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Teacher Educators' Use of Digital Tools and Needs for Digital Competence in Higher Education

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Abstract

Based on a study at two Swedish universities, this article aimed to identify teacher educators' use of digital tools and subsequent need for digital competence in higher education. Methodically, a digital survey was distributed via e-mail to 405 teacher educators representing two faculties at the two universities; in total, 105 teacher educators responded. The survey included 16 questions, with closed- and open-ended varieties. Two theoretical foundations were used: the TPACK model and, as a complement, computer self-efficacy. Through analysis of self-reported use, competence, and need for professional training in digitalization in teaching, results show that teacher educators do not use digital tools primarily for pedagogical purposes. Thus, they need extensive pedagogical support in creating digital teaching. Further, teacher educators need to identify the pedagogical surplus value in their own teaching and learning context with digital tools to increase motivation for concrete, effective, and subject-oriented successful examples as presented by experienced teachers. (Keywords: computer self-efficacy, digital competence, digital teaching, higher education, teacher educators, teacher training)

Introduction

The focus of this article was to identify teacher educators' use of digital tools and subsequent need for digital competence in higher education. Ungar and Baruch (2016) claim that teacher educators have a fundamental role in training teachers not only to teach but also to serve as role models for information- and communication-based teaching (ICT). When teachers believe that technology is valuable, they are more likely to incorporate it into their teaching practices (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). However, it is unclear "what interventions can be developed to decrease the amount of time it takes students to become functional in the online environment" (Wisneski, Ozogul, & Bichelmeyer, 2017, p. 8). According to Koehler, Mishra, and Cain (2013), digital technologies, in contrast to traditional pedagogical technologies, are protean (i.e., usable in many different ways), unstable (rapidly changing), and opaque (the inner workings are hidden from users). Consequently, teacher educators have to relate to these three components to use more technology in their instruction. Koehler et al. (2013) also argue that teachers often have inadequate or inappropriate experiences with using digital technologies and are often provided with inadequate training. However, several restrictions exist, such as lack of theoretical and pedagogical keystones, sustainable integration into formal educational contexts, and, particularly, lack of teacher support and training (Baran, 2014). Consequently, there is a constant need to study, develop, and discuss teachers' professional development and use of digital tools in teaching. In short, it is critical to study how teacher educators can support students to become functional in online environments.

Problem statement

Among other things, digital competence consists of managing and keeping abreast of different digital devices and their software in order to use the Internet and digital technology in an educational and critical approach. The UNESCO framework *Media and Information Literacy Curriculum for Teachers* explains the importance of strengthening teachers' knowledge of media and the communication community (Wilson, Grizzle, Tuazon, Akyempong, & Cheung, 2011). Research shows that digital competence for pedagogical purposes is still poorly integrated into teacher education programs. Moreover, innovative solutions are needed as they play an important part in teachers' professional development in using ICT in teaching (Maksimović & Dimić, 2016; Tømte, Enochsson, Buskqvist, & Kårstein, 2015). Technology use needs to be developed professionally through tutoring and underlying educational pedagogy (Lakkala & Ilomäki, 2015) for a better understanding of the skills, dispositions, and knowledge for teaching–learning contexts where information and communication technologies are increasingly pivotal (Forbes & Khoo 2015). These competences are important when society is increasingly digitalized and new media forms are integrated into everyday life with enlarged levels of mobility (e.g., Amhag, 2013, 2016a, 2016b; Lee & Salman, 2012; Rockinson-Szapkiw, Courduff, Carter, & Bennett, 2013).

The Swedish National Agency for Education (SNAE, 2016a) aspires to implement a national strategy for the digitalization of the educational system, with the focus on supporting pupils' learning and school development in more general terms. In a report on information technology (IT) usage and IT competence in schools in Sweden (SNAE, 2016b), teachers and preschool staff generally communicated a continuing need for additional competence development in several IT-related areas, such as online crime prevention, IT as educational tools, audio and video management, and Internet safety and technology law. The year 2022 is considered as a reasonable endpoint to ensure equivalent conditions throughout the school system in Sweden.

As a result, school systems and teacher training internationally expect to be better equipped to facilitate students with adequate digital technology to bridge electronic versus traditional teaching practices (Pegrum, Oakley, & Faulkner, 2013). However, the incorporation of ICT in teacher training may be compulsory or optional, depending on the country in question (Garapko, 2013). The development of adequate digital technology also provides opportunities for universities to rationalize their administration, which allows teacher educators and faculty heads to better manage their core education tasks and to collaborate on maximizing the effectiveness of higher education (Hwang, Lai, & Wang, 2015; Wagner, Laforge, & Cripps, 2013). Moreover, faculty contact time with students can be reduced by using an active e-learning classroom (Baepler, Walker, & Driessen, 2014). Gu et al. (2012) introduce the concept of technology-enhanced teacher professional development (TETPD), where the constant need for teachers to engage in professional development activities and the need to improve teachers' knowledge and skills are scrutinized. One conclusion is:

> Only when ICT and new ways of teaching, learning and professional developing are dynamically integrated, TETPD will truly promote the growth of teachers to enhance teaching quality and efficiency. (Gu et al., 2012, p. 288)

However, the roles of teachers and students, as well as relationships, are changing online and becoming more complex and complementary (Avalos, 2011; Wallace, 2014). For a long time, many researchers have realized that the introduction of new technology has not lived up to expectations. Baran's (2014) analysis of 37 research articles on mobile learning in teacher education shows six findings of this role changing.

