2015; Ludvigsen & Rasmussen, 2005). Several research studies came as a result of PLUTO, including Engelsen's (2006) doctoral thesis on ICT and new forms of assessment in teacher education, and Ottesen's (2006) doctoral thesis on student teachers' and mentors' discourse in internship. The last project, DigGLU (Digitalization of Primary and Lower Secondary School Teacher Education 2018-2020), involved local projects across five Norwegian teacher education institutions. Research output from four of the projects are presented in this special issue. A common characteristic across these projects is a gradual shift from a teacher-centered methodology to that of student active learning, and exploring new pedagogical and didactic ways of supporting student learning with the use of digital technologies.

PDC in Norwegian teacher education

The origins and development of the term PDC in a Norwegian educational context can be traced back over two decades and involves complex political and societal processes that are beyond the scope of this editorial (Krumsvik, 2011; Soby, 2008; Education and Research Ministry, 2004-2008). However, for the purpose of this special issue, we will focus on some of the progress made with PDC in TE in the last decade. In 2014, *Nordic Journal of Digital Literacy* had a special issue on digital competence in teacher education. In the context of the current special issue, it seems relevant to take a look at the 2014 issue for a contemporary view of the phenomenon.

In 2006, Norway was the first country in the world to make digital skills a basic skill, for all students to develop in primary and lower secondary schools, as a part of the Knowledge Promotion (REF). Leading up to this was a long process of developing a research-based understanding of what basic skills are (Soby, 2003, 2007). The 2014 special issue showed that Norwegian teacher education (TE) still had a lot of work to do before implementing PDC in TE. Ottestad, Kelentric, and Gudmundsdottir raised the need for further development of the concept of PDC and for a framework to assess student teachers' PDC (Ottestad et al., 2014). Røkenes and Krumsvik did an extensive literature review of the research literature showing how digital technology was used in TE (for secondary school), but also documenting that PDC was a new concept in the field of TE at the time (Røkenes & Krumsvik, 2014). Lund and colleagues argued that PDC is a much more complex competence than a skills-based competence, and thus suggesting more work on the conceptualization of PDC (Lund et al., 2014). Lastly, in the 2014 special issue, Instefjord argued that technology should be better integrated as pedagogical tools for teaching and learning in all subjects in the teacher education programs (Instefjord, 2014).

At the time of the previous special issue from 2014, other research publications concerning Norwegian TE had shown a slow development in implementing PDC (OECD, 2009; Tømte, Kårstein, et al., 2013), as student teachers reported a low degree of implementation of ICT in TE (Guðmundsdóttir et al., 2013; Tømte, Kårstein, et al., 2013; Wilhelmsen et al., 2009), and a need to focus on bridging the gap between technical knowledge and knowledge on how to employ technology in a learning context (Haugerud, 2011; Ørnes et al., 2011). What was also interesting at that time was that 70% of Norwegian in-service teachers reported a need for professional development regarding their ICT skills as shown in the TALIS study (Caspersen et al., 2014; OECD, 2013), which also showed that 45% reported a need for professional development on *new technologies in the workplace*. This process of developing an understanding of PDC led to the Norwegian Centre for ICT in Education publishing the *Professional Digital Competence Framework for Teachers* (Kelentrić et al., 2017) as a guiding policy document for TE in Norway. When it comes to PDC in TE at the present date, the latest study in Norway does show that the integration of PDC in TE has improved (Daus et al., 2019). Meanwhile, other journals have started publishing more research on PDC in Norwegian TE, but with a stronger focus on student teachers, policy, and curricula (e.g., Almås, Bueie, & Aagaard, 2021; Arstorp, 2021; Jimarkon, Wanphet, & Dikilitas, 2021; Nagel, 2021).

