Fredrik Mørk Røkenes

Preparing Future Teachers to Teach with ICT

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

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Norwegian University of Science and Technology
Faculty of Social Sciences and Technology Management
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"[…] Internet use, and educational technology in general, are only as good as the teachers who use it" (Castells, 2001, p. 258).

Scientific environment

This thesis was written between January 2012 and February 2016 at the Programme for Teacher Education (PLU), Faculty of Social Sciences and Technology Management at the Norwegian University of Science and Technology (NTNU). During this period, I was supervised by Associate Professor Tale M. Guldal at NTNU and Professor Rune J. Krumsvik at the University of Bergen (UiB). From July 2014 until July 2015, I was a visiting scholar at the Centre for Research on Computer Supported Learning and Cognition (CoCo), Faculty of Education and Social Work at the University of Sydney (UoS). Throughout the entire research process, I have been a member of and participated in the research program organized by the Norwegian National Graduate School in Teacher Education (NAFOL).

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[1] This famous statement is from a letter that Sir Isaac Newton sent to his rival Robert Hook, and is often used to demonstrate scientific progress and humility.

Abstract

This doctoral thesis examines secondary school English as a Second Language (ESL) student teachers' digital competence development at a Norwegian teacher education program. Specifically, it explores how ESL student teachers are taught how to integrate information and communications technology (ICT) into their English language teaching (ELT). The article-based thesis consists of three independent research articles and a synopsis. The synopsis includes a discussion of research on the use of ICT in teacher education, an overview of the study's theoretical background, a description of the applied methodology including the research design, methods for data collection and data analysis, and a summary and discussion of the three research articles. Finally, the synopsis ends with a discussion of the implications of the study's main findings along with study limitations and potential avenues for further research.

Article I is a review of the research literature that focuses on how secondary student teachers develop digital competence in teacher education. The review follows a number of strict inclusion/exclusion criteria which resulted in the inclusion of 42 peer-reviewed empirical articles on secondary student teachers' use of ICT in teacher education. Primary findings emphasize eight approaches used in teacher education to develop student teachers' digital competence: collaboration, metacognition, blending, modeling, authentic learning, student-active learning, assessment, and bridging the theory/practice gap. These approaches can inform further investigations and research designs on the development of student teachers' digital competence in teacher education. Secondary findings point out a lack of underlying epistemological and theoretical frameworks in more than half of the included studies, and a low number of studies from Scandinavian countries even though these are considered to be technologically advanced.

Article II is a case study examining secondary school ESL student teachers' digital competence development in an ESL didactics course at a Norwegian teacher education program over four academic semesters. Using a digital competence model as a research lens, the study focuses on how the ESL teacher educator's didactics lessons and the student teachers' school practicum prepare the student teachers to teach ESL with ICT. The study employs both quantitative and qualitative sources of data to investigate the student teachers' digital competence development, and findings indicate that their mastery and appropriation of digital competence varies throughout

teacher education. As pointed out in Article I, the student teachers' overall digital competence is inhibited or enabled through a number of approaches for ICT training used in teacher education, such as: modeling ICT integration, scaffolding learning experiences, linking theory and practice, encouraging reflection-on-action, providing resources and support, using innovating assessment practices, and facilitating collaborative learning. Results underscore the importance of systematic and reflexive use of ICT in teacher education, and note the significant role that teacher educators play as role models for integrating ICT didactically and innovatively in teaching.

Article III is a design-based research case study investigating how a digital storytelling (DST) workshop at a Norwegian teacher education program can promote secondary school ESL student teachers' digital competence development and didactical ways of integrating ICT in ELT. By drawing on results from Articles I and II, a DST workshop was implemented and trialed by the researcher through two iterations of interventions and evaluations. The workshop implemented a number of approaches, including: modeling ICT integration and assessment with ICT, scaffolding student-active learning experiences with ICT, collaborative learning, and linking theory and practice through reflection-on-action. Through the workshop, the ESL student teachers gradually moved from mastering basic digital skills to appropriating the more complex dimensions of digital competence, such as didactic ICT competence, learning strategies, and digital Bildung. In addition, the workshop allowed the student teachers to experience innovative ways of teaching ESL through seeing the real affordances of ICT.

The main contribution of this thesis is increased knowledge about approaches and innovative ways of teaching ESL with ICT with the goal of developing secondary school ESL student teachers' digital competence in Norwegian teacher education. Findings show that, although ESL student teachers might be confident in elementary and basic digital skills, they seem to lack knowledge and awareness of how to use ICT didactically to support pupils' learning in the subject discipline, and how to develop pupils' digital learning strategies and digital Bildung. Furthermore, the review of research literature revealed that ESL teacher educators most frequently use two strategies, namely modeling didactical ICT integration and scaffolding student teachers' learning experiences with ICT. These stand out as means of promoting student teachers' integration of ICT in their own teaching. Results imply that teacher educators are digital role models and need to reflect on the ways they use ICT in teacher education.

Sammendrag (Norwegian)

Denne doktorgradsavhandlingen undersøker lektorstudenter i engelsk sin digitale kompetanseutvikling ved en norsk lærerutdanning, og hvordan de blir utdannet til å integrere informasjons- og kommunikasjonsteknologi (IKT) i undervisningen. Avhandlingen er artikkel-basert, og består av tre uavhengige studier og en kappetekst. Kappeteksten inneholder en diskusjon angående tidligere forskning på lærerstudenters bruk av IKT i lærerutdanningen, avhandlingens teoretiske bakgrunn, metodologi inkludert forskningsdesign, metode for datainnsamling og analyse, og en oppsummering og diskusjon av de tre forskningsartiklene. Kappeteksten avsluttes med en diskusjon av implikasjonene av prosjektets hovedfunn, begrensninger og potensiale for videre forskning.

Artikkel I er en gjennomgang av forskningslitteraturen hvor fokuset er på ungdomsskole- og videregående lærerstudenter digitale kompetanseutvikling i lærerutdanningen som en måte å forberede dem på å undervise i dagens teknologirike skole. Studien fulgte et sett med inkluderings- og ekskluderingskriterier som resulterte i at 42 fagfellevurderte publiserte studier med fokus på ungdomsskole og videregående lærerstudenters bruk av IKT i lærerutdanningen, ble inkludert. Primære funn vektlegger åtte tilnærmingsmåter som blir brukt i lærerutdanningen for å utvikle lærerstudenters digitale kompetanse: samarbeidslæring, metakognisjon, blandet læring, modellering, autentisk læring, student-aktiv læring, vurdering, og sammenkobling av teori/praksis gapet. Tilnærmingene kan videre bidra i fremtidige studier og utviklingen av forskningsdesign for å fremme lærerstudenters digitale kompetanseutvikling i lærerutdanningen. Sekundære funn peker på mangel av epistemologiske og teoretiske rammeverk i over halvparten av studiene i litteraturgjennomgangen, og et lavt antall studier fra skandinaviske land til tross for at disse er ansett som teknologisk avanserte.

Artikkel II er en case studie som undersøker lektorstudenter i engelsk sin digitale kompetanseutvikling i et engelsk fagdidaktikkskurs ved en norsk lærerutdanning over 4 akademiske semester. Studien tok i bruk en digital kompetansemodell som forskningslinse, og fokuserte på hvordan lektorstudentene ble forberedt på å undervise engelsk med IKT gjennom lærerutdannerens undervisning i fagdidaktikk og gjennom skolepraksis. Både kvantitative og kvalitative data ble tatt i bruk for å undersøke forskjellige aspekter ved lærerstudentenes digitale

kompetanseutvikling hvor funnene påpeker at lærerstudentenes mestring og appropriering av digital kompetanse varierer gjennom lærerutdanningen. Lik Artikkel I viser studien at lektorstudentenes digitale kompetanseutvikling blir fremmet og hemmet av en rekke fremgangsmåter for utvikling av IKT ferdigheter som blir tatt i bruk av lærerutdanningen slik som modellering av integrering av IKT, stillasbygging av læring, sammenkoblingen av teori og praksis, refleksjon-om-handlinger, tilgang til ressurser og støtte, innovative vurderingspraksiser, og samarbeidslæring. Resultatene understreker viktigheten av systematisk og refleksiv bruk av IKT i lærerutdanningen, og påpeker spesielt lærerutdannerens signifikans som rollemodell for integrering av IKT i fagundervisningen på innovative didaktiske måter.

Artikkel III er en design-basert case studie som undersøker hvordan et verksted i digitale fortellinger ved en norsk lærerutdanning kan fremme lektorstudenter i engelsk sin digitale kompetanse og innovative måter å integrere IKT i undervisningen. På bakgrunn av funn fra Artikkel I og Artikkel II ble et verksted i digitale fortellinger implementert og gjennomført i 2 runder med intervensjoner og evalueringer. En rekke tilnærminger ble brukt: modellering av IKT-integrasjon og vurdering med IKT, stillasbygging av student-aktiv læring med IKT, samarbeidslæring, og kobling mellom teori og praksis gjennom refleksjon-om-handlinger. Gjennom verkstedet gikk lektorstudentene fra å mestre grunnleggende digital ferdigheter til å appropriere mer komplekse dimensjonene av digital kompetanse slik som didaktisk IKT-kompetanse, læringsstrategier og digital dannelse. De fikk også oppleve innovativ bruk av IKT i engelskfaget og samtidig reflektere over læringspotensialet som IKT kan ha for elvers læring.

Hovedbidraget til denne avhandlingen er økt kunnskap om tilnærmingsmåter og innovativ undervisning med IKT i norsk lærerutdanning som kan brukes til å utvikle lektorstudenter i engelsk sin digitale kompetanse. Funnene viser at til tross for at lektorstudentene fremstår som selvsikre i elementære og grunnleggende digitale ferdigheter så mangler de kunnskap og bevissthet om hvordan de kan bruke IKT på en didaktisk måte for å støtte elevenes faglige utvikling, og hvordan de skal fremme digitale læringsstrategier og digitale dannelse. Lærerutdanners modellering av IKT og stillasbygging av lektorstudentenes læring med IKT er noen av de mest tydelige tilnærmingsmåtene i litteraturen, og stod fram som måter for å fremme lektorstudentenes integrering av IKT i undervisningen. Implikasjonene er at lærerutdanner er en digital rollemodell og bør reflektere over måter IKT blir brukt i lærerutdanningen.

List of publications

Article I

Røkenes, F. M., & Krumsvik, R. J. (2014). Development of student teachers' digital competence in teacher education - A literature review. *Nordic Journal of Digital Literacy*, *9*(4), 250–280.

Article II

Røkenes, F. M., & Krumsvik, R. J. (under review). Prepared to teach ESL with ICT? A study of digital competence in Norwegian teacher education. Manuscript submitted for publication in *Computers & Education*.

Article III

Røkenes, F. M. (in press). Digital storytelling in teacher education: A promising way of integrating ICT in English teaching. *Acta Didactica Norge.*

List of abbreviations

CAQDAS – Computer Assisted Qualitative Data Analysis

DBR – Design-Based Research

DeSeCo – Definition and Selection of Competencies

DS – Digital Story

DST – Digital Storytelling

ESL – English as a Second Language

ELT – English Language Teaching

ICT – Information and Communications Technology

LMS – Learning Management System

NSD – Norwegian Social Science Data Service

OECD – Organisation for Economic Co-Operation and Development

SRS – Student Response System

TPCK – Technological Pedagogical Content Knowledge

UNESCO – United Nations Educational, Scientific and Cultural Organization

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Part I: Synopsis

1. Introduction

> What has not yet been fully understood is that computer-based technologies can be powerful pedagogical tools – not just rich sources of information, but extensions of human capabilities and contexts for social interactions supporting learning. The process of using technology to improve learning is never solely a technical matter, concerned only with properties of educational hardware and software. Like a textbook or any other cultural object, technology resources for education function in a social environment, mediated by learning conversations with peers and teachers. (Bransford, Brown, & Cocking, 2000, p. 230)

> We have not yet become good enough at the kind of pedagogies that make the most out of technology; that adding 21st-century technologies to 20th-century teaching practices will just dilute the effectiveness of teaching… The impact of technology on education delivery remains sub-optimal, because we may overestimate the digital skills of both teachers and students, because of naïve policy design and implementation strategies, because of poor understanding of pedagogy, or because of the generally poor quality of educational software and courseware. (Schleicher in OECD, 2015, p. 3)

The quotes above touch on the main focus of this doctoral thesis, which is about digital competence development in secondary school English as a Second Language (ESL)[2] student teachers in the Norwegian teacher education system. As noted by Darling-Hammond (2000), teacher education greatly influences teaching, and consequently influences the ways future teachers choose to integrate information and communications technology (ICT)[3] in teaching in

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[2] When discussing research on English language teaching (ELT) in Norwegian schools and higher education, the terms English as a Second Language (ESL) and English as a Foreign Language (EFL) are often used interchangeably without any distinction (e.g., Lund, 2004, p. 14). Although several researcher have acknowledged that English in Norway has traditionally had "foreign-language status" (Rindal, 2014, p. 8), Simensen (2007, p. 74), Rindal (2013), and Brevik (2015) have indicated that English is approaching the status of a second language (L2) due to its familiarity and exposure to Norwegians. The recent Official Norwegian Report also recognized English as a second language by presenting foreign languages as "every language except Norwegian/Sami, Danish, Swedish, and English" (NOU, 2015: 8, p. 52). However, with the increase of pupils with immigrant or refugee backgrounds in Norwegian schools where a language than Norwegian is their native tongue (L1), the question of which term to use in studies on English teachers has become complex (Surkalovic, 2014). In this thesis ESL, is used with no distinction from EFL, as previously done by Lund (2004).

[3] The broad term information and communications technology (ICT) refers "in principle to all possible technologies that are used for locating and processing information, communicating and producing digital media" (Aesaert & van Braak, 2015, p. 8). This includes computer technology, multimedia, the Internet, mobile devices, and so on where the

today's increasingly digitalized school (Krumsvik, 2014b). The first quote by Bransford et al. (2000) illustrates the untapped potential that ICT has for teaching and learning, and that is still yet to be fully unleashed and embraced in all levels of education, such as teacher education. Their rather optimistic perspective about how ICT can positively impact teaching and learning contrasts Schleicher's quote from a recently published report by the Organisation for Economic Co-operation and Development (OECD, 2015), which paints a rather negative picture of how ICT is used in many contemporary educational institutions. Schleicher's argument also raises concerns about how ICT should be used for "education delivery" (OECD, 2015, p. 3). This description stands in contrast to the findings pointed out in Tamim et al.'s (2011) landmark meta-analysis of over forty years of research on the impact of technology on learning. They suggested that "one of technology's main strengths may lie in supporting students' efforts to achieve rather than acting as a tool for delivering content" (Tamim et al., 2011, p. 17).

The motivation to conduct this research on digital competence in Norwegian teacher education stemmed from continuous reported criticism on the slow uptake, tool-focused and teacher-centered teaching practices, and lack of innovative ways to integrate and teach with ICT in Norwegian teacher education and schools (Gjerdrum & Ørnes, 2015; Hetland & Solum, 2008; Tømte, Kårstein, & Olsen, 2013; Ørnes, Wilhelmsen, Breivik, & Solstad, 2011). While Haugan's (2011) systematic review of research on Norwegian general teacher education from 2000 to 2008 revealed that few empirical studies have addressed ICT in this context, the last few years have witnessed growth in studies regarding the use of technology in Norwegian pre-school- and general teacher education[4] (Brox & Jakobsen, 2014; Helgevold & Moen, 2015; Instefjord, 2014; Instefjord & Munthe, 2015; Kvåle & Rambø, 2015; Nilsen, Almås, & Krumsvik, 2013; Strømman, 2015; Tømte, Enochsson, Buskqvist, & Kårstein, 2015). However, little empirical research in the field of Norwegian secondary teacher education[5] has focused on didactical, subject-related use of ICT and digital competence development in secondary school student

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integration of communications, audio, and video with computers make the individual technologies "nearly indistinguishable" (R. E. Anderson, 2008, p. 8). Also, ICT can be understood as cultural and cognitive tools which "extend the abilities individuals have to deal with the challenges of everyday life" (Preiss & Sternberg, 2005, p. 199).

[4] Student teachers enrolled in a Norwegian general teacher education program are qualifying to teach in primary- and lower-secondary school (grades 1–7 and grades 5–10 in the Norwegian school system, ages 6–12).
[5] A few exceptions exist, such as Krumsvik and Smith's (2009) study on the use of videopapers with student teachers in a one-year post-graduate teaching certification course in a Norwegian secondary teacher education program.

teachers[6] (Article I). Consequently, the research context for this study is a Norwegian teacher education program with secondary school ESL student teachers enrolled in an ESL didactics course qualifying to teach ESL in the Norwegian secondary school grade.

This doctoral thesis is set in the cross-section between research on ICT in teacher education, digital competence, subject didactics, and ESL teaching. However, to narrow the scope of the study, certain research fields are emphasized more than others. Thus, research on ICT in teacher education and digital competence is more central to this work than research on subject didactics and ESL teaching. While the latter issues are touched on only briefly, the former are scrutinize more thoroughly. Yet, the fields of subject didactics and ESL teaching act as important backdrops for conducting research on student teachers' digital competence development in teacher education by situating the study within a specific subject discipline and showcasing subject-specific ICT integration. Thus, the study can be read on two levels: first as a general examination of how teacher education programs can develop student teachers' digital competence (Article I & Article II), and second as an in-depth examination of ESL student teachers' digital competence development and integration of ICT in subject didactics and ESL teaching through teacher education (Article II & Article III).

The main argument emphasized throughout this thesis is that ESL student teachers need to master and appropriate innovative ways of teaching their subject discipline with ICT (Instefjord, 2014). Additionally, they need to develop a professional digital competence through their teacher education in order to meet the requirements of language teaching in today's digitalized schools and networked world (Lund, Furberg, Bakken, & Engelien, 2014). Otherwise, future language teachers might not be able to see the real affordances of ICT, and they would potentially not know how to use ICT professionally in new and innovative ways for teaching and learning. A lack of preparation through teacher education might result in future language teachers using ICT in ways guided by their personal use in their spare time, such as for entertainment, finding

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[6] In this study, a secondary school student teacher is understood as a student enrolled in a secondary teacher education program to qualify to teach in secondary school. In a Norwegian teacher education context aimed at the secondary school grade level, the student teachers specialize in two subject disciplines, such as ESL and Social Science. After their subject disciplinary courses, the student teachers continue their teacher education in either a one-year postgraduate practical pedagogical education program (PPU) or in a five-year integrated postgraduate teacher education program (5LU). The latter ends with students writing a Master's thesis in one of the subject disciplines. Both programs result in students attaining the title of "lector," (i.e., lektor in Norwegian) which means that they are qualified to teach in lower- and upper-secondary school (grades 8–13 in the Norwegian school system, ages 13–18).

information, and social media (Lei, 2009). Alternatively, they might revert to the traditional uses of ICT in schools, including lesson planning, administrative tasks, teacher-centered instruction, and content delivery (Drent & Meelissen, 2008). Also, future language teachers will necessarily become digital role models for pupils (Krumsvik, Egelandsdal, Sarastuen, Jones, & Eikeland, 2013); therefore, they must know how to promote digital competence among today's young people, the so-called generation of "digital natives" (Prensky, 2001a, 2001b, 2005).[7] While young people today might technically be expert users of technology, research has revealed that they lack the competence to transform this proficiency into learning opportunities and that their use of ICT is rather unsophisticated (Bennett, Maton, & Kervin, 2008; Selwyn, 2009). Hence, future language teachers must bear these aspects in mind so they can enable pupils to fully participate in the increasingly digitized and networked society, knowledge- and competency-based economy, and world of work (European Commission, 2007; Voogt, Erstad, Dede, & Mishra, 2013). Recent Norwegian research from upper-secondary school has shown that digitally competent teachers handle classroom management better in technology-rich environments than other teachers (Krumsvik, 2014a; Krumsvik, Ludvigsen, & Urke, 2011), and that a significant relationship exists between teachers' digital competence and pupils' general achievements in school (Krumsvik et al., 2013). Cole (1996) presented an argument regarding the importance of engaging students in a wide array of writing tasks, which can be extended to the domain of ICT integration in teacher education. He noted that, "if the uses of writing are few, the skill development they foster will also be limited to a narrow range of tasks in a correspondingly narrow range of activities and content domains" (Cole, 1996, p. 235). Similarly, if the ways that student teachers are invited to use ICT in teacher education are few and superficial, their integration of ICT in their subject disciplines and digital competence development will be limited.

1.1 Purpose, research questions, and design

Creswell (2009) offered the following guideline when stating the goal or purpose of a research study: "the purpose statement sets the objectives, the intent, or the major idea of a proposal or a

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[7] Other similar concepts have been used to describe the new generation of young people who are growing up with technology. These include "the Net Generation" (Oblinger & Oblinger, 2005; Tapscott, 1998, 2009), "Homo Zappiens" (Veen & Vrakking, 2006), "Millennials" (N. Howe & Strauss, 2000), "Born Digital" (Palfrey & Gasser, 2008), "Generation M" (Rideout, Roberts, & Foehr, 2010; Roberts, Foehr, & Rideout, 2005), "ScreenAgers" (Rushkoff, 2006), and "New Millennium Learners" (Pedró, 2007).

study. This idea builds on a need (the problem) and is refined into specific questions (the research questions)" (Creswell, 2009, p. 112). The overarching purpose of this design-based mixed methods research study is 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 is the following:

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

In order to examine this research question further, it has been divided into three sub-questions which have been investigated through three empirical studies. Table 1 presents an overview of the thesis and the three research articles.

Table 1. *Overview of thesis and research articles*

Study purpose	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.		
Main research question	*How is digital competence developed in secondary school ESL student teachers at a Norwegian teacher education program?*		
	Article I	**Article II**	**Article 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 promising way of integrating ICT in English 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 does an ESL didactics course at a Norwegian teacher education program contribute to developing digital competence in secondary student teachers?*	*How can a digital storytelling workshop in teacher education promote secondary school ESL student teachers' digital competence?*
Design	Literature review	Case study research	Case study research Design-based research
Sample	Peer-reviewed empirical articles Previous literature review articles	Student teachers Teacher educator	Student teachers Teacher educator
Data	Database searches Keywords Inclusion/exclusion criteria	Surveys Participant observations Semi-structured interviews	Survey Participant observations Semi-structured interviews Reflection logs
Analysis	Thematic analysis Coding/categorization	Digital competence model Coding/categorization	Digital competence model Coding/categorization

The overarching research design[8] of the thesis, encompassing the synopsis and the three research articles, is inspired by and draws on approaches from design-based research (DBRC, 2003). The inspiration to utilize design-based research comes from Herrington et al. (2007), who encourage doctoral students to utilize design-based research as a model for examining ICT in education because it is particularly well suited to address complex problem areas in a real-life educational context and often in collaboration with other researchers and/or practitioners (Brown, 1992; Collins, 1992). As described later in the Methods chapter, the utilization of approaches from design-based research involved four steps, which are addressed in different parts of the thesis (adapted from Reeves, 2006): 1) an analysis of practical problems (Article I & Article II), followed by 2) development of solutions (Article I & Article II) and 3) iterative cycles of testing and refinement of solutions (Article III), culminating in 4) reflection and production of design principles (Article III & synopsis). Drawing on design-based research as a foundation and as an overall approach in the thesis, the research design used in the three underlying empirical studies included a literature review (Article I), case study research (Article II & Article III), and design-based research (Article III).

This design-based research study employs a mixed methods research paradigm[9] (R. B. Johnson, Onwuegbuzie, & Turner, 2007), utilizing both quantitative and qualitative methods for collecting data (Creswell, 2009). As stated in the Methods chapter, the study can be classified as "*qualitative dominant* mixed methods research" (R. B. Johnson et al., 2007, p. 124, their italics) where the emphasis is put on qualitative methods over quantitative methods for data collection. A researcher's ontological and epistemological position affects the choice to mix research methods; thus, the following section provides more details regarding my personal stance, goals, and philosophical views.

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[8] Denzin and Lincoln (2011a) noted that a research design "describes a flexible set of guidelines that connect theoretical paradigms, first, to strategies of inquiry and, second, to methods for collecting empirical material" (Denzin & Lincoln, 2011a, p. 14).
[9] R. B. Johnson and Onwegbuzie (2004) drew on Kuhn's (1962) notion of paradigm, and argued that mixed methods research can be classified as "the third form of research paradigm" (R. B. Johnson & Onwuegbuzie, 2004, p. 14). The authors defined *research paradigm* as "a set of beliefs, values, and assumptions that a community of researchers has in common regarding the nature and conduct of research" including "ontological beliefs, epistemological beliefs, axiological beliefs, aesthetic beliefs, and methodological beliefs" (R. B. Johnson & Onwuegbuzie, 2004, p. 24). The authors argued that, "if you visualize a continuum with qualitative research anchored at one pole and quantitative research anchored at the other, mixed methods research covers the large set of points in the middle area" (R. B. Johnson & Onwuegbuzie, 2004, p. 15), meaning that it resides between the quantitative (e.g., positivism, post-positivism) and qualitative (e.g., critical social theory, constructivism, phenomenology) research paradigms (Lincoln, Lynham, & Guba, 2011; Savin-Baden & Major, 2013).

1.2 Personal stance, goals, and philosophical views[10]

Maxwell (2013), Merriam (2009), and Savin-Baden and Major (2013) have argued that researchers' personal perspectives, backgrounds, and identities influence their studies in a number of ways. Researchers are not neutral, but have their own world views, biases, and values which act as analytical lenses for looking at and interpreting "the already-interpreted world of participants" (Cohen, Manion, Morrison, & Bell, 2011, p. 225). Thus, to understand and deal with possible researcher bias, it is important to properly address, disclose, and make explicit one's personal stance, experiential knowledge, positions, and assumptions. As a result, being transparent about biases, personal beliefs, and background indicates researcher reflexivity (Alvesson & Sköldberg, 2009).

My background for conducting this study is partly related to my background from ICT and teaching English in secondary school. I have an apprenticeship diploma in ICT and Network Administration from vocational studies in the Norwegian upper-secondary school system, and I studied pre-engineering before enrolling in a five-year integrated postgraduate teacher education program and becoming a student teacher at a Norwegian university. There, I earned a Master's degree (MA) in Language Studies with Teacher Education, and I am a qualified English (and History and Spanish) teacher for teaching in lower- and upper-secondary schools (grades 8–13).

I grew up in the 1980s with computers and emerging digital technologies. Like many others, the way that I used computer technology was mostly self-taught and consisted of a range of technical skills and knowledge centered on hardware and software. In a way, I am a part of the "digital natives vs. digital immigrants" discourse raised by several authors such as Prensky (2001a, 2001b, 2005). Although these concepts have become heavily debated (Bennett et al., 2008; Bullen, Morgan, & Qayyum, 2011; Kennedy, Judd, Churchward, Gray, & Krause, 2008; Thomas, 2011) or even discredited by several researchers as an urban myth (Kirschner & van Merriënboer, 2013; Selwyn, 2009) or an unhealthy dichotomy (Bennett & Maton, 2010), the concepts paint a picture of the situation for current and future generations. These individuals are born into a world where digital technologies are a part of everyday life, and where they learn how to use these technologies at a fairly young age. However, my use of computers for learning did not evolve

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[10] Because this section regards reflections, goals, desires, and motives that are rather close and personal to the researcher, the personal pronoun "I" will be used in contrast to the rest of the thesis which is written in a more objective academic form.

properly before I enrolled in teacher education. On the contrary, my digital competence was not something I was born into (cf. "Digital Natives", Prensky, 2001a), but was a result of curiosity, eagerness to learn, and "hard work" (boyd, 2014, p. 177).

English has become the universal language or lingua franca of the Internet and digital technologies (Crystal, 2006), which underlines the importance of mastering the language for participating in the increasingly digitalized and networked world (Castells, 2001). These aspects motivated me to combine the two domains—digital technology and English—as a topic in my Master's thesis where I focused on source criticism of Internet-based sources in upper-secondary ESL teaching. Through my teacher education program, my work on my thesis, and my work as an ESL teacher, I noticed that, despite the possibilities that ICT afforded teaching, most teachers and teacher educators seemed to use technology for instruction and content delivery. Therefore, after teaching ESL in lower- and upper-secondary school for almost a year, I started to work on my PhD in teacher education. In my PhD project, my personal interests in digital technologies, innovative teaching with ICT, and ESL would influence my choice of research topic. As overarching goals, I wanted to understand the current situation of using ICT in teacher education both on a local and a global scale. In addition, I wanted to promote new ways of teaching ESL with ICT that moved beyond the current traditional and teacher-centered use dominated by the use of ICT solely for content delivery and instruction.

In addition to making explicit the researcher's personal stance, perspectives, and background knowledge, Savin-Baden and Major (2013) also suggested that researchers identify and articulate a "philosophical stance" which "suggests a view of reality and knowledge that in turn informs researcher perspectives, approaches and methods" (Savin-Baden & Major, 2013, p. 54). Creswell (2009) likewise underlined the importance of researchers being explicit about their philosophical views:

> Although philosophical ideas remain largely hidden in research (Slife & Williams, 1995), they still influence the practice of research and need to be identified. I suggest that individuals preparing a research proposal or a plan make explicit the larger philosophical ideas they espouse. This information will help explain why they chose qualitative, quantitative, or mixed methods approaches for their research. (Creswell, 2009, pp. 5-6)

In line with the views expressed above, Packer and Goicoecha (2000) noted the importance of articulating the ontological framework and epistemological considerations for a research study.[11] While ontology can been seen as "the consideration of being: what is, what exists, what is the means for something – or somebody – to be," epistemology can be understood as "the systematic consideration, in philosophy and elsewhere, of knowing: when knowledge is valid, what counts as truth, and so on" (Packer & Goicoechea, 2000, p. 227).

Ontologically, epistemologically, and methodologically, a majority of authors seem to associate mixed methods research with the philosophical view of pragmatism[12] (Creswell & Plano Clark, 2011; R. B. Johnson & Gray, 2010; R. B. Johnson & Onwuegbuzie, 2004; R. B. Johnson et al., 2007). However, even though the thesis is positioned within mixed methods research, it is written from a constructivist[13] stance and perspective of reality (Jonassen, 1991; Prawat, 1996), which is usually connected to qualitative research (R. B. Johnson et al., 2007). I chose the constructivist stance[14] over the pragmatic because, methodologically speaking, the thesis and the three research studies emphasize qualitative methods for collecting and analyzing data over quantitative. The emphasis on qualitative methods also aligns with a constructivist world view as this type of research "seek[s] to understand the way meanings are constructed and to apprehend how such meanings are presented and used though [sic] language and action" (Savin-Baden & Major, 2013, p. 63). In other words, constructivist researchers attempt to "make sense of (or interpret) the meanings others have about the world" (Creswell, 2009, p. 8). Consequently, with regard to methods, the thesis can be labelled as "*qualitative dominant* mixed methods research" (R. B.

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[11] Scholars have expressed a number of different understandings and interpretations regarding paradigm, ontology, epistemology, and methodology. However, this historical and philosophical debate is outside of the scope of this thesis, and thus will not be pursued further.

[12] Pragmatism is usually credited to the writings of Peirce, James, and Dewey (Biesta, 2010; R. B. Johnson & Gray, 2010; R. B. Johnson & Onwuegbuzie, 2004). This philosophical movement can be understood as "a move from philosophical legitimation of knowledge to the practical effects of knowledge; knowledge is justified through application, and the strength of our knowledge beliefs is demonstrated by the effectiveness of our actions" (Kvale & Brinkmann, 2009, p. 327). With regard to mixed methods research, Creswell and Plano Clark (2011) argued that the focus of pragmatism is directed on "the consequences of research, on the primary importance of the question asked rather than the methods, and on the use of multiple methods of data collection to inform the problems under study. Thus, it is pluralistic and oriented toward 'what works' and practice" (Creswell & Plano Clark, 2011, p. 41).

[13] Constructivism is commonly seen to be built on the developmental work of Piaget (Säljö, 2001). As a philosophical view, constructivism emphasizes that human beings do not passively receive information, but actively construct knowledge and their understanding about their surroundings based on their own experiences, and through their activities and interaction with the world (Savin-Baden & Major, 2013; Säljö, 2001).