1. An increasing trend in integrating mobile learning in teacher education contexts.
2. Theoretical and conceptual perspectives are barely reported.

3. Variations exist in insights, attitudes and usage patterns.
4. Engagement with mobile learning and devices is mainly reported as being helpful.
5. Challenges were scarcely reported.
6. Several pedagogical affordances support mobile learning integration into teacher education settings.

In an early effort, Compeau and Higgins (1995) tried to understand the factors that influence the individuals' use of technology. They found that a central factor for individuals to change a behavior is the belief that the new behavior will result in valued outcomes. Outcome expectations are important precursors to usage behavior. In the digitalized teaching context, this means teachers need to identify the pedagogical surplus value of ICT and believe it will have positive outcomes. Another factor is self-efficacy: the belief we have in our abilities to perform a particular behavior. In this context, it concerns how teachers evaluate their competence to use ICT in teaching and learning situations (Compeau & Higgins, 1995). The authors found that computer self-efficacy played an important role in individuals' behaviors. Furthermore, a study by Lee and Lee (2014) shows a significant increase in the potential of teachers' self-efficacy for technology integration (SETI) after their completion of an education technology course; this increase occurred mostly in their lesson planning practice. Teachers with high positive attitudes toward computers and greater ability for lesson planning showed a higher increase in their levels of SETI.

Other results by Chen (2010) indicate that training has the strongest influence on technology use; this was mediated by the participants' perceived value of teaching and learning, and included strategies to improve their online teaching self-efficacy. In comparison, Ali, Ali, and Jones (2017) found a significant moderate relationship between emotional intelligence (EI) and online teaching self-efficacy in different age groups or university degrees among 115 academic nurse educators who teach online (totally, blended, or both). Additional research points to a lack of self-efficacy and use of technology among teachers, and links back to insufficient exposure to ICT in their teacher training programs (e.g., Kaufman, 2014; Kumar & Vigil, 2011). Therefore, additional new research about how teacher educators are using digital tools, how they evaluate their digital competence and what training they need is important.

Aim and research questions of the study

The aim of the study was to identify teacher educators' use of digital tools and their need for digital competence in higher education. The following research questions were addressed:

1. How do teacher educators use digital tools and evaluate their competence to effectively practice ICT in different teaching situations?
2. What training do teacher educators need to make students to be functional in different teaching situations online?

The findings of the study are intended to help teacher educators to better meet the needs and challenges students encounter and to influence and design different teaching situations. It is a question of how to learn as a teacher educator and how to develop professionally. The research presented in the introduction is based on international studies. However, what is the situation concerning the competence of ICT among teacher educators in Sweden? Even though the situation in Sweden may be similar to the international situation, there has been no systematic examination of how teacher educators use digital tools in Sweden and what training they need. This study aims to fill this knowledge gap. How do teacher

educators at two universities in Sweden view their usage of digital tools and needs of digital competence to support students to be functional online in different teaching situations, and what are the implications for teacher educators worldwide?

Literature review

In our initial literature search, we searched for existing reviews, familiarized ourselves with the research field, determined relevant databases, identified search terms, and documented a search strategy (Booth, Papaioannou, & Sutton, 2012). Our strategy and search terms were generated from the aim and questions. Peer-reviewed journals during the years 2015–2017 were scrutinized, and resulted in 94 search outcomes, of which the titles and abstracts were skimmed through. As a result of the initial search, the descriptors (DE) were specified, and a search string was developed and specified. During stage two (the conducted search), the world's most widely used index to educational-related literature, ERIC, was searched. In ERIC, the search string including DE "teacher educator" AND "continuing professional development" AND "educational technology" AND "ICT in education" OR "teacher professional development" NOT "pre-service teachers," which resulted in 49 peer-reviewed search hits for 2004–2016. Our literature review that follows is based on these search hits.

Developing digital competence can be challenging for teacher educators when the landscape of technology tools is rapidly changing (Kaufman, 2014). Based on research by Ungar and Baruch (2016), the most significant hindering factors for implementation of ICT among teacher educators were lack of time and insufficient knowledge and skills. The most encouraging factor for implementation of ICT was technological and pedagogical support. A study by Nave, Ackerman, and Dori (2017) found that a well-planned professional development program regarding e-learning in forms of community of inquiry (CoI) and online forums changed faculty members' willingness to incorporate e-learning in their teaching from 40% to 78%.

Tondeur, Forkosh-Baruch, Prestridge, Albion, and Edirisinghe (2016a) claim that teacher professional development (TPD) needs a lifelong learning approach. The claim for longer technology integration programs is supported by a study by Uslu and Bümen (2012), in which they argue that after a 6-week development program "little or no change was detected on the teachers' attitudes towards ICT in education" (p. 115; McGarr & O'Brien, 2007). The implications for teacher educators are that they are never fully trained in how to use digital tools and that attitudes are not changed over a short period of time. According to Abuhmaid (2011), more than one follow-up to ICT training courses has been identified as crucial for any successful use of ICT by teachers, thereby illustrating the lifelong perspective and that no quick-fix solutions are to be found in connection to the complexity of digital competence among teacher educators.

