Digital Competence in Teacher Education Curricula: What Should Teacher Educators Know, Be Aware of and Prepare Students for?

Ilka Nagel[1]
        Østfold University College

Abstract

This qualitative study aims to contribute to the discourse on teacher educators' knowledge by examining the impact of digitalisation. To explore how digital competence is addressed in local curricula and what is expected of teacher educators (TEDs) in terms of preparing student teachers for epistemic changes, I thematically analysed the programme descriptions, course descriptions, and plans for school practicum from six Norwegian teacher education institutions. The findings show that TEDs are expected to focus on the (pedagogical) use of digital tools. However, they are also supposed to teach student teachers how to foster pupils' digital skills and digital responsibility while addressing digitalisation's influences on society and culture, subjects' contents, and educational practices. The findings imply that TEDs need an understanding of digitalisation's implications for epistemic practices to foster student teachers' digital competence and transformative digital agency.

Keywords: teacher education, teacher educator knowledge, digital competence, curricula

Introduction

Over the past two decades, the issue of teacher quality has received increasing international attention. The European Commission mapped out the education systems in Europe to identify the necessary competences regarding what a teacher should know and be able to do, resulting in the development of teacher competence frameworks (European Commission/EACEA/Eurydice, 2019). These frameworks can be seen as declarations of political intentions for what ought to be taught in teacher education. However, although political and professional discussions have begun, there is no clear description of what teacher educators (TEDs) are expected to know and be able to do (Goodwin et al., 2014; Kelchtermans et al., 2018). Therefore, there may be gaps between what TEDs as *teachers of teachers* (Dengerink et al., 2015) are supposed to address in teacher education and their actual knowledge and skills.

---

[1] Corresponding author: ilka.nagel@hiof.no

The ongoing digitalisation of society and schools, as well as people's access to and use of digital tools, impacts and fundamentally transforms epistemic and educational practices (Lund & Aagaard, 2020). The need for teacher education to adapt and integrate digital competence in study programmes has been emphasised by several actors, including policymakers, researchers, school leaders, and teachers (Drummond & Sweeney, 2017; Gudmundsdottir & Hatlevik, 2018; Kaufman, 2015; Ottestad et al., 2014).

Internationally, few studies have examined the framing of digital competence in educational policy documents (Coşkun, 2015; European Commission/EACEA/Eurydice, 2019; Ottestad & Gudmundsdottir, 2018), and few have considered how teacher education addresses digital competence at the institutional level (e.g. Baran et al., 2019; Reisoğlu & Çebi, 2020). Thus, there is a lack of research on how TEDs should handle the development of student teachers' digital competence. Specifically, such research could not only examine the expectations for TEDs' knowledge and understanding of digitalisation but also digitalisation's influence on educational practice. Studying these expectations would enable a profound discussion on what TEDs need to know and be able to do, serving as a starting point for considering TEDs' knowledge, beliefs and identity and their implications for future professional development.

In the Norwegian context, few studies have examined the integration of digital competence into teacher education policies (Engen et al., 2015; Instefjord & Munthe, 2015). However, recent national efforts have attempted to provide prospective teachers with better digital competencies. In the fall of 2017, a new national curriculum for a five-year master's programme in teacher education was implemented. This was a profound reform, both at the national and institutional levels, and many teacher education institutions redesigned their programmes to include digital competencies. Furthermore, in 2018, five teacher education institutions received 9 million euros for three years (2018–2020) from the Norwegian Ministry of Education and Research to develop professional digital competence (PDC) in teacher education. One funding requirement was to integrate PDC into all programme courses (Norgesuniversitet, 2017). Consequently, curriculum development at the institutional level in Norway is promising for studying what knowledge is expected from TEDs to integrate teachers' digital competence (TDC) into their courses.

The current study analyses local policy documents from several teacher education institutions and subject fields, exploring the following research questions (RQs):

RQ1: How is digital competence addressed in teacher education curricula at the institutional level?

RQ2: In what ways are teacher educators expected to be aware of and prepare student teachers for epistemic changes?

Below, I provide an overview of the relevant models that describe TDC and discuss knowledge resources for TEDs. Then, I describe my research design and analytic strategies and present the findings. In the concluding discussion, I outline a model that may serve as a basis for further discussion of TEDs' digital competence.

Teachers' Digital Competence and Professional Digital Competence

Over the past 15 years, several models have emerged for describing the digital skills and competencies that teachers should develop to meet the needs of the digital society; these models also imply what TEDs are expected to know as they develop TDC.

Mishra and Koehler (2006) developed the model of technological pedagogical content knowledge (TPACK), which is supported by the cognitive learning tradition and represents a first attempt to conceptualise TDC as a confluence of technological, pedagogical, and content knowledge.

Since then, several models (Brevik et al., 2019; Falloon, 2020; Instefjord & Munthe, 2015; Krumsvik, 2014; McGarr & McDonagh, 2019; Ottestad et al., 2014) have been developed, all of which focus on the knowledge and skills needed for teaching with digital technologies but adding or stressing different dimensions. In the following section, I will briefly describe the models relevant to this study. Krumsvik's (2014) TEDs' digital competence model proposes a developmental process in which didactical competence and competence in effective learning strategies (adaption and appropriation) build on technical proficiency (adoption) and in which digital Bildung—going beyond technical skills and netiquette toward reflexive digital citizens—is the highest level of competence. Furthermore, Brevik et al. (2019) added the dimension of transformative digital agency, the "competence in taking initiatives and transforming their practices by selecting and using relevant digital tools" (p. 4) to the model developed by Ottestad et al. (2014), which comprises generic digital competence, didactical digital competence, and professional-oriented digital competence; all four dimensions are mutually dependent and partly overlapping.