[14] According to R. B. Johnson (2011), mixed methods researchers do not need to advocate "a single philosophical paradigm for mixed research […] such as pragmatism" (R. B. Johnson, 2011, p. 31). Instead, he encouraged researchers to be creative and to freely choose which ontological and epistemological stance fits best with their world view and their respective research project (R. B. Johnson, personal communication, January 14, 2016).

Johnson et al., 2007, p. 124, their italics). This type of mixed methods research can be understood in the following way:

> Qualitative dominant mixed methods research is the type of mixed research in which one relies on a qualitative, constructivist-poststructuralist-critical view of the research process, while concurrently recognizing that the addition of quantitative data and approaches are likely to benefit most research projects. (R. B. Johnson et al., 2007, p. 124)

With regard to perspectives on learning and knowledge, the thesis follows sociocultural learning theory where knowledge is understood as being actively constructed in the learner (John-Steiner & Mahn, 1996; Prawat & Floden, 1994; Säljö, 2001; Vygotsky, 1978; Wertsch, 1991, 1998). Figure 1 illustrates the coherence in the thesis by aligning the main components that make up the overall project: ontology, epistemology, methodology, methods, instruments, and data analysis.

Figure 1. *Coherence in the thesis*

Learning in this thesis is, in short, perceived as a productive knowledge-constructing process, and not simply as the transfer of knowledge from *X* to *Y* (Krumsvik, 2007a). Hence, this epistemological perspective rejects the dualist beliefs concerning the separation of mind and body (Hannafin & Land, 2000). In contrast to the dualist ontology of Kant and Piaget, where

construction is viewed only as a cognitive activity, this nondualist ontology envisions a "practical process of construction where people shape the social world, and in doing so are themselves transformed" (Packer & Goicoechea, 2000, p. 234). In this view, the individual human can be perceived as a social construction as well as the social world in which he or she is an active learning agent. Learning takes place in socio-cultural settings, through legitimate peripheral participation in communities of practice, and through the process of mastery and appropriation of cultural artifacts (Lave & Wenger, 1991; Wenger, 1998; Wertsch, 1998). As a result, human learning, transformation, change, knowledge acquisition, and development in a sociocultural perspective "always entails participation in relationship and community and transformation both of the person and of the social world" (Packer & Goicoechea, 2000, p. 239). While the sociocultural perspective and notion of learning are discussed in more detail in Chapter 3, the discussion regarding ontology and epistemology will not be pursued further since it is not a main focus in the thesis. Instead, the focus is directed towards how ESL student teachers develop digital competence in teacher education and how they use ICT in English teaching.

At the very core of this thesis is the concept of digital competence, which is discussed in Chapter 3. In this case, what is socially constructed here is an idea of the concept as well as a reference to the concept or object itself (Hacking, 1999, p. 28). That is, the idea (the concept of digital competence) and the object (the behavior or practice of digital competence) are both socially constructed. Moreover, the thesis also uses a model to describe the socially constructed phenomenon digital competence where the model and the underlying categories can be considered an abstraction and a reduction of the complexities of reality (Rosch & Lloyd, 1978). Using a model to describe a phenomenon where a small number of parameters or characteristics are abstracted works as a kind of compromise. Arguably, even through a comprehensive analysis, it is difficult to fully capture all of the complexities of reality involved with investigating a phenomenon or a research field (Suppe, 1989). This is also the case with the three research articles in this thesis, where the proposed approaches for student teachers' digital competence development in teacher education are socially constructed categories that reduce the complexities of reality (Krumsvik, 2014b).

1.3 Structure of the synopsis

The thesis is made up of two parts: the synopsis (Part I) and the three research articles (Part II). Following the present Introduction chapter, which has given a brief account of the overall aim of the study and the researcher's stance, the synopsis consists of the following chapters:

Chapter 2 provides a background of relevant international and Norwegian research on the use of ICT in teacher education. The discussion includes relevant policy documents and reports.

Chapter 3 discusses the theoretical and conceptual framework used including socio-cultural learning theory, digital competence, and ESL didactics with ICT.

Chapter 4 provides an account of the methodology, research design, and methods used for collecting and analyzing the empirical data. This includes a discussion on validity, credibility, and ethics.

Chapter 5 gives a summary of the three research articles and discusses the overall implications of the research project's main findings. Some of the study limitations and potential avenues for further research are also addressed. The chapter ends with brief concluding remarks.

2 Background and relevant research

The main aim of this chapter is to contextualize the current doctoral study. The chapter describes the background literature and offers a broad overview of the research field on the use of ICT in teacher education. In addition, the chapter presents arguments for developing student teachers' professional digital competence in teacher education. This chapter differs from Article I, a literature review study, in terms of aim, scope, criteria, and methods. While the literature review study employed methodological approaches similar to those used in systematic reviews and focused solely on how teacher education programs promote student teachers' digital competence, this chapter has a broader scope. Moreover, concepts such as competence and professional digital competence, which are essential here, are further discussed in the third chapter of the thesis.

Table 2 is adapted from Article I, and provides a brief yet broad overview of the focus, scope, included literature, search techniques, and analysis methods[15] used in this chapter. Article I focused primarily on the use of ICT in teaching and teacher education, and in particular on student teachers qualifying to teach in secondary school. Several databases were reviewed for literature published from 2000 until the end of 2015. Here, a broad range of literature was consulted ranging from peer-reviewed empirical studies, book, and book chapters, to grey literature such as Norwegian steering documents and white papers.

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[15] The Methods chapter covers the literature review method and data analysis in more depth.

Table 2. *Inclusion and exclusion criteria for synopsis*

	Included	**Excluded**
Databases	ERIC, Web of Science, Scopus, EBSCOhost, Google Scholar, Research gate	PubMed, PsychInfo
Timeframe	2000–2015	Literature published before 2000 and after 2015
Publication type	Peer-reviewed articles, books, book chapters, conference proceedings, short papers, grey literature including PhD dissertations, steering documents, white papers, reports, frameworks, and surveys	Newspaper articles, book reviews, blogs, BA and MA theses
Focus	Use of ICT, digital competence, digital literacy, computer literacy, media literacy, ICT competence, Internet literacy, information literacy, ESL, EFL, pedagogy, didactics, and teacher education	Literature focusing on other activities (e.g., not related to ICT, teaching, and teacher education)
Types of teaching activities/strategies	E-learning, web-based and multimodal teaching methods, teaching in classrooms, schools, courses, auditoriums, workshops, electronic portfolios	Activities not related to teaching (e.g., psychological experiments, healthcare interventions)
Language	English, Norwegian, Swedish, and Danish	Other languages
Target population	Student teachers, pre-service teachers, training teachers, prospective teachers, mixed in-service and student teachers, teacher educators	Literature focusing on pupils, in-service teachers, or other populations (e.g., nurses, seniors, special needs, general faculty, university staff, adults)
Target teaching level	Lower- and upper-secondary school, grades 8–13, middle school, high school, university	Elementary school, primary school, kindergarten, pre-school, special education, adult education, adults' professional development

As described in more detail in Chapter 4, the literature or collected data was analyzed using thematic analysis (Braun & Clarke, 2006) and strategies from Grounded Theory (Corbin & Strauss, 2008), including coding and categorization (Saldaña, 2013). After merging overlapping codes into meaning-bearing categories, several overarching themes were identified which describe research on ICT and digital competence development in student teachers in teacher education. This section discusses the following themes which provide the contextual backdrop for the thesis: 1) ICT in teaching, 2) ICT in teacher education, and 3) ICT in ESL didactics.

2.1 ICT in teaching

As ICT continues to become ubiquitous and omnipresent in the contemporary networked society (Castells, 2001), knowing how to critically use digital technologies or digital competence is as an important aspect for social interaction, civic inclusion, work, and education in today's knowledge-based economy (Aesaert & van Braak, 2015; Castells, 1996; European Commission, 2007; Janssen et al., 2013). This is reflected in the way digital competence has been listed as important for citizens and educators of the future workforce in, for instance, policy documents (European Commission, 2007), frameworks (Ferrari, 2012; UNESCO, 2011), and national curricula for schools and teacher education (Ministry of Education and Research, 2006a, 2013). Currently, the critical role of ICT in a number of professions in the information or knowledge society such as in finance, computer science, healthcare, and teaching (Plomp, 2013) has led to an increased demand for new skills. For example, while some researchers have recognized that the development of digital competence is highly "relevant for starting new business ventures" (Scuotto & Morellato, 2013, p. 301), others have focused on the social ramifications and referred to issues such as "enabling active participation in a democratic society" (Pope & Walton, 2009, p. 4) and empowering participants to become engaged citizen (Meyers, Erickson, & Small, 2013; Pangrazio, 2014). However, these claims have also met scrutiny (Selwyn, 2013) as researchers have argued that the use of ICT and digital devices in the classroom have little or even a negative impact on students' learning outcomes and test scores (Ravizza, Hambrick, & Fenn, 2014). Yet, others have asserted that ICT can have a positive impact when technology, rather than being used in traditional teacher-centered ways for content delivery and instruction, is used to support students' efforts to achieve (Tamim et al., 2011, p. 17).

In educational policy, ICT has permeated school curricula through standards and frameworks as governments and governing bodies set explicit expectations and guidelines for integrating digital skills and literacies across school subjects (Ferrari, 2012; Krumsvik, 2006; Vanderlinde, van Braak, & Hermans, 2009). In parallel, today's educational institutions are becoming increasingly rich with digital technologies such as personal computers, smartphones, interactive whiteboards, and tablets (Hatlevik, Egeberg, Gudmundsdottir, Loftsgarden, & Loi, 2013; Rambøll Management, 2013). However, alongside the educational possibilities afforded by ICT, researchers have reported the emergence of new challenges. For instance, in the *Horizon Report Europe: 2014 Schools Edition,* some of the imminent trends and challenges noted were the

changing role of school teachers as a result of the influence of ICT, integrating ICT into teacher education, and addressing pupils' low digital competence (L. Johnson et al., 2014). Generally, these reports seem to paint a picture of contemporary schools as becoming highly digitalized with tech-savvy pupils. However, research has highlighted that, in the contemporary classroom, simply providing pupils and teachers with access to computers does not guarantee that skills, knowledge, and competencies that are required for being online are developed (van Deursen & van Dijk, 2014).

The technological trends in education are evident in Norway, where the majority of young people own a computer or a mobile device with a high-speed Internet connection (OECD, 2015; Vaage, 2013). In addition, Norwegian schools are well-equipped with a modern ICT infrastructure with high-speed Internet, one-to-one laptop programs in upper-secondary schools, and digitally confident and positive pupils and teachers (Wastiau et al., 2013). The Norwegian national curriculum, the *Knowledge Promotion* (Ministry of Education and Research, 2004, 2006a), included digital competence as the fifth basic skill, thereby acknowledging it as important as the other basic skills—writing, reading, speaking, and arithmetic. Moreover, recent governmental white papers such as the *Framework for Basic Skills* (Norwegian Directorate for Education and Training, 2012) have emphasized developing pupils' digital competence by providing ways of defining and assessing its progression.

Although pedagogical and didactical use of ICT in education seems to be emphasized, research has shown that teachers feel unprepared to teach with the digital technologies available to them in schools. The OECD's first and second *Teacher and Learning International Survey* (TALIS) revealed that considerable proportions of teachers in lower-secondary school reported a high level of need for professional development in "ICT teaching skills" (OECD, 2009, p. 61) and using "new technologies in the workplace" (OECD., 2014, p. 109). In Norway (Carlsten, 2014; Vibe, Aamodt, & Carlsten, 2009), the recently reported needs for professional development in ICT teaching skills have decreased slightly since the first survey (OECD., 2014, p. 110). Moreover, the recent *International Computer and Information Literacy Study* (ICILS) showed that 75% of lower-secondary grade 9 pupils in Norway used their computers daily at home. However, only 8% of them used computers daily for school-related purposes (Hatlevik & Throndsen, 2015; Ottestad, Throndsen, Hatlevik, & Rohatgi, 2014). In addition, on a digital skill

level scale from 1 (lowest) to 4 (highest), nearly one out of four pupils (24%) scored on the lowest digital skill level (Hatlevik & Throndsen, 2015; Ottestad, Throndsen, et al., 2014). These results might indicate a continuing challenge for teachers and schools to keep up to date with the current and evolving technological trends, understand how to utilize ICT to benefit teaching and pupils' learning, and learn how to develop pupils' digital competence. Furthermore, these needs for professional development for teaching with ICT might be decreased if they were properly addressed with student teachers in teacher education. According to Erstad (2010a), the way people perceive ICT must evolve for it to be used in a pedagogical way. He argued that pedagogical use of ICT needs to move away from an instrumental or tool-based understanding, where it is perceived as a means to achieve certain goals, to an expanded conceptual understanding as a medium. Here, ICT represents the new physical and abstract technological forms which permeate our social and cultural processes, and which "humans use to mediate their opinions, comprehension, and knowledge" (Erstad, 2010a, p. 66, my translation).

In addition, a number of studies have shown that pupils and students today are not as digitally competent as often presumed. In fact, their digital competence might be much lower compared to their "digital teachers" (Gallardo-Echenique, Marqués-Molías, Bullen, & Strijbos, 2015, p. 156). In turn, pupils and students need digitally competent teachers who will act as role models through their use of ICT (Krumsvik, 2014b). Results from OECD's *Programme for International Student Assessment* (PISA) studies (OECD, 2010, 2015) have underscored these findings. Here, OECD recommended a stronger focus on the use of ICT in teacher education to better prepare student teachers to meet the new learning demands and expectations from what Pedró (2009) refers to as the "new millennium learners" (Pedró, 2007, 2009). Based on their findings from PISA 2006, OECD (OECD, 2010) argued the following:

> In a number of respects, those responsible for teaching the new millennium learners have to be able to guide them in their educational journey through digital media. Teacher-training, both initial and in-service, is crucial in disseminating this key message and for equipping teachers with the required competences (OECD, 2010, p. 169).

In summary, research, reports, and policy documents have pointed to a need for increasing pupils' and teachers' digital skills in school so that they are prepared to face and adapt to the uncertain and complex world of work in the contemporary knowledge society. Hence, the

situation puts pressure on teacher education to prepare student teachers to teach their subject disciplines such as ESL, in new and innovative ways with ICT.

2.2 ICT in teacher education

As presented in Article I and Article II in this thesis, a number of studies point to the need to prepare student teachers to teach their subject disciplines with digital technologies in pedagogical, didactical, and innovative ways. Teaching student teachers how to integrate ICT in their subject-disciplinary teaching through teacher education could promote their professional digital competence and prepare them to face the complexities of teaching in today's digitalized schools.[16] Consequently, a growing body of research on ICT in teacher education has emerged from counties such as the USA (Davis, 2003), the UK (Haydn, 2009), Australia and Singapore (Yeung, Tay, Hui, Lin, & Low, 2014; Yeung, Taylor, Hui, Lam-Chiang, & Low, 2012), and Norway (Tømte et al., 2015). Deriving from this research are several professional development programs in teacher education, which have attempted to address the challenges involved with preparing student teachers to use ICT. For example, in the United States, the program Preparing Tomorrow's Teachers to use Technology (PT3), which was run from 1999 to 2003, awarded project grants to teacher educators who successfully implemented ICT in their courses (Polly, Mims, Shepherd, & Inan, 2010). The endorsed projects were designed to transform teaching and learning through, for instance, teacher educator development, restructuring courses, online teacher preparation, mentoring partnership, and policy changes in certification (Enochsson & Rizza, 2009). Another example is from Norway, where the PLUTO development project (Benan, 2004; S. R. Ludvigsen & Rasmussen, 2006), which ran from 2000 to 2003 with the Innovation with ICT in language teacher education (INVITIS) sub-project at the University of Bergen (Helleve & Krumsvik, 2009; Trebbi, 2003), stands out as an example of innovative work with ICT in Norwegian teacher education.

However, teacher education programs across the world have been criticized for their slow uptake of digital technologies and lack of innovative ways of teaching with ICT (Kay, 2006; Tondeur et

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[16] Several prominent researchers in the field of teacher education such as Darling-Hammond (2000) and Cochran-Smith and Zeichner (2005) have argued that teacher education plays a crucial role in preparing student teachers for the future teaching profession. However, most of these researchers have under-communicated the use of ICT in teaching or how future generations of teachers are to develop digital competence through teacher education. These shortcomings could be linked to Grossman and McDonald's (2008) argument that contemporary research on teacher education is disconnected from research on teaching, higher education, and professional education.

al., 2012). Globally, one of the professional challenges and causes for change in teacher education is connected to the use of and learning with ICT and digital technologies (Enochsson & Rizza, 2009; European Commission, 2014; E. R. Howe, 2014; L. Johnson et al., 2014; Rizza, 2011; Tirri, 2014). A common problem with the integration of ICT for teaching and learning in schools and teacher education is that teachers and teacher educators have, metaphorically speaking, simply "electrified old teaching methods" (Larsen, 1998, in Krumsvik, 2007b, p. 65 , my translation). The main issue here is that the mediation of teaching materials and practices can hardly be considered a technological upgrade when lecture notes make their way from transparent slides to PowerPoint to Prezi, and "chalk and talk" practices from ordinary blackboards to interactive whiteboards (Wood & Reiners, 2015).

In Norwegian teacher education and higher education, ICT is reported to be mostly teacher-centered, tool focused, and used for content delivery and instruction. Accordingly, several reports have shown that there is little focus on the use of ICT and digital competence development in teacher education (Gjerdrum & Ørnes, 2015; Hetland & Solum, 2008; Tømte et al., 2013; Ørnes et al., 2011). These findings are in stark contrast to over forty years' worth of research on the use of technology in learning, which has revealed that "one of technology's main strengths may lie in supporting students' efforts to achieve rather than acting as a tool for delivering content" (Tamim et al., 2011, p. 17). Thus, the use of ICT and digital technologies in Norwegian teacher education has been heavily criticized as being in "disharmony" (Søby, 2007b, p. 136, my translation) with the current digital goals and competence aims in the Norwegian national curriculum (Ministry of Education and Research, 2006a).

In addition, student teachers have reported that they feel unprepared to teach with ICT after graduating from teacher education, and they have argued that their ICT-training in teacher education is not aligned with the requirements of the digital schools (Guðmundsdóttir, Loftsgarden, & Ottestad, 2014). Furthermore, research has shown that student teachers lack professional experiences using ICT for teaching and learning through their teacher education, which is quite different from using ICT for the purpose of entertainment such as social media (Lei, 2009). As noted by Haugerud (2011), the research literature has suggested that there "seems to be a gap between technical knowledge and knowledge on how to employ technology in a learning context" (Haugerud, 2011, p. 227). This gap can in turn be seen in relation to a second

digital divide developing among students in schools—and which has the potential to develop among student teachers if it is not addressed in teacher education. The *second digital divide* refers here to the division between "those who have the necessary competence and skills to benefit from computers use and those who do not" (OECD, 2010, p. 13).

Consequently, researchers have investigated a number of issues within the field of ICT training and teacher education: barriers and enablers for ICT integration (Brzycki & Dudt, 2005; Goktas, Yildirim, & Yildirim, 2009), implementation of institutional frameworks and models for ICT use (Krumsvik, Westrheim, Sunde, & Langørgen, 2012; Otero et al., 2005), policy research and initiatives with ICT in teacher education (Rizza, 2011; UNESCO, 2011), assessing student teachers' and teacher educators' self-efficacy, skills, needs, and attitudes to using and teaching with ICT (Drent & Meelissen, 2008; Sang, Valcke, Braak, & Tondeur, 2010), and examining student teachers' digital competence development through subject teaching and learning activities with ICT (Doering & Beach, 2002; Nilsen et al., 2013). This study falls in the latter category and examines student teachers' digital competence development in an English didactics course at a Norwegian teacher education program.

Little research has been conducted in the field of digital competence development and teacher education in Norway. A systematic review of the literature by Haugan (2011) found eight studies in Norwegian general teacher education that were "concerned with how ICT tools can facilitate the student teachers' development" (Haugan, 2011, p. 234). However, all of the reviewed studies "focused solely on mathematics in terms of the development of subject matter", and he argued that "other subject matter areas must also be investigated, particularly the ability to teach reading and writing" (Haugan, 2011, pp. 236-237). In addition, he pointed out that future research should focus on "a further and more holistic exploration of student teachers' development with respect to the areas of competence listed in White Paper no. 11" (Haugan, 2011, p. 237).

What becomes evident in the research literature on digital competence in Norwegian teacher education is that most of the research has focused on general teacher education and on student teachers qualifying to teach grades 1–7 and 5–10. These issues are further problematized in Article I, which demonstrated that no studies have investigated student teachers' digital competence development in Norwegian postgraduate teacher education, that is, those student teachers qualifying to teach grades 8–13 in the Norwegian secondary school. Moreover, as

supported by Haugan, there is a need for research on the use of ICT in teacher education in subject disciplines and subject didactics other than mathematics education. Thus, Article II examines how ICT is used in ESL didactics in teacher education, and Article III investigates how working with the method of digital storytelling (DST) in teacher education can be used to promote digital competence in English language teaching.

2.3 ICT in ESL didactics

Research has shown that ICT can help teachers reach pedagogical goals and positively influence pupils' foreign language learning by affording access and exposure to authentic language material, communication opportunities, instant and individualized feedback, and classroom integration (Felix, 2005; Stockwell, 2007; Zhao, 2003). These affordances are supported by various types of digital tools including online chat, computer-assisted pronunciation training, electronic dictionaries, video, and interactive whiteboards (Golonka, Bowles, Frank, Richardson, & Freynik, 2014; Zhao, 2003). For example, Stockwell (2007) highlighted the use of multimedia-tasks and video technologies in foreign language learning as effective for teaching and improving different language skills including pronunciation and listening. Furthermore, multiple studies have showcased the benefits of using ICT with student teachers in foreign language teaching in teacher education. These benefits may involve the use of video editing tools (Bruce & Chiu, 2015), wikis (Brox & Jakobsen, 2014), and podcasts and blogs (Kim, 2011). The findings suggest that, with regard to ESL didactics in teacher education, teaching with ICT in innovative and didactical ways should be prioritized in order to prepare future ESL teachers to integrate ICT in English language teaching.

Article III in this thesis specifically focuses on how DST in teacher education can be used as an innovative method for teaching ESL with ICT, and develop digital competence in student teachers. Originally, DST started as a method for amateur digital video composition originating from the Center for Digital Storytelling in Berkeley, California (Center for Digital Storytelling, n.d.; Lambert, 2013). In brief, digital stories are short videos lasting between two and three minutes, and consisting of a number of still images with overlaying narration, music, and sound effects. The stories can be used for different purposes, and the narrator usually employs a first-person perspective when telling the story which is narrowly focused on a specific topic. Commonly, digital stories are created using basic desktop video composition software such as

Movie Maker, Photo Story, or iMovie (Bull & Kajder, 2004; Ohler, 2013). However, with the growth of Web 2.0 applications, smartphones, and tablets, users are capable of creating these stories using almost every digital and mobile device available (Alexander, 2011). In other words, the method combines a range of narrative approaches with digital video composition software, and has been applied in several storytelling projects such as BBC's *Capture Wales* and *Telling Lives* (Hartley & McWilliam, 2009).

A growing body of empirical research has investigated the use of DST for educational purposes. Most of this research has focused on topics such as enhancing pupils' language learning, the use of different forms of narratives, and digital literacy practices in schools (Gyabak & Godina, 2011; Hughes & Robertson, 2010; Hung, Hwang, & Huang, 2012; Verdugo & Belmonte, 2007; Yang & Wu, 2012), and on in-service teachers' use, perspectives, and approaches to the method (Parsons, Guldberg, Porayska-Pomsta, & Lee, 2015; Robin, 2008; Sadik, 2008; Walters, Green, Wang, & Walters, 2011). However, multiple research studies have also examined the use of DST in teacher education as an innovative teaching method for teaching pedagogical and didactical integration of ICT in teaching for student teachers (Ávila, 2013; Condy, Chigona, Gachago, & Ivala, 2012; DeGennaro, 2010; Heo, 2011; Istenic Starcic, Cotic, Solomonides, & Volk, 2015; Kearney, 2011; Kobayashi, 2012; Sancar-Tokmak & Yanpar-Yelken, 2015). With regard to foreign language teaching, several researchers and educators have noted the benefits of using DST for promoting pupils' language skills and understanding of curricular content (Haug, Jamissen, & Ohlmann, 2012; Sadik, 2008), and as a way for language teachers to reflect on and transform their teaching with ICT (Bruce & Chiu, 2015; Castaneda, 2013; Gregori-Signes, 2008; Haug et al., 2012).

In Norway, research on DST for educational purposes has focused on teachers' use of the method and assessment practices (Aagaard, 2014; Haug et al., 2012), pupils' subject learning (Silseth, 2013), and professional development (Jamissen & Skou, 2010). With the exception of Jamissen (2013) and Brodahl and Wergeland (2007), who investigated DST in Norwegian general teacher education with student teachers qualifying to teach in primary school, few studies have explored the use of DST with secondary student teachers in teacher education. Moreover, no studies have concerned the use of DST in Norwegian teacher education for English teaching. According to Dawes (2001), "teachers require the chance to look at new developments and examples of

technology used in educational practice so that they become aware of the opportunities it offers"; further, they also "need an awareness of educational purpose for ICT use" (Dawes, 2001, p. 68). Her argument could also extend to student teachers in teacher education. Thus, to promote the innovative use of ICT, such as DST, Article III showcases how the method can be used with ESL student teachers to promote innovative and didactical use of ICT in English teaching.

3   Conceptual framework

This chapter deals with the conceptual framework of the thesis, which is often referred to as the "theoretical framework or idea context" (Maxwell, 2013, p. 41). According to Miles, Huberman, and Saldaña (2014), a conceptual framework "explains, either graphically or in narrative form, the main things to be studied – the key factors, concepts, or variables – and the presumed relationships among them" (Miles et al., 2014, p. 20). Moreover, Maxwell (2013) perceived a conceptual framework as "the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs [one's] research" (Maxwell, 2013, p. 39). In addition, a conceptual framework makes up a research study's frame or underlying structure, and thus permeates all its parts and processes ranging from determining the study's purpose and research questions to selecting methods for collecting and analyzing data (Anfara & Mertz, 2015; Merriam, 2009). Such a framework helps researchers sort out, organize, and frame their observations, perspectives, and questions while making them theory-laden (Merriam, 2009). In this sorting process, however, a framework also determines what is omitted or ignored, which means that they both reveal and conceal understandings and meanings (Anfara & Mertz, 2015; Merriam, 2009).

The main concepts discussed in this section are sociocultural perspectives on learning, competence, digital competence, and didactical aspects of ESL teaching. However, as with many broad and encompassing terms, it is important to be aware that such concepts can also be limiting and reducing (e.g., using the term *competence* over *literacy*). In addition, debates over which concepts should be used occur within different political, social, and cultural climates (e.g., using *digital competence* in Norway versus *digital literacy* in the UK/USA). Based on this understanding, the choice of one set of definitions and research traditions over another requires an awareness of what is potentially included and excluded.

3.1 Sociocultural perspective on learning[17]

As briefly mention in the Introduction, this thesis draws on a sociocultural perspective of learning and construction of knowledge (Säljö, 2001). However, the concept of learning is a complex and multifaceted activity which is not easily captured by theory. This statement can be illustrated by

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[17] The concepts of *learning* and *competence* (described in the next section) are used interchangeably in this thesis as a way of understanding change or development of individuals' knowledge, skills, and attitudes.

referring to some of the theories which have attempted to explain learning from a sociocultural perspective. From this perspective, learning is described through multiple theories, such as situated and participatory (Greeno, 1998; Lave & Wenger, 1991; Rogoff, 1990; Wenger, 1998), expansive (Engeström, 1987, 2001), collaborative (Dillenbourg, 1999; Roschelle, 1992), knowledge creation (Paavola & Hakkarainen, 2005; Scardamalia & Bereiter, 2006), and mastery and appropriation of the use of cultural tools (Säljö, 1999; Wertsch, 1998). In addition, when related to ICT and the field of instructional technology, several of these sociocultural learning theories have been expanded, re-interpreted, and re-conceptualized through a number of new approaches and fields of research (Wasson & Morgan, 2014). Some of these include computer-supported collaborative learning (Dillenbourg, 1999; Goodyear, Jones, & Thompson, 2014; Koschmann, 1996), knowledge building (Scardamalia & Bereiter, 2006), and technology-enhanced and computer-assisted learning (Balacheff, Ludvigsen, Jong, Lazonder, & Barnes, 2009; Cox, 2008; Goodyear & Retalis, 2010). Although digital technologies might paint an optimistic picture with regard to learning, Säljö (2010) has reminded us that "technology does not facilitate or improve learning in the linear sense, rather it is currently changing our interpretations of what learning is and changing our expectations about what it means to know something" (Säljö, 2010, p. 56). Within this landscape of theories, this thesis draws on the notion that learning has to do with mastery and the appropriation of cultural tools; in this landscape, ICT exemplifies such a cultural tool that could potentially change how student teachers teach and pupils learn in school.

Based on a sociocultural perspective, Säljö (1999) argued that "learning is always learning to do something with cultural tools (be they intellectual and/or theoretical)" (Säljö, 1999, p. 147). Säljö (1999) further explained that "when understanding learning we have to consider that the unit that we are studying is people in action using tools of some kind" (Säljö, 1999, p. 147). Wertsch (1998) elaborated on the concept of "mediated action" and linked it to discussions of contexts about ways human action is mediated through the use of cultural tools within social practices. One concern that he discussed was "how the introduction of novel cultural tools transforms the action" (Wertsch, 1998, p. 42). Wertsch (1998) used the introduction of fiberglass poles in pole vaulting as an example of how new mediational means can fundamentally transform mediated action. Concerning digital technologies, it is important to also consider them as significant

cultural tools in society with "broad social and cultural implications on different levels" (Erstad, 2011, p. 299).

When discussing mediated action, Wertsch (1998) referred to Ryle's (1949) term "knowing how" and proposed the term "mastery" over the notion of "internalization" (Wertsch, 1998, pp. 50-51). He advocated the use of less-loaded terms such as "knowing how" or "mastery" because terms such as "internalization" can be misleading (Wertsch, 1998, p. 53). Several forms of mediated action must be carried out externally, whereas "internalization" proposes "an image in which processes that were once carried out on an external plane come to be executed out of sight on some kind of internal plane" (Wertsch, 1998, p. 50). He mentioned an example by Vygotsky (1978) about counting where counting happens on an external plane with the aid of material cultural tools such as one's fingers or matches, and then gradually fades and disappears through the process of becoming internalized (Wertsch, 1998). In contrast, he argued that most forms of mediated action "never progress toward being carried out on an internal plane" and pointed to an "absence or incompleteness of internalization" where instead of applying the notion of "internalization," it might be more fruitful to speak of "mastering the use of cultural tools" (Wertsch, 1998, p. 51). Moreover, according to Preiss and Sternberg (2005), mastering a cultural tool or an artifact involves the learning of a specific skill while meaningfully expanding the individual's intellectual capabilities. They noted that this skill acquired by the individual is not universal, but "*a skill that is intrinsically connected to an artifact*" (Preiss & Sternberg, 2005, p. 204, their italics).

Wertsch (1998) further drew on the writings of Bakhtin (1981) when he discussed the term "appropriation" in regard to the process of mastering and appropriating cultural tools. According to him, "to appropriate" and "appropriation" refer to the process of "taking something that belongs to others and making it one's own" (Wertsch, 1998, p. 53). Moreover, Wertsch (1998) acknowledge that, in the process of "appropriation," there is almost always some sort of resistance involved, which he referred to as a kind of "'friction' between mediational means and unique use in mediated action" (Wertsch, 1998, p. 54). As an example, he explained the concept of language as a cultural tool where speakers "must 'buy into' an existing set of linguistic terms and categories" or "terministic screens" when speaking (Wertsch, 1998, p. 55). The point is that language as an example of a cultural tool offers unique constraints and affordances that must be

taken into consideration by agents. Also, he remarked that, due to resistance, cultural tools can be mastered and at the same time not appropriated by agents where the agent can use the cultural tool, but does so while resisting. To illustrate his argument, Wertsch (1998) gave an example of non-Christian children participating in the celebration of Christmas in public schools in the United States where Jewish children simply stopped singing when Jesus was referred to in a song (Wertsch, 1998, p. 57). In this example, the agent had mastered the text, but had not appropriated it due to resistance to the cultural tool.