Another study by Tondeur, van Braak, Siddiq, and Scherer (2016b) indicates that the design of ICT-rich lessons and providing adequate feedback can be considered challenging for teacher training institutions to support teachers. Their SQE model (synthesis of qualitative evidence) to integrate technology in teaching and learning processes can be useful for both teacher training institutions and schools in developing their ICT competence. Teachers must learn not only how to use new technologies but also how to deeply integrate them into their curriculum to meet the changing needs of their students (Gunter & Reeves, 2017), as well as to train, plan, and stimulate online interactions and to create artifacts, such as teacher-recorded flipped classroom videos, instructions, and examples of language learning (Amhag, 2017; Wong, Chai, Aw, & King, 2015).

Kahn (2015) attempts to fill the gap by investigating teachers' conceptions of ICT-enhanced teaching with a particular focus on identifying potential variation among the

categories. The result shows four dimensions of variation to establish relationship among the categories of conceptions: (a) the role of the teachers, (b) the role of the students, (c) the impact of technology on student and teacher knowledge, and (d) who benefits from the use of ICT in teaching. Pegrum et al. (2013) highlight that mobile digital tools can support a variety of teaching methods; however, it is important to plan how to use them—for example, the ability to use mobile devices in different contexts, such as classrooms, field trips, or wherever a learning situation can take place—to create opportunities for learning and development. From a teacher's point of view, the study by Marin et al. (2016) shows that the digital tools were conceived as mediators and cognitive tools that enhanced the creation of ubiquitous learning spaces. Amhag (2016a, 2016b, 2017) raises some challenges and implications by using digital tools to expand teacher students' participation and motivation across different contexts for creation of ubiquitous knowledge access during mobile-assisted seamless learning activities.

Schibeci et al. (2008) explored teachers' confidence and competence in using ICT, as part of an ICT development project conducted by the Australian education system in 12 primary schools. They identified three of four stages proposed to describe teachers' ICT learning. Stage 1: Teachers moved from gaining basic ICT skills to conducting ICT-focused lessons and eventually appropriate ICT integration. Stage 2: Teachers who progressed to Stage 3 were able to exploit additional learning opportunities and began to make fundamental changes to their pedagogy. However, they needed more time to reach the final stage of challenging existing pedagogical structures. While the majority of teachers exhibited characteristics attributable to Stage 1 or Stage 2, fewer progressed to Stage 3, and there was sparse evidence of teachers developing Stage 4 characteristics. Furthermore, development was not necessarily a linear process from stage to stage; rather, it appeared to oscillate as teacher motivation ebbed and flowed with the various challenges that arose during the project. Teachers often had to spiral back to an earlier level of engagement with ICT before further progress was made.

Continuous and hasty development of modern ICT necessitates teacher educators involving themselves in constant pedagogical progress. Development of projects in the local context and collegial sharing of those projects are suggested to be effective for promoting teacher professional development (TPD) (Uslu & Bümen, 2012). Peer mentoring—involving sensitive, non-expert and listening support, and pedagogical understanding—could be a support system that reduces feelings of anxiety and stress when applying technologies to teaching practices (Amhag, 2013; Jones & Vincent, 2010; Stigmar, 2016).

The concrete principles of TPD for ICT in education are lifelong learning, local context, and collegial networks. Another principle found to boost ICT implementation among teacher educators was the need for demonstrating effective, practical models of ICT implementation (Ungar & Baruch, 2016; Zyad, 2016), thereby promoting an understanding of the benefits of ICT for teaching. According to a study by Wu and Wang (2015), motivation and usefulness are two predictors of teachers' intentions to integrate ICT in teaching. Teacher perceptions and attitudes toward digital tools also seem to influence technology adoption (Sugar, Crawley, & Fine, 2004). Practical preparation in real environments with real subjects influences teachers' personal beliefs about and willingness to adapt to ICT (Sugar, Crawley, & Fine, 2004). McGarr and O'Brien (2007) also stress the importance of contextual factors within the working environment. Likewise, Abuhmaid (2011) discusses the importance of teachers' beliefs about content and pedagogy and their attitudes in connection to the adoption of ICT. Teachers having time to participate in ICT training and to actually practice newly developed ICT skills are crucial factors for ICT professional development (Abuhmaid, 2011).

Our main findings from the search conducted in connection to digital competence and training needs are the importance of lifelong learning around ICT, local real

environment context projects, collegial networks, motivation, usefulness, attitudes, beliefs, and reserved time. We return to and address these findings in our results.

Theoretical perspective

In this study, the technological, pedagogical, and content knowledge—TPACK—model (Mischra & Koehler, 2006) and computer self-efficacy (CSE; Compeau & Higgins, 1995) are used to analyze different aspects of the teacher educator's use of digital tools and needs of digital competence in higher education. The TPACK model consists of three knowledge domains (see Figure 1): pedagogical knowledge, PK; technical knowledge, TK; and content knowledge, CK; and, importantly, the interaction between these domains. The more the three domains coincide, the better the prerequisite for effective teaching with digital tools (Koehler et al., 2013). The area where the domains of technical knowledge and pedagogical knowledge interact explains how teachers can use technology for an educational purpose, while the area where the domains of technical knowledge and content knowledge interact explains how teachers can integrate technology into a particular subject content. Lastly, the area where pedagogical knowledge and content knowledge interact explains how teachers can use content together with subject didactic knowledge in the students' teaching practice.