In the Norwegian context, the concept of PDC is important. In 2006, the Norwegian Directorate for Education and Training (2012, revised 2017) defined digital skills as one of the five basic skills in the compulsory and secondary education reform, targeting the need for digitally competent teachers. In 2012, the Norwegian Centre for Information and Communication Technology (ICT) in Education coined the term PDC (Kelentrić et al., 2017), and in 2017, it launched the comprehensive Norwegian framework for teachers' PDC[2] (Kelentrić et al., 2017). In the framework, PDC is divided into the following seven areas: 1) subject and basic skills, 2) school in society, 3) ethics, 4) pedagogy and subject didactics, 5) leadership of learning processes, 6) interaction and communication and 7) change and development. Here, PDC is understood as being twofold, with teachers continuously developing their digital competence and that of their pupils. The framework was developed as a guideline to be used in teacher education (Kelentrić et al., 2017) and is now rooted in all national plans and academic regulations for teacher education in Norway (Krumsvik, 2020). However, little is known about the integration of TDC at the formal curricula level (Goodlad et al., 1979) in teacher education. Engen et al. (2015) showed that the link between the national regulations for teacher education and the

---

[2] The term is still new and mostly used in the Scandinavian context. Therefore, I use PDC to refer to digital competence as defined in the framework and more generally to TDC.

curriculum for basic education is weak. Instefjord and Munthe (2015) stated that TDC's knowledge areas are hardly addressed in the national and local teacher education curricula. However, these studies were conducted before the latest Norwegian teacher education reform.

TED Knowledge—Epistemic Change in the Age of Digitalisation?

TEDs have heterogenic backgrounds; some are former teachers, while others are researchers who have specialised in their discipline or subject field (Lunenberg, 2010). Usually, TEDs in Europe enter the profession without formal preparation, without or with little guidance from a more experienced mentor, and little attention is paid to systematic professional development (Czerniawski et al., 2018). Knowledge resources informing TEDs' work and professional development have been debated at national and international levels (Garm & Karlsen, 2004; Goodwin et al., 2014; Kelchtermans et al., 2018). Koster and Dengerink (2008) discussed standards for TEDs and the need for a framework describing what is expected of TEDs; however, they pointed out that when seen as external normative structures, standards offer little room for reflection on the existing norms, values, and beliefs, are not used for professional development and may lead to de-professionalisation. Still, educators must navigate an increasingly digitalised society and tools that were originally not designed for educational purposes. This requires a complex epistemic engagement that may challenge individual professional autonomy and freedom (Hermansen, 2017). Such knowledge work could describe knowledge resources, not as standards that prescribe instructional approaches (Hermansen, 2017); instead, it could contribute to a fuzzy frame of reference, supporting reflection and providing a starting point for professional development (Koster & Dengerink, 2008, p. 140). The International Forum for Teacher Educator Development (InFoTED) suggested such a knowledge frame as part of its conceptual model of teacher educator professional development, calling for more research on TED knowledge (Kelchtermans et al., 2018). InFoTED agreed with Goodwin et al. (2014), who pointed out that such a frame of reference could be "responsive to shifting local and global contexts and emphasise research in/on practice" (p. 284), meaning it would be continuously undergoing development and transformation. Such constant development is especially important concerning the recent discourse on societal and epistemic changes brought about by digitalisation (Ludwig, 2015; Lund & Aagaard, 2020; Aagaard & Lund, 2020). Epistemic change may influence our epistemic practices, meaning the patterns of social practices used to generate knowledge about the world with shared cultural values, meanings and tools (Jiménez-Aleixandre & Crujeiras, 2017), which may also influence our educational practices. Digital technologies are no longer simply tools used by humans; they are partners (Brox, 2017; Lund & Aagaard, 2020; Aagaard & Lund, 2020). Lund and Aagaard (2020) argued that this changing relationship between humans and digital technology has "severe implications for how people construct knowledge and arrive at valid responses to complex challenges" (p. 57). Relating to the 4E approach to distributed cognition, which holds that cognition can be extended,

embedded, embodied and enactive (Newen et al., 2018), but focusing on understanding interactions among people and technology, Lund and Aagaard (2020) identified the following three ways digitalisation influences epistemic practices:

(1) Extended cognition: Humans engage with technology to distribute cognitive load and cognition.

(2) Embedded cognition: "Digitalization is increasingly *embedded* in both mundane and scientific practices to the extent that it is ubiquitous but invisible" (Lund & Aagaard, 2020, p. 61, emphasis in original text).

(3) Embodied cognition: Digital artefacts that can be worn on (or in) the body and enable the use of one's senses and body to connect to the world in new ways.

Lund and Aagaard (2020) further explained that these categories "are not discrete or without grey areas, but they might still help us analyse and reflect on the complex relationships between humans and digital technologies, including epistemological and ethical implications" (p. 62). They emphasised that teacher education should address the epistemic consequences of digitalisation, suggesting the integration of TDC should focus on digital transformative agency in teacher education in response to changes in epistemology. Therefore, the models describing TDC and Lund and Aagard's (2020) categories were used in the analysis.

Method

Empirical Context

In Norway, there are two teacher education models. The consecutive model focuses on pedagogy and didactics for students who have already completed their disciplinary studies and decided to become teachers. The concurrent model integrates disciplinary and pedagogical studies, teaching them at the same time. In this study, I collected data from five-year teacher education master's programmes following the concurrent model. The programmes prepare student teachers to teach grades 5–10, meaning children aged 10 to 15.

Method and Dataset

The empirical data consisted of 317 local policy documents from six teacher education institutions in Norway. I contacted all 13 institutions offering initial teacher education, and eight were interested in participating. The Sámi University of Applied Sciences was excluded from the study because of my lack of language proficiency in Sámi. To ensure as much variety as possible, I then selected the institutions that differed the most in terms of size (from 60 to 150 students per year), organisational structure (several campuses vs. one campus, separate faculty for teacher education vs. offering teacher education at

different faculties) and location (urban and rural, in the north, south, east, and west). If the institution consisted of several campuses, I chose to focus on the campus offering the most courses in teacher education. Three of these institutions were among the five that received funding in 2018 for digitalisation projects. I established contact with the leaders of the study programmes at each institution, who gave me access to the newest versions of the curricula, even if they had not been officially published yet. I analysed general programme descriptions, course descriptions, and plans for school practicum, omitting all course descriptions on research methods and the master's thesis because my study does not focus on knowledge related to TEDs as *researchers* (Dengerink et al., 2015). I collected the documents in December 2020. Table 1 provides an overview of the types and numbers of documents included in the sample.

