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PhD revisited: Preparing future teachers to teach with ICT

An investigation of digital competence development in ESL student teachers in a Norwegian teacher education program¹

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ABSTRACT This chapter reports a doctoral study (Røkenes, 2016b) which investigated English as a Second Language (ESL) student teachers' development of digital competence in a Norwegian secondary teacher education context. Results show that ESL student teachers might be digitally confident, but lack knowledge and awareness of how to use information and communications technology (ICT) didactically to support pupils' learning in English. Implications and further research for professional digital competence (PDC) development in ESL for Norwegian teacher education are discussed.

KEYWORDS Professional digital competence | student teachers | teacher education | ESL | ICT

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1. The chapter presents the overall results of a doctoral study (Røkenes, 2016b) from the Norwegian University of Science and Technology, focusing specifically on its practical implications for Norwegian teacher education and the teaching of English in Norway. This is an article-based thesis, with three published articles (Røkenes, 2016a; Røkenes & Krumsvik, 2014; Røkenes & Krumsvik, 2016). The doctoral thesis in its entirety is available here: <http://hdl.handle.net/11250/2395012>.

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INTRODUCTION

English can be considered a global language or the lingua franca of the Internet, software and digital technologies (Crystal, 2006), which underlines the importance of mastering the language for participating in the increasingly digitalized and networked world. Hence, English language teachers play an important role in enabling pupils to participate fully in our increasingly digitized and networked society, knowledge- and competency-based economy, and world of work (Voogt, Erstad, Dede, & Mishra, 2013). In order to meet the requirements of language teaching in today's digitalized schools and networked world, language teachers need professional digital competence (PDC) in subject disciplines such as ESL (Lund, Furberg, Bakken, & Engelién, 2014; Tømte, 2013). Teaching English with information and communication technology (ICT) in Norwegian secondary schools (grades 8–13) and in higher education is now considered a given; pupils in upper-secondary schools are commonly provided with laptops while several schools use tablets and mobile devices, and most classrooms and lecture halls are equipped with projectors, interactive whiteboards and broadband Internet (Egeberg, Hultin, & Berge, 2016; Gjerdrum & Ørnes, 2015). The situation puts pressure on teacher education institutions to prepare future language teachers to be able to master and appropriate teaching with ICT in their disciplinary field in a didactic manner (Instefjord, 2014). However, Norwegian teacher education institutions have been criticized for over a decade for their slow uptake, tool-focused and teacher-centered teaching practices, and lack of innovative ways to integrate and teach with ICT (Hetland & Solum, 2008; Tømte, Kårstein, & Olsen, 2013). At the time of this doctoral study, little empirical research in the field of secondary teacher education, both internationally and in Norway, has focused on didactical, subject-related use of ICT and digital competence development in secondary school student teachers (Haugan, 2011; Kay, 2006; Tondeur et al., 2012). The research context for this study is a Norwegian teacher education program with secondary school ESL student teachers enrolled in an ESL didactics course leading to a qualification to teach ESL in the Norwegian secondary school.

The overarching purpose of this study was to gain a deeper understanding about how secondary school ESL student teachers develop digital competence and become proficient in integrating ICT in ESL teaching through teacher education. The main research question examined throughout the study was:

How is digital competence developed in secondary school ESL student teachers at a Norwegian teacher education program?

In order to examine the main research question further, the study investigated different aspects related to ICT training in secondary teacher education, ESL student teachers' self-reported digital competence, and their digital competence development after completing a workshop in digital storytelling.

THEORY

The study draws on a sociocultural perspective of learning and the notion that learning has to do with mastery and the appropriation of cultural tools (Wertsch, 1998). ICT exemplifies such a cultural tool that could potentially change how student teachers teach and pupils learn English in school. Over the last two decades, the notion of digital competence has been used to capture how we use, interact, and learn with ICT and digital tools. Digital competence is often referred to as “skills, knowledge, creativity, and attitudes required to use digital media for learning and comprehension in a knowledge society” (Erstad, Kløvstad, Kristiansen, & Sjøby, 2005, p. 8, my translation). Erstad (2010) has further suggested several categories to specify and operationalize core components of digital competence in school, which in turn can be used to assess pupils' digital skills. These include: 1) having basic skills, and being able to 2) download/upload, 3) search, 4) navigate, 5) classify, 6) integrate, 7) evaluate, 8) communicate, 9) cooperate, and 10) create (Erstad, 2010, pp. 101–102, my translation). These components move from mastering technical skills towards appropriating critical reflection regarding the role and function of media in society, and can be related to learning both inside and outside of a school setting.