> TPACK is different from knowledge of all three concepts individually. Instead, TPACK is the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies, pedagogical techniques that use technologies in constructive ways to teach content, knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face, knowledge of students' prior knowledge and theories of epistemology, and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones. (Koehler et al., 2013, p. 16)

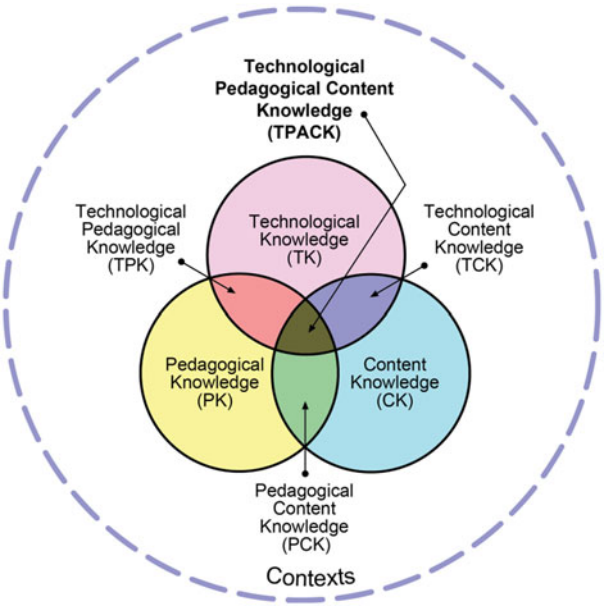

Figure 1. TPACK model by Mishra & Koehler, 2006. Reproduced by permission of the publisher, © 2012 by tpack.org

Koehler et al. (2013) argue there is no single digital technological solution that solves every teaching and learning situation. Further, they stress it is essential that teachers learn how pedagogical, technological, and content knowledge can interact and compensate for the problems students face. Though the TPACK model has been widely disseminated, it is questioned, as in practice it is difficult to distinguish the different overlapping three domains of knowledge; moreover, they can be contradictory (Ruthven, 2014). A literature review by Voogt, Fisser, Pareja Roblin, Tondeur, and van Braak (2013) about the theoretical basis and the practical use of TPACK showed different understandings about TPACK and technological knowledge. Teacher knowledge and beliefs about pedagogy and technology were intertwined and determined whether a teacher decided to teach using technology. A promising strategy was active involvement in (re)design and enactment of technology-enhanced lessons for the development of TPACK. For example, a study by Mouza, Karchmer-Klein, Nandakumar, Ozden, and Hu (2013) shows that participants experienced significant improvements in all TPACK domains when they applied their teaching and knowledge in practice with technology.

The theoretical approach of computer self-efficacy (CSE) is based on Compeau and Higgins (1995), who extend Bandura's (1997) self-efficacy theory, which refers to how confident an individual feels about handling particular tasks, challenges, and contexts. Bandura identified four factors affecting the development of one's self-efficacy: mastery experience, mediated experience, social persuasion, and physiological state. Among these four factors, mastery experience is the most important knowledge in determining an individual's self-efficacy. These factors also affect self-efficacy in digital related contexts (Wu & Wang, 2015). Compeau and Higgins (1995) divided CSE into three interrelated dimensions: magnitude, strength, and generalizability. The magnitude of CSE can be understood as a reflection of the teachers' cognitive knowledge processes, based on the ability to mediate and manage information; to communicate; to understand ideas, concepts, and theories; and to analyze content knowledge. The strength of CSE refers to teachers' ability to provide mastery, perform pedagogical knowledge, and teach and learn with technology that can redress some of the problems that students face. Generalizability of CSE reflects the degree of technical knowledge that is needed to connect different technologies to an educational purpose. It also includes knowledge concerning where specific technologies are best suited for addressing subject-matter learning. These perspectives make the TPACK model and CSE relevant analyzing tools for our study. Importantly, the three respective interrelated dimensions of technology, pedagogy, and content knowledge, as well as the domains of magnitude, strength, and generalizability, need to be viewed in interrelation and not in isolation.

Method

Methodically, our study includes both quantitative and qualitative data from a digital survey with closed-ended and open-ended questions from two faculties of teacher education at two different universities in Sweden.

Participants

A digital survey was distributed via e-mail to all teacher educators ($N = 405$), representing two faculties at two different universities in Sweden. The teacher educators reported (multiple answers possible) teaching in preschool teacher training (19.2%), elementary school teacher training, years 1–3 (27.9%), elementary school teacher training, years 4–6 (32.7%), elementary school teacher training, leisure-time center (20.2%), subject teacher training (38.5%), special needs teacher training (11.4%), and further education of teachers (18.1%). The sample consisted of 105 respondents (62.5% female). The overall answering frequency

was 26%. Among the participants, most had been employed 1–5 years at the university (30.7%), were ages 51–60 years (36.5%), and had a doctoral degree (58.8%).