PDC in TE is of importance as teacher educators can be viewed as second-order teachers (Uerz et al., 2018) leaving TE as an important instrument in creating change for future teachers on all educational levels (Karlsen, 2005; OECD, 2020). Nonetheless, PDC in TE is still a rather under-researched area in Norway (Daus et al., 2019; Hjukse et al., 2020; Tømte et al., 2019), but at the same time rather well defined (Kelentrić et al., 2017; Lund et al., 2014; Ottestad et al., 2014; Røkenes & Krumsvik, 2016). Meanwhile, in Norway, six out of

ten pupils in primary and lower secondary schools have their own digital device, and all pupils in upper secondary school have had these for over ten years (Gilje, 2021). What is also important to stress here is that student teachers are expected to be able to use digital technologies in their teaching when in their school practicum and when becoming in-service teachers (Guðmundsdóttir & Hatlevik, 2018; Instefjord & Munthe, 2017; Røkenes & Krumsvik, 2016). In the government strategy document *Norwegian National Strategy Teacher Education 2025: National Strategy for Quality and Cooperation in Teacher Education*, the challenges of making teacher education relevant for the school and the school practicum experience are addressed, as well as trying to bridge the gap of what is often perceived as two separate worlds (Ministry of Education and Research, 2018). The need for teachers to have PDC was stressed by the implementation of the previous national curriculum reform: the Knowledge Promotion (LK06), in Norway in 2006, where the ability to use digital tools became one of five basic skills (Ministry of Education and Research, 2006). Here, basic digital skills are related to searching for and processing information, communicating online, and exercising digital judgement, to name a few key elements. The framework for basic skills was updated in 2012, where in terms of basic digital skills, more emphasis was put on problem-solving, privacy, and security (Norwegian Directorate for Education and Training, 2012). In 2017, policymakers suggested in the *Norwegian National Strategy Digitalization strategy for the University and University College sector 2017-2021* (Ministry of Education and Research, 2017) that educators enhance their digital competence in order to utilize the affordances and possibilities of digital technology for enhanced learning processes and more efficiency. Also in the policy document mentioned above, *Teacher education 2025*, PDC is referred to as important in the national development of teacher education (Ministry of Education and Research, 2018). In 2020, the new *Norwegian National Curricula for Knowledge Promotion 2020 (LK20)* (Ministry for Education and Research, 2019) required students to use digital technologies for reaching competence aims across and within subject domains, thus putting further pressure on TE to develop PDC in the programs and practice.

The framework for teachers' PDC

The release of the Norwegian *Professional Digital Competence Framework for Teachers* (Kelentrić et al., 2017) helped address the aforementioned need for defining teachers' digital competence. The framework is based both on previous research on digital literacy and policy documents on the teacher role in Norwegian education, but it also draws on the content of national regulations, guidelines for teacher education programs, the national curriculum, the Basic Skills Framework, and the National Qualifications Framework.

The role of the teacher is central to the framework, as the ambition was to shift the focus from being technology-centered, as mentioned in previous research (Haugerud, 2011; Johannesen et al., 2014), to focusing on the competences needed for the individual teacher (Kelentrić et al., 2017). The framework's seven areas were originally defined in the Report to the Storting No. 11 (white paper) (2008-2009) *The Teacher – the role and the education*. A key component in the thinking behind the framework is that having a high level of PDC means being capable of developing pupils' basic digital skills, but also one's own PDC (Kelentrić et al., 2017). The framework is based on and draws on the content of national regulations, guidelines for teacher education programs, the National Curriculum for Knowledge Promotion, the Basic Skills Framework, and the National Qualifications Framework. Drawing on the Framework of Teachers' PDC and existing literature mentioned above, we suggest defining PDC as follows:

A teacher's professional digital competence consists of both the knowledge and skills needed for designing for learning, teaching and assessment, but it also entails a deep understanding of how digital technology changes society, schools, core subjects and its methods, as well as our interactions, the way we express ourselves. A teacher's professional digital competence incorporates these aspects in the teaching profession. (Our definition)

In order to fulfil the ambitions of the framework, the national guidelines and regulations, PDC must be integrated into the actual practice of TE, which is the aim of the digitalization projects presented in this special issue. However, before addressing them, it seems pertinent to unfold the seven areas of the PDC framework defining the teacher's role in a digital perspective. Altogether, the framework consists of 57 learning outcomes intended to be implemented in national and local program plans (Kelentrić et al., 2017):

1. Subjects and basic skills

This first area is related to the teacher's understanding of how digital technology changes and expands the content and methods of school subjects, but also the teacher's understanding how to integrate digital resources into learning processes, in order to achieve competence aims and develop students' basic skills. This area also covers knowledge about digital assessment and new methods to be integrated into subjects.

2. School in society

This second area is about understanding how technological development including digital media in today's society challenges us all, and how this must be addressed in schools. It is about being able to bridge the digital divide and assist students in being actively participating in a global, digital and democratic society.