The notion of resistance could also be extended to the use of ICT in schools where an agent, for example a teacher, can master the use of technology without having appropriated it—that is, without making it a part of his or her own learner identity. Teachers might know how to use digital learning resources including electronic dictionaries and online textbooks in their teaching while at the same time resisting appropriating these tools into their own identity as professional teachers. Thus, when teachers resist the use of ICT in teaching, pupils could potentially miss out on learning opportunities. On the other hand, Erstad (2011) reflected on the notion of resistance with pupils who are often asked by teachers to use certain technologies in school. He noted the danger in introducing technologies without taking into consideration the broader social issues which might happen when teachers try to use technologies that are "not seen as relevant by the students, but which are defined as part of the institutionalized practice in schools by the teachers" (Erstad, 2011, p. 300).

As explained above, this thesis draws on a sociocultural perspective of learning (Säljö, 2001), and in particular perceives learning according to Wertsch's (1998) concepts of mastery and appropriation. These theoretical perspectives aid the investigation of the main research question concerning how digital competence is developed in student teachers in teacher education. The next section discusses the concept of competence, which is also connected to the perspective of learning used in this thesis. Moreover, since perspectives on learning and the development of competence are intertwined with the core concept investigated, digital competence, a thorough discussion is in order.

3.2 Competence[18]

Several definitions, perspectives, and understandings of competence or competencies exist depending on discipline, field, approach, culture, and research paradigm. Moreover, research in the field of competence seems to pursue different paths depending on whether it is situated in a European or an American context.[19] In US research, the term *expertise* seems to be preferred over *competence*. In this context, the term is closely tied to the world of work (Illeris, 2012). In contrast, a European understanding of competence is perhaps more holistic. The OECD's *Definition and Selection of Competencies* (DeSeCo) project (Rychen & Salganik, 2001, 2003) has proposed the following understanding:

> Competencies can be understood as cognitive skills or abilities. These include all of an individual's mental resources that are used to master demanding tasks in different content domains, to acquire necessary declarative and procedural knowledge, and to achieve good performance. (Weinert, 2001, p. 46)

In addition, competence can be seen as a set of skills related to a particular field or specialization that can be operationalized into actions. Through reflexive practices, practitioners gather experience and knowledge regarding how and when to use skills in different contexts. Competence then is situated, that is, it is context- and performance-based (Qvortrup in Haugsbakk & Nordkvelle, 2011). Building on these and several other understandings, the contributors to DeSeCo (Rychen & Salganik, 2001, 2003) argued that competence must be understood as something more than just knowledge and skills. As a summarizing project remark, the researchers asserted that competence should be understood as "the ability to meet complex demands, by drawing on psychosocial resources (including skills and attitudes) in a particular context" (OECD, 2005, p. 4). As an example of a competence, they noted the ability to communicate effectively, and acknowledged that this competence may draw on an "individual's knowledge of language, practical IT skills and attitudes towards those with whom he or she is communicating" (OECD, 2005, p. 4). According to Haugsbakk and Nordkvelle (2011),

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[18] The concept of competence is related to Becker's (1964) theory of human capital which has greatly influenced educational systems, and which is used as an argument for allocating more resources and attention to schools and education due to long-term socioeconomic benefits (Krumsvik, 2011).
[19] Because this thesis is written in a Norwegian research context, it draws on a European understanding of competence.

competence is not seen as a single mental construct or ability, but can be interpreted more broadly where emphasis is placed on "reflectiveness" which is at the "heart of key competencies" and which includes "taking a critical stance […] to understand and consider the wider context" of "actions and decisions" (OECD, 2005, in Haugsbakk & Nordkvelle, 2011, p. 351). In other words, competence or competencies address what an individual can do, what an individual is capable of doing, and the ability to react in various situations and contexts with the capabilities that an individual possesses (Illeris, 2012).

The DeSeCo project laid the groundwork for the European Commission's (2006, 2007) reference framework *Key Competencies for Lifelong Learning* (European Commission, 2006, 2007). The framework divided competence into eight underlying key competencies: 1) communication in mother tongue, 2) communication in foreign languages, 3) mathematical competence and basic competence in science and technology, 4) digital competence, 5) learning to learn, 6) social and civic competence, 7) sense of initiative and entrepreneurship, and 8) cultural awareness and expression (European Commission, 2007, pp. 4-12). Clearly, the notion of key competencies draws on the DeSeCo project and points to an understanding of competence as "multifunctional and transdisciplinary […] [these competences are] useful for achieving many important goals, mastering different tasks, and acting in unfamiliar situations" (Weinert, 2001, p. 52). At the same time, the DeSeCo project has advanced and expanded competence as an educational concept by integrating and presenting it as applied knowledge and skills. Central to the understanding of competence as an educational concept is that the individual, i.e. a pupil or a student, is able to apply skills and knowledge in order to carry out reasonable assessments and decisions regarding new situations and altered circumstances (Illeris, 2012). Moreover, the term consists of theoretical knowledge and practical skills. An individual's competence can be formalized through various forms of assessment such as exams and tests at the end of an education stage, quantitative measurements, or through testing of a person's acquired competence from other areas of life such as work (Hagen & Nyen, 2009).

However, competence as an educational concept is also contested. For instance, Willbergh (2015) argued that competence as an educational concept for the twenty-first century struggles with theoretical problems, is mostly based on political rhetoric, and "neglects the content aspects of

education" (Willbergh, 2015, p. 347). She highlighted that the implementation of a competency-based education and assessment by policymakers causes problems in classrooms including:

> increased teaching to the test, a narrow curriculum, a fragmentation of educational content, reproduction of knowledge (as opposed to the intent of fostering innovative thinking), increased inequality in education, increased individualization, damage to democratic education, disempowerment of teachers and poorer teacher-student relationships. (Willbergh, 2015, p. 335)

As a consequence, she asserted that competence should be abandoned as an educational concept because of its shortcomings. Alternatively, Willbergh (2015) suggested using a revised concept of Bildung[20] for preparing the "young generations of the 21st century to think critically, constantly evolve and be creative and imaginative" (Willbergh, 2015, p. 345). Yet, Haugsbakk and Nordkvelle argued that the broad definition of competence as laid out by the DeSeCo project also invites the notion of competence as another version of Bildung, which makes it adaptable to a Norwegian educational discourse. At the same time, the authors warned that having two competing concepts could result in "the redundancy of the Bildung term" (Haugsbakk & Nordkvelle, 2011, p. 351, my translation). While the debate about competence and Bildung as educational concepts is interesting, this discussion is beyond the scope of this thesis and will thus not be pursued further. Instead, the focus is on digital competence development in student teachers where both the notion of competence and Bildung as discussed above make up important parts of the concept.

In the Norwegian educational context, the concept of competence has been written into national policy documents. For instance, the Norwegian white paper number 30 (2003-2004), *Culture for Learning*, defined competence as "the ability to master a complex challenge or perform a complex activity or task" (Ministry of Education and Research, 2004, p. 125, my translation).

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[20] The German term *Bildung* lacks a proper English term. Roughly translated, Bildung ("dannelse" in Norwegian) means formation, development, or shaping of something, and "refers to the subtler aspects of education; those that are 'more than just knowledge'. This could include awareness of limitation to one's knowledge, respect for other ways of knowing and, not least, a sense of social (or moral or ethical) responsibility" (Beck, Solbrekke, Sutphen, & Fremstad, 2015, p. 446). Furthermore, Bildung regards "ethical and moral issues of *being*" and can be attached to student teachers' and pupils' moral development over time (Krumsvik & Almås, 2009, p. 113). Klafki (2000), one of the most prominent writers regarding Bildung theory, has promoted the notion of Bildung as a "qualification for reasonable self-determination [...] for autonomy, for freedom for individual thought, and for individual moral decisions" (Klafki, 2000, p. 87). Moreover, Løvlie (2003/2011) discussed Bildung in the age of the Internet as a form of "interface," and as a concept in constant movement, unrest, and transformation (Løvlie, 2003/2011, pp. 347-348).

The white paper further noted that "it is crucial that the pupil or apprentice is capable of applying their knowledge, attitudes or skills" (Ministry of Education and Research, 2004, p. 125, my translation). In addition, competence is found in the latest Norwegian school reform, the *Knowledge Promotion*, which introduced competence-based aims in all subject levels (Ministry of Education and Research, 2006a). Through competence-based aims in the *Knowledge Promotion*, competence is used as a "concept for cognitive learning and knowledge" (Krumsvik, 2011, p. 40). As such, Norwegian educational policy seems to follow international trends where educational institutions are increasingly required to assess their students' competence, not only their knowledge (Krumsvik, 2011). Moreover, the curriculum sets expectations of the teachers' professional competence where "the ability to teach the subject, the ability to structure the learning activities and knowledge of assessment and guidance are central elements" (Ministry of Education and Research, 2006b, p. 5). Finally, through the recent Official Norwegian Report[21] (NOU, 2015: 8), the notion of competence has been expanded to four distinct competencies that are considered important for pupils in an increasingly complex, pluralistic, and changing society. The four competencies are defined as: 1) subject-specific competence, 2) competence to learn, 3) competence to communicate, collaborate, and participate, and 4) competence to explore and create (NOU, 2015: 8, pp. 8-10, my translation). Similar to the definitions of competence as discussed above, the notion of competence reflected in the report is broad, and encompasses cognitive and practical skills as well as social and emotional learning and development (NOU, 2015: 8). Of particular interest to this thesis is the following recommendation in the report under the area of subject-specific competence:

> In light of increased globalization and an international workplace, a strengthening of the language subject-disciplines is recommended. The technological development influences every subject-discipline, and digital competence needs to be expressed in all school subjects. (NOU, 2015: 8, p. 10, my translation)

Thus, from the perspective of competence as reflected in Norwegian steering and policy documents, and the national curriculum and notion of teachers' professional competence, digital competence can also be seen as an important part of teachers' professional competence

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[21] Translated from Norwegian as Norges offentlige utredninger (NOU).

(Krumsvik, 2011), and as "ways of being" professional with distinct forms of tools (Sandberg & Pinnington, 2009).

3.3 Digital competence

Currently, several overlapping concepts and definitions have attempted to describe the necessary knowledge, skills, and attitudes needed for citizens to use digital technologies in today's digitalized society. To name a few, these include: digital literacy (Buckingham, 2006; Eshet-Alkalai, 2004, 2012; Gilster, 1997; Lankshear & Knobel, 2006, 2008; Tyner, 1998), computer literacy (Frallion, Ainley, Schulz, Friedman, & Gebhardt, 2014; Nawaz & Kundi, 2010; Özsevgeç, 2011), information literacy (Bawden, 2001; Drotner & Kobbernagel, 2014; Elmborg, 2006), media literacy (Hobbs, 1998; Jenkins, 2007; Livingstone, 2014; Potter, 2014; Tyner, 2010), Internet literacy (Livingstone, Bober, & Helsper, 2005), and digital competence (Ala-Mutka, 2011; Erstad, 2010a; Erstad, Kløvstad, Kristiansen, & Søby, 2005; Krumsvik, 2007b; Søby, 2003). Consequently, these concepts have different meanings in different academic, cultural, historical, social, and educational contexts.

Internationally, the term *literacy*, which means to be able to read and write and "to understand and employ printed information in daily activities" (OECD & Human Resources Canada in, Salganik, 2001, p. 20), is more often used than *competence*. When transferred to a digital context, the result is a new concept, *digital literacy*, which is often understood as "the ability to understand and to use information in multiple formats from a wide range of sources when it is presented via computers" (Gilster, 1997, p. 3). Gilster (1997) argued that the most important aspect of digital literacy is critical thinking and the ability to make reflected and informed judgments regarding online content. Lankshear and Knobel (2006) similarly stated that digital literacy encompasses more than basic technical skills in ICT. The term should rather be perceived as multiple social practices and concepts related to reading and writing. Examples of such social practices can be writing blogs, participating in social networking communities, assessing the credibility of online sources, and navigating web links. The authors pointed out that the technical aspects of digital literacy, that is, how to operate hardware and software, should be considered the least significant part of this social practice (Lankshear & Knobel, 2006). Similarly, Nawaz and Kundi (2010) referred to digital literacy as computer literacy, and defined it as "an understanding of computer characteristics, capabilities, and applications, as well as an ability to implement this

knowledge in the skillful, productive use of computers in a personalized manner" (Nawaz & Kundi, 2010, p. 20). Likewise, in his review on information and digital literacy, Bawden (2001) found that the broad concept information literacy "is generally taken to include an ability to deal with electronic sources" (Bawden, 2001, p. 246). While computer and information literacy have features that overlap with digital literacy, the former seems to focus on technical computer skills while the latter is centered around online searching and judgement skills within library practice.

Other scholars have preferred the broad term *media literacy*, which encompasses how young people use and encounter media in different ways and contexts (Buckingham, 2007; Erstad, 2010b; Jenkins, 2007). Hobbs (1998), for instance, provided a general understanding of media literacy as "the ability to access, analyze, evaluate, and communicate messages in a wide variety of forms" (Hobbs, 1998). Livingstone et al. (2005) perceived Internet literacy as being a part of media literacy, and as being made up of three elements: "*access*" to hardware, online content, and services; "*understanding*" online information and opportunities through critical evaluation; and "*creation*" of online content, including consumption, participation, and interaction (Livingstone et al., 2005, p. 6, their italics). In Norway, some scholars have chosen to adopt the term *literacy*, either in the form of digital or media literacy. Østerud (2004) expanded the literacy term to encompass participation in society and in situations where written language and other symbolic forms of mediation are involved. However, most Norwegian scholars and policymakers have expressed a preference for the concept *digital competence*. According to Erstad (2010b), competence is the more commonly used concept in a Scandinavian context since literacy "does not translate to the languages in these countries" (Erstad, 2010b, p. 57). Based on the arguments discussed above, this thesis uses the term *competence* over *literacy* because, in a Scandinavian setting, competence is arguably preferred over literacy due to its holistic and broad meaning in the Scandinavian languages (Krumsvik, 2008). Moreover, as discussed in the previous section, competence as an educational and developmental concept can be traced to several Norwegian educational policies and steering documents including the Norwegian national curriculum (Ministry of Education and Research, 2006a). For example, in the national curriculum, "competence functions as a cognitive learning concept, and in which there are competency-based aims (kompetansemål in Norwegian) in all subjects at all levels" (Krumsvik, 2011, p. 40).

The European Commission (EC) identified digital competence as one of eight key competencies for lifelong learning. Digital competence is now considered essential for full participation in today's increasingly digitalized society, economy, education system, and world of work (European Commission, 2007). In addition, digital competence is a central factor for future economic, social, and cultural growth (Haugsbakk & Nordkvelle, 2011). The European Commission (2006) proposed the following broad understanding of the concept:

> Digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet. (European Commission, 2006, pp. L394/15-16)

Researchers and policymakers have further argued that digital competence is a "transversal key competence" (Ala-Mutka, 2011, p. 1), meaning that it enables the promotion of other key competences such as mathematics, language learning, learning to learn, and cultural awareness. These so-called twenty-first century skills (Binkley et al., 2012) are considered important for living and participating in contemporary society, and for adapting to the changing world of work (Ala-Mutka, 2011).

The definition of digital competence has been further developed and refined through the European Commission's *Digital Competences for Teachers* (DIGICOMP) project, which aims to better understand and develop digital competence in Europe. Based on this work, Ferrari (2012) recently proposed the following encompassing definition:

> Digital competence is the set of knowledge, skills, attitudes (thus including abilities, strategies, values and awareness) that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socialising, consuming, and empowerment. (Ferrari, 2012, pp. 3-4)

Digital competence as a concept was introduced into the Norwegian educational context with the Norwegian white paper number 30, *Culture for Learning* (2003-2004), which marked the

foundation for the new curriculum reform in Norway, the *Knowledge Promotion* (Ministry of Education and Research, 2006a). Also, the Ministry of Education and Research followed up these policies with the *Programme for Digital Competence* (2004-2008), where the focus was on various schemes for cooperation between public and private entities (see also Editorial, 2008). By then, several Norwegian educational institutions had already been involved in a broad national campaign with investments in ICT through reform programs such as *PILOT*, *PLUTO*, and Learning Networks (Erstad & Hauge, 2011; Ottestad, Skaug, & Synnevåg, 2009). Moreover, in order to support and follow up these policies and reforms, the Ministry of Education created the Centre for ICT in Education (formerly known as ITU) in 1997, which works under the directive of the Ministry for examining and promoting digital competence in education. Through national monitor surveys, the Centre tries to map and get an overview of the digital landscape in Norwegian schools, thus signaling the digital status of the country's educational institutions to the Ministry. Furthermore, through their academic journal, *Nordic Journal of Digital Literacy* (Søby, n.d.), the Centre has created a forum for discussing and promoting research on pedagogical and subject-related use of ICT in education.

From a Norwegian educational perspective, 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 et al., 2005, p. 8, my translation). Erstad (2010a, 2010b) has further suggested several categories to specify and operationalize various core components of digital competence in school, which can be used to assess pupils. These include: 1) having basic skills and being able to 2) down-/upload, 3) search, 4) navigate, 5) classify, 6) integrate, 7) evaluate, 8) communicate, 9) cooperate, and 10) create (Erstad, 2010a, 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 (Erstad, 2010b).

The latest Norwegian school reform, the *Knowledge Promotion*, introduced digital competence as one of five basic skills along with numeracy, reading, writing and oral skills. This set of five skills permeates all of the subject curricula. This addition signals that digital competence or "being able to use digital tools" (Ministry of Education and Research, 2006c, p. 3) is now considered as important as numeracy, writing, reading, and oral skills. Unfortunately, in the new

curriculum reform, digital competence was initially presented solely as a practical skill and in an instrumental way which in turn could lead to the misinterpretation of digital competence as merely a technical skill (Otnes, 2009). In order to provide a more nuanced depiction of the basic skills, the Norwegian Directorate for Education and Training issued the *Framework for Basic Skills* (Norwegian Directorate for Education and Training, 2012). In this framework, wording in the definition for digital competence has been adjusted from "being able to use digital tools" to "digital skills." In addition, the Directorate has provided educators with a rubric which can be used in assessing pupils' digital competence (Norwegian Directorate for Education and Training, 2012, pp. 12-13).

Historically speaking, validating ICT knowledge, skills, and attitudes in the Norwegian educational context has been and continues to be an uphill struggle (Søby, 2001). This issue could perhaps be seen as connected to massive critique of positivism and instrumentalism in education inspired by technocratic thinking, which was launched in the 1970s by pedagogical philosopher Hellesnes (1975), and to some degree Skjervheim (1972/1996) and Dale (1972). Hellesnes' (1975) fears were related to an educational system that was shaped in line with a technocratic and educational technology model where "the educational technology promotes adaptation in an effective way" (Hellesnes, 1975, p. 27, my translation). In his writings, he continued to propose and legitimize a total rejection of what he described as technocratic education and educational technology: "More controversial is it to insist that educational technology includes a philosophical interpretation of pedagogy, and that this interpretation is positivistic. However, this is my main proposition" (Hellesnes, 1975, p. 142, my translation). In other words, this critique could be interpreted as a fear that educational technology, in light of positivistic thinking, goal-oriented education, and behavioristic learning theories, would reduce learning to a mechanical and efficient, yet alienating and uncritical act, and where learners would become passive consumers of information. However, technologies for learning have always been a presence in the classroom in the form of blackboards, pencils, paper, and textbooks, although their use and implementation have been transformed and internalized or mastered and appropriated over time, thus making this social practice invisible (Lave & Wenger, 1991; Säljö, 2010; Søby, 2001). So far in Norway, digital technologies in the classroom have yet made teaching and learning instrumental or mechanical acts as previously feared. On the contrary, some pedagogical philosophers such as Løvlie (2003/2011) and Skjervheim began to recognize

the importance of technology as a part of contemporary culture and Bildung in a postmodern society. For instance, Skjervheim (1991/1996) wrote that "technology and technological competence is just as an important cultural phenomenon as literature and literacy, which also applies to humanists" (Skjervheim, 1991/1996, p. 200, my translation). Moreover, educational researchers have argued that, due to digital technologies, teaching and learning have become even more interactive yet complex activities as they can occur on several different arenas without necessarily being restricted or bound to time and physical space (Erstad, 2010a; Krumsvik, 2007b).

What is evident from the discussion above is that, as with the concept of competence, the concept of digital competence also suffers from having a multitude of meanings and interpretations in different areas such as research, policymaking, media, and the private sphere. Søby (2007a) referred to Connolly (1993) when he argued that digital competence is a "contested concept," an object for fundamental discussion due to its vague conceptual core and essence (Søby, 2007a, p. 256). Furthermore, it could be argued that the concept suffers from what Weinert (2001) called a "conceptual 'inflation' where the lack of precise definition is accompanied by considerable surplus meanings" (Weinert, 2001, p. 45). In the end, however, most definitions of digital competence point to a need for citizens to possess some form of basic digital skills in order to be able to navigate and communicate through the Internet and to be critical consumers and producers of digital content in their spare time and for work. Furthermore, policymakers and researchers have pointed out that the development of this competence should be instigated through all levels of education. Since this thesis is focused on the teaching profession, it is not concerned with how citizens use ICT, but how teachers can use ICT to teach their subject disciplines in a purposeful pedagogical and didactical manner. Teachers must promote the development of digital competence in their pupils or students. This competence includes basic digital skills, the ability to learn with ICT, how to locate and critically assess online content, and how to behave and act in an online environment. Thus, teachers must necessarily possess a form of professional digital competence that is specifically related to the teaching profession.

3.3.1 Professional digital competence

Professional competence is seen as a combination of the ability to act and insight within a defined context in which the competence is valid (Dale, 2001). Teachers' professional competence is

highlighted in the Norwegian national curriculum and thus makes up an important part of their professional work:

> The total competence of teachers and instructors consists of a number of components where professional competence, the ability to teach the subject, the ability to structure the learning activities and knowledge of assessment and guidance are central elements. Teachers and instructors must also have multicultural competence and knowledge on the different points of departure and learning strategies their pupils have. (Ministry of Education and Research, 2006b, p. 5)

Digital competence can be argued to also be a part of teachers' professional competence, where the use of ICT in teaching has increasingly become an important aspect of teachers' work (Krumsvik, 2011; Lund et al., 2014). This aspect is due to several factors including technological developments and progress worldwide that has caused a global shift from an industrial- to an information-based networked or competence society (Castells, 2001; Illeris, 2012). These trends have also affected Norway, where digital technologies have permeated society over the last ten to fifteen years. As a response, there has been substantial top-down ICT investments in Norwegian schools as directed by political reform, ambitions, and policy (Haugsbakk, 2011). Currently, research on the use of ICT in education has pointed to the complexities of using digital technologies for teaching and learning, and researchers have noted that teachers' professional use of ICT differs from that of other users (Krumsvik, 2014b). As a result, several analytical frameworks and models have attempted to identify, understand, and assess the knowledge, skills, and attitudes that are essential for educators' use of ICT to support teaching and learning. Examples of these models include the Technology Acceptance Model (Teo, 2009) and the Will, Skill, Tool model (Knezek & Christensen, 2008). The overall notion is that digital competence in an educational context involves more than technical mastery of digital technologies, and encompasses critical reflections such as what, why, how, when, and where these technologies should be used (Erstad, 2010a; Krumsvik, 2009).

By building on Shulman's (1987) concept of pedagogical content knowledge (PCK), which can be understood as how teachers relate their pedagogical knowledge to their subject matter knowledge, Mishra and Koehler (2006) developed the technological pedagogical content knowledge (TPCK) framework. The framework articulates the relationships between content,

pedagogy, and technology, and "emphasizes the complex interplay of these three bodies of knowledge" (Mishra & Koehler, 2006, p. 1025). Their framework describes "three pairs of knowledge intersections and one triad" (Mishra & Koehler, 2006, p. 1026): pedagogical content knowledge (PCK), technological content knowledge (TCP), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK). The authors argued that:

> TPCK is the basis of good teaching with technology and requires 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 and to develop new epistemologies or strengthen old ones. (Mishra & Koehler, 2006, p. 1029)

Through their TPCK framework (now referred to as TPACK, see Koehler, Mishra, Kereluik, Shin, & Graham, 2014), Mishra and Koehler (2006) highlighted the complexities that teachers need to take into consideration when integrating technology into their teaching. They showed how teachers' use of technology is different from other professions and users such as engineers, computer scientists, and pupils in school.

In her comprehensive overview of different frameworks about digital competence from the European Commission's DIGICOMP project, Ferrari (2013) attempted to identify key features and provide a better understanding of what digital competence is and how it has developed across Europe. She presented a framework of digital competence for all citizens consisting of five areas: 1) information, 2) communication, 3) content creation, 4) safety, and 5) problem-solving. Furthermore, these areas can be assessed along three proficiency levels: 1) foundation, 2) intermediate, and 3) advanced (Ferrari, 2013, p. 14). Although the framework is meant to provide a general overview of citizens' needs to be or become digitally competent in an increasingly digitalized society (Ferrari, 2013, p. 9), it also illustrates the multifaceted nature of using ICT to support teaching and learning, which points to a need for digitally competent teachers.

The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2011) has proposed a similar digital competence framework focusing on describing how teachers' ICT competence is developed and affected through six modules: 1) understanding ICT in education, 2) curriculum and assessment, 3) pedagogy, 4) ICT, 5) organization and administration, and 6) teachers' professional learning. Also, the progression through these modules can be assessed through three successive stages or approaches to teaching: 1) technology literacy, 2) knowledge deepening, and 3) knowledge creation (UNESCO, 2011, pp. 7-8). Here, the importance of digitally competent teachers for supporting pupils' learning with ICT is also highlighted:

> The successful integration of ICT into the classroom will depend on the ability of the teacher to structure the learning environment in new ways, to merge new technology with a new pedagogy, to develop socially active classrooms, encouraging co-operative interaction, collaborative learning and group work. This requires a different set of classroom management skills. The teaching skills of the future will include the ability to develop innovative ways of using technology to enhance the learning environment, and to encourage technology literacy, knowledge deepening and knowledge creation. (UNESCO, 2011, p. 8)

Thus, UNESCO's (2011) framework described a type of professional digital competence that teachers necessarily should possess and develop to integrate ICT in their teaching in new and innovative ways.

Since the 1990s, digital technologies have been strategically spread and implemented at all levels of the Norwegian education system (Erstad, 2006). For example, the Norwegian national ICT project Project Innovation in Learning, Organization, and Technology *(PILOT)* focused on implementation of ICT and pedagogical use of technology for teaching in schools from 1999 until 2003 (Erstad, 2004). The project also prompted professional development programs for teachers such as LærerIKT[22] (Johansen & Schaathun, 2004; Johansen et al., 2004), which focused on improving digital skills and pedagogical practices with ICT. Another Norwegian ICT project entitled Program for Teacher Education, Technology, and Adaption *(PLUTO)* focused on preparing teacher education for the challenges of teaching with ICT in contemporary schools

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[22] The Norwegian name can be roughly translated to "TeacherICT" and was meant to be associated with the Norwegian word "lærerikt", i.e. "educational" in English (cf. Johansen, Schaathun, & Streitlien, 2004).

from 2000 until 2004 (Benan, 2004; S. R. Ludvigsen & Rasmussen, 2005). The overarching aim of the project was to educate learners in teacher education programs to use ICT in their future teaching with new student-active learning and teaching models (S. R. Ludvigsen & Rasmussen, 2006). Stemming from this project and the *Programme for Digital Competence* (2004-2008) was the ICT-based school development project, Learning Networks, which was led by several teacher education programs around the entire country (Eliassen, Jøsendal, & Erstad, 2008; Ottestad et al., 2009). Since the conclusion of these ICT projects, a number of studies have continued to focus on examining digital competence in teacher education and schools (Almås & Krumsvik, 2007; Krumsvik, 2011; Tømte, 2013).

Taken together, these reports, frameworks, and research projects reveal that teachers, teacher educators, and future teachers must possess a *professional digital competence*—a term that has been constructed and debated in a number of recent publications (Guðmundsdóttir et al., 2014; Lund et al., 2014; Tømte et al., 2015). A recent strategy document for raising teachers' competencies also confirmed this notion. In this document, the Norwegian Ministry of Education and Research (2014) emphasized that teachers need a broad pedagogical and subject didactical competence in addition to solid subject content knowledge. Additionally, they underlined that this also includes digital competence which "in a greater sense enables teachers to utilize increased flexibility when choosing forms of instruction and learning resources" (Ministry of Education and Research, 2014, p. 16, my translation). Furthermore, they recognized the lack of focus on developing teachers' professional digital competence in teacher education, and suggested that teacher educators should act as "proper role models for the student teachers" (Ministry of Education and Research, 2014, p. 42, my translation). The Ministry's concerns are also supported by the previously mentioned Official Norwegian Report *School of the Future* (NOU, 2015: 8), which recommended strengthening the presence of digital competence in every school subject as it is an "overarching subject-related competence" that is "relevant across subject areas" (NOU, 2015: 8, p. 26, my translation).

3.3.2   A model for professional digital competence

Based on the discussion above, it becomes clear that teachers' use of ICT differs from other professions, resulting in a need to develop professional digital competence among teachers, teacher educators, and future teachers. Drawing on Norwegian policy and steering documents,

and research on teachers' experiences with and innovative use of ICT in Norwegian schools (Almås & Krumsvik, 2007, 2008; Krumsvik, 2005, 2006), Krumsvik (2007b, 2011, 2014b) has developed a definition of digital competence that attempts to describe professional digital competence in teachers and teacher educators specifically: "Digital competence is the teachers/TEs' [teacher educators'] proficiency in using ICT in a professional context with good pedagogic-didactic judgement and his or her awareness of its implications for learning strategies and the digital Bildung of pupils and students" (Krumsvik, 2011, pp. 44-45). From his definition, Krumsvik (2011, 2014b) has created a theoretical model for making visible "tacit knowledge" (Polanyi, 1966), and for prompting teachers and teacher educators' "reflection-on-action" (Schön, 1983) on their digital competence (Figure 2). The theoretical foundation of the model is sociocultural learning theory (Säljö, 2001) including distributed cognition (Hutchins, 1995), situated learning and communities of practice (Lave & Wenger, 1991; Wenger, 1998), and mastery and appropriation of cultural tools (Wertsch, 1998). Moreover, the model is based on previous studies on ICT integration in schools such as the Apple Classrooms of Tomorrow project[23] (Dwyer, Ringstaff, & Sandholtz, 1991) as well as other models and frameworks comparable to the TPCK framework (Mishra & Koehler, 2006).

For the purpose of this thesis, which investigates secondary school ESL student teachers' digital competence development in Norwegian teacher education, the model has been used as an analytical research lens to support the interpretation of the collected data (Creswell, 2013; Merriam, 2009). According to Savin-Baden and Major (2013), a research lens is a "mental model that helps researchers to clarify the focus on the investigation […] and helps researchers to interpret data" (Savin-Baden & Major, 2013, p. 46). However, they pointed out that researchers always use a set of different research lenses to understand the phenomena under scrutiny and noted that "each of these lenses leads a researcher to focus on certain things, while ignoring others" (Savin-Baden & Major, 2013, p. 46).

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[23] The project is often referred to by the acronym ACOT.

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Figure 2. *Model of student teachers' digital competence*

Both the horizontal and vertical axes in the model depict different stages in the student teachers' practical proficiency and self-awareness[24] with ICT through the four dimensions of *adoption*, *adaptation*, *appropriation*, and *innovation*. These dimensions are related to Wertsch's concepts of mastery and appropriation of cultural tools where *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 make it one's own" (Wertsch, 1998, p. 53). While in the mastery stage, the student teachers are relatively incompetent, unsure, and unaware of the possibilities and limitations of ICT in teaching, i.e., perceived affordances (Kirschner, Martens, & Strijbos, 2004; Norman, 1999). However, as they progress towards the appropriation stage, they become more competent, confident, and aware of the potential that ICT can offer in teaching, i.e., real affordances (Kirschner et al., 2004; Norman, 1999). As a research lens, this

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[24] Krumsvik (2014b) referred to the intersection in the model as being between "a 'mental digital competence journey' (self-awareness, vertical axis) and a 'practical competence journey' (proficiency, horizontal axis)" (Krumsvik, 2014b, p. 275).

model can help describe student teachers' digital competence on a micro- or interactional level by making visible their "tacit knowledge" (Polanyi, 1966) and stimulating "reflection-on-action" (Schön, 1983) about the association between pedagogy, content, knowledge, and technology (Mishra & Koehler, 2006; Shulman, 1987).