In Norway, digital competence has been considered a part of teachers' and teacher educators' professional competence since the last curriculum reform, where the use of ICT for teaching and learning has increasingly become an important aspect of teachers' work (Krumsvik, 2011; Lund et al., 2014). Research shows that teachers' use of ICT differs from other professions, resulting in a need to develop PDC among teachers, teacher educators, and student teachers. Accordingly, PDC can be understood as “the teachers/TEs' [teacher educators'] proficiency in using ICT in a professional context with good pedagogic-didactic judgment and his or her awareness of its implications for [digital] learning strategies and the digital Bildung of pupils and students” (Krumsvik, 2011, pp. 44–45). From his definition, Krumsvik (2011, 2014) has created a theoretical model for making visible “tacit knowledge”, and for prompting teachers and teacher educators' “reflection-on-action” on their digital competence (Figure 8.1). The model, originally developed for digital competence in teachers and TEs, also takes into

account the various key aspects contained in the concept PDC by attempting to show “the many ways in which teachers have to deal with this complex competence journey” (Krumsvik, 2011, p. 46).

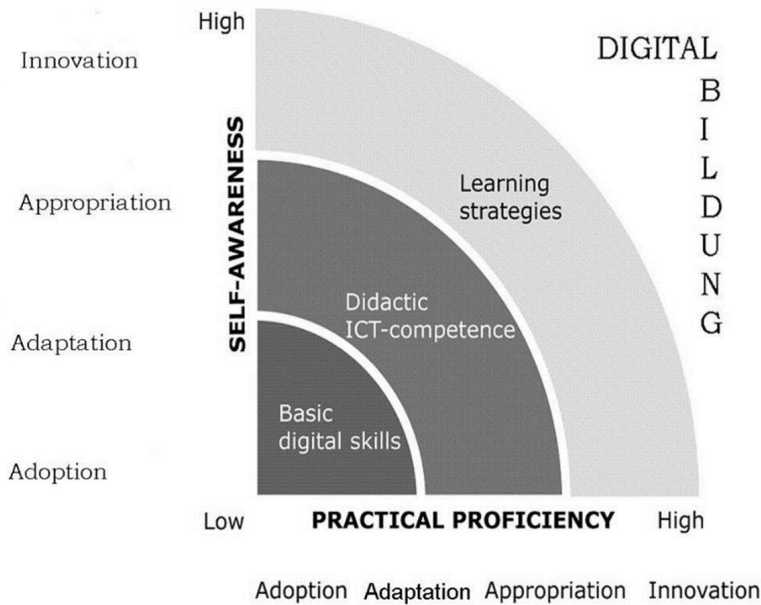


FIGURE 8.1. Model of digital competence for teachers and teacher educators (Krumsvik, 2011, p. 45).

Both the horizontal and vertical axes in the model depict different stages in the teachers’ practical proficiency and self-awareness with ICT through the four dimensions of adoption, adaptation, appropriation, and innovation. These dimensions are related to Wertsch’s (1998) concepts of mastery and appropriation of cultural tools in which adoption and adaptation (i.e., mastery) refer to knowing how to use a cultural tool, while appropriation and innovation point to “the process of taking something that belongs to others and making it one’s own” (Wertsch, 1998, p. 53). In the adoption and adaptation stages, the teachers are relatively incompetent, unsure, and unaware of the possibilities and limitations of ICT in teaching. However, as they progress towards the appropriation and innovation stages, they become more competent, confident, and aware of the potential that ICT can offer teaching. Eventually, during the innovation stage, they might develop their own digital resources and working methods while commenting on existing technologies and practice.

While the two axes in the model focus on the practical and mental aspects of digital competence development, the center region of the model is concerned with pedagogical use of ICT in education. Digital competence is described as consisting of four core components (Krumsvik, 2014, pp. 276–277):

- 1) Basic digital skills – elementary use of ICT for leisure and social communication (e.g., fundamental technical skills, social media, news, music, games) outside of school and work, and basic use of administrative and office software, and technical tools for teaching in schools (e.g., office tools, email, LMS, interactive whiteboards, laptops, tablets).
- 2) Didactic ICT competence – reflective pedagogical use and seamless integration of ICT in subject disciplines (particularly relevant for ESL are e.g., online dictionaries, multimodal learning resources, digital quizzes, chat, discussion boards), and the awareness of its added value and limitations for teaching subject content knowledge and for pupils’ learning potential (e.g., writing with pen and paper versus on a laptop, using paper-based textbook versus digital textbook, showing still images versus animations).
- 3) [Digital] Learning strategies – awareness of how to scaffold pupils’ development of learning strategies, knowledge construction, and metacognition with ICT (e.g., when working with reading screen-based texts, creating digital mind maps, conducting Internet searches, comparing and interpreting multiple online sources), as well as how ICT impacts forms of assessment, adapted education, and learning environment (e.g., digital exams, e-portfolios, task differentiation, classroom management, individual versus group and whole-class activities).
- 4) Digital Bildung – awareness of ethical considerations, social implications, and effects that ICT has on human development, how to deal with these issues, and how to foster positive moral behavior and use of ICT by discussing ethical pitfalls and dilemmas involved with pupils’ increasingly digital lifestyle inside and outside of school (e.g., cyberbullying, plagiarism, source criticism, illegal downloading, privacy, online anonymity, escapism).