3. Ethics

This third area is related to the teacher's awareness and ability to act according to the school's core values in relation to digitalisation in society, and to educating students on legislation and ethical concerns related to sharing and developing digital content. Ethics are also about educating future generations to act carefully and exercise good judgement in digital environments, including preventing digital bullying and harassment.

4. Pedagogy and subject didactics

This fourth area is about the teacher's pedagogical knowledge related to teaching in digital environments, such as integrating digital resources into lesson planning, organizing, implementing and evaluating for the students' learning and development. This implies being able to locate, critically evaluate, choose, and integrate digital teaching and learning materials based on the subject's content, subject methods and competence aims.

5. Leadership of learning processes

This fifth area is related to the teacher's competence in guiding learning processes in a digital environment where there are constant changes especially to the role of the teacher. This area describes how the teacher must be able to use the opportunities inherent in the digital resources available to develop a constructive and inclusive learning environment for all students. This requires being able to use diverse forms of assessment of learning and creating an environment which fosters innovation, a desire to learn and the students discovering their individual learning strategies.

6. Interaction and communication

This sixth area is about using digital communication channels appropriately for information, collaboration, and knowledge sharing with various stakeholders in ways that support diversity, inclusion, sharing and development.

7. Change and development

This seventh area is about the teacher being aware of how developing one's own digital competence is a lifelong, dynamic, situational and flexible process. This addresses the need for continued development of the school's and the individual teacher's professional development related to the pedagogical use of digital technology.

The descriptions of the seven areas in the Framework for PDC resembles that of learning outcomes, and there is a way to go for TE to operationalize these learning outcomes into actual teaching practice and competence. The research presented in this special issue are examples of just this, of transforming learning outcomes into action and practice in TE and into professional development in TE.

The Renewal of the Curriculum: National Curriculum for Knowledge Promotion 2020

In the recent renewal of the Norwegian National Curriculum for Knowledge Promotion, LK20, the focus on students' learning has, to a greater degree than before, expanded beyond the individual subjects (Norwegian Directorate for Education and Training, 2020). In the new curriculum, there now is an emphasis on the promotion of in-depth learning and cross-curricular topics including 1) democracy and civics, 2) public health and lifelong learning, and 3) sustainability. Moreover, several of the curriculum's competence aims and assessment explicitly mention and demand the use of digital technologies. For example, in social studies after year 10, pupils are expected to be able to "assess the ways in which different sources provide information on social studies related topics, and reflect on how algorithms, biased sources or the lack of sources can affect our understanding" (Norwegian Directorate for Education and Training, 2020). Another example can be found in mathematics, where pupils after year 10 are expected to be able to "explore and compare the properties of different functions using digital tools" (Norwegian Directorate for Education and Training, 2020). Taken together, LK20 expects in-service and pre-service teachers to implement digital technologies for teaching and learning, in the operationalization of competence aims, and through formative and summative assessment.

At the time of writing this special issue, LK20 is still a relatively new curriculum reform, in which important elements, such as the future of examinations in schools, are still yet to be decided. However, there is little doubt that digital technologies will play a key role for teachers and pupils working with the new curriculum, especially when it comes to the cross-curricular topics, which can invite in-depth learning across subject disciplines. In addition, developing educators' PDC might be a worthwhile investment when facing an uncertain future, with an increased frequency of homeschooling and remote teaching due to the ongoing Covid-19 global pandemic (Krumsvik, 2020). The importance of Norwegian teachers' PDC, pupils' digital skills, and digital infrastructure was especially evident during school shut downs and switching from physical to remote teaching in Norway from March until May 2020. However, as pointed out by Blikstad-Balas et al. (2022, p. 177), "Norwegian teachers and school leaders were not prepared to go digital overnight, despite good technological infrastructure and a curriculum that explicitly emphasizes the importance of digital com-

petence across subjects.” From a national survey administered to parents (N = 4,642) about how digital homeschooling was organized, the researchers’ main finding was that pupils to a large degree worked on “individual tasks, with limited support from their teachers, especially in the lowest grades” (Blikstad-Balas, Roe, Dalland, & Klette, 2022, p. 177). Paradoxically, the researchers note that “while teachers in Norway have been expected to draw on digital tools across all school subjects and grades since 2006 [...] this has not resulted in a shared digital repertoire of practices across, or even within, schools” (Blikstad-Balas et al., 2022, p. 196). An important lesson for the future, especially in light of the new curriculum, will be for teachers to develop a shared ambition for physical, remote, and hybrid teaching, and “a shared repertoire on ways to engage children in social, real-time interaction” (Blikstad-Balas et al., 2022, p. 197).