The term *basic digital skills* refers to the student teachers' elementary or informal use of ICT for everyday use and entertainment such as social media, online banking, news, music, and games. This also includes fundamental technical skills like using computer, interactive whiteboards, mobile devices, and so on. Finally, the category describes their basic use of ICT, which concerns the use of administrative and office software including word processors, presentation tools, spreadsheets, and learning management systems (LMSs). *Didactic ICT-competence* is related to the work of Shulman (1987) and the concept of PCK as well as Mishra and Koehler's (2006) TPCK framework. This competence implies the student teachers' seamless integration of ICT for teaching the subject discipline in a well-founded pedagogical and didactical manner. Moreover, this includes an awareness of the added value that ICT can have in teaching the subject-discipline such as using digital textbooks, electronic dictionaries, online learning resources, and educational applications. *Learning strategies* focus on student teachers' awareness of the impact that ICT has on their own and pupils' learning strategies, metacognition, and professional development in the subject discipline through "reflection-on-action" (Schön, 1983). This includes knowing how to scaffold pupils' skills in reading digital texts, developing search and problem-solving strategies, and interpreting and using multiple online sources. Furthermore, the competence implies an awareness of how ICT can impact formative and summative assessment, classroom management, and adapted education through, for example, e-portfolios, digital quizzes, online exams, and more. *Digital Bildung* highlights the student teachers' ethical and moral awareness of how ICT affects different aspects of "human development: communicative competence critical thinking skills, and enculturation processes, among others" (Søby, 2003, p. 8). This competence regards awareness of how to discuss and deal with dilemmas and hazards related to negative behaviors and actions such as cyberbullying, privacy and copyright violations, plagiarism, and so on.

In summary, the model attempts to give a holistic description of the most important dimensions of professional digital competence for the teaching profession both as separate components and as a whole. For the purpose of this thesis, the model was chosen over other widely cited

frameworks and models presented in the previous section because it is based on a Norwegian research context, and takes into consideration Norwegian steering documents, policies, and the national curricula. Throughout the project, the model has acted as an analytical lens in the investigation of student teachers' digital competence development in Norwegian teacher education (Article II & Article III). Although the model is mostly based on a Norwegian educational research setting, it could also be applied to other research contexts outside of Norway such as Scandinavia where similar learning concepts and terminology are used (e.g., didactics and Bildung).

3.4 Didactics, ESL teaching, and ICT

As mentioned in the Introduction, studies concerning digital competence development in subject-discipline teaching such as ESL in Norwegian teacher education are lacking. Hence, this thesis is situated in the context of ESL teaching and ESL didactics in Norwegian teacher education. The following section gives a brief clarification of the concept of didactics. In general terms, didactics can be understood as "the field of educational theory that provides guidelines and tools that are used to develop the practice of teaching" (Laursen, 1994, p. 125), and as "a science and theory about teaching and learning" (Gundem, 1998, p. 6). While didactics is the most important tool for planning, performing, and thinking about teaching in Central and Northern Europe, according to Hopman and Riquarts (2000), it might be more common to refer to it as pedagogy in the English-speaking world (Hamilton, 1999).

Künzli (2000, p. 43) summarized didactics as dealing with the following questions:

- What is to be taught and learned? (i.e., the content aspect)
- How is "content" to be taught and learned? (i.e., the mediation or method aspect)
- Why is "content" to be taught and learned? (i.e., the goal aspect)

As an academic discipline, didactics can be divided into two domains: general didactics and specific subject-discipline didactics (Künzli, 2000, p. 44). This thesis is concerned with the latter and in particular the subject-didactics of ESL. Hopman and Riquarts (2000) stated that subject-didactics is the "Didaktik produced and delivered inside the boundaries of school subjects" in which "almost every student teacher has compulsory training in" (Hopmann & Riquarts, 2000,

pp. 9-10). In this thesis, the student teachers being investigated are educated in ESL didactics through their teacher education program.

Didactics provides student teachers with reflective tools to consider the essential questions concerning what, how, and why questions which involve "*their* teaching of *their* students in *their* classrooms" (Wallin, 1998, in Westbury, 2000, p. 17, italics in original). Today, this notion of didactics can also be expanded to networked environments where, according to Lund and Hauge (2011), it is appropriate to ask the additional questions "*when* to teach and *where* to teach" (Lund & Hauge, 2011, p. 263, my italics). Overall, these critical questions must be considered by student teachers as ICT continues to permeate educational institutions as well as challenge traditional school practices such as face-to-face teaching, pen and paper assessment, textbooks, and notions of what constitutes a classroom or learning space.

The importance of pupils' need to master English in order to function in contemporary society is made even more obvious with the spread of digital technologies, where most online environments, resources, and networks across the world have adopted English as a lingua franca (ELF), in other words "as a 'common language' in many societies" (Simensen, 2007, p. 75). Lund (2004) further underlined this notion, arguing that "learners today will encounter and familiarize themselves with the world largely through the use of (variants of) English mediated by a diversity of digital technologies" (Lund, 2004, p. 11). As a subject discipline in Norway, English has historically held the position as a foreign language in Norwegian schools, but since the 1990s English has been been recognized as a second language (Simensen, 2014).[25] During teacher education, student teachers are prepared to teach English through ESL didactics courses, which also includes preparing them to teach with ICT as digital competence is regarded as one of the five basic skills (Ministry of Education and Research, 2006a; Norwegian Directorate for Education and Training, 2012).

The English subject curriculum opens up for the use of a wide array of digital tools by both teachers and pupils. For instance, digital competence as a basic skill is understood in the following way in the curriculum:

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[25] See the footnote in the Introduction for a further discussion on the use of ESL versus EFL in this thesis.

Digital skills in English means being able to use a varied selection of digital tools, media and resources to assist in language learning, to communicate in English and to acquire relevant knowledge in the subject of English. The use of digital resources provides opportunities to experience English texts in authentic situations, meaning natural and unadapted situations. The development of digital skills involves gathering and processing information to create different kinds of text. Formal requirements in digital texts means that effects, images, tables, headlines and bullet points are compiled to emphasize and communicate a message. This further involves using digital sources in written texts and oral communication and having a critical and independent attitude to the use of sources. Digital skills involve developing knowledge about copyright and protection of personal privacy through verifiable references to sources. (Ministry of Education and Research, 2006c)

Further, several competence aims listed in the curriculum involve teachers and pupils using ICT. While some competence aims are quite explicit regarding the use of ICT, other competence aims are more implicit in the sense that digital tools are sometimes required or not to fulfill the aims. Some of the competence aims in English explicitly mention the use of ICT after year 10 in the four main subject areas *language learning, oral-* and *written communication,* and *culture, society and literature* express that pupils should be able to:

- Select different digital resources and other aids and use them in an independent manner in own language learning;
- Listen to and understand variations of English from different authentic situations;
- Use digital tools and formal requirements for processing, text production and communication;
- Be familiar with protection of personal privacy and copyright and chose and use content from different sources in a verifiable way; [and]
- Create, communicate, and converse about own texts inspired by English literature, films, and cultural forms of expression. (Ministry of Education and Research, 2006c)

These competence aims suggest the use of digital tools such as using digital audio recordings, online videos, and digital learning resources for listening to and understanding variations of English from different authentic situations. Evidently, in order to meet the competence aims

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outlined in the English subject curriculum, teachers, student teachers, and pupils must master and appropriate digital competence. However, reaching this goal means teachers must go beyond basic ICT use such as word processors, presentation software, and information searches by utilizing the innovative and creative aspects which are also afforded by ICT.

4 Methodology

This chapter discusses the methodology used in the overall project. First, this includes a brief introduction to the main research design and methods of the thesis (see Table 1 in Introduction). Second, the section gives a detailed account of the methodology used in the three research studies including their respective research designs and methods for data collection and data analysis. Third, trustworthiness or credibility is assessed through a discussion of reliability, validity, and generalizability of the results of the empirical studies. Finally, the chapter concludes with a discussion of the ethical aspects concerning study participation and the data collection processes.

4.1 Research design and methods

The overarching research methodology and design for the thesis draws on approaches and strategies from design-based research (DBRC, 2003) where both quantitative and qualitative methods are used for collecting data to understand the investigated phenomena both in breadth and in depth (discussed in the next section). In addition, the main research method for the thesis can also be classified as following mixed methods research since both quantitative and qualitative data are collected and used in different stages in the study (Creswell, 2009; Creswell & Plano Clark, 2011). R. B. Johnson et al. (2007) proposed the following definition for mixed methods research:

> Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purposes of breadth and depth of understanding and corroboration. (R. B. Johnson et al., 2007, p. 123)

Although the project follows mixed methods research, it does not give "equal status" to both methods (R. B. Johnson et al., 2007, p. 123). The main emphasis is on qualitative methods, and the project could thus be labeled as "*qualitative dominant* mixed methods research" (R. B. Johnson et al., 2007, p. 124, their italics). Figure 3 shows a qualitative–quantitative continuum and attempts to illustrate the different overlapping groups or types of mixed methods research (from R. B. Johnson et al., 2007, p. 124).

Figure 3. *Graphic of the three major research paradigms of mixed methods research*

In Figure 3, the area in the center shows where "mixed methods research, broadly speaking, falls, with the center representing the strongest or 'pure' form" (R. B. Johnson et al., 2007), and where this study would fall to the left towards the "Qualitative Dominant" area in the continuum. Accordingly, the combination of both a design-based research methodology and mixed methods research enabled the exploration of the project's main research question both on a broad scale and in-depth through the use of different perspectives, strategies, and approaches. Teddlie and Tashakkori (2011) called this "*methodological eclecticism*," which involves "*selecting and then synergistically integrating the most appropriate techniques from a myriad of QUAL, QUAN, and mixed methods* in order to more thoroughly investigate a phenomenon of interest" (Teddlie & Tashakkori, 2011, p. 286, their italics). In other words, this combination, eclecticism, or mixing of approaches, advances what Greene (2007) described as "multiple ways of seeing and hearing, multiple ways of making sense of the social world, and multiple standpoints on what is important and to be valued and cherished" (Greene, 2007, p. 20).

Although the emphasis is mainly on qualitative methods for collecting and analyzing data, the thesis uses both "variance theory" and "process theory" as approaches to exploring and explaining the research questions (Maxwell, 2013; Van de Ven, 2007). Variance theory is

connected to quantitative research and a positivistic research paradigm which tends to perceive the world as different variables and explain phenomena in terms of demonstrating statistical relationships between them (Maxwell, 2013). Process theory, on the other hand, is related to qualitative research and constructivism where people, situations, events, and processes relating to these influence each other (Maxwell, 2013). According to Maxwell, explanation in process theory is "based on an analysis of how some situations and events influence others" (Maxwell, 2013, p. 29). Figure 4 shows the distinction between the two approaches (from Van de Ven, 2007, p. 149).

Figure 4. *Two approaches to explaining strategic change*

The thesis combines variance theory and process theory in the research design in order to explore the overall study question regarding student teachers' digital competence development in teacher education both in breadth and in depth. With regard to the three empirical studies, three different methodological approaches were used: literature review (Article I), case study (Article II & Article III), and design-based research (Article III). Table 1 (see Introduction) provides an overview of the research questions explored and design approaches used in the thesis and in the three empirical studies. These approaches are explored in more detail in the section below.

4.1.1 Design-based research

As noted at the start of this chapter, the overall research design in this thesis as well as the research design in the third empirical study draws on approaches from design-based research (T.

Anderson & Shattuck, 2012; DBRC, 2003; McKenney & Reeves, 2013). As a concept, design-based research originates from "design experiments" (Brown, 1992; Collins, 1992), "formative research" (Newman, 1990), "development research" (Akker, 1999), and "design research" (Akker, Gravemeijer, McKenney, & Nieveen, 2006; McKenney & Reeves, 2014). Design-based research can be broadly defined as "a series of approaches, with the intent of producing new theories, artifacts, and practices that account for and potentially impact learning and teaching in a naturalistic setting" (Barab & Squire, 2004, p. 2). Akker et al. (2006) summarized the critical characteristics of design-based research as:

- Interventionist: the research aims at designing an intervention in the real world;
- Iterative: the research incorporates a cyclic approach of design, evaluation, and revision;
- Process oriented: a black box model of input-output measurement is avoided, the focus is on understanding and improving interventions;
- Utility oriented: the merit of a design is measured, in part, by its practicality for users in real contexts; and
- Theory oriented: the design is (at least partly) based upon theoretical propositions, and field testing of the design contributes to theory building. (Akker et al., 2006, p. 5)

Over the last decade, researchers have expressed growing interest in design-based research as a way of bringing relevance and social responsibility to educational technology research (McKenney & Reeves, 2013; Reeves, Herrington, & Oliver, 2005). Design-based research establishes direct links between research and practice, thus enhancing the chances that study findings will have an impact in educational research (Reeves, McKenney, & Herrington, 2011). Ensuring that this type of research is perceived as meaningful is accomplished through collaboration between researchers and practitioners in identifying, designing, and redesigning solutions to problems in teaching and learning (DBRC, 2003). Also, design-based research can involve both qualitative and/or quantitative data where the types of data vary depending on the phases (Herrington et al., 2007). Thus, this type of research works well in combination with different other methodologies and methods such as case study and mixed methods.

In this thesis, the approach was adapted from The Design-Based Research Collective (2003), Reeves (2006), and Herrington et al. (2007). Figure 5 explains how the approach was employed to guide the overall thesis design (adapted from Reeves, 2006, p. 59).

Research design

Figure 5. *Research design*

This design includes the following steps: First, a literature review was conducted in order to map out knowledge gaps and analyze the research field to identify practical problems, e.g. how the use of ICT in teacher education could be used to develop digital competence in student teachers (Article I). Second, a case study informed by the literature review was designed to further investigate the practical problems and develop solutions to these problems (Article II). Third, an intervention study based on the previous two studies was trialed and evaluated through two iterative cycles of design in collaboration with practitioners. This phase aimed to investigate how a DST workshop in teacher education could promote digital competence in ESL student teachers (Article III). Finally, the resulting "design principles" or approaches identified in the intervention study were further assessed and discussed in the study as well as in the synopsis of the thesis.

The research design in the thesis followed a carefully planned-out sequence where the different stages built on, informed, and succeeded each other. In turn, this helped narrow the scope of the investigation conducted in the project from exploring the main research question both broadly (Article I & Article II) and in-depth (Article II & Article III).

4.1.2 Literature review

A thorough and sophisticated literature review is, according to several scholars including Boote and Beile (2005), "the foundation and inspiration for substantial, useful research" (Boote & Beile, 2005, p. 3). Therefore, this methodology was used in the research design of the first study (Hart, 1998; Jesson, Matheson, & Lacey, 2011). The purpose was to produce an overview of other studies that were relevant to the two following studies (Article II & Article III), and to relate the studies to the "larger, ongoing dialogue in the literature, filling in gaps and extending prior studies" (Creswell, 2009, p. 25). Hence, the literature review in Article I attempted to meet three criteria proposed by Creswell (2009): "to present results of similar studies, to relate the present study to the ongoing dialogue in the literature, and to provide a framework for comparing the results of a study to other studies" (Creswell, 2009, p. 45). In order to meet these criteria, a five-step process was followed, as recommended by Creswell: "1) identify key terms to use in your search; 2) locate literature about a topic by consulting several types of material and databases; 3) critically evaluate and select the literature; 4) organize the literature; and 5) write a literature review" (Creswell, 2012, p. 81). To increase methodological transparency and quality, the review incorporated approaches from systematic reviews (e.g., Gough, Oliver, & Thomas, 2012; Petticrew & Roberts, 2006). This included using a strict set of inclusion/exclusion criteria, documenting database hits, and providing a comprehensive overview describing different aspects of the included studies.

An analytical framework outlined by Boote and Beile (2005) guided the analysis of the reviewed studies. Boote and Beile (2005) proposed five categories including a number of criterions for preparing and conducting doctoral literature reviews in education: 1) coverage, 2) synthesis, 3) methodology, 4) significance, and 5) rhetoric (Boote & Beile, 2005, p. 8). In a commentary article, Maxwell (2006) critiqued their framework as being too excessive, and proposed relevance as being a key criterion for including studies in this type of review. Here, Maxwell (2006) distinguished between doing reviews *of* and *for* research, where the former is "intended to summarize and synthesize a specific field of research" and the latter "to inform a planned study" (Maxwell, 2006, p. 28). He pointed out relevance (i.e., how relevant previous studies are to one's own study) as the most important criterion when doing a review *for* research in doctoral disseminations (Maxwell, 2006, p. 28). Taken together, these analytical categories and perspectives helped guide the design of the literature review study (Article I) which was a review

for research. This means that the study helped inform the proceeding studies in the thesis (Article II & Article III) by narrowing down their focus of the aims, scope, design, and methods.

4.1.3 Case study research

Another main methodology used in the research design of the second and third empirical studies in this thesis was case study research (Merriam, 2009; Stake, 1995; Yin, 2009). Merriam (2009) defined a case study as "an in-depth description and analysis of a bounded system" (Merriam, 2009, p. 40). Similarly, Yin (2009) viewed a case study in terms of the research process, and defined it as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenology and context are not clearly evident" (Yin, 2009, p. 18). Creswell (2013) provided perhaps the most detailed definition:

> Case study research is a qualitative approach in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a case description and case-based themes. (Creswell, 2013, p. 97)

The bounded system, bounded context, or boundaries define the unit of analysis or object of study (i.e., what will and will not be studied) and characterizes the case study (Miles et al., 2014). Since it is the bounded system or object of study that defines the case, the methodology can be combined with other types of methodological approaches, such as design-based and mixed methods research, and with multiple methods for collecting and analyzing data (Merriam, 2009; Yin, 2009).

The unit of analysis chosen for this case study and thesis was an ESL didactics course offered at a Norwegian teacher education program. The course was studied over four academic semesters from fall 2012 until spring 2014. The reason for choosing this particular ESL didactics course as the object of study was that it represented an interesting context for investigating student teachers' digital competence development in teacher education. Also, the ESL didactics course was taught by a seasoned teacher educator who had over twenty years of experience with integrating ICT in ESL teaching in secondary school. Finally, the course had one of the largest populations of student teachers at the particular teacher education program, which increased the

potential for generalizing study findings to other teacher education programs. George and Bennett (2005) argued that one of the strengths with case studies is that they allow researchers to acquire high degrees of conceptual validity, and/or to discover and explore indicators that might best represent the theoretical concept being investigated (George & Bennett, 2005, p. 19). In line with this argument, the case chosen in the second and third research studies (Article II & Article III) allowed the exploration of the theoretical concept *digital competence* and its indicators, and how professional digital competence could be potentially developed in teacher education. Thus, the type of case study used in this thesis can be classified as intrinsic or instrumental (Stake, 1995), meaning that the case is used to provide insight into an particular issue, to redraw generalizations, and to build theory (Merriam, 2009, p. 48).

4.1.4 Sampling

A sample can be understood as a set of subjects or informants from a larger population such as student teachers. Through the process and use of sampling strategies, the researcher attempts to select a sample that can best represent and characterize the population being researched (Miller & Salkind, 2002). The sampling in the literature review study (Article I) was guided by a set of inclusion/exclusion criteria. Meanwhile, the case study (Article II) and design-based research study (Article III) employed a flexible approach to sampling as recommended by Savin-Baden and Major (2013), and was guided by both a convenience and purposive sampling strategy when recruiting and selecting participants (Creswell, 2013; Maxwell, 2013; Patton, 2015). According to Maxwell (2013), "purposeful sampling or selection is a strategy in which particular settings, persons, or activities are selected deliberately in order to provide information that can't be gotten as well from other choices" (Maxwell, 2013, p. 97). Patton (2015) further argued that:

> [the] power of purposeful sampling lies in selecting *information-rich* cases for in depth study. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the inquiry, thus the term *purposeful* sampling. (Patton, 2015, p. 264, italics in original)

While the sample in the first research study consisted of 42 online peer-reviewed empirical studies ($N = 42$), the sample in the second and third research studies consisted of four cohorts of secondary school ESL student teachers attending an ESL didactics course from fall 2012 until spring 2014. From these four cohorts, fifteen ESL student teachers ($N = 15$) were purposefully

sampled for follow-up classroom observations in their school practicums and interviews. In addition, the observed ESL teacher educator ($N = 1$) was sampled for a follow-up interview. The selection criteria meant that 1) the student teachers had English as one of their subject disciplines, 2) the student teachers were enrolled in a five-year postgraduate degree program offered at the teacher education institution as opposed to those student teachers following the one-year practical pedagogical program, 3) the student teachers were taking the English didactics course offered at the teacher education program, and 4) the student teachers' school practicum took place at a lower- or upper-secondary school within the same county as the teacher education program. As recommended by Lincoln and Guba (1985), sampling was terminated at a point of data "saturation" (Corbin & Strauss, 2008, p. 143), that is, when no new information, development of categories, or variation in data was forthcoming from new sampled participants. For instance, when different student teachers were repeatedly observed using word processors and presentation tools in their English teaching during their school practicum, and no new use of ICT in English teaching was observed, it was determined that a point of saturation had been reached.

Because the study was organized around the setting and schedule of a teacher education course, its course participants, and their school practicums, the study was sensitive to temporal concerns such as time. Sandelowski (1999) argued that "temporal factors play a critical role in purposive sampling, the content and structure of data collection and analysis techniques, and in the re-presentation of data" (Sandelowski, 1999, p. 79). In this study, time could be regarded as having a constraining effect on both the researcher and the participating student teachers in the sense that there always seemed to be a lack of time for the student teachers to be observed during their school practicum or to be interviewed. For the student teachers, this was often due to conflicting schedules between teacher education classes and practicum schools while at the same time managing the teacher education's heavy workload and assignment deadlines. For the researcher, this influenced the number of study participants volunteering to participate in the study, and the number of school practicum observations and interviews that could be conducted in a non-invasive way with the purposefully sampled student teachers. All in all, time was an important structural and ethical dimension to consider when conducting the study with human participants as their involvement could have potentially constrained their daily routines.

4.1.5 Validity, credibility, reliability, and generalizability

This study ensured internal and external validity, credibility, and reliability by using data triangulation by using multiple methods for collecting data and multiple sources of data (Cho & Trent, 2006; Denzin & Lincoln, 2013; Maxwell, 2013; Merriam, 2009). While internal validity can be understood as "the truth value, applicability, consistency, neutrality, dependability, and/or credibility of interpretations and conclusions within the underlying setting or group," external validity is defined as "the degree that the findings of a study can be generalized across different populations of persons, settings, contexts, and times" (Onwuegbuzie & Leech, 2007, pp. 234-235). The study employed methodological triangulation through the use of both quantitative and qualitative methods to address the same research questions (Article II & Article III). Also, this type of methodological triangulation can be classified as sequential triangulation where, according to Morse (1991), "the results of one method are essential for planning the next method" (Morse, 1991, p. 120). In this study, the results of the literature review study (Article I) was essential for designing and conducting the quantitative surveys. In turn, the results of the surveys were essential for informing, designing, and conducting the qualitative participant observations and semi-structured interviews. In addition, the use of multiple sources of data in the study such as surveys, participant observations, semi-structured interviews, and student produced artifacts ensured data triangulation (Denzin & Lincoln, 2013). Moreover, in the data triangulation, "convergent, inconsistent, and contradictory evidence" (Mathison, 1988, p. 13) were also taken into account to increase study validity. Moreover, these aspects were ensured through methodological transparency in the thesis and in the empirical studies where the researcher was explicit about what methods and analytical tools were used to analyze the collected data, thus leaving an audit trail for readers to follow (Lincoln & Guba, 1985; Merriam, 2009).

Generalizability with case study methodology is a heavily debated topic where some scholars have argued that one cannot transfer findings from single-case studies, and that they therefore do not contribute to scientific development (Flyvbjerg, 2006, 2011). However, Flyvbjerg (2006) dismissed this critique as a misunderstanding, and argued from the standpoint of social science research that "a discipline without a large number of thoroughly executed case studies is a discipline without systematic production of exemplars, and a discipline without exemplars is an ineffective one" (Flyvbjerg, 2006, p. 219). In this thesis, generalizability or transferability was

ensured through the use of rich, thick descriptions of the case study's context, participants, methodology, and findings (Geertz, 1973; Lincoln & Guba, 1985), and through the use of purposeful sampling (Maxwell, 2013). Although the findings are difficult to generalize to the overall student teacher population because of the use of one object of study and low sample size, the findings can be applied to other contexts through what Saldaña (2013) called "inferring transfer" where key assertions are drawn from the "particular to the general" (Saldaña, 2013, p. 14). Also, even though the studies undertaken in this doctoral project primarily benefit the researcher (Harland, 2014, p. 1114), the findings can also potentially be of use for other student teachers, teacher educators, mentor teachers, policymakers, and educational technology designers.

4.1.6 Researcher bias

H. S. Becker (1967) argued that research can never be free of bias because it is unavoidably conducted from the point of view of the researcher. However, Savin-Baden and Major (2013) advised that researchers should engage with their own biases through exploring and mentioning personal perceptions, views of reality and knowledge. In the Introduction chapter, the researcher's perspectives, assumptions, and biases were made explicit through the practice of reflexivity. With regard to bias and methodology, Miles, Huberman and Saldaña (2014) listed two types of researcher effects or biases: 1) "the effects of the researcher on the case", and 2) "the effects of the case on the researcher" (Miles et al., 2014, p. 296). The potential for experimenter effects has been minimized throughout the study with minimal intrusion in the ongoing activities of the study participants and in the institutions being scrutinized (e.g., through considerations regarding roles and positioning in participant observations, see Section 4.2.2), and through the researcher's practice of reflexivity (Alvesson & Sköldberg, 2009).

In the study context, the researcher can be interpreted as to hold the position of "insider" as well as "outsider" (Kvernbekk, 2005, p. 22). This is due to the researcher's previous status as an ICT network administrator, a recent postgraduate student teacher, and an English language teacher in lower- and upper-secondary school (see Introduction). The research context of the study was familiar to the researcher (teacher education, English didactics), whereas the study participants were unfamiliar strangers (student teachers, teacher educator). A similar insider/outsider position was reported in a study by Sherif (2001) who felt torn "between conflicting identities: the

American graduate student, the Egyptian daughter, the single woman in her late 20s, and the trained anthropologist who was always observing and aware of the process as if from the outside" (Sherif, 2001, p. 440). One benefit of being an insider, according to Savin-Baden and Major (2013), is that the researcher "has considerable knowledge that an outsider does not" (Savin-Baden & Major, 2013, p. 343), such as information about the study context. The authors noted, however, that boundaries might become blurred between the researcher and the research participants, and they recommended that the researcher reflect on his or her own subjectivity, perspectives, practices, and interpretations. In addition, Patton (2015) argued that "the challenge is to combine participation and observation so as to become capable of understanding the setting as an insider while describing it to and for outsiders" (Patton, 2015, p. 338). For doctoral research projects involving insider research, Drake (2010) further noted that the "validity of insider research requires reflexive considerations of the researcher's position" (Drake, 2010, p. 85). However, this epistemological position also acknowledges that "one need not be Caesar to understand Caesar" (Merton & Sztompka, 1996, p. 258). Thus, it is not a necessary requirement to be an insider (e.g., a former student teacher or a university lecturer) in order to study a phenomenon such as digital competence development in teacher education. Yet, this dualism in positioning needs to be declared and made explicit to the reader in order to clarify issues surrounding potential research biases and distancing regarding the study context.

4.1.7 Ethical considerations

The research project has been conducted according to the ethical guidelines proposed by the Norwegian Committee for Research Ethics in the Social Sciences and the Humanities (NESH). The Norwegian Social Science Data Service (NSD) granted ethical approval for the research project in the spring of 2012 before the researcher started recruiting study participants and collecting data (Appendix). The names of research participants as well as the names of organizations and locations such as towns, practicum schools, and educational institutions have been anonymized and replaced with pseudonyms in order to maintain participant confidentiality, study integrity, and trustworthiness.

At the beginning of the semester, the researcher informed the teacher educator and the student teachers about the project and gave them informed consent forms (Flick, 2014; Kvale & Brinkmann, 2009), which they had to fill out and return to the researcher (Appendix). During the

orientation, the researcher emphasized that participation in the study was voluntary, that all data would be made anonymous and treated with confidentiality and privacy, and that the participants could withdraw their consent at any point during the study (Miles et al., 2014). This was the case with one student teacher (Benny), who withdrew mid-way through the project because of the program's heavy workload.

All data were stored on the encrypted and password-protected university network. Before conducting participatory classroom observations, the researcher sought informed consent and approval from the schools' principals and the student teachers' mentor teachers, who were notified by email of the purpose of the study and of the researcher's school visit (Appendix). Informing these "gatekeepers" (Lincoln & Guba, 1985, p. 253) was not only considered an important ethical concern, but also a key strategy for getting access to the sites for conducting fieldwork (Creswell, 2013). Emphasizing openness about the goals and aims of the research project with the study participants was important for developing a sense of trust between the researcher, study participants, and other individuals that were involved such as pupils, principals, and mentor teachers (Miles et al., 2014).

Member checking or respondent validation was to some degree implemented to increase the trustworthiness, credibility, and ethical compliance of the study, especially when conducting and writing up the analysis of the qualitative data (Lincoln & Guba, 1985; Merriam, 2009). This step usually involves returning or feeding back the researcher's interpretations of the data, which in this case were observational and interview data, to the study participants so that they are able to confirm the accuracy of the analysis, and rectify potential misinterpretations and misrepresentations (Maxwell, 2013; Savin-Baden & Major, 2013). However, because of the interpretive nature of the data analysis where the aim was not to recreate, but instead to go beyond the participants' saying and doings, member checking was not fully utilized as a strategy in this study as this criterion "cannot automatically 'guarantee' knowledge claims" (Cho & Trent, 2006, p. 322) or guarantee study validity as, ultimately, the "account is the researcher's construction" (Torrance, 2012, p. 116). Moreover, Angen (2000) criticized that member checking has been subject to "relying on the foundational assumption of a fixed truth or reality against which the account can be measured" (Angen, 2000, p. 383). Although some researchers would argue that not using member checking can potentially reduce the participants' voice (Maxwell,

2013), Miles et al. (2014) warned that these agreements can also result in "truncated or distorted conclusions if someone has been given, and exercises, the right of censorship" (Miles et al., 2014, p. 58). Also, involving the study participants by returning the researcher's interpretations and drafts of reports back to them might also cause confusion and make them change their minds about the subject matter (Angen, 2000; Carlson, 2010). Instead, as a form of member checking, the participants were followed up during the interviews with questions regarding the researcher's interpretation of their statements, and whether these interpretations were accurate or not. Furthermore, the participants who were interviewed twice (Ellie, Mariam, Jude, and Tim, see Table 3) were asked to confirm and clarify their statements from previous interviews as a form of member checking. Final reports of the study findings were shared with the participants once these publications were made publically available as a way of demonstrating the participants' significance, voice in, and contributions to the overall doctoral project.

4.2 Data collection

Besides database searches for gathering empirical studies for the literature review (Article I), four methods for collecting data were used in this thesis: surveys, participant observations, semi-structured interviews, and document analysis (Article II & Article III). In this section, these methods are described in further detail.

4.2.1 Surveys

In order to get a broad overview of the student teachers' self-perceived digital competence and perspectives on the use of ICT in their teacher education program, two quantitative self-reporting surveys were used in two of the empirical studies (Article II & Article III; see Appendix). Surveys were used for this task because they allow for simple distribution to larger populations, are anonymous, and can provide concrete data and a wide overview of a field of study (R. B. Johnson & Onwuegbuzie, 2004). The survey items were constructed based on participant observations of the campus-based lectures in the English didactics course and of the student teachers' school practicum, and through consultations with the research literature and expert input (Janssen et al., 2013; Krumsvik et al., 2013). Therefore, constructing the survey items followed an abductive approach which is both theory-driven and inferential (Reichertz, 2007). Both surveys were conducted after the student teachers had returned to the university campus after finishing their school practicum.