In sum, the model attempts to illustrate the core components of teachers’ PDC through abstract and to some extent overlapping categories. The model was used as an analytical research lens in the study to support the interpretation of the collected data on ESL student teachers’ PDC development in teacher education.

REVIEW

In several international studies on language teaching, ICT is highlighted as effective for learning and teaching by affording access and exposure to authentic language material, communication opportunities, instant and individualized feedback, and classroom integration (Golonka, Bowles, Frank, Richardson, & Freynik, 2014; Stockwell, 2007). For example, in their review of over 350 studies on language teaching and learning with technology, Golonka et al. (2014) found that technology made a significant impact on foreign language learning in studies on “computer-assisted pronunciation training, in particular, automated speech recognition (ASR)” (Golonka et al., 2014, p. 70). The improvement of pronunciation in language learning could be facilitated using ASR and provide efficient feedback to the learner “to a larger extent than human teachers can” (Golonka et al., 2014, p. 88). The authors also found strong evidence for the use of online chat in foreign language learning, where these studies showed a significant increase in both complexity and amount in the learner’s language production.

Another review by Stockwell (2007) examined the use of technology in teaching language skills by looking at 206 studies published in four major English-language journals in the field of computer-assisted language learning from 2001 to 2005. Stockwell (2007) found that most studies focused on developing the learner’s grammar and vocabulary skills through incorporating online learning resources, online chat, or presenting the language skill with “different annotation styles (e.g., links for textual meaning, audio, graphics etc.)” (Stockwell, 2007, p. 110). Both reviews showed that the range of technologies used in language teaching is broad and constantly evolving, and that technologies such as ASR, chat and online learning resources can have an impact on language skills.

In Norwegian educational research on technology, in particular with Norwegian secondary school ESL teachers, there seems to be an increased use of digital technologies to promote pupils’ language production, proficiency, and knowledge such as through Wikis (Lund, 2008), social networking sites (Vasbø, Silseth, & Erstad, 2013) and digital storytelling (Normann, 2012). In particular, research on the use of digital storytelling (DST) for educational purposes has focused on teachers’ use of the method for developing pupils’ language skills. However, at the time of this doctoral study, little was known how DST is used in teacher education for teaching ESL with ICT, and for developing PDC in student teachers.

The increased use of technology in language teaching and learning has consequences for teacher education, being responsible in preparing future language teachers, both in Norway and internationally. Researchers and policymakers note that as the demands of teaching ESL with ICT in Norwegian classrooms increase, future

teachers need to develop PDC through teacher education to fulfill curricular requirements and be able to teach in today's digitalized schools (Krumsvik, 2014; Lund et al., 2014; Tømte, 2013). Moreover, as pointed out by Stockwell (2007), it could be argued that student teachers should be introduced to relevant teaching activities and approaches that prepare them to integrate ICT in their language teaching.

However, in Norway there was currently very little research on the preparation of future teachers to teach with technology. In particular, at the time of my doctoral study, no studies had been conducted in the field of PDC development in Norwegian teacher education for grades 8–13 (for studies on grades 1–7 & 5–10, see Instefjord, 2014; Tømte, 2013), and no studies had examined how this competence is developed in subject disciplines such as ESL. This doctoral study attempted to fill the knowledge gap by investigating the development of PDC among ESL student teachers in Norwegian teacher education (grades 8–13).

METHODOLOGY

The overarching research methodology for the study drew on approaches and strategies from literature review (Hart, 1998) and design-based research (DBRC, 2003). In the latter approach, both quantitative and qualitative methods were used for collecting data to understand the investigated phenomena both in breadth and in depth. In addition, the main research method for the study can be classified as following mixed-methods (MM) research since both quantitative (surveys) and qualitative data (document analysis, participant observations, semi-structured interviews, document analysis) were collected and integrated in the three sub-studies making up this doctoral study (Johnson, Onwuegbuzie, & Turner, 2007).