Implementation

In the spring semester of 2017, a digital survey was sent out to teacher educators via e-mail. The respondents were informed that participation was voluntary, that they could withdraw from the study at any time, and that confidentiality was assured. Moreover, they were informed that the purpose of the project was to investigate the competence of teacher educators within two different areas of importance for students: digitalization of teaching, and encountering students with special educational needs. The survey included 16 questions; for the purpose of this study, the questions regarding digitalization of teaching were analyzed. The survey took approximately 20–30 minutes to complete. Only one reminder of participation was circulated.

Instrument

The instrument included six background variables (sex, age, academic institution, highest education level, years of employment, and task assignment). In total, 10 questions were asked regarding digitalization of teaching, all created by the project's researchers. The questions were open-ended as well as closed-ended (Likert 6-point scale), with a field for comments. The respondents were asked to rate their competence, training experience, and needs regarding digitalization of teaching, as well as questions regarding what type of digitalization tools they use in their work and how they use them. Response categories varied on a 6-point scale from (1) *very low* to (6) *very high* (How do you rate your digital competence?); from (1) *very small* to (6) *very big* (How do you rate your need for professional training?); and from (1) *very problematic* to (6) *unproblematic* (Would you rate creating digital learning environments as something problematic or unproblematic?). To get more robust analyses, response categories 1 and 2 were combined to represent a low/small rating, categories 3 and 4 were combined to represent a medium rating, and categories 5 and 6 were combined to represent a high/big rating.

Analysis

The analysis has been exploratory where the empirical material was in focus, with the analysis concepts of TPACK and CSE based on the two research questions of how teacher educators use digital tools and evaluate their competence to effectively practice ICT in teaching situations, and what training teacher educators need to make students functional online. Analysis, using cross tabulation and Fisher's exact tests, was performed using the statistical software package IBM SPSS Statistics 24. To explore research question 1, descriptive analysis of the following items was performed: What digital tools do you use in your work; what type of services/programs do you use in your work; in what situations and in what ways do you use digital tools and programs; and how do you rate your competence regarding digitalization of teaching? Moreover, Fisher's exact test was used to examine differences among participants who self-reported high and low competence and who perceived creating digital learning environments as something problematic or unproblematic. To explore research question 2, descriptive analysis of the following items was performed: How do you rate your need of training regarding digitalization of teaching, and have you participated in training regarding digitalization of teaching? Further, differences in self-reported need for competence training and experiences with competence training among teacher educators with high and low self-reported competence were tested using Fisher's exact test. Lastly,

Table 1. Summary of Knowledge Domains of Technological, Pedagogical, and Content Knowledge in the TPACK Model (Koehler et al., 2013) and Computer Self-Efficacy (CSE) (Compeau & Higgins, 1995)

Technological, pedagogical, and content knowledge, TPACK (Koehler et al., 2013)	Computer self-efficacy, CSE (Compeau & Higgins, 1995)
Pedagogical knowledge, PK. Pedagogical knowledge and content knowledge interact when teachers can use taught content together with subject didactic knowledge in the students' teaching practice.	Strength of CSE—refers to teachers' ability to provide mastery experiences and perform pedagogical knowledge, and how to teach and learn with technology that can redress some of the problems that students face.
Content knowledge, CK. Technical knowledge and content knowledge interact when teachers can use technology in a particular subject content.	Magnitude of CSE—refers to reflection of the teachers' cognitive knowledge processes, based on the ability to mediate and manage information; to communicate; to understand ideas, concepts, and theories; and to analyze content knowledge.
Technical knowledge, TK. Technical knowledge and pedagogical knowledge interact when teachers can integrate technology into an educational purpose.	Generalizability of CSE—refers to the degree of technical knowledge that is needed to connect different technologies to an educational purpose. It also includes knowledge concerning which specific technologies are best suited for addressing subject-matter learning or perhaps even changes of technology.

analysis of the responses to the open-ended question "What type of training do you think would enhance your competence regarding digitalization of teaching?" was based on the three knowledge domains of the TPACK model—technological, pedagogical, and content knowledge (Mishra & Koehler, 2006)—and complemented with the three interrelated dimensions of computer self-efficacy (CSE): magnitude, strength, and generalizability (Compeau & Higgins, 1995) (See Table 1). One of the authors conducted the initial analysis, followed by discussions until consensus was reached among all three authors.

Results

First, to examine how teacher educators ($N = 105$) use digital tools and to evaluate their competence to effectively practice ICT in teaching situations, we asked the respondents to report which tools they use in their work. Almost half of the respondents use a stationary computer (47.1%), 92.0% use a laptop, 51.0% report using a tablet, 71.2% use a smartphone, and 18.3% report using interactive boards (i.e., smart boards) in their work.

To further examine how teacher educators use digital tools to support student learning, the respondents were asked to report what type of services or programs they use in their work. The most commonly used service was itslearning (a digital student platform), which is used by 66.7% of the respondents. Among the digital communication tools, Skype Business is the most commonly used (52.9%), with Hangouts and Zoom also reported as being used. Half of the respondents use e-meeting system tools, such as Adobe Connect, and 46% report using some form of mobile application such as Adobe Connect, Box, Google Drive, Hangouts, Kahoot, Skype Business, or Zoom.

To examine the situations in which the respondents used digital tools in their work, open-ended answers to the question "In what situations and in what ways do you use digital tools and programs?" were analyzed and categorized into four different themes: teaching, communication/meetings, daily administration, and research (see Table 2). The largest variations were found within the theme of teaching, where respondents reported using ICT as digital tools not only in the classroom but also as an integrated part of the curriculum or as an artifact.