The first survey (S1) was distributed during the fall semester in 2012 to all of the EFL student teachers. The survey was conducted "live" (see also Krumsvik & Ludvigsen, 2013, p. 89) in the auditorium by the researcher at the end of one of the final lectures in the English didactics course. Here, all of the purposefully sampled (Maxwell, 2013; Patton, 2015) student teachers were invited to self-assess their digital competence using *TurningPoint* Student Response System (SRS) feedback clickers (Turning Technologies, n.d.). The survey was hosted on a laptop running Windows 7 and Microsoft PowerPoint, and each participant received a radio frequency (RF) response transmitter (feedback clicker) which was collected at the end of the survey. SRS feedback clickers allow for the collection of quantitative data in a fast and easy manner, and can be an effective way to carry out and collect, for instance, formative assessment data in plenary lectures (Krumsvik, 2012; Mayer et al., 2009). Moreover, previous studies have shown that the response rate can increase significantly when using SRS feedback clickers as a method to collect data (Krumsvik & Ludvigsen, 2012, 2013).

The survey was made up of two sections of self-reporting items: demographic information (10 items) and concept mapping questions and statements regarding digital competence and ICT use in teacher education (19 items). Survey materials consisted of 41 slides in PowerPoint where 12 slides contained explanations and concept definitions while the remaining 29 slides were multiple-choice self-assessment questions (Appendix). With every conceptual question and statement, the student teachers were asked to choose the answer which fit 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). An example of a question from the survey is: "How well do you master the use of laptops and digital tools (e.g., online banking and social media) in your spare time (outside of work and school)?" Moreover, an example of a statement from the survey about the didactical use of ICT is: "I use ICT so that pupils can remember subject content better (e.g., remember concepts and definitions)." A 7-point Likert scale was used in order to ensure a more nuanced scale for the data analysis where 3–7 points have been recommended (Ringdal, 2007).

The survey took 30 minutes from start to finish, and was conducted by the researcher and one of the researchers' supervisors in an auditorium. The survey was carried out in Norwegian in order to avoid miscommunication. An Internet-based version of the survey using Questback survey

software (Questback, n.d.) was later distributed through e-mail to the student teachers in order to reach out to those who were not present during the live survey. Participation was voluntary, and those who did not want to participate were free to leave the auditorium during the survey or could choose to ignore the e-mail with the Internet-based version of the survey. A total of 41 student teachers ($n = 41$) out of 61 ($N = 61$) decided to participate, resulting in a response rate of 67% from the small cohort of student teachers in English didactics.

The second survey (S2) used the same questions and statements as S1. Four new items were added (one question about demographic background information and three statements).[26] The survey was conducted during the spring semester 2014, and was distributed electronically using Questback survey software (Questback, n.d.). To increase the number of respondents, the second survey was distributed to the entire student teacher population enrolled in the teacher education program that semester through the institution's LMS. A total of 112 student teachers ($n = 112$) out of 270 ($N = 270$) responded to the survey, resulting in a response rate of 41% from the teacher education program's overall student teacher population. Before conducting the data analysis, missing values and incomplete inputs were removed from the datasets in order to avoid reliability issues (Christophersen, 2009; Ringdal, 2007).

4.2.2 Participant observations

Observation is often considered an everyday practice, and is a way of collecting data about a phenomenon which cannot be expressed in words (Hatch, 2002; Silverman, 2013). However, observation becomes a method when it is used systematically in the setting where the phenomenon occurs, and when it is used to address specific research questions (Merriam, 2009). The purpose of including participant observations in the design of the second and third studies (Article II & Article III) as a method for collecting data was in line with DeWalt and DeWalt (2011) who argued that observation can help "develop a holistic understanding of the phenomena under study that is as objective and accurate as possible given the limitations of the method" (DeWalt & DeWalt, 2011, p. 110). In addition, Patton (2015) emphasized the insider aspect of participant observations and argued that "experiencing the program as an insider accentuates the participant part of participant observation. At the same time, the inquirer remains aware of being

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[26] An example of one of the new statements is about teachers' professional digital competence: "I agree that professional digital competence is important for my future profession as a teacher."

an outsider" (Patton, 2015, p. 338). The participant observations helped the researcher get a firsthand encounter and a deeper understanding of how ICT was being used by the student teachers and by the teacher educator in the teacher education program. Also, the observations helped inform the design of the surveys and the interview guide as well as aiding in triangulating the findings (Merriam, 2009). Finally, the observations were used in combination with other methods as a way to triangulate the data by validating the survey and interview findings. By doing so, the observations could help uncover potential convergent, inconsistent, and contradictory findings (Mathison, 1988) regarding what the student teachers expressed in the surveys and in the interviews, and how they integrated ICT in their ESL teaching during the school practicum.

The participant observations were conducted in the ESL didactics course held at the teacher education program campus, and in the sampled ESL student teachers' classrooms where they were undertaking their school practicums over four academic semesters from fall 2012 until spring 2014. The process of collecting data in these research sites followed three stages described by Merriam (2009): "entry, data collection, and exit" (Merriam, 2009, p. 122). In order to gain entry to the various research sites, such as the English didactics course and classrooms, the researcher requested access from the student teachers and the teacher educator by informing them about the research project at the beginning of the semester and by distributing informed consent forms for them to sign (Appendix). The forms were designed according to the ethical guidelines suggested by the NSD. As for gaining entry to the classrooms, the student teachers' mentor teachers and school principals were contacted, informed about the project, and asked for permission for access (Appendix). 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). With regard to exiting the research site in a manner that was natural, the researcher stopped the collection of observation data as the student teachers' teaching semester ended.

Creswell (2013) suggested that researchers need to have an explicit and clear focus in their observations. In the second and third research studies, the focus of the participant observations in the ESL didactics course was on the student teachers, teacher educator, and the activities involving ICT for teaching and learning in English language teaching. Each lecture lasted for

ninety minutes (90) with a fifteen minute (15) break in the middle. During the observations in the student teachers' school practicum English lessons, the focus was on the student teachers' activities, use, and integration of ICT during their lessons. Each classroom lesson lasted between forty-five minutes (45) to two hours (120 minutes) with breaks in-between. Table 3 offers extracts of the field notes from the participant observation.

Table 3. *Extracts from participant observations*

Time and place	Topic	Observations	Interpretations	Comments
October 17, 2012 12:15-13:15; Ellie's ESL lesson	Developing listening and reading skills	Student teacher shows a YouTube video clip and plays a clip from an audiobook on interactive whiteboard (IWB) while the pupils read in their textbooks.	Student teacher is using the IWB as a projector, and using ICT in a traditional teacher-centered way for content delivery and instruction. No pupils use ICT.	9th grade pupils in lower-secondary school. The school has a modern infrastructure with IWB and laptop trolleys.
January 9, 2013 08:15-10:00 ESL didactics lesson	Literature and writing	Teacher educator shows a Google Docs document on the projector and writes on the screen while thinking out loud.	Teacher educator is modeling the writing process and didactical use of ICT in ESL for the student teachers.	ESL student teachers in their final teaching semester. Lesson held at the teacher education camps.
October 24, 2013 08:15-10:00 Ron's ESL lesson	Multiculturalism	Student teacher draws a mind map around the word "multiculturalism" on IWB. Shows a YouTube video clip and asks pupils to discuss in pairs afterwards. Instructs pupils not to use their laptops.	Student teacher uses IWB to support pupils' reflective process, but is using IWB as a traditional blackboard and in a teacher-led way. Communicates expectations for pupils' ICT-use.	12th grade in upper-secondary school. The school has a modern infrastructure with IWB and every pupil have their own free school laptop.
January 30, 2014 08:15-10:00 ESL didactics lesson	Visual media in the classroom	Teacher educator shows examples of multimodal compositions on the projector which are made in PowerPoint. Explains how ICT can be used for pre-reading.	Teacher educator models didactical use of ICT for developing language skills Uses authentic examples. Links to theories of language learning.	ESL student teachers in their final teaching semester. Lesson held at the teacher education camps.

During the participant observations in the ESL didactics course and in the ESL student teachers' English lessons in their school practicum, the researcher maintained the role of being an "observer-as-participant" (Gold, 1958, p. 221) or participant observer (Atkinson & Hammersley,

1994). The researcher was positioned for conducting the observations from the corner of the room, and this meant minimal involvement in the lecture and lesson activities as well as reducing the researcher's influence and bias towards the study participants. The presence of the researcher was notified to the student teachers at the beginning of the semester by the teacher educator and to the pupils in each observed school practicum English lesson conducted by the student teachers (Article II & Article III). In contrast, the researcher was also a "participant-as-observer" (Gold, 1958, p. 220) during the DST workshops (Article III) where he actively collaborated with the student teachers and the teacher educator. At the same time, the student teachers were aware of the researcher's role as a PhD student. After the DST workshops were finished, the researcher collected the student teachers' digital stories[27] and reflection logs as well as the teacher educators' prepared instruction materials for document analysis (Merriam, 2009).

4.2.3 Interviews

The qualitative research interview is a an important approach for attempting to understand and gain access to the life world from the point of view of the research participants where knowledge is produced in the interaction between the interviewer and the interviewee (Kvale & Brinkmann, 2009). Although the use of interviews as a method for collecting data has been criticized for a number of reasons, such as being non-scientific and biased (Kvale, 1994), the literature surrounding the method has grown extensively, which suggests that the method has gained legitimacy in the research community (Alvesson, 2011; Gubrium, Holstein, Marvasti, & McKinney, 2012; Kvale & Brinkmann, 2009; Roulston, 2010; Rubin & Rubin, 2012). The interviews used in the research studies (Article II & Article III) were semi-structured. The researcher acted as the interviewer, and followed a list of themes or issues to be explored through an interview guide while asking questions that were open-ended, flexible, and open to follow-up questions (Kvale & Brinkmann, 2009). Interviews were conducted with a total of 15 purposefully sampled student teachers ($N = 15$) and their ESL didactics teacher educator ($N = 1$). 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 practicums. 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

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[27] The student teachers' digital stories were collected, but not used as a part of the data analysis, as discussed in Chapter 5.

program. Table 4 presents demographic information regarding the purposefully sampled student teachers (adapted from Twidle, Sorensen, Childs, Godwin, & Dussart, 2006, p. 216).

Table 4. *Information about purposefully sampled ESL student teachers*

Name	Gender	Subjects	Interviewed	Visits	Prior ICT experiences
Ellie	F	English, Norwegian	Fall 2012, Spring 2014	3	Personal use, research, gaming
Benny	F	English, Geography	Fall 2012	1	Personal use, research
Marilyn	F	English, German	Fall 2012	1	Personal use, research
Mariam	F	English, History	Fall 2012, Spring 2014	3	Personal use, research, programming
Jude	F	English, History	Fall 2012, Spring 2014	2	Personal use, research
Sarah	F	English, Mathematics	Spring 2013	1	Personal use, research, gaming, web design
May	F	English, Norwegian	Spring 2013	0*	Personal use, research
Eric	M	English, Social Studies	Spring 2013	2	Personal use, research
Tim	M	English, Religion	Fall 2013, Spring 2014	3	Personal use, research
Andrew	M	English, History	Fall 2013	0*	Personal use, research, web design
Fran	F	English, Norwegian	Fall 2013	0*	Personal use, research
Ron	M	English, History	Fall 2013	1	Personal use, research
Katie	F	English, Norwegian	Fall 2013	1	Personal use, research
Tara	F	English, Social Studies	Spring 2014	0*	Personal use, research, web design, business

* The researcher was not able to visit some student teachers during their school practicum. This was due to conflicts in the teaching schedule, illness, or unforeseen events resulting in school visits being cancelled.

The interview guide, which was based on the questions used in the survey and participant observations, drew on Kvale and Brinkmann's (2009) seven-stage process for conducting qualitative interviews. The interview guide was first pilot-tested with two recently graduated student teachers teaching ESL in secondary schools to explore ideas and theories, and to improve and revise the design of the interview questions as recommended by Maxwell (2013). The

interview guide was divided into five main themes: 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 practicum, 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 (Appendix).

In order to preserve anonymity, all interviews were held in the researcher's office located at the teacher education program, which was conveniently close and easily accessible for the participating student teachers and teacher educator. All interviews were scheduled after the school practicum period and after the student teachers' final campus-based lecture on ESL didactics. Thus, the interviews did not interfere with the student teachers' ongoing study program. By the time the student teachers had finished their last campus-based lecture, not more than five weeks had passed from when they had completed their school practicum. This also ensured that the student teachers' school practicum experiences and their experiences from the ESL didactics course were fresh in their minds. In order to establish a relaxed and safe interview environment, the participants were served refreshments like tea, coffee, and cookies. All of the interviews were semi-structured and based on the interview guide. During the interviews, the researcher asked open-ended questions and followed up with probing questions when and where it was appropriate. Throughout the interviews, it was imperative for the researcher to be a good listener and let the student teachers do the talking (Rubin & Rubin, 2012). In this way, the researcher worked towards bringing the student teachers' and the teacher educator's voice to the forefront. All of the interviews were conducted by the researcher in the interviewees' native language, Norwegian. Each interview ranged from forty-five minutes (45) to two hours (120 minutes), and was digitally recorded, transcribed, and analyzed by the researcher. Passages and excerpts from the interviews that were relevant for the project's research questions were translated from Norwegian to English, and afterwards inspected by a native English speaker.

To reduce bias in the interview process, Hammersley and Atkinson (2007) and Alvesson and Sköldberg (2009) noted the importance of reflexivity where the researcher recognizes that he or she is a participant in the world being studied, and that the interview participants will "always be influenced by the interviewer and the interview situation" (Maxwell, 2013, p. 125). From a

reflexive standpoint, the researcher approached the role as an interviewer and the interview situation according to guidelines proposed by Alvesson (2011) and Roulston (2010) as "neo-positive" (Roulston, 2010, p. 52). This involved asking good open-ended questions, minimizing researcher bias by attaining a neutral stance during the interview, generate quality data, and attempt to produce valid findings.

4.2.4   Document analysis

Merriam (2009) used *documents* as an umbrella term when referring to various sources of data such as "written, visual, digital, and physical material" (Merriam, 2009, p. 139) that can be potentially relevant for the study. Although only making up a small part of the thesis, a wide range of documents 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 and reports, and the second being documents generated in the overall project throughout the research process. Examples of the first type include Norwegian national policy documents and white papers related to the use of ICT in education (Governmental White Paper NO. 11, 2008-2009; Programme for Digital Competence, 2004-2008); reports on the use of ICT in schools, higher education, and teacher education (Gjerdrum & Ørnes, 2015; Hatlevik et al., 2013; Hetland & Solum, 2008; Tømte et al., 2013; Ørnes et al., 2011); the *Knowledge Promotion*, the *Framework for Basic Skills*, and the English subject curriculum (Ministry of Education and Research, 2006a, 2006c; Norwegian Directorate for Education and Training, 2012); digital learning resources, online newspapers, and websites (e.g. NDLA, n.d.); and curricula and stipulations for Norwegian teacher education (Ministry of Education and Research, 2010, 2013). Examples of the second type include researcher-generated documents and reflective memos; the ESL student teachers' assignments for the ESL didactics course; and student teachers' reflection logs and digital stories produced for the DST workshop. While some of the documents were located through systematic searches in databases, search engines, or in bibliographical reference lists in research articles, others emerged naturally as a part of the research process in the project. The authenticity of all documents was established and verified through source criticism using criteria such as authorship, place, online placement, and publishing date (McCulloch, 2004).

4.3 Data analysis

This section describes the approaches used to analyze the different categories of data described so far. The overall approach to data analysis was in line with Hatch (2002) who perceived it as a "systematic search for meaning" (Hatch, 2002, p. 148). This involved an iterative process of moving back and forth between consolidating, reducing, interpreting, and abstracting what had been said and done by the research participants with the intention of answering the research questions (Merriam, 2009).

4.3.1 Quantitative data analysis

The quantitative data from the two student teacher surveys (S1 and S2), the first conducted fall 2012 (S1, $N = 41$) and the second conducted spring 2014 (S2, $N = 112$), were analyzed for descriptive and quasi statistics (Maxwell, 2013; Yin, 2009) using the statistical software IBM SPSS 21 for Windows (IBM, n.d.). The descriptive statistical analyses included calculating frequencies, means, and standard deviations. The purpose of these analyses was to examine the student teachers' self-perceived digital competence 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 (Article II). One factor was identified in both surveys which included six variables related to the student teachers' self-perceived digital competence (S1, Cronbach's alpha = .705, mean = 4.74, Standard deviation (SD) = .730; S2, Cronbach's alpha = .795, mean = 5.33, SD = .644). Although it can be argued that the first survey had a fairly low sample size to perform a solid statistical analysis (Field, 2009), the internal reliability for these factors was within an acceptable level (Cronbach's alpha = $\geq$ .70). Other scales were excluded from the analysis due to low reliability. The following variables were included: 1) elementary digital skills, 2) basic digital skills, 3) didactical ICT competence, 4) digital learning strategies, 5) digital Bildung, and 6) overall digital competence. Krumsvik et al.'s (2013) study was used as a backdrop to validate the survey since this is a similar analysis of digital competence in Norwegian upper-secondary schools using the same scale as the one used in this thesis, i.e. the *Bergen Digital Literacy Scale*. Krumsvik et al. (2013) found one factor consisting of six variables for teachers (Cronbach's alpha = .86) and five variables for pupils (Cronbach's alpha = .82), which indicated a high level of internal consistency for the scale.

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4.3.2 Qualitative data analysis

This thesis included multiple analytical entry points for conducting the qualitative data analysis including participant observations, interviews, and document analysis (Leech & Onwuegbuzie, 2007). All field notes, interviews, and researcher-generated documents were imported, analyzed, and treated using the computer-assisted qualitative data analysis software (CAQDAS) NVivo 10 for Windows (Bazeley & Jackson, 2013; QSR International, n.d.). Leech and Onwuegbuzie (2007) have argued that CAQDAS is extremely useful for coding data as it "allows the researcher to take analysis of qualitative data significantly further than is possible undertaking this analysis by hand" (Leech & Onwuegbuzie, 2007, pp. 577-578). However, CAQDAS such as NVivo 10 cannot replace the researcher in doing the actual analysis. The researcher in this study was the main active agent, and the software was used only to support the analytical process (Bazeley & Jackson, 2013; Denzin & Lincoln, 2011b).

The data imported into NVivo 10 were scrutinized and coded line-by-line several times as recommended by Charmaz (2008) to ensure a more accurate and trustworthy analysis. Significant passages of data from these sources, what Sullivan (2012) called "key moments," were used to construct, support, and illustrate assertions, theories, or propositions. Analytical memos were kept as a record of written reflection on deep and complex meanings triggered by the data, and functioned as a site of "conversation" with the researcher about the data (Clarke, 2005, p. 202). The analytical memos also functioned as a site of reflexivity for the researcher and as a way of stimulating reflexive practice during the analysis process (Alvesson & Sköldberg, 2009; Saldaña, 2013).

The qualitative data analysis process in this study followed approaches from thematic analysis (Braun & Clarke, 2006) and from the constant comparison method (Charmaz, 2014a; Corbin & Strauss, 2008). Codes, categories, themes, and passages were continuously compared with each other and carefully examined through data immersion and scrutiny to find consistencies, inconsistencies, patterns, and connections. Through an abductive approach (Leech & Onwuegbuzie, 2007; Reichertz, 2007), this process was repeated until data saturation was achieved and no new codes or categories were constructed (Corbin & Strauss, 2008). In turn, the data analysis supported the interpretation where fragmented bits of data were put together and translated into themes, categories, and concepts (Peshkin, 2000; Savin-Baden & Major, 2013).

The procedure of coding the data followed a cyclical process suggested by Saldaña (2013) as "First Cycle [and] Second Cycle coding methods" (Saldaña, 2013, p. 58). First Cycle coding methods refer to the processes that happen during initial coding and recoding of data, which corresponds to Corbin and Strauss' (2008) concept of "open coding" (Corbin & Strauss, 2008, p. 195). During this phase, data were split into several smaller codes using a "splitting method" (Saldaña, 2013, p. 23). Also, this phase employed the use of different coding methods with underlying strategies proposed by Saldaña (2013) such as Elemental (*Descriptive, Structural, Initial, In Vivo, Process*), Affective (*Versus, Evaluation*), and Exploratory (*Holistic, Provisional*). For example, a "start list" (Miles et al., 2014, pp. 77-78) of *provisional codes* was developed prior to the fieldwork and data analysis based on reviewing the research literature (Kay, 2006; Tondeur et al., 2012), Article I in this thesis, the researcher's previous knowledge and experience, and the study's conceptual framework (Krumsvik, 2007b, 2008, 2014b). Some of these codes were then modified, recoded, deleted, or expanded to accommodate new codes that emerged from the data collection and data analysis process. However, as cautiously pointed out by Packer (2011), codes and themes identified in the data by the researcher "never simply 'emerge' […] [they are] the product of interpretation" (Packer, 2011, p. 70).

As for Second Cycle coding, codes from the First Cycle were "reorganized and reconfigured to develop a smaller and more select list of broader categories, themes, concepts, and/or assertions" (Saldaña, 2013, p. 207). In this phase, an "Axial Coding" strategy was used where data previously "split" or broken apart in the First Cycle coding were scrutinized, sorted, reconstructed, and put back into categories (Corbin & Strauss, 2008, p. 198). The codes generated in the First Cycle coding were recoded, reduced, and then categorized according to their resemblance during the Second Cycle coding until data saturation was achieved (Corbin & Strauss, 2008). This resulted in a number of categories with underlying subcategories. Codes were first constructed in the researcher's native tongue, Norwegian, and later translated into English. Charmaz (2014b) pointed to the tension between coding in one's native tongue and in English. Language is a central aspect of research and thus must be taken into consideration since it "shapes meaning, fosters forming different types of meanings, and clarifies or conceals connections between meanings and actions" (Charmaz, 2014b, p. 1078). To ensure that the translations were correct, translated passages were later inspected by an native English speaker before being used in publications.

5   Results – Summary and discussion

This chapter provides a summary and discussion of the three empirical research studies. This includes a presentation of research questions, aims, contexts, and findings. Next, the main contributions and implications of the findings from the thesis are discussed. The contributions that the thesis makes to the research field are presented as having empirical, theoretical, and methodological implications. Then, study limitations are addressed. Finally, the chapter ends with some concluding remarks and reflections about further research.

5.1 Summary of studies

The central aim of this thesis was to investigate the development of digital competence in secondary school ESL student teachers in the educational context of ESL didactics and Norwegian teacher education. The main research question guiding the project was examined through three underlying research studies where the overarching focus was on how digital competence is developed in ESL student teachers in Norwegian teacher education (see Introduction). At the same time, the results from each study informed the scope, aims, goals, and design of the next study. Article I scrutinizes the research literature in the field of student teachers' digital competence development through working with ICT in teacher education. In light of the findings from the previous study, Article II discusses the development of digital competence in student teachers and ICT use during their school practicum. Informed by the two former studies, Article III investigates how a DST workshop in teacher education can be used to promote digital competence development in ESL student teachers. The following section gives a brief summary of the three individual research studies in the thesis where the main findings are highlighted.

5.1.1   Article I

Røkenes, F. M., & Krumsvik, R. J. (2014). Development of student teachers' digital competence in teacher education - A literature review. *Nordic Journal of Digital Literacy*, *9*(4), 250–280.

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?*

The primary findings from the literature review study showed that, on a micro-level in teacher education programs, a broad range of different approaches are employed to develop student teachers' digital competence in order to prepare them to teach with ICT in secondary school. A strict set of inclusion/exclusion criteria were used in the database searches, which resulted in 42 online peer-reviewed empirical studies being included in the final review and making up the data material in the study. After employing a thematic analysis combined with coding and categorization strategies, eight approaches for digital competence development in teacher education were found: 1) collaboration, 2) metacognition, 3) blending, 4) modeling, 5) authentic learning, 6) student-active learning, 7) assessment, and 8) bridging theory/practice gap. The approaches found in the literature review were in line with other research reviews in the field of ICT training in teacher education (Enochsson & Rizza, 2009; Kay, 2006; Tondeur et al., 2012). Overall, teacher education programs may use these approaches to help develop student teachers' professional digital competence, and to promote didactical ways of integrating ICT in teaching. The study concluded that teacher education institutions should systematically implement similar approaches to develop student teachers' digital competence so that they can potentially utilize the real affordances of ICT professionally for teaching and learning. Secondary study findings revealed a lack of underlying epistemological and theoretical frameworks in a majority of the reviewed studies. Furthermore, a lack of studies from Scandinavian countries was identified, which was a surprising result considering how pupils, teachers, and students in schools and higher education in these countries are perceived as digitally well equipped, well supported, and highly confident in their digital skills (Hatlevik et al., 2013; Wastiau et al., 2013; Ørnes et al., 2011). Consequently, these findings revealed a gap in the literature regarding studies on secondary school student teachers' use of ICT in Scandinavian teacher education. The findings from the literature review study helped inform and narrow the scope of the aims, design, and methods used in the proceeding case study (Article II). The approaches from the literature review also helped inform the design of the final design-based research study (Article III).

5.1.2 Article II

Røkenes, F. M., & Krumsvik, R. J. (under review). Prepared to teach ESL with ICT? A study of digital competence in Norwegian teacher education. Manuscript submitted for publication in *Computers & Education*.

Research question: *How does an ESL didactics course at a Norwegian teacher education program contribute to developing digital competence in secondary student teachers?*

Using both quantitative and qualitative data, this case study focused on digital competence development in secondary school ESL student teachers participating in an ESL didactics course at a Norwegian teacher education program. Results from the case study revealed that the student teachers' mastery and appropriation of digital competence varied throughout their studies in ESL at the teacher education program. Particularly, their digital competence and innovative use of ICT for teaching ESL in secondary school was both promoted and inhibited through a number of factors and approaches which they encountered both in their ESL didactics course and during their school practicum. By using a digital competence model as an analytical lens (Krumsvik, 2014b) in the data analysis, several approaches stood out. Some of these were teacher-focused, such as the teacher educator or mentor teacher modeling ICT integration and innovative assessment with ICT, scaffolding hands-on learning activities, and offering access to resources and support. Others were learner-focused, requiring the student teachers to comprehend the link between theory and practice concerning teaching ESL with ICT, seeing the role and real affordances of ICT in ESL teaching through critical reflection, and learning about teaching with ICT with peers through collaborative learning. These approaches were also validated and theoretically supported through the prior literature review study on the use of ICT in teacher education (Article I).

One of the main findings in Article II was that the student teachers seemed confident in their elementary and basic digital skills while at the same time lacking didactical ICT competence, digital learning strategies, and digital Bildung. Moreover, the student teachers appeared to rely heavily on the teacher educator as a digitally competent role model for their own integration of ICT in ESL teaching during their school practicum. A potential explanation could be that the student teachers lacked opportunities to experiences hands-on activities of innovative ICT-integration in ESL teaching during the ESL didactics course in the teacher education program. As a consequence, a majority of the student teachers reverted to teacher-centered pedagogies during their school practicum where the primary use of ICT was for instruction and content delivery.

In addition to being a practical contribution, a theoretical implication of the study was the approach of analyzing data on student teachers' development of digital competence using a digital competence model as a research lens (Krumsvik, 2014b). The model was originally meant to be used in examining digital competence in teachers and teacher educators. Hence, Article II showed how the model can be applied to other sample populations such as student teachers. Because the model was based on a sociocultural learning perspective and considered perspectives from the Norwegian educational research context, Norwegian educational policy and steering documents, it provided unique insight into the development of secondary ESL student teachers' digital competence compared to similar analytical frameworks (e.g., Mishra & Koehler, 2006). An empirical implication of the study was that teacher educators and mentor teachers should be reminded of their role as digital role models for student teachers' pedagogical and didactical use of ICT (Krumsvik, 2014b). Consequently, teacher educators might need to shift their teaching with ICT from using it for instruction and content delivery towards the approaches noted in the literature review study (Article I). In summary, if student teachers are to develop digital competence and learn how to integrate ICT in creative and innovative ways in their subject discipline, teacher educators need to "teach as they preach" by shifting their role from being a "sage on the stage" to a "guide on the side" (McWilliam, 2008).

A methodological implication was that the transparency of methods used in the study to collect and analyze data could allow other researchers and educators to replicate the study for other settings and for similar purposes. Another methodological development was the use of SRS feedback clickers as a way of conducting surveys and for collecting self-reported data in educational research (Krumsvik, 2012). Since this method of collecting data has not been attempted before with student teachers in Norwegian teacher education, it could potentially be considered a methodological innovation. The overall findings of the study guided and prompted the design and execution of a design-based research intervention study (Article III), which comprises the final study in the thesis.

5.1.3   Article III

Røkenes, F. M. (in press). Digital storytelling in teacher education: A promising way of integrating ICT in English teaching. *Acta Didactica Norge*.

Research question: *How can a DST workshop in teacher education promote secondary school ESL student teachers' digital competence?*

This study used a design-based research approach (DBRC, 2003) to explore how a DST workshop in teacher education can promote digital competence in secondary school ESL student teachers. Using a digital competence model as a research lens (Krumsvik, 2014b), the study followed three phases, each of which informed the design and development of a DST workshop. Through two consecutive trials and evaluations of the workshop, the design of the study incorporated a number of approaches or "design principles" (Reeves, 2006) identified in the two previous studies (Article I & Article II) such as modeling ICT integration and assessment, scaffolding student-active learning, collaborative learning, and linking theory and practice through reflection–on–action.

The main findings from the study indicated that, through the DST workshop, the ESL student teachers were able to see, experience, and reflect upon innovative and didactical ways of using ICT in their future ESL teaching. Also, the workshop activities helped the student teachers link theoretical concepts about ESL teaching with ICT and with the English subject curriculum. Furthermore, the student teachers seemed to be able to move beyond the mastery of elementary and basic digital skills towards appropriating didactical ICT competence, digital learning strategies, and digital Bildung. In terms of empirical implications, the study showcased how the concept of DST could be used in teacher education as a purposeful and innovative way of promoting digital competence among student teachers, in ESL didactics, and in language teaching. Furthermore, the transparency of methods used in the study could encourage other researchers and teacher educators to replicate and implement the workshop design in other teacher education programs, thus promoting innovative, student-active ways of using ICT in teacher education.

5.2 Discussion

The overarching focus of the thesis was how ESL student teachers develop digital competence 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 must 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' professional digital competence for integrating ICT in their subject-discipline such as ESL. Ultimately, such a competence could better equip student teachers to face the increasingly complex demands of the curriculum, contemporary schools, and learning expectations of current and future generations of pupils. Otherwise, a gap might be created between what student teachers are taught in teacher education and the actual practices that they face in school settings after graduation (Krumsvik, 2014b). Supposedly, through teacher education, student teachers are exposed to and taught different pedagogical approaches and didactical ways of teaching their subject-discipline, which may or may not involve the integration of ICT. Literature reviews on ICT-training in teacher education (Enochsson & Rizza, 2009; Kay, 2006; Tondeur et al., 2012), including the first research study in this thesis (Article I), have identified several approaches about how student teachers work with ICT in teacher education. The multitude of these approaches in the research literature seems to paint an optimistic picture of how student teachers are and can be prepared to teach with ICT in their future careers as professional teachers. However, the data material in the thesis, notably the data analyzed in Article II, showed that few of these approaches are actually implemented by the ESL teacher educator. Moreover, from the data, it appears that most ICT usage by both the student teachers and the teacher educator in this study is based on traditional teacher-centered ways of teaching, i.e. content delivery and instruction.

Some of the findings in the thesis, for instance, how ICT integration in teacher education seems to be mostly teacher-centered and tool-focused, are not necessarily new as they have been previously mentioned in reports on digital competence and ICT use in Norwegian teacher education (Gjerdrum & Ørnes, 2015; Hetland & Solum, 2008; Tømte et al., 2013; Ørnes et al., 2011). At the same time, 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 for content delivery and instruction. Although this might be the most common use of ICT in teaching today, over forty years of research about the impact of technology on learning has shown that "one of technology's main strengths may lie in supporting students' efforts to achieve rather than acting as a tool for delivering content" (Tamim et al., 2011, p. 17). 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, 2014b). In a report on professional digital competence in recently graduated teachers, Guðmundsdóttir et al. (2014) emphasized these results and noted that little correspondence between the ICT training in teacher education and the demands regarding teaching with ICT in school. The next sections present and discuss the overall implications of the study related to developing digital competence in teacher education. These are organized into empirical, theoretical, and methodological implications including study limitations.