RESEARCH DESIGN

The overall research design is presented in Table 8.1. A qualitative document analysis² was first conducted (sub-study 1) to examine what approaches were used for ICT training teacher education programs to develop digital competence in secondary school student teachers. The document analysis was followed up with an MM case study where a quantitative survey was first used to investigate ESL student teachers' self-reported digital competence. This was followed up with qualitative participant observations of their ESL didactics university teaching, school practice,

2. For the purpose of this chapter, the term “document analysis” is used instead of “literature review”.

and semi-structured interviews of a sample of purposefully selected ESL student teachers including their teacher educator in ESL didactics. Finally, results from the sub-studies were used to inform the execution of a design-based research study on the use of digital storytelling (DST) for developing PDC in teacher education.

TABLE 8.1. An overview of the three sub-studies, MM data and analyses used in the doctoral study.

	Sub-study I	Sub-study II	Sub-study III
Title	Development of Student Teachers' Digital Competence in Teacher Education – A Literature Review	Prepared to teach ESL with ICT? A study of digital competence development in Norwegian teacher education	Digital storytelling in teacher education: A meaningful way of integrating ICT in ESL teaching
Research question	What approaches for ICT-training do teacher education programs use to develop digital competence in student teachers educated to teach in the secondary school grade level?	How is secondary student teachers' digital competence developed through an ESL didactics course at a Norwegian teacher education program?	How can a digital storytelling workshop promote secondary ESL student teachers' digital competence in teacher education?
Design	Document analysis	Case study research	Case study research Design-based research
Sample	Online peer-reviewed empirical articles Previous review articles	Student teachers Teacher educator	Student teachers Teacher educator
Data	Database searches ($N=3104$) Keywords <ul style="list-style-type: none"> ▶ Digital competence ▶ Digital literacy ▶ Computer literacy ▶ Media literacy ▶ Teacher Inclusion/exclusion criteria <ul style="list-style-type: none"> ▶ Included studies: 42 	Surveys <ul style="list-style-type: none"> ▶ S1: $N=41$ ▶ S2: $N=112$ Participant observations <ul style="list-style-type: none"> ▶ ESL didactics lessons: $N=20$ ▶ Classroom visits $N=18$ Semi-structured interviews <ul style="list-style-type: none"> ▶ ESL student teachers: $N=15$ ▶ ESL teacher educator: $N=1$ 	Survey <ul style="list-style-type: none"> ▶ S1: $N=41$ Participant observations <ul style="list-style-type: none"> ▶ ESL didactics lessons: $N=20$ ▶ Classroom visits $N=18$ Semi-structured interviews <ul style="list-style-type: none"> ▶ ESL student teachers: $N=15$ ▶ ESL teacher educator: $N=1$ Reflection logs
Analysis	Thematic analysis Coding/categorization	Digital competence model Coding/categorization	Digital competence model Coding/categorization

SAMPLE

The study included different types of sample including documents (study I), ESL student teachers, and their ESL teacher educator (studies II & III). The main sample population in the study was made up of ESL student teachers following a five-year postgraduate degree program at a Norwegian teacher education institution, which qualifies them to teach ESL in Norwegian secondary school, grades 8–13. The student teachers were between 20 to 30 years old, and would finish their teaching degree by writing a Master's thesis in their main subject discipline. The student teachers were sampled from four cohorts of ESL student teachers attending ESL didactics lessons (2012–2014). From these four cohorts, 15 ESL student teachers (11 females, 4 males) were purposefully sampled for follow-up investigations along with their ESL teacher educator. Student teachers were also sampled for two surveys. The first survey, S1, comprised 41 ESL student teachers in their first teaching semester while the second survey, S2, comprised 112 student teachers in their second and final teaching semester.

DOCUMENTS

A thorough document analysis was conducted exploring approaches to ICT training in secondary teacher education. The sample in the literature review consisted of 42 online peer-reviewed empirical studies in which eight approaches to ICT training in teacher education were uncovered. These approaches were later used to inform the research design and analysis in the following sub-studies. Furthermore, a wide range of documents (grey literature, i.e. unpublished documents that are sometimes difficult to access) was explored to inform the design of and complement the study. The documents used can be classified into two types; the first being policy documents, reports and the national curriculum; the second being documents generated in the overall project throughout the research process, including the ESL student teachers' assignments, digital stories and reflection logs. The purpose of analyzing these was to shed light on the use of ICT in ESL teaching and Norwegian teacher education.