Table 1. The Type and Number of Documents from Each Teacher Education Institution

	TEI 1[3]	TEI 2	TEI 3	TEI 4	TEI 5	TEI 6	Total
Programme description	1	1	1	1	1	1	6
Course description	59	42	35	65	48	38	287
Arts and Crafts	-	-	*1*	*6*	*5*	*2*	*14*
English	*9*	*7*	-	*6*	*5*	*2*	*29*
Mathematics	*6*	*8*	*7*	*5*	*5*	*5*	*36*
Music	*6*	-	*2*	*9*	*3*	-	*20*
Natural Sciences	*6*	*2*	*2*	*9*	*5*	*6*	*30*
Norwegian	*4*	*8*	*6*	*4*	*5*	*5*	*32*
Nutrition and Health	*1*	-	-	-	*3*	-	*4*
Pedagogy	*7*	*4*	*6*	*4*	*4*	*7*	*32*
Physical Education	*6*	*1*	*2*	*8*	*5*	-	*22*
Religious and Ethical Studies	*6*	*1*	*4*	*5*	*3*	*5*	*24*
Social Studies	*6*	*7*	*4*	*7*	*5*	*6*	*35*
Special Needs Education	-	*3*	-	*1*	-	-	*4*
Other	*2*	*1*	*1*	*1*	-	-	*5*
Plans for school practicum	4	4	4	4	4	4	24
Total	64	45	39	74	53	41	317

Analytical Strategy

I employed document analysis (Bowen, 2009) to identify and analyse how TDC was addressed in the documents. I analysed the data thematically, inspired by the steps suggested by Braun and Clarke (2006). First, I familiarised myself with the documents, imported them into NVivo12, and assigned background data that might be relevant, such as institution and subject. Second, I applied an abductive approach to coding (van Maanen et al., 2007), developing codes in a back-and-forth movement between the aforementioned

---

[3] TEI = teacher education institution

models describing TDC and the data (e.g. "digital tools" or "algorithms and program-ming"). Third, I combined the descriptive categories that covered similar topics and cre-ated seven themes, which are presented in the findings section. Fourth, I focused on finding the relations and patterns between the themes and used cross tables in NVivo12 to investigate patterns related to institutions, document types and courses. As I discovered differences in how TDC was addressed depending on the extent to which it was integrated into the documents, I labelled the documents accordingly (not at all = zero references; basic = one or two simple standard phrases; intermediate = two to four different and more complex references; advanced = more than four different references). Then, I decided to analyse the 21 documents that addressed TDC at an advanced level in depth. Table 2 provides an overview of these documents. Three programme descriptions and 16 course descriptions are represented but no plans for school practicums. Two institutions—TEI 2 and TEI 6—provided most of the 21 documents. These institutions received funding for digitalisation projects. This might be an indication of the projects' successful contribution to the process of curricula making and integration of TDC. However, comparing the in-stitutions and studying the projects' effects are not within the scope of this study. Never-theless, the data might show where Norwegian teacher education is heading in terms of integrating TDC.

Table 2. Documents Chosen for the In-depth Analysis

	TEI 1[4]	TEI 2	TEI 3	TEI 4	TEI 5	TEI 6	Total
Programme description		1	1			1	3
Course description	2	5	1	2	1	7	16
Arts and Crafts						*1*	*1*
English		*1*					*1*
Mathematics						*3*	*3*
Music			*1*	*1*			*2*
Natural Sciences							*-*
Norwegian		*1*			*1*		*2*
Nutrition and Health							*-*
Pedagogy							*-*
Physical Education							*-*
Religious and Ethical Studies						*1*	*1*
Social Studies		*2*				*2*	*4*
Special Needs Education							*-*
Other	*2*	*1*		*1*			*4*
Plans for school practi-cum							-
Total	2	6	2	2	1	8	21

---

[4] TEI = teacher education institution

I again followed an abductive approach, this time going back and forth between Lund and Aagard's (2020) descriptions of categories and the documents to operationalise the categories and identify them in the data (Table 3).

Table 3. Operationalisation of Lund and Aagard's (2020) Three Perspectives with Epistemological Implications

Perspective	Operationalisation
Extended cognition	- Explicit use of tools as extended partners/meta-perspective on learning with digital tools - Real-life problems (that can be solved with digital approaches) - Assignments without final answers that facilitate student learning through the appropriation of digital tools - Promotion of transformative digital agency
Embedded cognition	- Learning activities/assignments that use embedded technology - Awareness of embeddedness and the possibilities and challenges connected to it - Awareness of teaching practices in embedded environments (e.g. online teaching)
Embodied cognition	- Prepare students for living and working with embodied technology - Address ethical issues

Because the documents were in Norwegian, I translated the sections quoted in the current paper into English.

Findings

In the following section, I will start by presenting the findings related to RQ1 and first describe the themes identified. Further, I will illustrate the patterns and outline the differences in ways of addressing TDC depending on the extent (basic/intermediate/advanced) to which it was integrated into the documents. Finally, I will focus on RQ2 and show indications of Lund and Aagard's (2020) three perspectives, which may imply epistemic changes in the documents that addressed PDC at an advanced level.

Themes Addressing TDC

This section provides an overview of the following seven themes identified in the data: (1) *digital tools*, (2) *digital didactics and pedagogy*, (3) *pupils' basic and digital skills*, (4) *culture, society and democracy,* (5) *digital responsibility and ethical awareness*, (6) *PDC* and (7) *development and transformation*. I present the themes according to their frequency of occurrence.

The most frequent theme was *digital tools*, which covers all references to the use of digital tools, digital resources, educational software, online learning,[5] technology, and

---

[5] There were three exceptions that addressed online teaching as a skill needed for future teachers.

learning management systems (LMS) without relating to a pedagogical context—for example, "we are going to use the institution's digital tools" or "use of LMS" in the description of the organisation of a course. In the learning outcomes, the word "digital" was included in existing outcomes, or a standard phrase was added ("the student can use digital tools"). The second theme, *digital didactics and pedagogy*, is closely related to *digital tools*. The references focused on the pedagogical use of the tools, or the tools were placed in a didactical context ("The student can assess and use digital tools to promote mathematical learning in statistics and probability calculation"). This theme refers to digital assessment practices and the teaching methods related to algorithms and programming,[6] communication and collaboration, differentiated instructions, flipped classroom, mentoring, multimodality and multimedia, the use of digital presentations, teaching in technology-rich classrooms and digital learning arenas as well as with simulations and modelling and video.