5.2.1 Empirical implications

The main empirical contribution of this thesis is increased knowledge about how digital competence is developed in teacher education in student teachers who are qualifying to teach in secondary school. Following a design-based research methodology (DBRC, 2003) and qualitative dominant mixed methods research (R. B. Johnson et al., 2007), the thesis showcases different approaches for ICT training in teacher education, which in turn can be used to develop digital competence in student teachers. For example, the literature review study (Article I) highlights approaches such as modeling, metacognition, and collaborative learning as important steps in teacher education towards digital competence development. Further, the thesis shows how the teacher educator is an important factor with regard to digital competence development in student teachers, notably through modeling and scaffolding ICT integration in teaching as pointed out in the case study (Article II). Finally, the thesis shows how working with the method of DST in teacher education can be used to integrate ICT in ESL teaching in an innovative way, as well as to develop student teachers' digital competence. The design-based research study further shows how the approaches found and scrutinized in the former studies could be applied in developing a workshop design on DST in teacher education (Article III). Taken together, the findings inform, demonstrate, and underline how teacher education can develop digital competence in future teachers, which will be discussed further in this section.

First and foremost, across all of the studies in this thesis (Articles I–III), the teacher educator stands out as the most important factor for developing digital competence in student teachers. One of the most noticeable empirical findings in the data is the importance of the teacher educator as a digital role model for the student teachers. During the ESL didactics course, the ESL teacher educator modeled a number of digital technologies and demonstrated for the student teachers how to seamlessly integrate these into English language teaching (Article II).

Consequently, this thesis offers evidence that student teachers pick up and employ these uses of ICT during their school practicum when teaching English in secondary school. Thus, the data give strong indications of a link between what and how the teacher educator uses digital tools and the student teachers' subsequent integration of ICT in teaching. While the research literature has for some time emphasized the use of modeling in teacher education (e.g., Lunenberg, Korthagen, & Swennen, 2007), this concept has perhaps become even more important and at the same time more complex in the last decade with the spread of ICT at all levels of education (Krumsvik, 2014b). The research literature offers strong support for modeling (Enochsson & Rizza, 2009; Kay, 2006; Tondeur et al., 2012), and the thesis contributes to the discussion that the use of modeling in teacher education is an important approach to develop digital competence in student teachers. Notably, the literature review study (Article I) found that modeling was used as an approach in 31 out of 42 peer-reviewed studies on ICT training in teacher education. Furthermore, data from both the case study and the design-based research study (Article II & Article III) note the effect that modeling has on ESL student teachers' integration of ICT in ESL teaching.

Second, with regard to learning how to integrate ICT in subject-discipline teaching such as ESL, the teacher educator consequently plays a critical role for student teachers to master and appropriate professional digital competence (Instefjord, 2014; Lund et al., 2014). As discussed above, it became evident in the data that the teacher educator in ESL didactics played an important part as a digitally competent role model for the ESL student teachers in the ways ESL was perceived to be taught with or without ICT (Article II). However, because a majority of the ICT usage by the ESL teacher educator was teacher-centered and with a focus on instruction and content delivery, the ESL student teachers' ICT integration also seemed to be affected by these experiences during the school practicum. Evidence from the data showed that the student teachers' use of ICT ended up being fairly superficial, and was mostly dominated by administrative and office software, presentation technologies, social media, and using the Internet to locate information. Thus, the student teachers drew on their elementary and basic digital skills. Although these digital technologies were already familiar and mastered by the student teachers, the issue was how to develop their digital competence so that they moved from mastering basic digital skills to appropriating didactical ICT-competence. A possible solution here is to provide student teachers with opportunities to master and appropriate professional digital competence

(Instefjord, 2014), which means that they need to get hands-on experience with how they integrate ICT in their subject-discipline teaching (Article III). 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 professional digital competence (Tearle & Golder, 2008). The empirical implications here are that teacher educators and mentor teachers need to set aside time in didactics lessons on the university campus and during the school practicum to provide scaffolded support for the student teachers to experience and practice authentic, pedagogical, and didactical ways of teaching with ICT. However, as expressed clearly by the ESL teacher educator in the interview data, time is a major constraint when trying to include ICT in ESL didactics courses. Here, teacher educators might need to redistribute what is to be taught in the university campus lectures and what is to be taught by the mentor teachers in school. Alternatively, using a flipped classroom model of instruction (Fraga & Harmon, 2014) could solve some of the issues regarding time constraints mentioned by the teacher educator. Also, more responsibility could be put on mentor teachers to support the development of digital competence in student teachers during their school practicum (Grove, Strudler, & Odell, 2004). Overall, the findings imply that teacher educators need to critically and didactically reflect on what, how, and why they use ICT during teacher education as they can be shown to set an example for how student teachers will be using ICT in their future teaching. In other words, if teacher educators want student teachers to use ICT in innovative, student-active ways in their teaching, then teacher educators themselves need to "teach as they preach" with ICT in teacher education. Finally, this argument can also be extended to include the students' mentor teachers during the school practicum, who also stand out as digital role models.

Third, the empirical contributions of this thesis also concern the field of ESL didactics in teacher education. More specifically, an empirical or didactical implication regards the use of DST as an innovative way of teaching ESL with ICT, and how the method can be used for developing digital competence in ESL student teachers (Article III). The evidence from the study shows how approaches from the research literature about ICT training in teacher education can be applied to a design-based research study context for promoting professional digital competence in ESL student teachers. Notably, this includes the teacher educator modeling DST and setting aside time for the student teachers to try out DST for themselves in a scaffolded and collaborative learning environment. Through the use of familiar, basic desktop tools for creating digital stories such as

Movie Maker, the threshold for integrating ICT in teaching is potentially lowered, thus increasing the chances that the student teachers will use DST in their future teaching. Also, a critical aspect is to have student teachers reflect on the work process, purpose, and learning potential that ICT integration such as DST can have on pupils' learning in ESL, thus ensuring "reflection-on-action" (Schön, 1983). Taken together, these approaches or "design principles" might stimulate the student teachers' digital competence development to go beyond mastering basic digital skills towards appropriating didactical ICT-competence. Further, 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. Additionally, the thesis shows how the design also took into considerations issues raised by the ESL student teachers in the case study, such as lack of time and opportunities to try out digital tools in ESL teaching, lack of access to supporting role models and resources, and lack of student-active teaching activities with ICT (Article II). Although the length of the workshop was limited to three hours, it seemed that the activity managed to address most of the student teachers' concerns. Thus, the student teachers were given an opportunity to experience authentic and innovative teaching with ICT in a scaffolded learning environment where their roles were shifted from being passive consumers of information to active producers of knowledge. Moreover, the results of the study iterations and refinements of the workshop design can potentially provide a blueprint for other researchers and teacher educators who wish to implement the method in similar contexts.

No prior empirical study in this field has investigated the context of ESL subject didactics and teacher education with secondary school ESL student teachers. Thus, this thesis can be considered an original empirical contribution to the literature and the field of teacher education research, ESL didactics, and professional digital competence.

5.2.2 Theoretical implications

A theoretical contribution of this thesis is related to the use of Krumsvik's (2014b) theoretical model for examining digital competence development in student teachers (Figure 2). Originally, the model was intended for investigating digital competence in teachers and teacher educators (Krumsvik, 2014b). In this thesis, the model was applied as a research lens for examining ESL student teachers' digital competence development in teacher education in two of the studies (Article II & Article III). Hence, the application of the digital competence model in the thesis

shows how such a model could potentially be applied to other sample populations such as university lecturers, mentor teachers, and pupils (Krumsvik et al., 2013; Skaar & Krumsvik, 2015). The theoretical and empirical backdrop of the model helped in the methodological design of research instruments including the construction of survey items and development of the interview guide. Furthermore, the application of the model in the data analysis process provided a language for examining, describing, and discussing the ESL student teachers' digital competence journey in teacher education. Additionally, the model helped generate empirical evidence that shed light on the different parts that make up student teachers' digital competence where they express mastery of elementary and basic digital skills. Thus, the model helped make explicit the student teachers' "tacit knowledge" (Polanyi, 1966). As such, one theoretical contribution is the illustration of how teacher educators and student teachers can employ such a model to critically reflect on what, how, and why they integrate ICT in teaching. In other words, the model can be used as a starting point for stimulating "reflection-on-action" (Schön, 1983) about professional digital competence in the teaching profession.

Other Norwegian studies on digital competence in teacher education seem to prefer the more widely cited TPCK model (Tømte et al., 2015) by Mishra and Koehler (2006) or the DIGCOMP framework (Instefjord, 2014; Tømte, 2013) by Ferrari (2013). In contrast, this thesis demonstrates how Krumsvik's (2014b) model can be applied to study this phenomenon in a Norwegian teacher education setting. The model draws on terminology found in Norwegian educational policy and steering document such as digital skills, didactics, and Bildung, and directs focus on which skills, knowledge, and attitudes (i.e., competencies) are important to take into consideration when promoting digital competence in student teachers and the use of ICT in the overall teaching profession. In this sense, another theoretical implication and contribution of this thesis is to the debate regarding professional digital competence. Specifically, this study calls for more critical awareness and focus on how teachers, teacher educators, and student teachers can utilize ICT for teaching in a sound pedagogical and didactical way (Guðmundsdóttir et al., 2014; Lund et al., 2014; Ottestad, Kelentrić, & Guðmundsdóttir, 2014; Tømte et al., 2013). Here, the thesis provides theoretical arguments for further promoting the development of professional digital competence in teacher education. In particular, the literature review study (Article I) points out the lack of research on digital competence in Scandinavian teacher education, which implies that ICT has received little attention in the field of teacher education research.

Finally, the thesis makes a third theoretical contribution by employing sociocultural learning theory in research on digital competence development in teacher education. Specifically, Wertsch's (1998) concepts of mastery and appropriation of cultural tools were used in conjuncture with Krumsvik's (2014b) digital competence model which are both rooted in sociocultural learning theory (Säljö, 2001). Thus, the thesis has contributed with expanded knowledge to the research field of teacher education and ESL teaching about how and why ESL student teachers should learn how to integrate ICT in English language teaching through mastery and appropriation of professional digital competence in teacher education (Article II & Article III). As such, the thesis attempts to address some of the epistemological and theoretical shortcomings found in over half of the studies scrutinized in the literature review study (Article I).

5.2.3 Methodological implications

The transparency of methods used in the thesis can be considered to be a methodological contribution. Throughout the research process, the underlying intention has been to promote transparency to encourage other researchers in the field of teacher education research to attempt to replicate or utilize the research design in similar contexts. In addition, transparency can encourage other teacher educators to implement the approaches and innovations regarding the use of ICT in teacher education. In brief, methodological transparency was achieved in the following ways: Throughout the synopsis and the three research studies, the research design, methods for data collection, and the process of data analysis were thoroughly described and scrutinized along with potential validity threats such as research bias. For instance, inclusion/exclusion criteria, database searches, and article hits were well-documented and explained in Article I. Moreover, in Article II and Article III, methods were thoroughly described in every step of the process related to the analytical coding process of field notes and to the interviews where the construction of categories was described in detail. Finally, being explicit and transparent about methodology has been a way to address findings from literature reviews (e.g., Kay, 2006), which note methodological flaws and the underreporting of designs in studies on ICT training in teacher education.

Another methodological implication regards the use of innovative research designs and methods for collecting data. For example, the use of SRS feedback clickers for collecting survey data live

in a plenary lecture can perhaps be considered an innovative method, and thus holds methodological implications for collecting quantitative data. Other Norwegian studies have successfully employed this method in different contexts including for data collection on pupils and teachers' digital competence in secondary school (Krumsvik et al., 2013), and students' learning outcomes in higher education (Krumsvik & Ludvigsen, 2012; K. Ludvigsen, Krumsvik, & Furnes, 2015). This thesis, however, might be the first to collect data on ESL student teachers' digital competence in teacher education using SRS feedback clickers. In turn, this could also be considered an empirical contribution as well as a methodological one.

Finally, the use of design-based research (DBRC, 2003) with mixed methods research (Creswell & Plano Clark, 2011; R. B. Johnson et al., 2007) in this thesis can be considered a methodological contribution to the research field. The thesis was inspired by design-based research and drew especially on Herrington (2007) who encouraged more doctoral students to employ this type of research design for investigating educational technology. Following the use of research phases suggested in the literature on both design-based and mixed methods research helped inform and design the three studies in the thesis. Although the emphasis was on qualitative methods for data collection, both the quantitative and the qualitative dimensions of the project have added to both broad and detailed insight into the data. This richness of data was important for highlighting what goes on in teacher education as well as in the student teachers' school practicum with regard to digital competence development. In this context, the various sources of data have attempted to draw a picture of not only what goes on in terms of ICT usage, but also of how the processes involved are perceived, mastered, and appropriated by the student teachers and their teacher educator.

5.2.4 Limitations

As with all research projects, this thesis has certain limitations. In Article I, the focus of the review was limited to student teachers qualifying to teach the secondary school grade, and the focus could also have encompassed primary or elementary student teachers. Another limitation regards the number of keywords, which could have been expanded to include "Internet literacy," "pedagogy," "didactics," and "teacher education." Moreover, other available online databases could have been explored such as Google Scholar, ProQuest, PsychInfo, and PubMed. Additionally, a manual search could have been performed with the leading journals in the field of

ICT and education like *Computers & Education*; *Technology, Pedagogy and Education*; and *Teaching and Teacher Education*. Finally, excluded sources other than online peer-reviewed empirical articles such as conference proceedings, book chapters, doctoral theses, and policy documents could have been examined for relevant literature to include in the review process. However, focusing the review on secondary school student teachers also helped narrow the focus and scope of the review and the proceeding research studies in the thesis, thus making it a necessary choice to conduct the research project. Also, including more keywords, databases, and conducting time-consuming manual searches might not have yielded more results.

For Article II, other Norwegian teacher education programs could have been investigated to get a comparative perspective on digital competence development across both subject disciplines and institutions. What is more, the collected survey data from the student teachers using ARS feedback clickers were based on self-reported measures, and might have reflected the student teachers' attitudes and beliefs rather than the actual situation at the teacher education program. On one hand, comparing digital competence development in different groups of student teachers from various subject-disciplines and teacher education programs would be interesting. However, on the other hand, such as study would perhaps be too time-consuming and outside of the scope for this doctoral project where the focus was on ESL student teachers in one ESL didactics course at one Norwegian teacher education program. Moreover, the use of self-reported measures to assess student teachers' digital competence can also be argued to be a common method for collecting survey data, and where previous studies have tested and validated the scale used in the study (*Bergen Digital Literacy Scale*) with other populations in educational settings (Krumsvik et al., 2013; Skaar & Krumsvik, 2015).

Limitations with Article III regard the short amount of time allocated to the DST workshop. In addition, the number of iterations with the workshop could have been extended to include more trials and assessments to refine the didactical design. Also, the study did not examine the student teachers' digital stories as a part of the assessment of their digital competence. However, even though workshop time and the number of iterations in the study were limited, results showed improvements in the workshop design, an increase in the number of digital stories and reflection logs, and a shift in didactical thinking regarding teaching ESL with ICT. A solution might be to supplement the workshop with a flipped classroom model of instruction for expanding the

traditional, physical classroom (Fraga & Harmon, 2014). Then, ICT would perhaps require ESL didactics to not only focus on what to teach, how to teach, and why teach (Künzli, 2000), but would also have to consider "when to teach and where to teach" (Lund & Hauge, 2011, p. 263). In addition, an analysis of the digital stories would have required other theoretical perspective and analytical tools such as multimodal theory, and was outside of the scope of the study. The digital stories could perhaps have been used as an indicator of the student teachers' basic digital skills, but these had already been assessed through other measures.

5.3 Conclusion

At the onset of this doctoral project starting in spring 2012, the amount of research on ICT use and digital competence in Norwegian teacher education was scarce and reserved to a few reports. In addition, studies on digital competence in student teachers qualifying to teach in the Norwegian secondary school system was completely absent in the research literature. Likewise, the number of studies on ICT use in ESL didactics in this setting was close to (if not actually) non-existent. Present day, in the spring of 2016, four years have passed, and the increased output in publications can be said to mirror a significant rise of interest in the field of technology use in teacher education and subject didactics.[28] Hopefully, this thesis is a contribution in this movement, and is an attempt to address the lack of research, focus, and priority that has been put on ICT in teacher education.

As discussed throughout this thesis, digital competence has become crucial in contemporary society where new technological innovations seem to constantly have a disrupting effect on the way we learn, do business, communicate with each other, work, and do research. Therefore, one of the main arguments in the thesis should be repeated: Developing professional digital competence in future teachers in Norwegian teacher education needs prioritizing so that they are better equipped to face the uncertainties and complex[29] demands of teaching in the digitalized school. In turn, these teachers will potentially play an important part in developing digital

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[28] The *Nordic Journal of Digital Literacy* (Søby, n.d.) dedicated two special issues on the topic (2014, vol. 04 and 2015, vol. 01), which most likely put more focus on investigating the use of digital technologies in teacher education.
[29] It can be argued that the complexities of being a professional teacher have increased in contemporary society with an increased amount of reporting and assessment, and governmental demands and standards for academic qualifications and subject-discipline competence. The presence of ICT contributes to this context where a digitally competent teacher might experience a reduced complexity compared to those teachers who are not digitally competent (Krumsvik et al., 2013). These are perhaps aspects that teacher educators need to take into consideration when preparing future teachers in teacher education.

competence in pupils by standing out as digital role models. The research presented in this thesis could possibly inform policymakers, teacher educators, mentor teachers, and student teachers about how ICT can be used for teaching in pedagogical and didactical ways. Although there seems to be a renewed interest in research on digital competence in teacher education, the research community must continue to explore current and innovative ways of teaching with ICT. Of particular interest is more research on how ICT can be used didactically in teacher education with future teachers qualifying to teach various subject disciplines. While this thesis is an original contribution to this line of research, there should be more interest in knowing how to prepare future teachers to utilize ICT didactically in their teaching other than using technology for instruction and content delivery.

While undertaking a research project focusing on the development of digital competence in teacher education, many interesting avenues for research seem to emerge which are difficult to pursue within the timeframe of a doctoral thesis. However, these avenues can be interesting paths to pursue as further research in the field of teacher education, language teaching, and teaching with technology. First, a number of interesting topics appeared in the data, but were not pursued further. One example was ESL student teachers' lack of exposure and formal training with interactive whiteboards, which is a widespread yet underused digital tool in a majority of Norwegian secondary schools. Based on British educational research where the spread of interactive whiteboards has been high (Hennessy & London, 2013), Kneen (2015) argued that research on and formal training in the use of interactive whiteboards for teaching English in secondary school is lacking. A similar argument could be applied to Norway, where there is a need to further investigate how these interactive technologies can be used in teacher education to promote ESL student teachers' didactical use of ICT in teaching. In addition, recent Norwegian studies have directed their attention to the weak links between the teacher education guidelines, national regulations, curriculum, and digital competence (Engen, Giæver, & Mifsud, 2015; Instefjord & Munthe, 2015). Thus, more studies should continue to explore how teacher education programs interpret digital competence in the teacher education curriculum and further operationalize the concept into their teaching.

Secondly, because the thesis focused on digital competence development in ESL student teachers in teacher education, data or reports of how they use or do not use ICT when teaching ESL in

secondary school after graduation was not collected. Hence, further research should investigate graduated student teachers' professional digital competence and the effects of ICT use in teacher education. As previously reported by Guðmundsdóttir et al. (2014), recently graduated teachers saw little correspondence between the ICT training in teacher education and the demands regarding teaching with ICT in school. While these findings are important and relevant for teacher education, future studies should adopt longitudinal mixed methods designs where different sources of data are collected over longer periods of time. Krumsvik (2014b) supported this assertion, arguing for more knowledge about digital competence in teacher education in order to make sound research-based decisions and recommendations because it is a relatively new area and "we have little longitudinal research to rely on" (Krumsvik, 2014b, p. 269). Furthermore, these investigations should be extended across more groups of student teachers and subject disciplines such as social studies, foreign languages, and physical education where ICT is also frequently mentioned in the Norwegian national curriculum (Ministry of Education and Research, 2006a).

Finally, the thesis attempted to showcase how ICT could be used for teaching ESL in an innovative way, which was exemplified through the use of DST (Article III). 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, while there seems to be an abundance of literature regarding the use of video in teacher education, more research could explore the use of video with ICT integration in teacher education. The combination of video and teaching with ICT could help "situate teaching activity by capturing practice in context and relating these with associated evidence of student learning" (Koh, 2015, p. 230). In turn, the use of video technologies in teacher education such as video annotation tools (Rich & Hannafin, 2009), open digital exams using relevant and authentic video cases (Lund & Engelien, 2015), and recordings of authentic subject teaching situations with ICT (Ho, Leong, & Ho, 2015) could enable student teachers to engage in "reflection-on-action" (Schön, 1983) on the role of theory and the potential for innovative use of ICT in their teaching. Moreover, video technologies could also 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, which is often a result of "apprenticeship of observation" (Lortie, 1975, p. 61), i.e. the notion that student teachers tend to teach the way

they were taught. Finally, an emerging topic for further research is how student teachers' digital competence could be assessed using Big Data[30] and complex features with existing and new technologies in teacher education such as applying learning analytics to online learning environments including massive open online courses (MOOCs) and learning management systems (Martin & Whitmer, 2015).

Based on the main findings in this thesis, an overall recommendation for teacher education is perhaps to move away from traditional teacher-centered instruction and content delivery with ICT towards constructivist pedagogy and student-active teaching. However, this requires a shift in pedagogical control and epistemological beliefs. For teacher educators, an important step might therefore be to move from being a "sage on the stage" to becoming a "guide on the side" (King, 1993).

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[30] Manovich (2011) refers to a definition of Big Data which is offered by the computer industry: "Big Data is a term applied to data sets whose size is beyond the ability of commonly used software tools to capture, manage, and process the data within a tolerable elapsed time" (Manovich, 2011, p. 1).

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Part II: The studies

Paper I

Development of Student Teachers' Digital Competence in Teacher Education

A Literature Review

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PEER REVIEWED ARTICLE

ABSTRACT

This article is a literature review of online peer-reviewed empirical studies from 2000 to 2013 regarding the development of digital competence of student teachers in teacher education qualified to teach in the secondary school grade level. The purpose of the review is to showcase and establish knowledge about empirical research on ICT-training in teacher education, and contribute with an overview of approaches for researchers, teacher educators, and policymakers on how teacher education develop student teachers' digital competence for the secondary school grade level. A total of 42 studies met the inclusion criteria and were included in the review. Based on a thematic analysis of the studies, including coding and categorization strategies, eight approaches were identified: *collaboration, metacognition, blending, modeling, authentic learning, student-active learning, assessment*, and *bridging theory/practice gap*. The approaches consider ways that teacher education programs promote student teachers' digital competence, and educate them in professionally using ICT for their future use in school and classroom teaching in secondary education.

Keywords

digital competence, digital literacy, computer literacy, media literacy, student teacher, teacher education, review, ict, technology

INTRODUCTION

In the last decade there has been a significant increase in the number of empirical studies that focus on technology training of student teachers in teacher education, and investigate their preparedness to use and teach with Information and Communications Technology (ICT) in today's technology rich schools (Barton

& Haydn, 2006; Dexter & Riedel, 2003; Tømte, 2013). Previous literature reviews by Kay (2006), Enochsson & Rizza (2009), and Tondeur et al. (2012) have assessed different strategies used by teacher education institutions to train student teachers in the use of ICT for their future teaching profession. In his influential review of sixty-eight studies of student teachers' technology training in teacher education, Kay (2006) found ten key strategies commonly used where the two most common program strategies were either a fully integrated approach or a single technology course. His review revealed that the vast majority of studies suffered from methodological flaws, and concluded that "more rigorous and comprehensive research is needed to fully understand and evaluate the effect of key technology strategies in preservice teacher education" (Kay, 2006, p. 383). Tondeur et al. (2012) carried out a similar literature review focusing on synthesising the qualitative evidence in nineteen empirical studies of technology training of student teachers in teacher education. Their synthesis generated twelve key themes for "content and delivery methods that prepare pre-service teachers to integrate technology into their future classrooms" (Tondeur et al., 2012, p. 138). Some of the most reoccurring themes identified in the review were scaffolding, aligning theoretical and practical knowledge through the use of ICT, and the use of modeling by teacher educators. However, the authors observed an overlap between the themes, and they seemed to be "linked together in a way that made it difficult to address them separately" (Tondeur et al., 2012, p. 141). As a consequence, they argued that "in order to successfully train pre-service teachers to use technology, teacher education programmes need to address all these key variables thoughtfully" (Tondeur et al., 2012, p. 141).

Although previous reviews have provided some well-defined overviews of strategies, approaches, and themes regarding student teachers' ICT-training in teacher education, none of them clearly differentiate between the student teachers' qualified school grade teaching level and the teaching competence they receive during their teacher education. In fact, there have been no reviews focusing exclusively on ICT-training in teacher education of student teachers that are qualified to teach in secondary schools (i.e., lower-secondary to upper-secondary school, 8th to 13th grade, or from Middle school to High school). Kay (2006) points to the lack of studies within this field, and recommends future studies to "expand the focus to pre-service teachers of older students" (Kay, 2006, p. 386). Past reviews and studies have focused more on a macro- and meso-level analysis of how teacher educations usually organize their student teachers' ICT-training with an emphasis on program technological infrastructure, policy, and barriers and enablers rather than on a micro- or interactional levels focusing on showcasing daily teaching practices and activities with ICT (e.g., Kay, 2006; Y.-M. Wang & Chen, 2006; Wild, 1995). Rasmussen and Ludvigsen (2008) call for an interactional orientation and note that a problem with too much focus on a "top-down approach is that it conceals changes that happen on the microlevel" (Rasmussen & Ludvigsen, 2008, p. 83). In response to the issues described by Kay (2006) and Rasmussen and Ludvigsen (2008), this study is a literature review (Hart, 1998; Jesson, Math-

eson, & Lacey, 2011) of online peer-reviewed empirical studies within the research field of student teachers' digital competence development in teacher education published in online journals from 2000 to 2013. The purpose of this study is to establish knowledge about empirical research on ICT-training in teacher education, and contribute with an overview of approaches for researchers, teacher educators, and policymakers on how teacher education institutions can develop student teachers' digital competence in secondary education.

The concept of digital competence is central in this review, and can be broadly defined as "skills, knowledge, creativity, and attitudes that everybody needs in order to use digital media for learning and functioning in the knowledge society", a definition found in Scandinavian studies on ICT in education (Erstad, Kløvstad, Kristiansen, & Søby, 2005, p. 8, my translation). Here, digital competence is largely understood as more than just the ability to use software or operate digital devices, and involves "a large variety of complex skills – cognitive, motoric, sociological, and emotional – users need to have in order to use digital environments effectively" (Eshet-Alkali & Amichai-Hamburger, 2004, p. 421). The review also recognizes that there are several different terms and definitions concerning digital competence (Ala-Mutka, 2011; Ferrari, 2012) as well as knowledge, skills, and attitudes about technology and media use such as digital literacy (Buckingham, 2006; Lankshear & Knobel, 2006), computer literacy (Nawaz & Kundi, 2010), and media literacy (Hobbs & Jensen, 2009; Potter, 2014), and that these concepts have different meanings in different academic, cultural, historical, social, and educational contexts. Moreover, based on the vast number of studies on teachers' use of ICT in the classroom (e.g, Almås & Krumsvik, 2007; Blikstad-Balas, 2012; Cox et al., 2004; Karaseva, Pruulmann-Vengerfeldt, & Siibak, 2013), this article also emphasizes that teachers' professional use of digital technologies and digital competence is different than that of other professions. This point is underscored in Krumsvik's (2011b) definition of digital competence, which focuses first and foremost on teachers, where he defines digital competence as "the teacher's…proficiency in using ICT in a professional context with good pedagogic-didactic judgment and his or her awareness of its implications for learning strategies and the digital Bildung of pupils and students" (Krumsvik, 2011b, pp. 44–45). Furthermore, this review is informed by and draws on knowledge produced by previous reviews on student teachers' technology training in teacher education. The research question addressed in this study is: *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?*

BACKGROUND

The success of the uptake, use, value, role, and effect of digital technologies in school and education has been heavily debated over the past decade (Cuban, 2001; Hennessy, Ruthven, & Brindley, 2005; Livingstone, 2012; Olofsson, Ola Lindberg, Fransson, & Hauge, 2011). Prior debates have mainly been con-

cerned with whether or not the integration of ICT has an effect on student learning, achievement scores, and whether it can stimulate deeper subject knowledge, learning, and understanding (Condie, Munro, Seagraves, & Kenesson, 2007; Kirkwood & Price, 2005; Lei & Zhao, 2007; Means, Toyama, Murphy, Bakia, & Jones, 2010; Russell, Bebell, O'Dwyer, & O'Connor, 2003; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011). Recently, studies exploring the use of digital technologies in education have shifted their focus to the increased role of ICT in the knowledge-based society, its role in learners' personal lives, and its role in the development of appropriate knowledge, skills, competencies, and attitudes for lifelong learning (Bennett, Maton, & Kervin, 2008; Erstad, 2010b; Janssen et al., 2013; Lankshear & Knobel, 2006; Ng, 2012; Voogt, Erstad, Dede, & Mishra, 2013). The effectiveness of implementing ICT in schools may partly rely on the students' digital competence, or their abilities and skills to use technology and digital environments effectively (Hatlevik & Christophersen, 2013). However, this also depends on how well teachers and future teachers are able to implement and use ICT in an effective and appropriate manner for teaching and learning (Gudmundsdottir, Loftsgaarden, & Ottestad, 2014; Hatlevik, Egeberg, Gudmundsdottir, Loftsgaarden, & Loi, 2013; Krumsvik, 2007).

Several studies (Kirschner & Davis, 2003; Krumsvik, 2011b, 2014; Polly, Mims, Shepherd, & Inan, 2010; Valcke, Rots, Verbeke, & van Braak, 2007) emphasize that teacher education programs must properly educate student teachers in the use of ICT in order to develop their digital competence. However, research on teacher education still depicts an overall lack of knowledge among student teachers and teacher educators on how to utilize ICT in a pedagogical and didactical manner (Haugerud, 2011; Hetland & Solum, 2008; Tømte, 2013; Ørnes, Wilhelmsen, Breivik, & Solstad, 2011). This digital competence or digital literacy has the potential to promote student subject learning, and equip students with the necessary digital skills and attitudes to function in the twenty-first century knowledge society. Due to the rapid development of digital technologies in the emerging information society, today's workforce requires individuals to be able to employ a variety of cognitive skills in order to solve problems in digital environments (Alviram & Eshet-Alkalai, 2006). As a consequence, the digital revolution and the increasing digitalization of school life over the past decades have created a need for digitally competent teachers who can implement ICT in an adequate manner (Krumsvik, 2011b; Mishra & Koehler, 2006). Thus, it has been argued that both students and teachers must acquire a certain level of computer-literacy to keep up with the growing digital societies (Nawaz & Kundi, 2010).

The increasing focus on skills, attitudes, and competencies such as digital competence is also reflected in educational reforms, policies, and frameworks (European Commission, 2007; Ferrari, 2012, 2013). For example, in the latest Norwegian educational reform, the "Knowledge Promotion" (Ministry of Education and Research, 2006), digital competence has become the fifth basic skill together with reading, writing, arithmetic and oral skills. However, the

research literature suggests that among in-service teachers, teacher educators, and student teachers there "seems to be a gap between technical knowledge and knowledge on how to employ technology in a learning context" (Haugerud, 2011, p. 227). Krumsvik (2007, 2008, 2011a, 2014) and Erstad (2010a), underline the positive effect this competence has for students' subject matter knowledge, and computer skills, abilities, and understanding. For example, a recent study conducted by Krumsvik et al., (2013) involving 17529 students and 2524 teachers in Norwegian secondary schools, found strong correlations between teachers' digital competence and students' subject learning outcome. The study underlines the importance of the teacher as a digitally competent role-model for students' subject learning and use of ICT, and indicates that this competence development needs to start with student teachers during their teacher education. Assuming that digitally competent teachers have an positive effect on students' subject learning and use of ICT in schools, teacher education programs and student teachers are a "natural place to start with respect to integrating technology into education" (Kay, 2006, p. 384), and need to critically reflect on how they structure and facilitate their approaches and strategies for this integration.