QUANTITATIVE SURVEYS

Following the document analysis, two quantitative self-reporting surveys were distributed. The surveys were made up of two sections of self-reporting items: demographic information (10 items) and concept mapping questions and statements regarding digital competence (i.e. exploring the respondents' attitudes, per-

ceptions, and needs for PDC), ICT use in the teacher education program and among their teacher educators (19 items). With every conceptual question and statement, the student teachers were asked to choose the answer that fitted their own self-perceived beliefs on a 7-point Likert scale ranging from 1 (very low level of skills/competence/completely disagree) to 7 (high level of skills/competence/completely agree).

The quantitative data from the two student teacher surveys were analyzed for descriptive statistics (Maxwell, 2013); S1 ($N=41$, collected using “clickers” during plenary lecture) and S2 ($N=112$, collected by electronic survey). The descriptive statistical analyses included calculating frequencies, means, and standard deviations. The purpose of these analyses was to examine the ESL student teachers’ self-perceived PDC and their views on the use of ICT in the teacher education program. A confirmatory factor analysis was conducted to check the validity of the variables in the digital competence model (Figure 1). Table 8.1 shows the variables included in the factor PDC as well as mean differences, and standard deviations.

PARTICIPANT OBSERVATIONS

The participant observations were conducted in ESL didactics lessons and two DST workshops (January 2013 & January 2014) at the university, and in the sampled ESL student teachers’ classrooms during school practice over four academic semesters (2012–2014). The collection of observation data was recorded through ethnographic field notes during and after the observations, where the researcher included both descriptions and personal reflections (Emerson, Fretz, & Shaw, 2011). The focus of the participant observations in the ESL didactics lessons was on the student teachers, teacher educator, and in-class teaching and learning activities involving the use of ICT in English language teaching. During the observations in the student teachers’ school practice English lessons, the focus was on the student teachers’ activities, use, and integration of ICT during their lessons.

SEMI-STRUCTURED INTERVIEWS

Semi-structured interviews (Kvale & Brinkmann, 2009) were conducted with a total of 15 purposefully sampled student teachers and their ESL didactics teacher educator. The purpose of using interviews in these studies was to get a deeper understanding of how the student teachers developed their digital competence in ESL teaching, and what, how, and why they used ICT in their school practice.

Interviewing the teacher educator also helped shed light on what, how, and why ICT was used in the ESL didactics course and in general in the teacher education program. The interview guide was divided into five main themes and piloted with two graduate ESL student teachers: 1) the student teacher's reflections on prior ICT experiences in and out of school, 2) the student teacher's teaching experiences with ICT during the school practice, 3) ICT training and the use of digital technologies in the English didactics course, 4) ICT training and the use of digital technologies during the teacher education program, and 5) the student teacher's reflections on self-perceived digital competence development during the teacher education program. All interviews were conducted in Norwegian and translated into English by the researcher.

RESULTS

The results from the surveys, participant observations, and interviews show that the ESL student teachers' development of PDC varied throughout their teacher education. Although they seemed to be confident in elementary and basic digital skills, the ESL student teachers seemed to lack knowledge and awareness of how to use ICT didactically to support pupils' learning in English, and how to develop pupils' digital learning strategies and digital Bildung (Table 8.2). The outcome of the two DST workshops, which were organized and run by teacher educators on campus in 2013 and 2014, showed that the ESL student teachers were able to move beyond basic digital skills and that they started thinking didactically about the learning potential that ICT could have for English language teaching.

TABLE 8.2. Student teachers' self-perceived PDC.

Question	S1		S2	
	Mean	SD	Mean	SD
Elementary ICT skills – how well student teachers master the use of laptops and digital tools (e.g. online banking and social media) in their spare time (outside of work and school)	6.00	0.949	6.32	0.750
Basic ICT skills – how well student teachers master the use of digital tools (e.g. learning management systems, Word, Excel, and Power-Point) in their studies in a coherent way	5.39	0.919	5.89	0.809
Didactical ICT skills – how well student teachers master the use of digital tools (for instance digital learning resources in ESL) for teaching and potentially enhancing pupils' subject learning	4.44	0.950	4.94	0.942

Question	S1		S2	
	Mean	SD	Mean	SD
Digital learning strategies – how student teachers master guiding pupils in reading screen-based texts with concentration, persistence, flow, and coherence	3.49	1.247	4.34	1.119
Digital Bildung – how well student teachers master guiding pupils in developing digital Bildung associated with ethical challenges (e.g. cut and paste, illegal downloading and similar) that their digital lifestyle offers	4.46	1.645	5.36	1.012
Overall digital competence – based on the previous questions, how well student teachers assess their digital competence for teaching	4.68	1.011	5.16	0.812

Questions used a 7-Point Likert scale (1 = no skills, 7 = very good skills).