The third theme is *pupils' basic and digital skills*, which contains two categories. One refers to *basic skills* because, in Norway, digital skills were defined as one of the basic skills in 2006 (Norwegian Directorate for Education and Training [NDET], 2012, revised 2017). Usually, the category refers to a standard sentence in the learning outcomes: "The student can foster pupils' basic skills." However, some documents emphasised that "the student can foster all basic skills, including digital skills." These sentences were labelled *digital skills.*

The fourth theme refers to *culture*, *society and democracy,* covering references to digital citizenship ("the subject aims to give a profound picture of the pupils as digital global citizens") and democracy, youth culture, which refers to knowledge about pupils' digital everyday life and the ability to advise their use of (social) media and digital arenas, fostering digital Bildung and addressing the digital divide and health aspects.

The theme *digital responsibility* is composed of the categories referring to the umbrella term itself and the dimensions that it contains, including copyright, cyberethics, digital identity, netiquette, privacy and internet safety, and source criticism. Often, some categories were addressed together: "can foster netiquette, cyber ethics and critical reflection, including the use of digital media." This theme partially overlapped with (social) media.

The theme *PDC* was employed whenever the term PDC was found in a document ("the student has knowledge of and can reflect about their professional digital competence"), usually without further explanation or definition but twice with a reference to the Norwegian PDC framework (Kelentrić et al., 2017).

The least mentioned theme, *development and transformation*, covers references to lifelong learning, research-based pedagogical use of ICT in teaching and learning, and the transformation and change of subjects and educational practice because of digitalisation.

---

[6] This category refers to teaching programming and how it might contribute to mathematical thinking and understanding science concepts. It did not reflect a deeper understanding of how algorithms influence or interact with people, for example, on social media; therefore, I placed this category in the theme *digital didactics and pedagogy* rather than *society and democracy*.

Patterns

The most prominent pattern applying to all types of documents (programme description, course description, and plans for school practicum) summarises the description of the above-mentioned themes. The documents focused on digital tools, digital didactics and pedagogy, and pupils' basic and digital skills.

The different course descriptions handled the topics in different ways. The natural sciences addressed algorithms and programming, flipped classrooms, and simulation and modelling, while other subjects did not. Languages generally focused on digital didactics and pedagogy and digital tools, especially multimodality and multimedia. Religious and ethical studies, arts and crafts, and physical education emphasised digital responsibility rather than digital didactics and pedagogy and digital tools. Social studies had the broadest approach, covering all the themes mentioned above.

Further, while all the institutions explicitly addressed PDC in their programme descriptions, two institutions (TE 2, TE 6) addressed TDC more thoroughly in all types of documents than the others. Compared with the other institutions, these two focused less on digital tools and more on digital didactics and pedagogy. Moreover, they both addressed development and transformation, and TE 6 also addressed culture, society and democracy notably more often than the other four institutions. TE 6 also addressed TDC more often in the plan for school practicum, touching upon all the themes except development and transformation, while the others focused on digital tools and digital didactics and pedagogy. TE 2 and TE 6 had received funding for digitalisation projects. The three institutions that integrated TDC to a lower degree (TE 1, TE 3, TE 4) focused more on digital tools than on digital didactics and pedagogy. One of these institutions had received funding for promoting digital competence.

Of the 317 documents, 51 did not address TDC at all; 122 addressed it at a basic level, which usually meant having one or two simple standard phrases; 123 addressed it at an intermediate level, with two to four complex references; and 21 addressed TDC at an advanced level. Thus, about two-thirds of all documents addressed TDC. However, there were differences in how TDC was mentioned. The documents that addressed TDC at a basic level typically used standard phrases from their institutions or simply added the word "digital" where appropriate. The more thoroughly TDC was addressed, the more detailed and complex the formulations were. There was also a tendency to describe the teaching goals for learning with digital tools in a more subject-specific manner, as illustrated by the example in Table 4. Here, at the basic level, the student is generally expected to learn how to use digital tools for teaching. At the intermediate level, specific didactical and subject-related goals are connected to the use of digital tools, and at the advanced level, the student is expected to learn how to produce digital educational resources. At the advanced level, examples of resources (programming, social media) that can be employed are given. However, these examples are unspecific, and it is up to TEDs to decide how to operationalise the curriculum's requirements.

Table 4. Examples of Formulations Addressing TDC in the Documents

Theme	Basic level	Intermediate level	Advanced level
Digital didactics and pedagogy	The student can use digital tools when teaching.	The student can systematically plan, conduct, and assess digital teaching methods when teaching English.	The student can produce, use and assess digital tools and educational resources when teaching, for example, using programming and social media.

Furthermore, as illustrated in Figure 1, there was a visible shift in the themes and categories used in the documents depending on the extent to which TDC was addressed. Although the categories *digital tools* and *digital didactics and pedagogy* could be found at all levels, the focus shifted toward the category *digital didactics and pedagogy* in the documents addressing TDC at an intermediate or advanced level. At these levels, the category *culture*, *society and democracy* was most prominent, followed by the category *digital responsibility*. Further, the category *development and transformation*, which was not present at the basic level, gained importance at intermediate and especially at the advanced level. There was also a shift in the theme of *pupils' basic and digital skills* from the general use of *basic skills* to the explicit use of *digital skills and competence* (not shown in Figure 1).