METHODOLOGY

This review follows a literature review method (Hart, 1998; Jesson et al., 2011), and covers online peer-reviewed studies of student teachers' ICT-training through teacher education published between 2000 and 2013. The studies for the review were collected, analyzed, and synthesized according to Creswell's (2012) five step procedure where he recommends to: "1) identify key terms to use in your search; 2) locate literature about a topic by consulting several types of material and databases; 3) critically evaluate and select the literature; 4) organize the literature; and 5) write a literature review" (Creswell, 2012, p. 81). The design of this review was guided by Boote and Beile's (2005) and Maxwell's (2006) analytical and conceptual framework for analyzing literature reviews in doctoral dissertations.

DATA COLLECTION

Four search terms were identified by consulting key literature in the field of technology use in teacher education and through recommendations from expert researchers (Janssen et al., 2013). The following keywords were used in the process: "digital competence + teacher", "digital literacy + teacher", "computer literacy + teacher", and "media literacy + teacher". Two important databases within the area of education, technology, and social science research, ERIC and ISI Web of Science, were used for the search, while others databases such as PubMed and PsychInfo were excluded because of overlapping results or lack of hits. A manual search or "hand-searching" (Chapman, Morgan, & Gartlehner, 2010, p. 23) was conducted in three previous reviews by Kay

(2006), Enochsson and Rizza (2009), and Tondeur et al. (2012) in order to locate relevant studies missing in the database searches.

Studies identified through the database and manual searches needed to meet a set of relevant inclusion criteria (Table 1) to be included in the review. For example, the studies had to be peer-reviewed, empirical studies of student teachers and ICT-training in teacher education published in online journals, and written in English, Norwegian, Swedish, or Danish. Thus, "grey literature" (Savin-Baden & Major, 2013, p. 118) including book chapters, dissertations, short papers, magazine articles, government- and research reports, and conference proceedings were excluded. Moreover, the search was limited to student teachers, pre-service teachers, prospective teachers, and teacher trainees qualifying to teach in secondary school as recommended by Kay (2006). Therefore, the included studies in this review focused on student teachers qualified to teach from lower-secondary school (from 8th to 10th grade, Middle school) up to upper-secondary school (from 11th to 13th grade, High school). Hence, studies with a main focus on ICT-training in teacher education with student teachers qualifying to teach other grades such as primary, elementary, kindergarten, preschool, and special education were excluded as well as studies with a main focus on ICT training with pupils, general university and college students, faculty, teacher educators, mentors or in-service teachers. Studies which only surveyed student teachers' perceived ICT skills, competencies, and self-efficacy without being empirically related to ICT-training in teacher education were excluded, because they did not properly describe the technology training in the research context. In addition, studies and short papers lacking fundamental information on methodological framework, study design, and empirical material (e.g. not reporting sample size) as well as articles with irrelevant focus, such as descriptive texts of programs, models, and software were also excluded from the review. Studies that did not provide details about the level that the student teachers were qualified to teach were also excluded from the review. However, studies with samples that had mixed qualifying teaching levels of student teachers (primary and secondary), and mixed sample populations (primary and-, secondary student teachers-, and in-service teachers) were included, because a significant number of the studies had such mixed sample populations.

TABLE 1. INCLUSION AND EXCLUSION CRITERIA.

	Included	**Excluded**
Databases	ERIC, ISI Web of Science	PubMed, PsychInfo
Time frame	2000–2013	Articles published before 2000 and after 2013
Publication type	Online peer-reviewed articles	Books and book chapters, conference proceedings, short papers, grey literature (e.g., reports), editorials
Focus	Empirical studies with primary focus on developing digital competence, digital literacy, computer literacy, and media literacy in teacher education	Articles focusing on other aspects (e.g., frameworks, information literacy; sole focus on attitudes, beliefs, confidence, perception, judgments, ICT knowledge and skills)
Types of teaching activities/strategies	E-learning, web-based and multimodal teaching methods, teaching in classrooms, courses, auditoriums, workshops, electronic portfolios	Teaching in schools and school classrooms
Language	English, Norwegian, Swedish, and Danish	Other languages
Target population	Articles focusing on student teachers, pre-service teachers, training teachers or prospecting teachers, mixed in-service and student teachers	Articles focusing on pupils, in-service teachers or other populations (e.g., nurses, seniors, special needs, teacher educators, faculty, adults)
Target teaching level	Lower- and Upper-Secondary School, 8th to 13th grade, Middle School, High School, University	Elementary School, Primary School, Kindergarten, Pre-School, Special Education, Adult Education/ Adults Professional Development

The database searches resulted in 2951 hits, while manual searches resulted in 153 hits, adding up to a total of 3104 hits (Table 2). After manually screening the abstracts, 304 articles were identified based on inclusion and exclusion criteria illustrated in Table 1, all focusing on student teachers and ICT-training in teacher education. Of these, 65 were reoccurring articles. Thus, 239 articles were inspected through a full-text mapping. Of the remaining 239 screened articles, 42 articles focused on student teachers' digital competence for lower- and upper-secondary school, thus meeting all of the inclusion criteria for the review.

TABLE 2. SEARCH RESULTS

ERIC				
Search term:	**Results:**	**Potentially relevant:**	**Reoccurring articles:**	**Included in review:**
Digital competence + teacher	22	8	0	5
Digital literacy + teacher	228	33	4	4
Computer literacy + teacher	770	149	17	15
Media literacy + teacher	342	29	14	0
ISI				
Search term:	**Results:**	**Potentially relevant:**	**Reoccurring articles:**	**Included in review:**
Digital competence + teacher	292	6	1	1
Digital literacy + teacher	380	18	7	0
Computer literacy + teacher	462	15	5	1
Media literacy + teacher	455	13	11	1
MANUAL SEARCH				
Reviews searched:	**Results:**	**Potentially relevant:**	**Reoccurring articles:**	**Included in review:**
Kay (2006)	68	9	0	3
Enochsson et al. (2009)	66	15	1	8
Tondeur et al. (2012)	19	9	5	4
TOTAL	3104	304	65	42

The table column to the left display the different search engines and reviews manually searched, and the terminology used in the different searches. The Results-column indicates the number of articles that were found, and the Potentially relevant-column illustrates how many of these articles were about student teachers and ICT. The Reoccurring articles-column indicates relevant articles that had either occurred earlier in the same search or in one of the other searches. Finally, the Included in review-column shows articles that met the inclusion criteria and that had not occurred in earlier searches.

DATA ANALYSIS

The 42 included studies were analyzed and classified through an abductive coding and categorization approach inspired by Grounded Theory (Corbin & Strauss, 2008; Reichertz, 2007), and through a deductive and inductive thematic analysis (Braun & Clarke, 2006). After several full-text readings, prominent patterns or themes were sorted into a coding scheme through a process of

open coding (Corbin & Strauss, 2008). For example, studies that mentioned ICT-training of student teachers using teacher educators, mentor teachers or peers as models were given codes such as "role-model", "technology demonstration", and "cognitive apprenticeship". When no new codes emerged due to data saturation, existing codes were collapsed and formed into categories. For instance, the above-mentioned codes were collapsed into the category labeled modeling. During this process, studies were also assessed according to method, organization of the technology training, strategies, and approaches used by the teacher education institutions. Boote and Beile's (2005) and Maxwell's (2006) frameworks were used as a theoretical lens for assessing the content and quality of the reviewed studies. Eight categories in the form of approaches were developed and identified through the analysis (Table 3): *collaboration, metacognition, blending, authentic learning, modeling, student-active learning, assessment*, and *bridging theory and practice gap*. The included Appendix provides a more detailed overview of information regarding each of the studies.

TABLE 3. STUDY APPROACHES

#	Study	Approaches							
		Collaboration	Metacognition	Blending	Authentic Learning	Modeling	Student-Active Learning	Assessment	Bridging Theory/ Practice Gap
1	Ajayi, L.	x	x		x		x		x
2	Barton, R.	x		x	x	x	x	x	
3	Beilke, J. R.	x	x		x		x		x
4	Bencze, L.		x	x		x		x	x
5	Bravo, V. J.	x	x		x		x	x	
6	Brodahl, C.	x	x		x	x	x	x	
7	Brown, N. R.	x	x	x	x	x	x	x	x
8	Carlson, D. L.	x	x	x	x		x		
9	Clift, R. T.		x			x	x	x	
10	DelliCarpini, M.	x	x		x	x		x	
11	Develotte, C.	x	x	x	x	x	x		x
12	Dexter, S.		x			x	x	x	
13	Doering, A.	x	x	x	x	x	x	x	
14	Ebsworth, M. E.	x	x	x		x	x	x	
15	Foulger, T. S.	x	x			x	x	x	
16	Fuchs, C.	x	x	x	x	x	x	x	
17	Haydn, T.	x			x	x		x	
18	Heo, M.			x	x	x	x		
19	Hutchison, A.		x	x	x	x	x	x	
20	Jang, S. J. (a)	x	x	x		x	x	x	x

TABLE 3. STUDY APPROACHES (FORTS.)

#	Study	Approaches							
		Collabora-tion	Metacog-nition	Blending	Authentic Learning	Modeling	Student-Active Learning	Assess-ment	Bridging Theory/ Practice Gap
21	Jang, S. J. (b)	x	x	x	x	x	x	x	x
22	Judge, S.	x	x		x	x			
23	Kay, R. H.	x	x	x		x	x	x	
24	Krumsvik, R. J.		x	x	x	x			x
25	Lee, J. K.		x	x	x		x	x	
26	Lipscomb, G. B.			x	x	x	x	x	
27	Masats, D.	x	x	x	x	x	x	x	x
28	Milman, N.		x	x	x	x	x	x	
29	Niess, M. L.	x	x		x		x	x	
30	O'Reilly, D.		x				x	x	x
31	Ozgün-Koca, S. A.		x		x		x	x	x
32	Oztürk, I. H.	x	x	x	x	x	x	x	
33	Sardone. N. B.	x	x	x	x		x		
34	Shoffner, M.		x	x	x	x	x		
35	Skerrett, A.	x	x	x	x		x	x	x
36	Strudler, N.	x	x			x	x	x	
37	Taylor, L.		x			x		x	x
38	Tearle, P.				x	x	x		x
39	Truxaw, M.	x	x		x	x		x	
40	Vural, Ö. F.			x		x	x	x	
41	Wang, T. H.		x	x	x		x	x	
42	Wright, V.		x			x	x	x	x

RESULTS

The studies included in this review were conducted in ten different countries: Australia, Canada, France, Germany, Norway, Spain, Taiwan, Turkey, the UK, and the United States. The majority of the studies were conducted in the United States (n = 23), the UK (n = 5), Canada (n = 3), and Taiwan (n = 3), while two studies (n = 2) were conducted in Scandinavia. The methodology used in the reviewed studies varied between being qualitative (n = 24), quantitative (n = 7) or mixed methods (n = 11). Also, the reported size of the sample population in the included studies ranged from only a few student teachers (lowest n = 4) to somewhat larger samples (highest n = 318). Less than half of the studies (n = 17) explicitly mention the use of an epistemological theoretical framework or learning theories to guide the research. Some studies (n = 7) dealt with ICT-training with student teachers qualifying to teach in science, chemistry, biol-

ogy, and mathematics, while other studies (n = 9) were concerned with literacy, literature, and foreign language teaching. Notably, only a few studies (n = 6) were concerned with ICT-training of student teachers in other subjects such as social studies, geography, history, and physical education. The majority of studies (n = 20) were situated within multiple teaching subjects or in courses in general education and educational technology. Remarkably, no studies reported on student teachers' ICT-training in aesthetic teaching subjects such as arts, drama, and theater or vocational teaching subjects.

DISCUSSION

This section reports on and discusses the different approaches (Table 3) used to facilitate the development of student teachers' digital competence in teacher education through ICT-training. The different approaches are illustrated through synthesis and quotes from single studies. Similar to Tondeur et al. (2012), most of the studies involved multiple approaches, which were overlapping or "linked together in a way that made it difficult to address them separately" (Tondeur et al., 2012, p. 141), and focused on student teachers getting experience with digital technologies relevant for their future profession during their teacher education.

Collaboration

Collaboration approaches and co-operative learning, here used interchangeably as done by Johnson and Johnson (2008), refer to technology training situations where two or more student teachers "work together to maximize their own and each other's learning" (Goodyear, Jones, & Thompson, 2014, p. 440). 25 out of 42 studies focused on developing student teachers' digital competence afforded through synchronous and asynchronous collaborative knowledge-building technologies including online forums, discussion boards, and learning networks (e.g., Ajayi, 2009; Doering & Beach, 2002; Jang, 2008a, 2008b; Kay & Knaack, 2005; Masats & Dooly, 2011), social networking sites and other interactive Web 2.0 applications (e.g., Carlson & Archambault, 2013; Skerrett, 2010), weblogs or blogs (e.g., Hutchison & Wang, 2012), computer-mediated communications software and virtual environments (e.g., Develotte, Mangenot, & Zourou, 2005; Fuchs, 2006; Sardone & Devlin-Scherer, 2008), and collaborative software (e.g., Bravo & Young, 2011; Brodahl, Hadjerrouit, & Hansen, 2011; Foulger, Williams, & Wetzel, 2008; Öztürk, 2012). In their exploratory case study with 201 student teachers, for instance, Brodahl et al. (2011) used Google Docs and EtherPad to assess whether the technologies could support collaborative writing and how effective the tools were in a group work setting. Through a collaborative writing task where the student teachers had to write a reflective essay, they "got acquainted with collaborative tools, and develop[ed] skills and competencies in implementation in educational tasks" (Brodahl et al., 2011, p. 90). Moreover, in their teacher education programs, student teachers were assigned to col-

laborate through technology-rich learning experiences with peers (Ajayi, 2009; Brodahl et al., 2011; DelliCarpini, 2012; Ebsworth, Kim, & Klein, 2010; Foulger et al., 2008; Jang, 2008a, 2008b; Kay & Knaack, 2005; Masats & Dooly, 2011; Sardone & Devlin-Scherer, 2008; Skerrett, 2010; Truxaw & Olson, 2010), students or student teachers from other higher educational institutions (e.g., Develotte et al., 2005; Fuchs, 2006), with pupils in school (Doering & Beach, 2002), university supervisors, in-service teachers, and mentor teachers during field experiences (e.g., Haydn & Barton, 2007; Judge & O'Bannon, 2007; Niess, 2005; Strudler, Archambault, Bendixen, Anderson, & Weiss, 2003), actors from other local (Beilke, Stuve, & Williams-Hawkins, 2008) and online communities (Bravo & Young, 2011; Öztürk, 2012). Foulger et al. (2008) designed a collaborative innovative technology project with 126 student teachers where the participants were assigned to explore different evolving technologies. The instructors composed small groups of novice and expert technology users and assumed that the "pre-service teachers could rely on each other to research and freely explore new technology, become expert users, and devise valuable ways to allow technology to enhance student learning" (Foulger et al., 2008, pp. 30–31). They found that the student teachers "took ownership of their own learning" and "produced a situation in which the knowledge gained by one group was also owned by others", while observing that the "students were able to practice collaborative professional development mirroring effective in-service teachers" (Foulger et al., 2008, pp. 36–37).

Metacognition

Metacognition approaches or reflective practice usually revolve around what Schön (1983) refers to as reflection-on-action, where student teachers analyze and document their thoughts, reactions, and/or consequences of their actions surrounding a situation involving ICT. In 36 studies student teachers were assigned to critically reflect and discuss how different technologies could be integrated into their classroom teaching. A recurring theme was the use of online bulletin-boards, forums, blogs, or discussion groups (e.g., Doering & Beach, 2002; Shoffner, 2009; Tearle & Golder, 2008), and multimedia artefacts and video cases (e.g., Bencze et al., 2003; Krumsvik & Smith, 2009; Masats & Dooly, 2011) to stimulate the student teachers' reflection and learning as well as have them critically assess classroom uses afforded by websites and software appropriate for the secondary school grade level. For instance, in one of the education course activities, in a case study by Clift et al. (2001), one of the student teachers, "Chris", was asked to critically assess software that would be appropriate for use in a secondary classroom involving "previewing and critiquing of multimedia software" (Clift et al., 2001, p. 43). Through this activity, he and the other student teachers were preparing themselves for teaching with technology in their imagined future classrooms. Similarly, Ajayi (2009) had student teachers in a literacy methods course reflect on literacy teaching in school using asynchronous discussion boards which allowed the 33 study participants to "generate questions and responses to questions, read other

students' responses, work collaboratively and independently, and provided links to different websites and sourced information" (Ajayi, 2009, p. 92).

Blending

Blended learning or a multimedia instruction approach regards ICT-training of student teachers through the use and combination of both face-to-face and online teaching, and the combination of different modes to create meaning through electronic mediums such as with video, animations, diagrams, photos, illustrations, written and spoken text (Garrison & Kanuka, 2004; Mayer, 2014). 24 studies fit in this approach and involved developing student teachers' digital competence through technology rich experiences in their teacher education using blended learning or multimodal teaching (e.g., Jang, 2008a, 2008b; Krumsvik & Smith, 2009), having student teachers interact with and create digital artefacts (e.g., Brown, 2009; Heo, 2011), video cases (e.g., Bencze et al., 2003; Vural, 2013), and engage in various multimedia activities (e.g., Beilke et al., 2008; Develotte et al., 2005). For instance, Jang (2008a) used online teaching materials containing videos, slides, online references, and course content in an asynchronous learning network to see if there was a difference between traditional face-to-face teaching and experimental blended learning approach with 134 student teachers. Although there were no significant differences between the control and the experimental group, the student teachers in the experimental group expressed more satisfaction with the curriculum and reported that the online learning "combined the effects of both traditional classroom and online teaching" (Jang, 2008a, p. 859). Kay and Knaack (2005) used a number of multimodal approaches to foster student teacher competence in technology integration throughout their teacher education program. They pointed out that even though ICT was thoroughly integrated in all of the program's courses and that the student teachers' overall computer skills increased, they discovered that the student teachers used technology "significantly more in their formal studies than in the field" although they "engaged in similar activities in both settings" (Kay & Knaack, 2005, p. 405). The authors also noted that while, in their field placements, even though student teachers "used their laptops consistently in lesson planning and group-work…integration of technology into classroom activities and lessons was minimal" (Kay & Knaack, 2005, p. 405). In conclusion, they stated that the implementation of additional approaches might be necessary to encourage the student teachers' further use of ICT during their field placements (Kay & Knaack, 2005).

Modeling

Modeling involves teacher educators, in-service teachers, mentors, and peers promoting particular practices and views of learning through "intentionally displaying certain teaching behaviour", which could play an important role in shaping "student teachers' professional learning" (Lunenberg, Korthagen, & Swennen, 2007, p. 589). A modeling approach was used in 31 studies for train-

ing student teachers in the use of technology, and involved explicit demonstrations of particular hardware and software, scaffolding, and technical support. In Niess' (2005) study, there was a focus throughout all of the courses in the teacher education program on "modeling instructional strategies that incorporated technology" (Niess, 2005, p. 521), while teacher educators modeling the use of blogs to facilitate literature discussion and purposeful integration of technology was a central theme in Hutchison and Wang's (2012) study. Barton and Haydn (2006) had tutors model technology integration and meaningful learning activities with ICT for two cohorts of student teachers in history and science during their field experience. In the interviews, the student teachers identified modeling as one of many "key moments…being particularly influential in their progress" (Barton & Haydn, 2006, p. 262). This involved demonstrating how to use PowerPoint, the Internet, creating a webpage using html code, and the use of data logging tools. However, it becomes clear through the studies that modeling needs to involve student teachers getting hands-on experience with the technologies that they will be using in their future classrooms. Although modeling was used by teacher educators as an approach to expose and demonstrate ICT for use in school in Tearle and Golder's (2008) study, the use was not made explicit and student teachers still felt that they needed "[m]ore hands-on experience" (Tearle & Golder, 2008, p. 63).

Authentic Learning

Authentic learning refers to a "pedagogical approach that situates learning tasks in the context of real-world situations" or "the context of future use" (Herrington, Reeves, & Oliver, 2014, p. 401). This approach was present in 30 studies and involved in studies where student teachers developed their digital competence, while being assigned to explore, create, and assess digital technologies for use in their future classrooms (e. g., Sardone & Devlin-Scherer, 2008; Truxaw & Olson, 2010). This approach has also been used in teacher education programs using field experience (e.g., Haydn & Barton, 2007; Taylor, 2004; Wright & Wilson, 2006), where teacher educators and in-service mentor teachers could actively support student teachers' lessons with technology during their teaching practicum in an attempt to "transfer...technological skills and processes learned during the methods classes…into the student teaching experience, and later…" (Wright & Wilson, 2006, p. 50). In a study by Develotte et al., (2005), French student teachers were assigned to collaborate in creating multimedia activities for Australian students in their first university year in order to stimulate the Australian students' language learning in French, and to provide the French student teachers with an authentic teaching experience. Meanwhile, in Sardone and Devlin-Scherer's (2008) study, 18 student teachers taking an educational assessment course participated in the exploration of the "River City Project, a virtual simulation game designed to teach science concepts through a historical and social lens to middle-school age groups" (Sardone & Devlin-Scherer, 2008, p. 44). Through "deep immersion in game tasks" and "in discussing the game with their peers" (Sardone & Devlin-Scherer, 2008, p. 46), the student teachers gained an authentic learning

experience with how they could potentially use virtual simulation games in their own teaching. However, they also remarked that even though "engagement is an attractive feature of games in classrooms" a question arises regarding "how to determine the game's value as an educational tool" (Sardone & Devlin-Scherer, 2008, p. 47).

Student-Active Learning

A student-active learning approach or learning by doing involves a shift of pedagogical control from the teacher to the individual where learners are supported, actively engaged, and involved in meaning making and the learning process (Iiyoshi, Hannafin, & Wang, 2005; Niemi, 2002). In 36 studies, student teachers learned to integrate technology for their future teaching by actively engaging in learning and meaning-making processes through experiencing, interacting with, and creating classroom-related digital resources (e. g., Heo, 2011; Kay & Knaack, 2005; Lipscomb & Doppen, 2004). In a study of a teacher education technology project by DelliCarpini (2012), student teachers were assigned class time in English as a Second Language (ESL) methods courses to "evaluate, use and develop technology based lesson/unit plans" where they worked in collaborative teams to "develop technology-based learning activities for ELLs [English Language Learners]" (DelliCarpini, 2012, p. 17). She discovered that the structure of the courses had a positive effect on the student teachers' self-efficacy beliefs, and argued that student teachers must be provided with "contextualized, hands-on practice with computer technology during pedagogy courses" in order to "build technology into teaching and actual practice" (DelliCarpini, 2012, p. 20). Another example is seen in a study by Ebsworth et al. (2010) where 90 student teachers and in-service teachers participated in a Technology-Enhanced Language Learning (TELL) course, where they "developed resource files containing TELL tools appropriate for their target student populations" and conducted an "in-depth analysis of a website or software package, concentrating on the educational value of the website/software package for their language learners" (Ebsworth et al., 2010, p. 352). The researchers concluded that the participants' expectations and interests with educational technology shifted from gaining "personal skills to teaching skills as they gained professional experience" (Ebsworth et al., 2010, p. 364).

Assessment

Broadly speaking, assessment as a general education term refers to "all those activities undertaken by teachers, and by their students in assessing themselves that provide information to be used as feedback to modify teaching and learning activities" (Black & Wiliam, 1998, p. 140). Examples of different forms of assessment includes summative and formative assessment or "assessment for learning" (Black, Harrison, Lee, Marshall, & William, 2003; Wiliam, 2011), and the use of different forms of feedback (Hattie & Timperley, 2007). An assessment approach was used in 33 studies with ICT-training of student teach-

ers through the use of various types of technology-based forms of assessment. This includes course designs and learning environments (e. g., Vural, 2013; T.-H. Wang, Wang, & Huang, 2008), but also more program specific assessment forms and requirements such as electronic portfolios and ICT related assignments (e. g., Clift et al., 2001; Taylor, 2004; Öztürk, 2012). While Milman (2005) explored 9 student teachers' experiences and reasons for creating electronic portfolios, O'Reilly (2003) used portfolio assessment with 18 mathematics student teachers where they were assigned to document, comment, and evaluate their use of ICT during their teacher education courses and their field experience. The student teachers claimed that the electronic portfolios were useful, motivating, and gave them "ideas for future uses of ICT in teaching" (O'Reilly, 2003, p. 436). Also, in relation to performance-based licensure, the student teachers thought that electronic portfolios were "more authentic assessments than the typical, standardized tests often used in teacher education" (Milman, 2005, p. 391). Furthermore, the study concluded that the "ICT portfolio did have an effect on student teachers' use of ICT during their school placements, with most of them going beyond the minimum requirements" (O'Reilly, 2003, p. 441). In addition, Strudler et al. (2003), and Dexter and Riedel (2003) discovered that setting explicit expectations for "designing and delivering instructions using technology was effective" for getting student teachers to use ICT during their school-based field experience (Dexter & Riedel, 2003, p. 334).

Bridging Theory/Practice Gap

The gap between theory and practice refers to the enduring tension and disconnect student teachers experience between the content taught in teacher education campus-based courses, and the realities of teaching facing them during their field experience and future teaching profession (Korthagen & Kessels, 1999; Zeichner, 2010). 15 studies involved the use of technology in an attempt to bridge this gap and align theoretical and practical knowledge, while at the same time exposing student teachers to ways of integrating technology in their teaching (e. g., Özgün-Koca, Meagher, & Edwards, 2010). For example, Jang (2008b) found that student teachers learned how to integrate technologies with appropriate pedagogy into their classroom teaching through an online learning environment and related Internet websites, and that the use of a technology team-teaching model (TTT) "led the preservice teachers to a better understanding of the theories and stimulated their thinking for technology teaching" (Jang, 2008b, p. 656). In Krumsvik and Smith's (2009) small pilot case study, 6 student teachers in a postgraduate certification education course chose to use a video-based technology known as videopapers instead of their traditionally prescribed curriculum texts. They argued that the videopapers helped the student teachers "understand theoretical concepts they felt that otherwise they would have problems understanding" and that it "brought the practice field to the university campus in a better way than traditional monomodal text papers did" (Krumsvik & Smith, 2009, pp. 274–275). Moreover, the videopapers prepared the student teachers for teaching in the digital school and a "multimodal

reality in the practice field where ICT is, perhaps, more integrated" by developing their digital competence (Krumsvik & Smith, 2009, p. 275). Finally, Bencze et al. (2003) had 168 science-specialist student teachers in a science methods course interact with multi-media cases of an expert science teacher, "Mr. Hamilton", conducting a technological design project. The multi-media cases were aimed at demonstrating the use of authentic learning in science classrooms and promoting "knowledge-building opportunities for students in realistic contexts in schools" (Bencze et al., 2003, p. 167). Here, the student teachers were afforded a "virtual window into particular school-based teaching and learning practices to which they may not, otherwise, be exposed during their practice teaching in schools" (Bencze et al., 2003, p. 164). In turn, the use of multimedia cases helped legitimize the use of authentic learning in science classrooms promoted at the teacher education program, and exposed the student teachers to authentic ways of technology in their future science classrooms.

STUDY LIMITATIONS

The purpose of this review is to examine approaches of how teacher education develops secondary student teachers' digital competence. Due to the strict inclusion and exclusion criteria applied for scrutinizing the literature, the review has a number of limitations.

First, this review is not exhaustive because it has only focused on teacher education and student teachers qualified to teach in the secondary school grade level. Studies that focused on elementary, primary, or pre-school education and studies that did not report the educational level of their teacher education or their student teachers were excluded. In addition, the review focuses on student teachers, not teacher educators, in-service practice mentors, pupils, in-service teachers or school leaders. However, because of the significant growth of research over the last decade on ICT-training of student teachers and technology integration in teacher education, the point of this study was not to be exhaustive and attempt to cover the whole field to include student teachers qualified to teach in kindergarten and those qualified to teach in secondary school. Instead, the target population investigated in this review were student teachers qualified to teach in the secondary school grade level as recommended by Kay (2006), since there had been no reviews specifically focusing on this group.

Second, the key terms used for searching the databases could potentially have overlooked important studies, and the database searches might not have resulted in uncovering all relevant studies for the review. Other search terms such as "didactics", "pedagogy", "technology literacy", "Internet literacy", "information literacy", and "ICT literacy" could also have been included, but would have yielded a significantly larger and possibly unmanageable number of database hits for the study. Yet, the key words used in this review represent

terms that are commonly used in the research literature on technology training in teacher education.

Third, by focusing only on online sources, studies in books, reports, and dissertations might have been overlooked. However, this is also an important strategy for limiting the study's focus. Additionally, the use of manual or hand searches in the list of references in the reviews by Kay (2006), Enochsson and Rizza (2009), and Tondeur et al. (2012) can be considered time consuming, inefficient, and a unsystematic search technique, which offers little transparency (Chapman et al., 2010).

Finally, the approaches generated in this review for educating student teachers in teacher education in technology use in their future classrooms are merely descriptions of phenomena developed and labeled as categories through the data analysis, which Hacking (1999) refers to as socially constructed. Hence, the categorization process will necessarily reduce the complexity of the phenomena as a kind of compromise, which in this case regards the reviewed studies (Rosch & Lloyd, 1978). This is because an comprehensive analysis cannot possibly "deal with phenomena in all of their complexity" since they are more "concerned with certain kinds of phenomena only insofar as their behavior is determined by, or characteristic of, a small number of parameters abstracted from those phenomena" (Suppe, 1989, p. 65). Thus, the categories in this review are considered universal, and they do not differentiate between the various studies' cultures, regions or countries. Nevertheless, exploring such differences in-depth could be an interesting topic for future research as discussed in the next section.

CONCLUDING REMARKS AND FURTHER RESEARCH

There has been an increase in the number of studies in the field of ICT-training in teacher education over the past decade, and thus there is a need to frequently review the literature and to narrow the scope of the research. This study has reviewed 42 online peer-reviewed empirical studies by focusing on the development of digital competence in student teachers qualified to teach in the secondary school grade level through preparing them in their teacher education program to use ICT in their future teaching. Eight approaches were identified and presented through the analysis: *collaborative, metacognitive, multimodal, modeling, authentic learning, student-active learning, assessment*, and *bridging the theory and practice gap*. These approaches highlight, at a micro- or interactional level, what teacher education programs can focus on for facilitating ICT-training and development of student teachers' digital competence.

Although there are similarities between the approaches used and found in this review and that of previous reviews (e. g., Kay, 2006; Tondeur et al., 2012), there are also several differences to point out. The main contribution of this review is the explicit and specific focus on the digital competence develop-

ment of student teachers in teacher education qualifying to teach in secondary school grade level. Where previous reviews have tended to ignore whether student teachers were qualifying to teach in kindergarten, primary, or secondary schools, this review has had an explicit focus on studies regarding secondary education. Moreover, where other reviews have tended to leave out study details regarding learning perspectives, theoretical framework, or contextual details regarding teaching subject, this study has attempted to include and describe these details in the reviewed articles through a comprehensive overview (see Appendix). These findings provide a more nuanced picture of the research literature, and can help further inform the design of future reviews and empirical studies.

A central finding in this review concerns the use of different approaches for ICT-training in teacher education. The most commonly used approach found in this review was metacognition, or the use of reflection when using ICT for teaching and promoting student content learning. Student teachers should be asked to discuss and reflect on the pedagogical and didactical value added to a lesson when integrating ICT in their teaching and to reflect in a similar manner when exploring new hardware, software, methods, and *models*. Furthermore, these discussions and reflections should be conducted through various forms and arenas both offline and online such as through blending. While recent research findings might criticize the "slow uptake of ICT" (Tømte, 2013, p. 75) in teacher education where the focus has mainly been on developing student teachers' tool knowledge in ICT instead of learning how to use it in a learning context (in Norway, see Haugerud, 2011; Hetland & Solum, 2008; Tømte, 2013; Ørnes et al., 2011), the approaches found in this review seem to hold an optimistic outlook for new generations of teachers who are required to purposefully integrate digital technologies in today's technology-rich schools. Yet, the systematic implementation of these approaches rely on the will and skill of several key contributors such as policymakers, school leaders, teacher educators, in-service mentor teachers, and the student teachers (Tondeur et al., 2012).