MODELING DIDACTICAL USE OF ICT

From the document analysis, eight approaches to ICT training in teacher education emerged, including collaboration, metacognition, blending, authentic learning, modeling, student-active learning, assessment, and bridging theory and practice gap. The most prominent of these approaches was modeling, i.e. having the ESL teacher educator serve as a role model was pointed out by the student teachers as an effective approach to generate more ideas on how they could integrate ICT into ESL teaching. In particular, observational and interview data showed that making pedagogical reasoning for practice clear, explicit and understandable promoted the student teachers' didactical ICT competence:

I was lucky with my mentor teacher. She worked with eTwinning [online collaborative platform], which our ESL teacher educator has also talked about at the teacher education program. I got the opportunity to see how it worked (Erich, spring interview, 2013).

The ESL teacher educator has shown us several good web pages such as BBC World News where you can go in and find short video clips. It becomes more authentic than the textbook in a way (Katie, fall interview, 2013).

Observation data from the ESL didactics lessons involved the teacher educator integrating ICT into ESL teaching through, for instance exemplifying writing digital texts in front of the student teachers while thinking out loud, demonstrating

quiz apps and online dictionaries, and showing pupils’ digital stories, podcasts, and multimodal compositions. Some student teachers were observed modeling the use of ICT in front of their pupils including critical use of social media, how to compose DSTs, and how to locate information by using search engines:

Sometimes I have to Google things, and then I take it up [on the projector] so that everybody [pupils] can see it. So when I am Googling then we can discover together what they are wondering about (Ellie, spring interview, 2014).

However, most of the time during the ESL didactics lessons the student teachers were observed passively listening to the ESL teacher educator’s instructions of how they could use ICT in ESL teaching. In the interviews, the student teachers expressed that they also wanted to actively try out the different digital tools rather than being passive listeners, and further explore the potential that the tools could afford for teaching and learning:

The ESL teacher educators could have invested more time on going in-depth with certain tools like “This is how you can do these things. You can use these in this and this context”. This might be the reason too why so few of us use it because we do not really know how to use the digital tools in our school practice (Andrew, fall interview, 2013).

TABLE 8.3. Teacher educators’ PDC.

Question	S1		S2	
	Mean	SD	Mean	SD
Overall digital competence of teacher educators* – based on the previous questions, how well student teachers assess the digital competence of their teacher educators	4.56	1.119	4.26	1.257
Competence development of teacher educators** – to what extent student teachers see a need for competence development in the use of ICT for teacher educators	5.41	1.322	5.44	1.354
Teacher educators as a role-model*** – to what extent student teachers perceive their teacher educators as a role-model for their own use of ICT in their teaching	3.66	1.296	3.60	1.372

Note. Questions used a 7-point Likert Scale (1 = no skills*/no extent**/completely disagree***, 7 = very good skills*/high extent**/completely agree***). The asterisks refer to the different question formulations.

Time with the ESL teacher educators to explore different digital tools in-depth seems to be a crucial factor for the student teachers to familiarize themselves with how to use these technologies in their school practice. In the surveys, the student teachers were asked to report on their teacher educators' PDC in their teacher education program and to what extent they perceived them as digitally competent role models for their own ICT use (Table 8.3).

In contrast to the interview data, both surveys (S1 & S2) showed that not all student teachers perceived their teacher educators as role models for their own use of ICT in teaching (Table 8.3). Likewise, a majority of the student teachers seemed to agree that there was a need to develop digital competence in teacher educators (Table 8.3). Furthermore, observational data showed that during their school practice, a majority of the student teachers tended to adopt teacher-centered styles of teaching ESL with ICT similar to those used by the teacher educator and mentor teachers, including using ICT for direct instruction and content delivery. Often, this entailed reliance on basic digital skills including using word processors, PowerPoint, and YouTube, which were also commonly featured in ESL didactics lessons. During the interviews, one student teacher argued that:

A lot of the digital learning in teacher education happens implicitly by “copying the teacher educator”, but that does not provide you with the competence to do it yourself. It ends up being a “trial and error” approach instead of giving us research or lessons about it (Tim, fall interview, 2013).

SCAFFOLDING LEARNING EXPERIENCES WITH ICT

Although the student teachers perceived modeling as helpful in developing their digital competence, they also noted a preference for practical activities where they were supported in authentic hands-on learning experiences with ICT. For instance, exploring online learning resources and creating digital artifacts in the ESL didactics lessons and in short workshops were pointed out as helpful activities for learning about how ICT could be used in a real classroom:

NDLA [Norwegian Digital Learning Arena] was new to me. It is a very good tool because you know you can find verified information there. In a way, it is a “teacher approved Wikipedia,” which I think is great (Mariam, fall interview, 2012).