Figure 1. Distribution of the Themes (Standardised per 100 Documents) in the Documents Addressing TDC at the Basic, Intermediate, and Advanced Levels
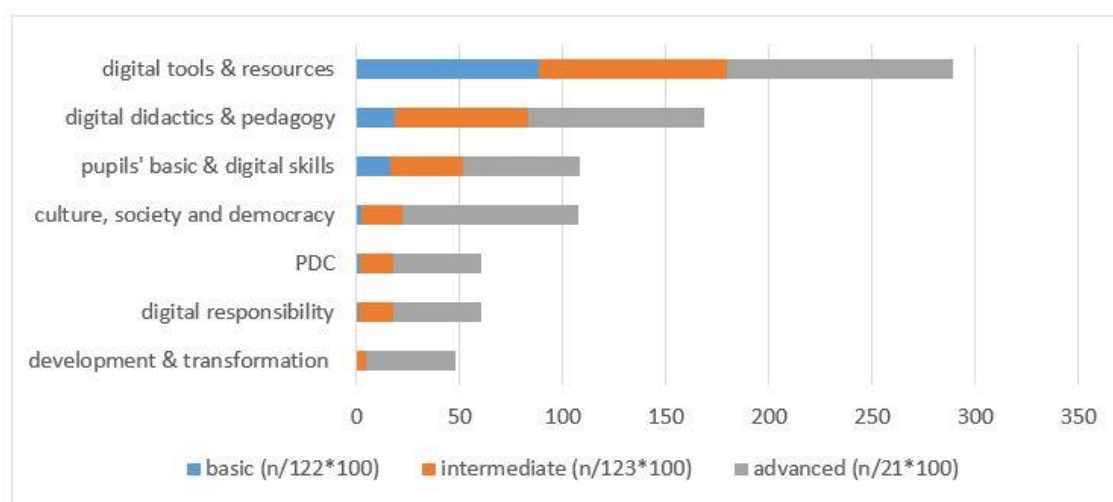
Implications for Epistemic Change

I analysed the 21 documents that addressed TDC at an advanced level, looking for indications that these documents expected TEDs to prepare student teachers to design for learning while considering changes in epistemic practices due to treating digital tools as partners.

Several sentences can be related to forms of *extended cognition*, such as reflection on and awareness of learning with digital tools ("can identify, analyse and critically reflect about possibilities and challenges related to the use of digital media in pupils' learning process"). Additionally, I found more general competences, such as "being able to reflect about how technology influences and changes/develops music as a subject in school."

Furthermore, fostering pupils' ability to live, work and be a democratic, digital citizen in an *embedded* society was an explicit goal in more than half of the documents ("the student can guide pupils' active participation in digital media and contribute to a reflective relation to digital arenas"). Learning in *embedded* environments was a central topic. TEDs were expected to teach students how to use digital arenas for learning, including social media and games, and to "be able to make motivated choices that promote their pupils' learning in a digital society." One course explicitly wanted to "prepare the students for being a mathematics teacher in a digital world, where flipped classrooms and online teaching have become more typical."

There were no expressions that could be connected to *embodied* technology; however, there were grey zones that could not be related to one of the three perspectives, expressing a general approach instead. For example, TEDs were expected to ensure that "the student has profound insight into how children and youths learn languages through digital technology" and to foster students' awareness and knowledge about "how digital developments are expanding and changing the subject's contents, conceptual framework, forms of assessment and working methods." Moreover, students "can discuss who provides the premises for technological development."

The documents also contained formulations showing that TEDs were supposed to prepare student teachers for future challenges and facilitate *transformative digital agency*: "being able to identify and analyse professional problems related to digital teaching and learning and to use that understanding in their teaching, development, and research."

Furthermore, the form of some obligatory assignments and exams has changed from "a four-hour written exam without tools and aids" to reflect learning with digital tools and to recognise knowledge as something that cannot be evaluated in the question-answer format, for example, "a collaboratively written text and a note describing reflection about the writing process," "group assignment: students will prepare a video lesson, present it and argue their choices" and the use of portfolios.

In sum, the 21 documents showed signs that TEDs should be aware of the epistemic consequences of digitalisation and prepare their students to cope with changes in educational practices and subjects' contents.

Concluding Discussion

In this section, I summarise and discuss how TDC was addressed in local policy documents and what was expected of TEDs in terms of being aware of and preparing student teachers for epistemic changes. Finally, I present a model for TEDs' digital competence based on previous models and the expectations identified in the curricula.

The focus in teacher education curricula at the institutional level was on the (pedagogical) use, adoption, and adaption—rather than appropriation—of digital tools, which is in line with previous findings (Instefjord, 2015; Lund et al., 2014). Although TDC, in general, was more integrated into the local policy documents than before the five-year master's programme in teacher education was implemented in Norway, TEDs were still mostly expected to use digital tools, in the best cases, not only for administration but also to support learning. However, TEDs were also expected to teach student teachers how to promote pupils' basic skills. While it may seem unnecessary, some documents emphasised that this includes pupils' digital skills. It might be, as Krumsvik (2014) pointed out, that the difference between *elementary* digital skills (simple, first use of ICT) and *basic* digital skills, as described by the Norwegian Directorate for Education and Training (2012, revised 2017), is not clear for TEDs. Emphasising *digital* skills implies that TEDs should go beyond *elementary* digital skills. Moreover, the term *PDC* itself is used in all programme descriptions, several course descriptions and some plans for school practicum. Even though it is not clear which TDC model the documents refer to, TEDs should be familiar with the concept of TDC.

Furthermore, at the course level, different subjects focused on different aspects of TDC. For example, the documents addressing TDC to a greater extent (intermediate/advanced) described the use of digital tools to achieve explicit subject-related learning goals. This may indicate that TEDs should be able to use specific digital tools and digital teaching methods for specific subjects. As Lund et al. (2014) pointed out, besides it being important that TEDs "recognize certain pedagogical attributes of the technologies," it is even more crucial for them to recognise that "different activities within different subject domains bring forth certain qualities in them that can be conducive to learning" (p. 293).

There are differences in how the six institutions addressed TDC in their local curricula. Two institutions distinguished themselves by integrating TDC more frequently and thoroughly. Compared to the other institutions, these two showed a tendency toward the adaption and appropriation of digital tools and less focus on adoption. Here, we could discuss whether these findings are related to the fact that these two institutions are among those that received funding for the integration of TDA. However, as stated above, comparing the institutions and studying the projects' effects are not within the scope of the present study. Moreover, to explore the projects' influence on the local curricula, a different research design (e.g. involving interviews with the people involved in the local process of curriculum development) would be needed since curriculum development in teacher education is not a straightforward process and is highly influenced by human factors, such as beliefs, knowledge, and identity (Willemse et al., 2005). Nevertheless, these two institutions may indicate where Norwegian teacher education is heading in terms of integrating TDC.