This special issue

It is important to note that the framework is a guiding policy document, as opposed to a required framework. However, in light of the challenges described above, the Norwegian Ministry of Education announced in 2017 that they would fund development projects for “Digitalization in Teacher Education” with 90 million NOK (Ministry of Education and Research, 2017), requiring that the projects be built on the *Professional Digital Competence Framework for Teachers* (Kelentrić et al., 2017). Five Norwegian TE institutions received funding for developing PDC in TE. This special issue contains the research done into four of these five projects.

The first article is from the DigiGLU project at **University College Volda**, with the title: “Professional digital competence in strategy and management: A case study of three teacher education programs in Norway. This article addresses the integration of PDC in local program plans with the University College Volda, which received funding for a digitalization project, and two other TE institutions which did not receive funding. Through interviews and document analysis in a mixed-method design, the article explores how educational management understands the developmental processes surrounding PDC in TE, and how this is addressed and reflected in the local program plans and strategic documents. The article shows how different institutions use different strategies based on the different conceptual understandings, but also economic and organizational priorities. This study thus highlights the effects of funding pushing for development and the implications such funding could have on local understandings, priorities and program plans.

The second article is from the digitalisation project “LUDO” at **University of South-eastern Norway**: “Teacher educator in a digital age: A study of transformative agency”. This article is based on a 10 ECTS course called “Teacher educator in a digital age” where the participants developed and implemented their own projects in the subjects they taught with the objective of enhancing the students’ PDC. This is done by applying Vygotsky’s theory of double stimulation to capture the teacher educators’ transformative agency. One finding in the article is that the transformative agency is stimulated by a number of factors, such as technology, literature, national policy documents, tasks given and the professional learning community established in the course. The authors argue for why initiating and engaging in teacher agency is an important part of professional digital competence (PDC), and in the article they identify how a course can be designed to stimulate such agency. This article shows possible new directions for, and the potential of, developing new courses for educators in TE.

The third article is from the DigGiLU project at the **Norwegian University of Science and Technology** with the article: “Teacher Educators’ Professional Digital Competence in

Primary and Lower Secondary School Teacher Education.” The authors study the experiences of teacher educators taking part in professional development in a course developed to enhance their PDC. Through a case study research design using semi-structured focus group interviews, the study shows how teacher educators report benefiting most from collective knowledge sharing, as it inspired and motivated them to use digital technology in their own practice. Other findings relate to: how the course helped shape their understanding of what PDC is; and the Covid-19 pandemic increasing the awareness of what possibilities and limitations digital technology has in TE.

The fourth article is from **the ProDig project at the University of Agder**. The title of the article is: “Professional digital competence in initial teacher education: An examination of differences in two cohorts of pre-service teachers”. It studies pre-service teachers’ perceived PDC and a program redesign to integrate digital technologies more actively. The study is based on survey data from two cohorts from before and after the course redesign and partnership initiatives, and the study shows an increase in the pre-service teacher students’ self-perceived PDC, when comparing the two cohorts. The study highlights the importance of TE actively addressing PDC in course redesign, but also the importance of establishing collaborative partnerships between mentor teachers and teacher educators in order to ensure PDC-competent future generations of teachers.

These four studies show certain aspects of the effect of funding for projects meant to develop PDC practice in TE, and raise PDC for students and teacher educators. One could argue that 90 million NOK in funding would have some kind of effect, even just from the attention it gets and the awareness that creates, meaning that the funding itself signals the importance of PDC to the institution receiving the funding, and that this creates opportunities that were not possible without it. It is difficult to disagree with or argue against such a point. However, what is interesting, across these articles, is what goes beyond basic expectations. The articles show that the initiatives, such as courses for teacher educators, redesign of the teaching programs, local changes in educational programs, and organizational awareness of PDC, create change because they feed institutional and individual awareness of the importance and the possibilities of digital technology, an awareness which seems to be beyond the basic awareness mentioned just above. This more extensive awareness seems to create change in different ways, as the studies show. However, it seems that across the different studies, it is safe to say that such funding changes TE, and it changes the way TE operates at different levels.

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