Digital storytelling [workshop], that's an example where we got to try out being a pupil and not just a teacher (Erich, spring interview, 2013).

Survey and observational data showed that the student teachers seemed fairly confident in their self-perceived digital competence, notably elementary and basic digital skills. For example, Table 8.2 describes how the student teachers rated their elementary and basic digital skills as very high, indicating mastery of basic use of ICT including for entertainment, social media, and office and administrative software. In addition, observational data also support these results where the student teachers' use of ICT in the ESL didactics lessons and during their school practice was observed to be centered on direct instruction and content delivery. Nevertheless, confidence does not necessarily transfer into practice and might just come off as "talk". Despite their mastery of basic digital skills, some student teachers expressed in the interviews that they did not have significant learning experiences with ICT from prior schooling, higher education, or teacher education. Therefore, they saw little educational value in using ICT in their own teaching. In other words, they were not able to see the real affordances that ICT could offer for teaching and learning, and therefore resisted appropriating ICT into their lessons. Although the ESL teacher educator was observed exemplifying how to use relevant digital learning resources to develop pupils' language skills such as the BBC Languages website and with DST, the student teachers did not seem to appropriate these resources into their own teaching:

We're used to using video, PowerPoint, and Word for writing assignments. I wish we could have developed a bit more and use apps and learning tools, other tools than those we already are familiar with (Mariam, fall interview, 2012).

Social media should have been discussed more just because a critical focus on social media is important (Tara, spring interview, 2014).

DISCUSSION: CONTRIBUTIONS TO THE ENGLISH DIDACTICS FIELD

The doctoral study presented here focused on how ESL student teachers developed professional digital competence (PDC) in Norwegian teacher education. The main argumentation was that teacher education plays an important role in preparing student teachers to teach with ICT in today's digitalized schools and should therefore enable them to meet curriculum demands, where teaching with ICT is significant in teaching various subject disciplines. Hence, teacher education programs should develop student teachers' PDC for integrating ICT in their subject discipline such as ESL. Ultimately, such a competence could better equip ESL student teachers to face the increasingly complex demands of the curriculum, con-

temporary schools, and learning expectations of current and future generations of pupils. In the following, empirical, methodological and theoretical contributions including implications for teaching English in teacher education and in school, and suggestions for further research, are discussed.

EMPIRICAL CONTRIBUTIONS

Through designing, trialing, and investigating the use of DST in teacher education, the thesis provides insight into an innovative, pedagogical, and didactical way of integrating ICT in ESL teaching. The study's document analysis seems to paint an optimistic picture of how technically competent student teachers are and how they can be prepared to teach with ICT in their future careers as professional teachers. However, the results from the doctoral study showed that few of these approaches, such as collaborative learning with ICT or setting aside time for hands-on experimentation with ICT, were actually implemented by the ESL teacher educator. Moreover, from the data, it appears that most ICT usage by both the ESL student teachers and their teacher educator in this study was based on traditional teacher-centered ways of teaching, i.e. content delivery and direct instruction. The data reflects the fact that innovative use of ICT is not prioritized in teacher education, and that the most frequent use of ICT revolves around using technology to support traditional teaching practices. This superficial and teacher-centered use of ICT in teacher education raises the critical issue of whether a gap is really being created between what student teachers are taught in teacher education and the demands they face in the digitalized school (Krumsvik, 2014).

The main empirical contribution of this thesis is increased knowledge about how PDC can be developed in student teachers qualifying to teach in secondary school. The study showcased different approaches for ICT training in teacher education. For example, the document analysis highlighted approaches such as modeling, metacognition, and collaborative learning as important steps in teacher education towards PDC development. The study showed the teacher educator as an important factor concerning PDC development in student teachers, notably through modeling and scaffolding ICT integration in teaching, as pointed out in the case study. Despite the reported lack of opportunities to try out digital technologies in teacher education, this study offers evidence that most ESL student teachers pick up and employ these technologies during their school practice when teaching English in secondary school. Thus, the data indicate a link between the teacher educator's use of digital tools and student teachers' subsequent integration of ICT in teaching.

Second, regarding how to integrate ICT in ESL teaching, the teacher educator played a critical role for student teachers to appropriate PDC. However, because a majority of the ICT usage by the teacher educator was teacher-centered, focusing on direct instruction and content delivery, the student teachers' ICT integration seemed affected by these experiences during school practice. The student teachers' use of ICT was fairly superficial, and dominated by administrative and office software, presentation technologies, social media, and using the Internet to locate information. Thus, the student teachers drew on their basic digital skills. Although these technologies were already mastered by the student teachers, the issue was how to develop their PDC to move from mastering basic digital skills to appropriating didactical ICT competence (Figure 1). A possible solution here is to provide student teachers with opportunities to appropriate PDC, by getting hands-on experience with how to integrate ICT in their teaching such as through DST. Watching the teacher educator model didactical use of ICT in subject discipline teaching might not be enough to ensure that student teachers will master and appropriate PDC.