Even though the use of digital tools for teaching and learning was present in all three document categories (basic, intermediate, and advanced level), there was a general shift from the use and adoption of digital tools in the documents addressing TDC at a basic level to adapt the tools for teaching in the documents that addressed TDC at an

intermediate level to appropriation and understanding the consequences of digitalisation for teaching and society in general in the documents that addressed TDC at an advanced level (see Figure 1). This implies that TEDs' digital competence is composed of layers, with the use of digital tools constituting the first layer, followed by pedagogical and didactical use and the ability to promote pupils' basic and digital skills, and then the awareness and enactment of digital responsibility, followed by an understanding of culture, society and democracy, and development and transformation in the digital context (see Figure 2; for a description of the layers, see section Themes Addressing TDC). These layers are reminiscent of Krumsvik's (2014) model for TEDs' digital competence.

The themes referring to TDC in the local policy documents cannot be related to Krumsvik's (2014) model alone because the Norwegian framework for teachers' PDC (Kelentrić et al., 2017) can also be identified. All the identified themes are related to the seven dimensions of the PDC concept elaborated by the Norwegian Centre for ICT in Education. However, subject and basic skills, pedagogy and subject didactics, and leadership of learning processes were implemented in more documents than interaction and communication, ethics, the school in society, and especially change and development, which aligns with the aforementioned focus on the (pedagogical) use of digital tools. Thus, the framework is not only present in all national plans and academic regulations for teacher education in Norway (Krumsvik, 2020) but also in local policy documents, such as programme descriptions, subject descriptions, and plans for school practicum. Moreover, one can also recognise the model suggested by Brevik et al. (2019). This model cuts across the themes because several themes can be related to one of the model's dimensions, such as generic digital competence, whereas transformative digital agency can be identified by reading between the lines in some learning outcomes and assignments related to digital didactics and pedagogy. Finally, the TPACK model (Mishra & Koehler, 2006) applies only to the themes that were the most present in the documents, namely digital tools and digital didactics and pedagogy. It is the oldest and most well-known model, the core of TDC, but as my analysis has shown, today's TEDs are expected to go beyond it.

In the 21 documents addressing TDC at an advanced level, I found learning outcomes and assignments reflecting educational practices related to the epistemic change brought about by the treatment of digital tools as extended or embedded partners. TEDs were expected to enable students to adopt a meta-perspective on the use of technology to reflect on teaching and learning in digital environments, to discuss how the subjects' contents may change and who provides the premises for learning with digital tools, and to foster students' digital transformative agency. Lund and Aagaard (2020) pointed out that digital transformative agency is crucial because it emphasises that the point of departure is not technological determinism but human agency and ethical considerations. Understanding the consequences of digitalisation for epistemic practices and attaining knowledge that goes beyond the employment of digital tools has also been advocated by Brox (2017).

Figure 2. Teacher Educators' Digital Competence
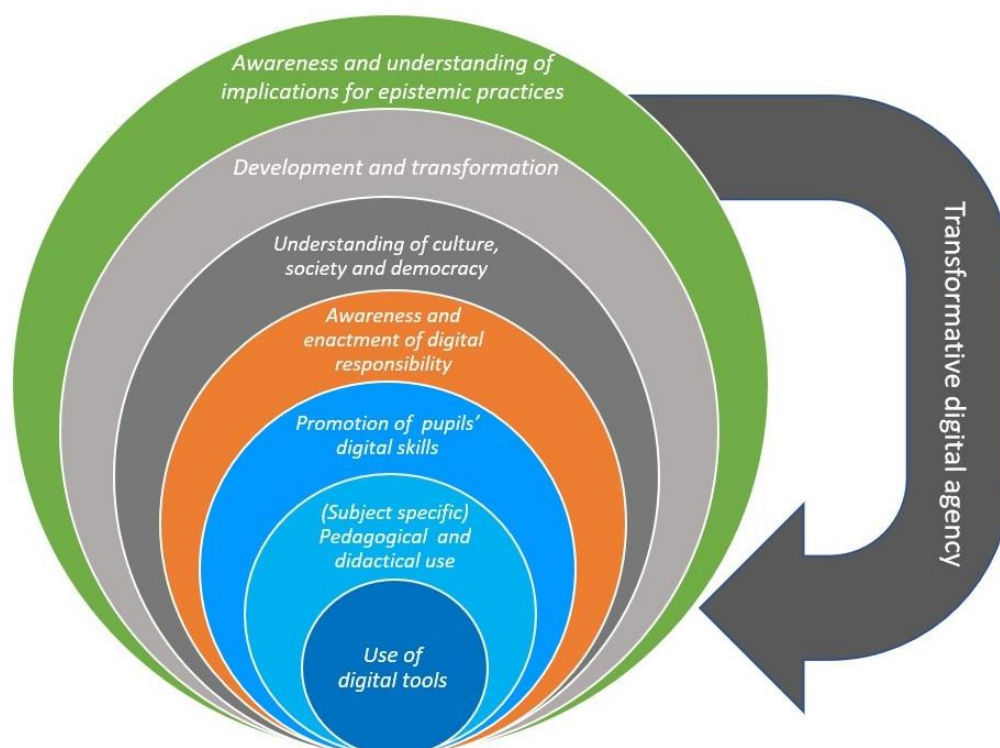
Awareness and understanding of digitalisation's implications for epistemic practices is an important layer that can be added to the description of TEDs' digital competence. It is the premise for TEDs' ability to enact transformative digital agency and use their professional knowledge to employ digital tools meaningfully in their practice as well as to design for learning and help students understand how they learn in digitally extended and embedded environments. This generic process is illustrated in the Teacher Educators' Digital Competence model (see Figure 2), which shows what TEDs are expected to know and be able to do based on the local policy documents.

This empirical model goes beyond existing models by combining the theoretical perspectives on TDC of Kelentrić et al. (2017), Krumsvik (2014), and Brevik et al. (2019) and adding the understanding of the implications of epistemic practices suggested by Lund and Aagaard (2020). At first glance, the TEDs' Digital Competence model's dimensions may appear similar to the dimensions in Kelentrić et al.'s (2017) PDC framework, but they are not. Some researchers (e.g., Brynildsen et. al. 2021; Hjukse et al., 2020) have indicated that the dimensions in the PDC framework are not only intertwined but also overlapping. The present model entangles the dimensions, rearranges their content, and shows their relation in layers, similar to Krumsvik's (2014) model. However, in contrast to Krumsvik's model, the layers are not necessarily developed diachronically; rather, the development may also happen simultaneously, as indicated by the position of the circles in Figure 2. Furthermore, the present model consists of more layers than Krumsvik's and, emphasising transformation and development and implications for epistemic practices due to digitalisation, goes beyond digital Bildung. Finally, the TEDs' Digital

Competence model assigns a specific and crucial position to digital transformative agency, which is not only an (intertwined) pillar (Brevik et al., 2019) of TDC but also the motor driving the continuous development of digital competence. The positioning of digital transformative agency in a turning arrow highlights the generic aspect of digital competence.