The respondents also reported digital tools as an important instrument for communication with students outside the teaching situation and as a collaboration instrument with

Table 2. Themes and Examples of Different Situations and Ways Teachers Report That They Use Digital Tools and Programs

Theme	Examples
Teaching	Digital classrooms, distance courses, Web-based lectures, recording lectures, PowerPoint presentations, seminars, tutoring, simplify students' learning processes, workshops, flipped classroom, preparation/planning, Kahoot (survey to analyze knowledge content), feedback, discussions, student active activities, reflection tool.
Communication/meetings	Communicate with students and colleagues, chat function, Web conferences, collaboration tool with other universities and authorities, e-mail, sharing texts.
Daily administration	Documentation, Excel.
Research	Analysis of research, digital surveys, research meeting, Google Drive, Box.

Table 3. Proportion of Teachers Rating Their Digital Competence as Low, Medium, and High, and Who Consider Creating Digital Learning Environments as Something Problematic or Unproblematic

	How do you rate your digital competence?		
How do you rate creating digital learning environments?	Low, *N* (%)	Medium, *N* (%)	High, *N* (%)
Problematic	9 (56.3)	3 (5.4)	2 (7.1)
Either or	5 (31.3)	35 (62.5)	8 (28.6)
Unproblematic	2 (12.5)	18 (32.1)	18 (64.3)
Total	16 (100.0)	56 (100.0)	28 (100.0)

colleagues and researchers at other universities. Situations that could be connected to students learning more indirectly include daily administration, such as documentation, and for their own research purposes.

To examine how teacher educators evaluate their competence of how to effectively practice ICT in teaching situations, they were first asked to rate their competence regarding digitalization of teaching. In total, 16.3% of the respondents rated their digital competence as low, 54.8% as medium, and 27.9% as high. Further, 13.9% of respondents reported creating digital learning environments as problematic and 37.6% as unproblematic, whereas 47.5% reported it as neither problematic nor unproblematic. Fisher's exact test was used to test whether creating digital environments was seen as problematic or not. The analyses showed that respondents who communicated a high competence regarding digitalization of teaching reported creating digital learning environments as unproblematic to a statistically significant higher extent ($p < 0.001$) compared to respondents who reported a low competence (Table 3). In short, viewing creating digital learning environments as something problematic or unproblematic relates to one's self-reported digital competence.

The main findings concerning how teacher educators use digital tools and evaluate their competence of how to effectively practice ICT in teaching situations are that they all use some form of digital tool in their work. Almost everyone uses a laptop, while one in five use interactive boards. The digital services and programs most commonly used by teacher educators are digital student platforms, digital communication tools, and e-meeting tools; these tools are used for teaching, communication and meetings, daily administration, and research. One-third of the teacher educators rate their competence regarding digitalization of teaching as high, whereas about one-fifth report their competence as low. Further, self-reported competence is also related to the perception of creating digital learning environments as something problematic. Respondents who report a high competence regarding digitalization of teaching report creating digital learning environments as something unproblematic to a statistically significant higher extent ($p < 0.001$) compared to respondents reporting a low competence.

Second, to examine what training teacher educators need to make students functional online, they were first asked to estimate their need for training regarding digitalization of

Table 4. Proportion of Teacher Educators Who Report Their Self-Assessed Competence and Need for Training Regarding Digitalization of Teaching

How do you rate your need of professional training?	How do you rate your digital competence?		
	Low, *N* (%)	Medium, *N* (%)	High, *N* (%)
Small	0	6 (10.9)	7 (24.1)
Medium	4 (25.0)	32 (58.2)	14 (48.3)
Large	12 (75.0)	17 (30.9)	8 (27.6)
Total	16 (100.0)	55 (100.0)	29 (100.0)

teaching. In total, 13.0% reported a low need, 50.0% a medium need, and 37.0% a high need. Fisher's exact test showed that respondents who reported low competence regarding digitalization of teaching communicated a statistically significant greater need for training ($p < 0.05$) compared to respondents reporting high competence (Table 4). That is, the self-reported need for professional training is greater among respondents reporting their digital competence as low. Interestingly, among respondents rating their digital competence as high, an equal proportion reported a modest need for training (24.1%) and a significant need for training (27.6%). In summary, there are respondents who consider themselves to have high digital competence and who are satisfied with their competence and who do not need more training. However, just as many respondents with high competence still want to learn more and receive more training. This illustrates two different needs within the group with high competence.

Further, a little more than half (55.4%) of the respondents reported having taken part in training regarding digitalization of teaching. Among these, 8.9% rated their own competence regarding digitalization of teaching as low, whereas 37.5% reported their competence as high. The proportion of respondents reporting their competence as high was significantly higher ($p < 0.05$) among those who had taken part in any type of training compared to those reporting they had not taken part in any type of training (17.8%).