Third, the study showed how working with DST in teacher education could be used to integrate ICT in ESL teaching in innovative ways, and to develop student teachers' PDC. The study shows how approaches from research literature about ICT training in teacher education can be applied to a design-based research study context to promote PDC in ESL student teachers. Notably, this includes the teacher educator modeling DST and offering the student teachers opportunities to try out DST for themselves in a scaffolded and collaborative learning environment. Using familiar, basic desktop tools for creating digital stories such as Movie Maker, the threshold for integrating ICT in teaching is lowered, thus increasing the chances that student teachers use DST in their future teaching. These approaches might stimulate student teachers' PDC development to go beyond mastering basic digital skills towards appropriating didactical ICT competence.

METHODOLOGICAL CONTRIBUTIONS

The results of the iterations and refinements of the workshop design could potentially provide a blueprint for other researchers and teacher educators who wish to implement the method in similar contexts. In addition, the use of “clickers” for collecting survey data during a plenary lecture (S1) can be considered an innovative method, and holds methodological implications for collecting quantitative data. Other Norwegian studies have successfully employed this method in different contexts, including pupils' and teachers' digital competence in secondary

school (Krumsvik, Egelandstad, Sarastuen, Jones, & Eikeland, 2013). This doctoral study, however, might be the first to collect quantitative data on ESL student teachers' PDC using "clickers", which could be considered a methodological contribution.

THEORETICAL CONTRIBUTIONS

As a theoretical contribution, this study used Krumsvik's (2011; 2014) theoretical model to examine PDC development in student teachers (Figure 1). Originally the model was intended to investigate digital competence in teachers and teacher educators (Krumsvik, 2014). In the doctoral study, it was applied as a research lens for examining ESL student teachers' PDC development in teacher education. The study demonstrates how Krumsvik's (2014) model can be applied to study this phenomenon in a Norwegian teacher education setting. Specifically, this study calls for more critical awareness and focus on how teachers, teacher educators, and student teachers can utilize ICT to teach in a sound pedagogical and didactical way. Here, the study provides theoretical arguments for further promoting the development of PDC in teacher education.

IMPLICATIONS FOR TEACHING ENGLISH IN TEACHER EDUCATION

Overall, the findings imply that ESL teacher educators need to critically and didactically reflect on what kinds of digital tools they use during teacher training as well as how and why, because they will model and influence how ESL student teachers will be using ICT in their future teaching. This argument can be extended to include the mentor teachers during school practice who are also digital role models. Furthermore, the study findings imply that teacher educators and mentor teachers need to set aside time to provide scaffolding for the student teachers to practice authentic, pedagogical, and didactical ways of teaching with ICT.

Modeling innovative ways of integrating ICT in ESL teaching during teacher education might lower the threshold for student teachers to use technology in their own English teaching, and ESL teacher educators should encourage student teachers to share new ICT practices from their school practice with their peer students in teacher education. Moreover, video technologies could help student teachers see alternative pedagogies and purposeful didactical integration of ICT. In turn, these technologies could potentially change their traditional teacher-centered ways of teaching with ICT.

SUGGESTIONS FOR FURTHER RESEARCH

More research on ICT in teacher education should focus on developing innovative teaching practices with technology through the use of interventionist research designs such as design-based research. For example, a recent study analyzed the development of PDC among student teachers at the University of Oslo through the use of a small private online course (SPOC), identifying how such use developed their PDC (Brevik, Gudmundsdottir, Lund & Strømme, in press). As there is a dearth of such studies, more research is needed. Moreover, there seems to be an abundance of reports in the media on the rise of non-academic use of mobile devices and cyberbullying in schools. Further research in teacher education could explore the use of mobile devices for teaching and learning, including how to address emerging ethical issues (c.f. digital Bildung, Figure 1) related to new technologies. In addition, there is a need for more mixed methods research showing subject specific use of ICT in teacher education such as in ESL, as the field seems to be dominated by quantitative studies reporting on general ICT use, attitudes or beliefs among staff and students (Gjerdrum & Ørnes, 2015). An emerging topic for further research is how teacher educators and teachers' PDC could be developed and assessed in further education courses (c.f. the DigGiLU project. 2018–2020).³

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