An approach to professional development to reach the outer layer of TEDs' digital competence and foster digital transformative agency should not focus solely on the use of digital tools for teaching and learning. It should leave room for discussions about how epistemic practices—and thus also educational practices, professional and disciplinary knowledge—may change in a digital environment and for developing knowledge and negotiating one's beliefs and identity as a TED in a digital context. Furthermore, TEDs as researchers (Dengerink et al., 2015) could research in the field as an alternative to more traditional professional development approaches. This would contribute to research-based knowledge resources that could inform TEDs' work and be used in teacher education.

The overall aim of the current article was to contribute to the discourse on teacher educator knowledge (and thus indirectly to teacher educator professionalism and quality) by focusing on the impact of digitalisation on the expectations of TEDs. By analysing how TDC is addressed at the formal level of local curricula, the present study offers a snapshot of what TEDs should know about digitalisation's influence on educational practice and the role TDC plays in coping with epistemic changes. TEDs need to gain a deep understanding of digitalisation's role in society and the consequences for epistemic practices to foster student teachers' development of digital competence, especially transformative digital agency.

Limitations and suggestions for future research

In terms of limitations, the current study was based solely on document analysis. Triangulation, for example, with interviews could have strengthened the findings. Furthermore, I did not provide information about and analyse the national guidelines for teacher education, nor did I investigate how they relate to and might have influenced the local documents. However, these issues were beyond the scope of the present study and could be addressed by future research. Concerning the generalisation of the results, three of the six studied institutions had received funding for the integration of TDA, which might skew the data. However, because five of the 13 Norwegian institutions offering teacher education for years 5–10 received such funding, the study should provide a picture of the integration of TDC at the local policy level in Norway. Future research could focus on these digitalisation projects, exploring if they led to change and transformation in teacher education. Furthermore, the research could explore the processes of curricula making related to the integration of TDA. Moreover, since the current study only addressed the intended curricula aims and expectations of TEDs, further research is needed to understand how

TEDs perceive and operationalise formal curricula (Goodlad et al., 1979) and their professional roles and responsibilities regarding the development of student TDC.

References

Baran, E., Canbazoglu Bilici, S., Albayrak Sari, A., & Tondeur, J. (2019). Investigating the impact of teacher education strategies on preservice teachers' TPACK. *British Journal of Educational Technology*, *50*(1), 357–370. https://doi.org/10.1111/bjet.12565

Bowen, G. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*, 27–40. https://doi.org/10.3316/QRJ0902027

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brevik, L., Guðmundsdóttir, G., Lund, A., & Strømme, T. (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

Brox, H. (2017). What's in a wiki? Issues of agency in light of student teachers' encounters with wiki technology. *Nordic Journal of Digital Literacy*, *12*(4), 129–142. https://doi.org/10.18261/issn.1891-943x-2017-04-03

Bryndildsen, S., Nagel, I. & Engeness, I. (under review). *Teachers' perspectives on enhancing professional digital competence by participating in TeachMeets – Insights for fostering transformative digital agency.*

Coşkun, Y. (2015). Promoting digital change in higher education: Evaluating the curriculum digitalisation. *Journal of International Education Research (JIER)*, *11*, 197–204. https://doi.org/10.19030/jier.v11i3.9371

Czerniawski, G., Gray, D., MacPhail, A., Bain, Y., Conway, P., & Guberman, A. (2018). The professional learning needs and priorities of higher-education-based teacher educators in England, Ireland and Scotland. *Journal of Education for Teaching*, *44*(2), 133–148. https://doi.org/10.1080/02607476.2017.1422590

Dengerink, J., Lunenberg, M., & Korthagen, F. (2015). The professional teacher educator: Six roles. *Beiträge zur Lehrerinnen- und Lehrerbildung*, *33*, 334–344.

Drummond, A., & Sweeney, T. (2017). Can an objective measure of technological pedagogical content knowledge (TPACK) supplement existing TPACK measures? *British Journal of Educational Technology*, *48*(4), 928–939. https://doi.org/10.1111/bjet.12473

Engen, B., Giaever, T., & Mifsud, L. (2015). Guidelines and regulations for teaching digital competence in schools and teacher education: A weak link? *Nordic Journal of Digital Literacy*, *10(Jubileumsnummer)*, 172–186. https://doi.org/10.18261/ISSN1891-943X-2015-Jubileumsnummer-12

European Commission/EACEA/Eurydice. (2019). *Digital education at school in Europe* [Eurydice Report]. Publications Office of the European Union. https://eacea.ec.europa.eu/national-policies/eurydice/sites/eurydice/files/en_digital_education_n.pdf

Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educational Technology Research and Development*, *68*(5), 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Garm, N., & Karlsen, G. (2004). Teacher education reform in Europe: The case of Norway; trends and tensions in a global perspective. *Teaching and Teacher Education*, *20*, 731–744. https://doi.org/10.1016/j.tate.2004.07.004

Goodlad, J., Klein, M. F., & Tye, K. A. (1979). The domains of curriculum and their study. In J. Goodlad (Ed.), *Curriculum inquiry. The study of curriculum practice* (pp. 43–76). McGraw-Hill Book Company.