The answers ($N = 57$) to the open-ended question "What type of training do you think would enhance your competence regarding digitalization of teaching?" were first analyzed based on the TPACK model with the three knowledge domains—technological, pedagogical, and content knowledge—and the interactions between them (Mishra & Koehler, 2006). The results display that more than one-quarter of the teacher educators (26.3%) related they need continuing didactic training with an emphasis on their use of subject content knowledge (CK) with digital tools and what works in digital teaching (Koehler et al., 2013):

- Continuing training in how I can use all the components that the learning tools we use can offer.
- How can the tools be used; how can tasks be created, smartboards or other tools in the classroom for using in teaching?
- Continuing education with the aim of building on what works in teaching/learning, not necessarily recreated and innovative.
- Such training that provides concrete examples of how other teacher educators work with digital teaching.

These quotes—based on the three interrelated dimensions of computer self-efficacy (CSE): magnitude, strength, and generalizability (Compeau & Higgins, 1995)—indicate that the teacher educators have inadequate magnitude of CSE to use ICT in teaching and learning situations. They are communicating a need for knowledge of how to design digital teaching and to understand ideas and concepts regarding using different technical tools.

Furthermore, almost one-fifth of the teacher educators (17.5%) convey they also need technical knowledge (TK) to interact with a particular subject content knowledge (CK)

(Mishra & Koehler, 2006). For this reason, support is needed in concrete and practical use of digital tools:

- The biggest obstacle in using digital tools is the technology. Making it work without problems is stressful!
- Wishing that we had more courses that technically concretize and practically show how Web-based education can be developed and used in higher education. I have mostly learned everything myself.
- To have time to get to know the programs a bit more (always lacking time to learn new teaching methods) and to get more support for using new computer programs in teaching.
- Practical workshops and concrete examples of applications.

These quotes illustrate that the teacher educators also have insufficient generalizability of CSE to use different technologies for an educational purpose (Compeau & Higgins, 1995). They highlight the need to know which specific technologies are best suited for addressing subject-matter learning with concreate features and applications, or even changes of technology.

Moreover, an interesting result is that only a few teacher educators (3.6%) relate the need for pedagogical knowledge (PK) to improve their competence to provide pedagogical benefits of learning in digital teaching (Koehler et al., 2013). A focus on technology itself is not enough; pedagogical/didactical teaching is needed:

- Continuing to focus on the pedagogical benefits of learning rather than on the technology itself (especially for the students, but also the teachers).
- The type of continuing education where experienced and pedagogically competent teacher educators participate in the design of teaching.
- Didactic support directly in core activities, preferably for the teacher team.
- An education based on pedagogical/didactical working methods and discussions how digitization can promote students' learning.

These excerpts illustrate deficient strength of CSE (Compeau & Higgins, 1995) to provide mastery experiences and to perform pedagogical knowledge for teaching content knowledge together with subject didactic knowledge in their teaching practice (Koehler et al., 2013). These teacher educators have not fully identified the pedagogical surplus value in their own teaching and learning context with digital tools.

In summary, the analysis of the respective three TPACK interrelated dimensions of technology knowledge, pedagogy knowledge, and content knowledge, as well as the CSE domains of magnitude, strength, and generalizability, reveals the importance of discovering the interrelation when teacher educators use technology in an educational purpose with a particular subject content. In this study, the teacher educators emphasize different digital support:

- A variety—information-based as well as practical with guidance because I experience that my skills are very low.
- You need everything regularly, a little refill for repetition and new inspiration.
- Practical concrete advice: do like this, have good support available all the time, and always greater access to digital tools.
- Workshops and supervision in my own digital teaching, based on my prerequisites, in suitable locations and with appropriate equipment.

In the next section, we discuss our results and present our conclusions in connection to teacher educators' use of digital tools and their training needs.

Discussion and conclusions

By analyzing self-reported use, competence and need for professional training regarding digitalization in teaching at two Swedish universities, the study aimed to identify teacher educators' ($N = 105$) communicated use of and needs for digital competence in higher education. To answer the aim, two research questions were asked: How do teacher educators use digital tools and evaluate their competence to effectively use ICT in teaching situations? What training do teacher educators need to make students functional online?

Most of the respondents answer the first question when they are using some kind of digital tools in their work. Almost all use laptops, about half use tablets, while relatively few use interactive boards in their work. It is worth noting that our results reveal that teacher educators in our study use ICT in four different ways: for teaching, communication, administration, and research. Only one of these four themes is directly connected to teaching activities, where ICT is used mainly as a tool to relocate the teaching from a physical classroom to a digital classroom. This is an important finding: It illustrates that although teacher educators use ICT for all sorts of reasons, they do not use it primarily as a pedagogical tool to improve student teaching and learning. Clearly, it is unacceptable that a teacher education institution poorly integrates ICT and offers no adequate training in its programs when teacher candidates are to be prepared to teach with ICT (Baran, 2014; Koehler et al., 2013; Maksimović & Dimić, 2016; Tømte et al., 2015). Competence to effectively use ICT in teaching situations is increasingly pivotal when technology tools are rapidly changing in society. Therefore, ICT training for teaching situations needs continuous follow-ups through tuition in different practical stages of development in underlying ICT educational pedagogy (Abuhmaid, 2011; Forbes & Khoo, 2015; Kaufman, 2014; Lakkala & Ilomäki, 2015; McGarr & O'Brien, 2007). We cannot expect teacher candidates to reform and improve their teaching when teacher educators themselves are inadequately trained.