Goodwin, A. L., Smith, L., Souto-Manning, M., Cheruvu, R., Tan, M. Y., Reed, R., & Taveras, L. (2014). What should teacher educators know and be able to do? Perspectives from practicing teacher educators. *Journal of Teacher Education*, *65*(4), 284–302. https://doi.org/10.1177/0022487114535266

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

Hermansen, H. (2017). Knowledge relations and epistemic infrastructures as mediators of teachers' collective autonomy. *Teaching and Teacher Education*, *65*, 1–9. https://doi.org/10.1016/j.tate.2017.03.003

Hjukse, H., Aagaard, T., Andersen Bueie, A., Moser, T., & Solbu Vika, K. (2020). Digitalisering i grunnskolelærerutdanningen: Om faglige forskjeller i arbeidet med profesjonsfaglig digital kompetanse [Digitalization in teacher education: How professional digital competence is adressed in different subjects]. *Acta Didactica Norden*, *14*(1). 1–27 https://doi.org/10.5617/adno.8023

Instefjord, E. (2015). Appropriation of digital competence in teacher education. *Nordic Journal of Digital Literacy*, *10(Jubileumsnummer)*, 155–171.

Instefjord, E., & Munthe, E. (2015). Preparing pre-service teachers to integrate technology: An analysis of the emphasis on digital competence in teacher education curricula. *European Journal of Teacher Education*, *39*, 1–17. https://doi.org/10.1080/02619768.2015.1100602

Jiménez-Aleixandre, M. P., & Crujeiras, B. (2017). Epistemic practices and scientific practices in science education. In K. S. Taber & B. Akpan (Eds.), *Science education. New directions in mathematics and science education* (pp. 69–80). SensePublishers. https://doi.org/10.1007/978-94-6300-749-8_5

Kaufman, K. (2015). Information communication technology: Challenges & some prospects from preservice education to the classroom. *Mid-Atlantic Education Review*, *2*(1), 1–11.

Kelchtermans, G., Smith, K., & Vanderlinde, R. (2018). Towards an 'international forum for teacher educator development': An agenda for research and action. *European Journal of Teacher Education*, *41*(1), 120–134. https://doi.org/10.1080/02619768.2017.1372743

Kelentrić, M., Helland, K., & Arstorp, A.-T. (2017). *Professional digital competence framework for teachers in Norway*. Centre for ICT in Education. https://www.udir.no/contentassets/081d3aef2e4747b096387aba163691e4/pfdk-framework.pdf

Koster, B., & Dengerink, J. J. (2008). Professional standards for teacher educators: How to deal with complexity, ownership and function. Experiences from the Netherlands. *European Journal of Teacher Education*, *31*(2), 135–149. https://doi.org/10.1080/02619760802000115

Krumsvik, R. J. (2014). Teacher educators' digital competence. *Scandinavian Journal of Educational Research*, *58*(3), 269–280. https://doi.org/10.1080/00313831.2012.726273

Krumsvik, R. J. (2020). Home schooling, remote teaching and digital Bildung in societal crisis. *Nordic Journal of Digital Literacy*, *15*(2), 71–85. https://doi.org/10.18261/issn.1891-943x-2020-02-01

Ludwig, D. (2015). Extended cognition and the explosion of knowledge. *Philosophical Psychology*, *28*(3), 355–368. https://doi.org/10.1080/09515089.2013.867319

Lund, A., Furberg, A., Bakken, J., & Engelien, K. L. (2014). What does professional digital competence mean in teacher education? *Nordic Journal of Digital Literacy*, *9*(4), 280–298. http://www.idunn.no/dk/2014/04/what_does_professional_digital_competence_mean_inteacher_e

Lund, A., & Aagaard, T. (2020). Digitalization of teacher education: Are we prepared for epistemic change? *Nordic Journal of Comparative and International Education (NJCIE)*, *4*(3-4), 56–71. https://doi.org/10.7577/njcie.3751

Lunenberg, M. (2010). Characteristics, scholarship and research of teacher educators. In P. Peterson, E. Baker & B. McGaw (Eds.), *International Encyclopedia of Education* (3rd ed., pp. 676–680). Elsevier. https://doi.org/10.1016/B978-0-08-044894-7.00674-6

McGarr, O., & McDonagh, A. (2019). Digital competence in teacher education. *Output 1 of the Erasmus+ funded Developing Student Teachers' Digital Competence (DICTE) project.* https://dicte.oslomet.no

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054. http://dx.doi.org/10.1111/j.1467-9620.2006.00684.x

Newen, A., Bruin, L. D., & Gallagher, S. (2018). *The Oxford handbook of 4E cognition*. Oxford University Press.

Norgesuniversitet. (2017). *Utlysning: Digitalisering av grunnskolelærerutdanningene [Call for proposals: Digitalisation of initial teacher education]*. Norwegian Agency for International Cooperation and Quality Enhancement in Higher Education. https://diku.no/programmer/digitalisering-av-grunnskolelaererutdanningene

Norwegian Directorate for Education and Training [NDET]. (2012, revised 2017). *Framework for basic skills*. Norwegian Directorate for Education and Training. https://www.udir.no/contentassets/fd2d6bfbf2364e1c98b73e030119bd38/framework_for_basic_skills.pdf

Ottestad, G., & Gudmundsdottir, G. B. (2018). Information and communication technology policy in primary and secondary education in Europe. In J. Voogt, G. Knezek, R. Christensen, & K. Lai (Eds.), *Second handbook of information technology in primary and secondary education. Springer International handbooks of education*. Springer. https://doi.org/10.1007/978-3-319-71054-9_92

Ottestad, G., Kelentrić, M., & Guðmundsdóttir, G. (2014). Professional digital competence in teacher education. *Nordic Journal of Digital Literacy*, *9*, 243–249. https://doi.org/10.18261/ISSN1891-943X-2014-04-02

Reisoğlu, İ., & Çebi, A. (2020). How can the digital competences of pre-service teachers be developed? Examining a case study through the lens of DigComp and DigCompEdu. *Computers & Education*, *156*, 103940. https://doi.org/10.1016/j.compedu.2020.103940

van Maanen, J., Sorensen, J. B., & Mitchell, T. R. (2007). The interplay between theory and method. *The Academy of Management Review*, *32*(4), 1145–1154. https://doi.org/10.5465/AMR.2007.26586080

Willemse, M., Lunenberg, M., & Korthagen, F. (2005). Values in education: A challenge for teacher educators. *Teaching and Teacher Education*, *21*(2), 205–217. https://doi.org/https://doi.org/10.1016/j.tate.2004.12.009

Aagaard, T., & Lund, A. (2020). *Digital agency in higher education: Transforming teaching and learning*. Routledge. https://doi.org/10.4324/9780429020629