Furthermore, the fact that teachers who report high ICT competence find it unproblematic to create digital learning environments should serve to attest to the importance of a well-planned professional development program regarding e-learning for all teacher educators (Nave et al., 2017). However, it is both serious and problematic that teacher educators who report low competence find it difficult to build digital learning environments. This is especially problematic as very few of the respondents in our study identify a need for pedagogical knowledge. Generating increased competence in how to design pedagogical digital learning environments is logically closely related to further training in pedagogy and concrete support in teachers' teaching and learning contexts. Moreover, it is remarkable that one out of five teacher educators (20%) in our study report their competence as low, and that more than one-quarter of them (26.3%) report having inadequate magnitude of CSE to use ICT in teaching and learning situations.

The second question is answered with 87% of the respondents conveying they need either medium or extensive ICT training to make students functional online. With this clear need for ICT training, an organized support focusing on both technology and pedagogy seems reasonable during their professional development (see also Tondeur et al., 2016a). Furthermore, the teacher educators report insufficient generalizability of CSE (17.5%) to connect different technologies for an educational purpose (Compeau & Higgins, 1995). They need pedagogical knowledge concerning subject-matter learning, trying concreate features, applications and skills, or changes of technology.

When it comes to teacher educators' need for training to enhance their competence regarding digitalization of teaching, the results point to a deficient strength of CSE regarding how to master experiences and perform teaching with technology that can redress some of the problems students face (Compeau & Higgins, 1995). These results indicate that they feel rather comfortable regarding their own subject didactic knowledge. In relation to our previous results, another explanation is that they do not consider how to master didactic knowledge enhancement as a part of digitalization competence to improve student teaching and learning. As

motivation and usefulness are important precursors for teachers to use ICT, teacher educators and teachers need to identify the benefits of using digitalized teaching for students' learning.

Consequently, a first step is for teachers themselves to identify what the pedagogical surplus value is in a given context. A second step is to offer effective and practical methods and models of ICT implementation (Baran, 2014; Ungar & Baruch, 2016; Zyad, 2016), as well as to train, plan, and stimulate online interactions, such as teacher-recorded flipped classroom videos, instructions online, and examples of language learning (Amhag, 2017; Wong et al., 2015). Crucial factors for ICT professional development are how to deeply integrate them and have time to understand the benefits of ICT for teaching, and to meet the changing needs of their students (Abuhmaid, 2011; Gunter & Reeves, 2017). Mobile digital tools can support a variety of teaching methods in different contexts—such as in classrooms, on field trips, or wherever a learning situation can take place—to create opportunities for learning and development (Pegrum et al., 2013). Teacher educators should also pay particular attention to how to develop teachers' evaluative strategies concerning digital teaching and how to increase their use of online searching strategies when designing training programs for improving teachers' computer self-efficacy (Wu & Wang, 2015).

A concrete suggestion is to organize a structured in-service training in order to increase motivation among teacher educators. The mandatory in-service training should address concrete, effective, and successful subject-matter exemplifications presented by experienced teachers, preferably with professional skills in teaching and learning for higher education. Since the mandatory training would be a part of every teacher's assigned in-service training, this means that the participation is paid compensation time. The participation in such training could also create networks for teacher educators with an interest in digitalized education and provide a basis for national and international exchanges, conference participation, and presentation of research papers and/or posters to develop the research field as well as the profession.

Methodological considerations

There are some strengths and limitations to the study for consideration. First, the relatively low number of respondents in the study should be taken into account, as this means that few cases are included in the analyses. The low response rate could be explained by the timing of the data collection: just before the end of the spring term, and with only one reminder of participation circulated. Further, the low response rate could limit the representativeness and generalizability of the results. Given larger samples, the association between teacher educators' use of digital tools and self-reported competence of using ICT in teaching situations may be analyzed at a finer level. For example, all response categories could have been used in the analysis. However, choosing teacher educators from two different universities from different departments enhanced the credibility of the data, as this offered a richer variation and understanding of teacher educators' use and needs for digital competence to support teacher students' online learning.

Second, since this study uses a cross-sectional design, it is not possible to draw any conclusions regarding the direction of causality between the factors under study. Nevertheless, this was never the intention of the study.

Third, the responses to the question on what type of digital technology the respondents use in their work is worded so that it may not have to imply teaching situations specifically (i.e., "What type of digital technology do you use in your work; what type of services/programs do you use in your work"). However, even though the aim of this study was to explore teacher educators' use of technology in teaching situations, the results showed that digital technology is not used primarily for pedagogical purposes. These are important results.

Finally, using a questionnaire asking the respondents which specific services or programs they are using in their work could have restricted their judgment of the given examples. However, the trustworthiness was enhanced by involving three researchers in the analysis

process to reach consensus and by including quotations from the transcribed text, thereby showing similarities and differences in the results (Graneheim & Lundman, 2004).

Conclusion

The main conclusions that may be relevant and applicable for teacher educators worldwide are the following:

- Since the teacher educators in our study do not use digital tools primarily for pedagogical purposes, extensive and continuing pedagogical support is needed in the field of creating digital teaching and learning environments.
- Teacher educators need to understand the potential of digital tools in education and identify the pedagogical surplus value in their own teaching and learning context with digital tools in order to increase motivation for concrete, effective, and subject-oriented successful examples presented by experienced teachers.
- The role of teacher educators in integrating digital technology becomes essential in addressing students' learning needs across several disciplines in higher education.

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