Research continues to show that improving access to technology and increasing confidence is not always enough to improve pedagogical use of ICT in schools. For example, surprisingly few studies in this review were from Scandinavian countries, where higher education institutions, schools, teachers, and pupils are considered to be digitally well-equipped, well-supported, and confident in their digital skills (Wastiau et al., 2013). The lack of studies from Scandinavian countries might be because of the study's filtering strategies, strict inclusion/exclusion criteria, fewer published studies in online journals, or a lack of research in the field. However, in this sense, the review has found a potential gap in the research literature on the use of ICT in secondary education and university-based teacher education among the Nordic countries. Moreover, the lack of studies found concerning ICT-training of student teachers in vocational studies and other teaching subjects such as arts, drama, and theater

also reveal gaps in the literature, which needs to be addressed with more empirical research.

Further research should focus on comparing ICT-training in elementary and secondary teacher education to see if there are differences in the ways student teachers are being trained to use ICT in their classroom teaching. With regards to ICT-training, the needs of student teachers teaching in the secondary school grade level are not necessarily similar to student teachers training to teach in kindergarten, elementary, and primary school. There is an acute absence of studies on preparing student teachers in using interactive whiteboards for the secondary school grade level. In addition, with an increased interest into research on teacher education, more studies should clarify what they mean by teacher education with regards to educational level, program description, and course requirements. Therefore, further studies need to specify the teaching level, which their student teachers are qualifying towards and provide detailed descriptions about the teacher education programs and courses involved in the studies (also noted by Kay, 2006). Simply writing about a cohort or population of student teachers or pre-service teachers is not an adequate description of a study sample. Moreover, due to anonymity issues, it is difficult to locate and verify course descriptions and study information from teacher education websites. Ontological and epistemological views concerning learning perspective and theories of learning should also be included and clarified in future studies. There is a need for further research concerning ICT-training of teacher educators and in-service mentor teachers who are responsible for promoting technology training to student teachers through their teacher education and field experience. Also, it would be interesting to see how the approaches generated in this review align with theories and frameworks (e. g., Mishra & Koehler, 2006) used in relation to technology use in present-day classrooms.

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APPENDIX

APPENDIX 1. OVERVIEW OF INCLUDED ARTICLES

Author(s)	Year	Country	Title	Rele-vance	Learning Perspective	Context & Data	Content				
							Level	Method	Size	Subject	Topic
Ajayi, L.	2009	USA	An Exploration of Pre-Service Teachers' Perceptions of Learning to Teach while Using Asynchronous Discussion Board	***	Sociocultural, distributed knowledge	Technology integrated, 2 reading literacy courses, 16 weeks, interviews, written reflections, discussion board postings	Mixed	Qualitative	33	Literacy	Asynchronous discussion board
Barton, R. Haydn, T.	2006	UK	Trainee Teachers' Views on What Helps them to use Information and Communication Technology Effectively in their Subject Teaching	**	Not specified	Technology integrated, science and history methods course, 36 weeks, interviews, focus group discussions, questionnaires, skills test	Sec.	Qualitative	71	Science History Multiple	Subject-based technology integration
Beilke, J. R. Stuve, M. J. Williams-Hawkins, M. A.	2008	USA	"Clubcasting": Educational uses of podcasting in multicultural settings	*	Not specified	Technology integrated and stand-alone course, case study, multicultural education course and educational technology course, collaborative project work, student written assignment, student artifacts	Sec.	Qualitative	8	Ed. Tech.	Podcasting
Bencze, L. Hewitt, J. Pedretti, E. Yoon, S. Perris, R. van Oostveen, R.	2003	Canada	Science-specialist Student-teachers Consider Promoting Technological Design Projects: Contributions of Multimedia Case Methods	**	Constructivist	Technology integrated, technological design study, science methods course, written survey, student written assignment, field notes, audio- and video recordings, interviews	Sec.	Qualitative	168	Science	Multimedia cases
Bravo, V. J.	2011	Canada	The Impact of a Collaborative Wikipedia Assignment on Teaching, Learning, and Student Perceptions in a Teacher Education Program	**	Not specified	Technology integrated, technology and literacy course, assignments, pre- and post-survey, e-mail correspondence, written reflections	Mixed	Mixed Meth.	16	Literacy Ed. Tech.	Collaborative writing
Brodahl, C. Hadjerrouit, S. Hansen, N. K.	2011	Norway	Collaborative Writing with Web 2.0 Technologies: Educational Students' Perceptions	***	Social constructivist perspective, community of practice	Technology integrated, exploratory case study, electronic survey	Mixed	Quantitative	201	Gen. Ed.	Collaborative writing
Brown, N. R.	2009	Australia	What can you Learn in Three Minutes? Critical Reflection on an Assessment Task that Embeds Technology	*	Not specified	Technology integrated, case study, action research, science methods course, two semesters, student reflection essay, questionnaire	Sec.	Mixed Meth.	40	Science	Video production
Carlson, D. L. Archambault, L.	2013	USA	Technological Pedagogical Content Knowledge and Teaching Poetry: Preparing Preservice Teachers to Integrate Content with VoiceThread Technology	**	Not specified	Technology integrated, English methods course, 3-week unit, self-report survey, digital artifacts	Sec.	Mixed Meth.	21	English	VoiceThread
Clift, R. T. Mullen, L. Levin, J. Larson, A.	2001	USA	Technologies in Contexts: Implications for Teacher Education	*	Not specified	Stand-alone and technology integrated courses, case study, teacher education program, 4 year project, surveys, e-mail analysis, interviews	Mixed	Qualitative	4	Gen. Ed.	Subject-based technology integration
DelliCarpini, M.	2012	USA	Building Computer Technology Skills in TESOL Teacher Education	*	Not specified	Technology integrated, action research, 3 ESL courses, two years, pre- and post-survey	Mixed	Quantitative	53	English	Computer skills assessment and development

APPENDIX 1. OVERVIEW OF INCLUDED ARTICLES

Author(s)	Year	Country	Title	Rele-vance	Learning Perspective	Context & Data	Content				
							Level	Method	Size	Subject	Topic
Develotte, C. Mangenot, F. Zourou, K.	2005	France	Situated Creation of Multimedia Activities for Distance Learners: Motivational and Cultural Issues	***	Situated learning, cognitive apprenticeship	Technology integrated, language methods course, one semester, field notes, interviews, questionnaires, students' multimedia artifacts	Sec.	Qualitative	16	French	Collaborative learning
Dexter, S. Riedel, E.	2003	USA	Why Improving Preservice Teacher Education Technology Preparation Must Go Beyond the College's Walls	**	Constructivist	Technology integrated, content specific method courses, one year, surveys	Sec.	Quantitative	201	Ed. Tech. Multiple	Subject-based technology integration
Doering, A. Beach, R.	2002	USA	Preservice English Teachers Acquiring Literacy Practices Through Technology Tools	***	Sociocultural, activity theory	Technology integrated and stand-alone course, composition-methods course, instructional technology course, one semester	Sec.	Qualitative	27	English Ed. Tech.	Asynchronous discussion board
Ebsworth, M. E. Kim, A. J. Klein, T. J.	2010	USA	Projections: From a Graduate TELL Class to the Practical World of L2 Teachers	*	Not specified	Technology integrated, action research, technology enhanced language learning course,1–3 years, pre- and post-questionnaire, interviews	Mixed	Mixed Meth.	90	English Foreign Language Teaching	Computer skills assessment and development
Foulger, T. S. Williams, M. K. Wetzel, K.	2008	USA	We Innovate: The Role of Collaboration in Exploring New Technologies	***	Constructivism, connectivism	Stand-alone course, educational technology course, one semester, questionnaire, focus groups, student assignments,	Mixed	Qualitative	126	Ed. Tech.	Collaborative learning
Fuchs, C.	2006	Germany	Exploring German Preservice Teachers' Electronic and Professional Literacy Skills	**	Not specified	Technology integrated, explorative case study, literacy methods course, one semester, field notes, student assignments, logs, pre-course questionnaire, post-course self-assessment, e-mail correspondence, chat transcripts	Sec.	Qualitative	34	English	Computer-mediated communication
Haydn, T. Barton, R.	2007	UK	Common Needs and Different Agendas: How Trainee Teachers Make Progress in Their Ability to Use ICT in Subject Teaching. Some Lessons from the UK	**	Not specified	Technology integrated field experiences, teacher education program, one year, questionnaires, focus groups, interviews	Mixed	Qualitative	133	Science History Multiple	Subject-based technology integration
Heo, M.	2011	USA	Improving Technology Competency and Disposition of Beginning Pre-Service Teachers with Digital Storytelling	***	Constructivist	Stand-alone course, quasi-experimental intervention study, educational technology course, 2 semesters, 1 week intervention, pre- and post-intervention online surveys	Mixed	Quantitative	76	Multiple	Digital Storytelling
Hutchison, A.	2012	USA	Blogging within a Social Networking Site as a Form of Literature Response in a Teacher Education Course	**	Not specified	Technology integrated, literature methods course, one semester, student blogs, site correspondence, interviews	Mixed	Qualitative	15	Literature	Learning through social networking
Jang, S. J.	2008 a	Taiwan	The Effects of Integrating Technology, Observation and Writing into a Teacher Education Method Course	***	Constructivism	Technology integrated, experimental design, education instruction course, 2 semesters, questionnaires, observation reports, online postings	Mixed	Mixed Meth.	134	Gen. Ed.	Asynchronous network learning

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Author(s)	Year	Country	Title	Relevance	Learning Perspective	Context & Data	Content				
							Level	Method	Size	Subject	Topic
Jang, S. J.	2008 b	Taiwan	Innovations in Science Teacher Education: Effects of Integrating Technology and Team-Teaching Strategies	***	Constructivism, community of practice	Technology integrated, experimental design, 2 science methods courses, 2 semesters, questionnaire, online postings, student online submissions, online feedback, online communication, interviews	Sec.	Mixed Meth.	42	Gen. Ed. Science	Collaborative learning
Judge, S. O'Bannon, B.	2007	USA	Integrating Technology into Field-Based Experiences: A Model that Fosters Change	*	Not specified	Stand-alone course/ workshop, field experiences, 1 year, focus group interviews, pre-, post- and exit-survey	Mixed	Mixed Meth.	49	Ed. Tech.	Subject-based technology integration
Kay, R. H. Knaack, L.	2005	Canada	A Case of Ubiquitous, Integrated Computing in Teacher Education	**	Constructivism	Technology integrated, method courses (computer science, mathematics and science), one year, pre- and post-survey	Sec.	Quantitative	52	Multiple	Laptop integration
Krumsvik, R. J. Smith, K.	2009	Norway	Videopapers – An Attempt to Narrow the Notorious Gap Between Theory and Practice in Teacher Education	***	Not specified	Technology integrated, case study, educational seminar group, one year, interviews	Sec.	Qualitative	6	Gen. Ed.	Learning with videos
Lee, J. K.	2006	USA	Pre-Service Social Studies Teachers Using Digital Civics Resources	*	Not specified	Technology integrated, social studies methods course, one semester, student assignments, interviews, student selected websites	Sec.	Qualitative	26	Social Studies	Blogs
Lipscomb, G. B. Doppen, F. H.	2004	USA	Climbing the STAIRS: Pre-Service Social Studies Teachers' Perceptions of Technology Integration	*	Not specified	Technology integrated, case study, social studies methods course, one semester, student assignments, student reflections, online postings, field notes, instructor's journal, interviews	Sec.	Qualitative	15	Social Studies	Learning with multiple digital technologies
Masats, D. Dooly, M.	2011	Spain	Rethinking the Use of Video in Teacher Education: A Holistic Approach	**	Socio-constructivism	Technology integrated, multiple case studies, 2 teacher education programs, 3 years, post-course observations, survey, focus group interviews	Mixed	Qualitative	72	Foreign Language Teaching	Learning with videos
Milman, N. B.	2005	USA	Web-Based Digital Teaching Portfolios: Fostering Reflection and Technology Competence in Preservice Teacher Education Students	**	Constructivism	Stand-alone course, electronic teaching portfolio course, one semester, observations, interviews, student journals, student portfolios, questionnaire	Mixed	Qualitative	9	Ed. Tech.	Electronic portfolios
Niess, M. L.	2005	USA	Preparing Teachers to Teach Science and Mathematics with Technology: Developing a Technology Pedagogical Content Knowledge	***	Not specified	Technology integrated, case studies, teacher education program, science and mathematics, 1 year, observations, student assignments, reports, interviews	Sec.	Qualitative	22	Science Math	Subject-based technology integration
O'Reilly, D.	2003	UK	Making Information and Communications Technology Work	**	Not specified	Technology integrated, teacher education program, mathematics, 1 year, student portfolios, periodical audits, student written reflections, student written evaluations and comments, questionnaires	Sec.	Qualitative	18	Math	Electronic portfolios

APPENDIX 1. OVERVIEW OF INCLUDED ARTICLES

Author(s)	Year	Country	Title	Rele-vance	Learning Perspective	Context & Data	Content				
							Level	Method	Size	Subject	Topic
Özgün-Ko-ca, S. A. Meagher, M. Edwards, M. T.	2010	USA	Preservice Teachers' Emerging TPACK in a Technology-Rich Methods Class	*	Not specified	Technology integrated, mathematics methods course, one semester, pre- and post-course surveys, additional surveys, student assignments, student field experience reports	Sec.	Mixed Meth.	20	Math	Inquiry-based learning with digital technologies
Oztürk, I. H.	2012	Turkey	Wikipedia as a Teaching Tool for Technological Pedagogical Content Knowledge (TPCK) Development in Pre-service History Teacher Education	**	Not specified	Technology integrated, action research approach, history methods course, one semester, shorter workshop, student works, response forms, interviews	Sec.	Qualita-tive	27	History	Collabora-tive learning
Sardone, N. B. Devlin-Scherer, R.	2008	USA	Teacher Candidates' Views of a Multi-User Virtual Environment (MUVE)	***	Constructiv-ism	Technology integrated, assessment methods course, short workshop, questionnaires, field notes, interviews, focus group	Sec.	Qualita-tive	18	Gen. Ed.	Game-based learning
Shoffner, M.	2009	USA	Personal Attitudes and Technology: Implications for Preservice Teacher Reflective Practice	*	Not specified	Technology integrated, workshop/information session, 8 months, blog entries, focus groups, interviews	Sec.	Qualita-tive	9	Multiple	Blogs
Skerret, A.	2010	USA	Lolita, Facebook, and the Third Space of Literacy Teacher Education	*	Third space, multiliteracies	Technology integrated, self-study, literacy methods course, one semester, course syllabus, student assignments, reflective journals, e-mail correspondence, online postings, teaching journal	Sec.	Qualita-tive	16	Literacy	Social media
Strudler, N. Archam-bault, L. Bendixen, L. Anderson, D. Weiss, R.	2003	USA	Project THREAD: Technology Helping Restructure Educational Access and Delivery	**	Not specified	Technology integrated, teacher education program project, one year, questionnaires, observations, interviews, exit surveys, document analysis	Mixed	Mixed Meth.	153	Multiple	Subject-based technology integration
Taylor, L.	2004	UK	How Student Teachers Develop Their Understanding of Teaching Using ICT	***	Not specified	Technology integrated, methods course, one year, student assignments, questionnaires, interviews	Sec.	Qualita-tive	44	Geography	Subject-based technology integration
Tearle, P. Golder, G.	2008	UK	The use of ICT in the Teaching and Learning of Physical Education in Compulsory Education: How do we Prepare the Workforce for the Future?	***	Not specified	Technology integrated, case study design, one year, interviews, observations, questionnaires, group discussions	Sec.	Mixed Meth.	46	Physical education	Subject-based technology integration
Truxaw, M. Olson, M.	2010	USA	Preservice Mathematics and Science Teachers' Inquiry into New Literacy Practices of the Internet	*	New literacies	Technology integrated, mathematics and science methods course, school practicum, one semester, student assignments	Sec.	Qualita-tive	24	Science Math	Inquiry-based learning with digital technologies
Vural, Ö. F.	2013	Turkey	The Impact of a Question-Embedded Video-Based Learning Tool on E-Learning	***	Constructiv-ism, cognitive information processing theory	Stand-alone,, quasi-experimental design, computer literacy course, one semester, two treatment groups, pre- and post-computer knowledge evaluation form, recordings of online platform interaction, quizzes	Mixed	Quanti-tative	318	Ed. Tech	Learning with videos

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Author(s)	Year	Country	Title	Rele-vance	Learning Perspective	Context & Data	Content				
							Level	Method	Size	Subject	Topic
Wang, T. H.	2008	Taiwan	Designing a Web-Based Assessment Environment for Improving Pre-Service Teacher Assessment Literacy	**	Not specified	Technology integrated, biology methods course, one semester, two treatment groups, pre-, mid- and post-tests	Sec.	Quantitative	60	Biology	Web-based assessment
Wright, V. H.	2006	USA	From Preservice to In-service Teaching: A Study of Technology Integration	**	Not specified	Technology integrated, case studies, methods courses, one year, pre- and post-survey, queries, students' electronic portfolios, assignments, artifacts, observations, interviews	Sec.	Mixed Meth.	22	Social studies	Electronic portfolios

The first four table columns from left to right display the different studies included in the review by the first author, year of publication, the country where the studies were conducted and title of the studies. The *Relevance*-column indicates the studies' match to Boote and Beile's (2005) and Maxwell's (2006) quality frameworks, and match to the review's research question using * (somewhat relevant), ** (relevant) and *** (very relevant). These indicators function as an assessment of the studies' focus, theoretical framework, methodology, sample population, data sources, and results. Moreover, the next seven columns describe the different studies' learning perspective or theoretical framework, context and data sources, sample population, study methodology, sample size, teaching subject, and general topic.

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Paper II

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Prepared to teach ESL with ICT? A study of digital competence in Norwegian teacher education

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ARTICLE INFO

ABSTRACT

The purpose of this study is to examine how secondary student teachers are educated to teach with ICT through an English as a Second Language (ESL) didactics course offered at a teacher education program in Norway. Using a case study methodology, four cohorts of postgraduate student teachers were examined over 4 academic semesters. The students were qualifying to teach ESL in secondary school. Data were collected through surveys, participant observations, and semi-structured interviews. A theoretical model for digital competence development was used as an analytical lens in the data analysis. Findings indicate that the mastery and appropriation of teaching ESL with ICT varies amongst student teachers. Through their studies, the overall digital competence development is both enabled and inhibited by a number of factors such as modeling, scaffolding learning experiences, linking theory and practice, reflection, access to resources and support, innovative assessment practices, and collaborative learning. The implications that these findings have for teacher education are discussed.

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1. Introduction

In Norway, the *National Curriculum for Knowledge Promotion* (Ministry of Education and Research, 2006b) regards digital competence as a basic skill along with writing, reading, arithmetic, and speaking. Pupils and teachers are required to use information and communication technology (ICT)[1] across all school subjects at all levels of school (grades 1—13), including English as a Second Language (ESL), in order to meet curriculum competence aims (Ministry of Education and Research, 2006c; Norwegian Directorate for Education and Training, 2012). Naturally, this is also the case in Norwegian teacher education programs where national curricula (grades 1—7, 5—10, and 8—13) require student teachers to master the use of ICT for teaching subject disciplines in a competent and professional manner (Ministry of Education and Research, 2010, 2013). Consequently, researchers recommend that teacher educators need to move beyond only providing student teachers with mastery learning of basic digital skills, and instead look for ways of appropriating the "interpretive and creative potential of ICT into teacher training" (Tømte, Hovdhaugen, & Solum, 2009, p. 25).

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  [1] The umbrella term information and communication technology (ICT) refers "in principle to all possible technologies that are used for locating and processing information, communicating and producing digital media" (Aesaert & van Braak, 2015, p. 8). In this study, ICT includes computer technology, multimedia, the Internet, mobile devices, and so on where the integration of communications, audio, and video with computers make the individual technologies "nearly indistinguishable" (Anderson, 2008, p. 8).

In ESL and foreign language teaching, research shows that ICT can help teachers reach pedagogical goals, and can have a positive impact on pupils' language skills including reading, writing, and listening, and development of vocabulary (Felix, 2005; Golonka, Bowles, Frank, Richardson, & Freynik, 2014; Stockwell, 2007; Zhao, 2003). Thus, future ESL teachers should be prepared in teacher education to stimulate pupils' language learning in schools through integration of ICT. However, despite the availability of digital tools and innovative teaching approaches, researchers observe that ICT-integration and digital competence development is limited. Internationally, ICT has been seen to be used in teacher education in a superficial manner for lesson planning, personal communication, word processing, presentation tools, and information searches (Blin & Munro, 2008; Drent & Meelissen, 2008; Kay & Knaack, 2005). Student teachers report that they feel unprepared to teach with ICT and innovative approaches to using ICT for teaching are not promoted in teacher education (Sang, Valcke, Braak, & Tondeur, 2010; Valcke, Rots, Verbeke, & van Braak, 2007). Often, student teachers' digital competence is limited to basic digital skills including office tools and social media while at the same time having little experience with using ICT for teaching and learning (Lei, 2009; Twidle, Sorensen, Childs, Godwin, & Dussart, 2006; Valtonen et al., 2013). A similar situation can be detected in Norway where the uptake of ICT in teacher education programs is like in international studies reported to be slow and poorly integrated, and where teaching is mostly tool-oriented and reliant on the initiative of enthusiasts (Hetland & Solum, 2008; Tømte et al., 2009; Tømte, Kårstein, & Olsen, 2013). For example, Guðmundsdóttir, Loftsgarden, and Ottestad (2014) report that newly qualified teachers see little correspondence between the ICT training provided in Norwegian teacher education and the demands imposed on them for teaching with ICT in schools (Guðmundsdóttir et al., 2014). Hence, the authors recommend a stronger focus on setting clear goals for ICT-usage in teacher education, to clarify the purpose of integrating ICT in the curriculum, and to make available digital learning resources for teaching in and across subject disciplines in schools.

Overall, there seems to be a situation in teacher education internationally as well as in Norway where it is challenging to promote ways of teaching with ICT that move beyond basic digital skills. Thus, researchers recommend that "teacher education programs should stimulate the pedagogical use of ICT to improve existing teaching practice and contribute to the development of new, innovative teaching practices" (Kirschner, Wubbels, & Brekelmans, 2008, p. 435). Accordingly, several literature reviews have identified approaches that could be implemented to promote digital competence in teacher education such as modeling ICT integration for teaching, scaffolding student teachers' learning experiences, and reflecting with and about didactical use of ICT (Enochsson & Rizza, 2009; Kay, 2006; Røkenes & Krumsvik, 2014; Tondeur et al., 2012). For instance, Røkenes and Krumsvik (2014) found eight approaches that can be used to develop digital competence in student teachers qualifying to teach in secondary school. The authors point out modeling as one of the most frequently used approaches in the research literature, and note that teacher educators play an important role in preparing future teachers for teaching with ICT since they act as digital role models (cf. Lunenberg, Korthagen, & Swennen, 2007). Other approaches identified by the authors include giving student teachers time to reflect on the educational value of ICT in their subject discipline, and providing them with hands-on opportunities to experience the digital tools themselves (Røkenes & Krumsvik, 2014). For future ESL teachers the preparation they undergo in teacher education should include opportunities to both master basic digital skills and, more importantly, to appropriate didactical ways of teaching with ICT to meet curricula requirements (Haugerud, 2011; Instefjord, 2014; Lund, Furberg, Bakken, & Engelien, 2014). Otherwise, as is the case with Norwegian teacher education, there is a danger "of a gap being created between teacher training and the practices that student teachers encounter when graduated" (Krumsvik, 2014, p. 270). At the moment, few studies have investigated digital competence development in ESL student teachers in Norwegian teacher education. To respond to this need, the aim of this study is to investigate how secondary ESL student teachers develop digital competence through an ESL didactics course in a Norwegian teacher education program.

2. Background

This section first describes the theoretical concepts used in this study such as digital competence. Second, a digital competence model is presented and discussed in light of research on ICT in teacher education. The model is later used as an analytical lens in the data analysis. Finally, research on ICT in ESL and foreign language teaching is presented and linked to the purpose of the study.

2.1. Digital competence

Digital literacy (Buckingham, 2006; Gilster, 1997; Lankshear & Knobel, 2006), or digital competence (Ala-Mutka, 2011; Erstad, 2010; Ferrari, 2012; Janssen et al., 2013; Krumsvik, 2007) as it is more commonly referred to in Norway, can be broadly defined as "skills, knowledge, creativity, and attitudes required to use digital media for learning and comprehension in a knowledge society" (Erstad, Kløvstad, Kristiansen, & Søby, 2005, p. 7, my translation). While this definition can be understood on a macro level by looking at the general role of the citizen in contemporary society, Krumsvik (2011) has narrowed the definition by focusing on a micro level and the teaching profession specifically: "Digital competence is the teacher/TE's [teacher educator's] proficiency in using ICT in a professional context with good pedagogic-didactic judgment and his or her awareness of its implications for learning strategies and the digital Bildung of pupils and students" (Krumsvik, 2011, pp. 44–45). This definition focuses on teachers' professional and pedagogical use of ICT by distinguishing them from other users.

According to Krumsvik (2011), teachers and teacher educators are digital role models for pupils and students' use of ICT in the different subject disciplines.

2.2. Model of digital competence for ESL student teachers

In an attempt to operationalizing his definition of digital competence, Krumsvik (2007, 2011, 2014) developed a model (Fig. 1) for describing digital competence among teachers and teacher educators. In this study, his model is used as an analytical lens for investigating digital competence in ESL student teachers in teacher education:
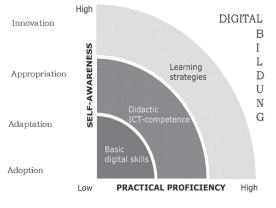
The model draws on frameworks and research of teaching practice with ICT (e.g., Almås & Krumsvik, 2007; Dwyer, Ringstaff, & Sandholtz, 1991; Krumsvik, Egelandsdal, Sarastuen, Jones, & Eikeland, 2013) and sociocultural learning theory (Hutchins, 1995; Lave & Wenger, 1991; Säljö, 2001; Wertsch, 1998). It attempts to make practitioners' "tacit knowledge" explicit (Polanyi, 1966), and stimulate "reflection on action" (Schön, 1983) regarding the relationship between pedagogy, content, knowledge, and technology (Mishra & Koehler, 2006; Shulman, 1987).

The model consists of two axes; the horizontal axis represents *practical proficiency* aspects and the vertical axis represents mental, *self-awareness* aspects; both ranging on a scale from low to high. The student teachers' development process starts with *adoption* and *adaptation* at a stage when they are relatively incompetent and unaware of the possibilities and limitations of using ICT for teaching, i.e. perceived affordances (Kirschner, Martens, & Strijbos, 2004; Norman, 1999). At this stage, the student teachers are preoccupied with "mastering" and learning the basic "know how" of ICT (Wertsch, 1998). Gradually over time, the student teachers reach the stages of *appropriation* and *innovation* by becoming more competent and aware of the real affordances of ICT (Kirschner et al., 2004; Norman, 1999), i.e. gradually being able to recognize the full potential that ICT offers for teaching.

A significant obstacle occurs during the *appropriation* stage where the student teacher attempts to "appropriate" teaching with ICT into their "own" (Wertsch, 1998, p. 55), and which presumes that he or she has mastered basic digital skills. During this process, ICT is not automatically appropriated without some form of resistance (Wertsch, 1998), here understood as the "tension between the tool and the use we make of it in a particular context" (Laffey, 2004, p. 362). As a result, a situation might occur where there is mastery without appropriation of ICT with student teachers not progressing beyond basic ICT skills in their digital competence development. Therefore, an important premise for reaching the *appropriation* and *innovation* stage for using ICT didactically, is that the student teacher both masters basic digital skills but is also able to recognize its real affordances, thus making the use of technology seamless, "unproblematic—invisible" (Lave & Wenger, 1991, p. 103). In turn, this allows the student teacher to direct attention away from the technicalities of ICT to the "visibility of, [sic] the subject matter" (Lave & Wenger, 1991, p. 103) such as teaching subject content with seamless integration of ICT.

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:

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, e-mail, LMS, interactive whiteboards, laptops, tablets).

Fig. 1. Model of digital competence for ESL student teachers.

2) *Didactic*[2] *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) *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*[3] — 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 behaviour 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 ESL student teachers' digital competence through abstract, and to some extent overlapping categories. However, the categories in the model are socially constructed, and are not intended to correspond directly with reality (Hacking, 1999). Yet, the model can be used as framework and as a research lens for informing practice, and for understanding the complexity of digital competence that student teachers will face in today's digitalized schools and in subject curricula (Krumsvik, 2014).

2.3. Purpose of study on ICT in ESL

In ESL and foreign 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 et al., 2014; Stockwell, 2007; Zhao, 2003). Reviews by Golonka et al. (2014) and Stockwell (2007) found that online learning resources (e.g., electronic dictionaries), video, and computer-assisted pronunciation training can have positive effects on pupil's language skills including expanding vocabulary, increasing language production and complexity, and improving grammar and pronunciation. Therefore, with regards to teacher education, student teachers should be introduced to relevant teaching activities and approaches that prepare them to integrate ICT in language teaching.

Over the last two decades, ICT has permeated Norwegian schools, and digital technologies are strongly present in all school subject including ESL (Krumsvik, 2011). As an illustration, two of the competence aims in the English subject curriculum after year 10 state that pupils shall be able to:

• use digital tools and formal requirements for information processing, text production and communication; [and]
• be familiar with protection of personal privacy and copyright and chose and use content from different sources in a verifiable way (Ministry of Education and Research, 2006c).

Norwegian ESL teachers have been shown to utilize a number 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 online learning resources (Wasson & Hansen, 2014). Thus, as the demands of teaching ESL with ICT in Norwegian classrooms increase, future teachers need to develop digital competence 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).

Currently, few studies have been conducted in the field of digital competence development in Norwegian teacher education for grades 8—13 (see Instefjord, 2014; Tømte, 2013; Tømte, Enochsson, Buskqvist, & Kårstein, 2015 for studies of grades 1—7 and 5—10). Particularly, there is a need to investigate how this competence is developed in future teachers of "older students" (Kay, 2006, p. 386) and also how this competence is developed in subject disciplines. This study investigates how digital competence can potentially be developed in secondary ESL student teachers through an ESL didactics course, and will attempt to answer the following research question: *How does an ESL didactics course at a Norwegian teacher education program contribute to developing digital competence in secondary student teachers' digital competence?* The study is informed by Kay's (2006) six recommended elements for researching technology in teacher education including clear sample and program

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[2] Didactics is often used synonymously with pedagogy, and refers to the "field of educational theory that provides guidelines and tools that are used to develop the practice of teaching" (Laursen, 1994, p. 125). While in an European context didactics can be understood as the art of teaching involving "planning, enactment, and thinking about teaching" (Krumsvik & Almås, 2009, p. 111), the Angelo-American interpretation of the term is narrower and associated to curriculum, methods, and "the art of instruction" (Nordkvelle, 2004, p. 428).

[3] Roughly translated, the German term *Bildung* means formation, development, or shaping of something, and "refers to the subtler aspects of education; those that are 'more than just knowledge'. This could include awareness of limitation to one's knowledge, respect for other ways of knowing and, not least, a sense of social (or moral or ethical) responsibility" (Beck, Solbrekke, Sutphen, & Fremstad, 2015, p. 446). Hence, "digital *Bildung* suggests an integrated, holistic approach that enables reflection on the effects that ICT has on different aspects of human development: communicative competence, critical thinking skills, and enculturation processes, among others" (Søby, 2003).

descriptions, reliability and validity estimates of data collection instruments, both qualitative and quantitative data, and measures of attitude, ability and ICT usage (Kay, 2006, pp. 394–395).

2.4. Study context

The teacher education program in this case is an integrated postgraduate degree teaching program at a university in Norway, examined from the fall semester of 2012 until the spring semester of 2014. Approximately 270 student teachers enroll annually in the five-year integrated teaching program or in the one-year practical pedagogical education, which qualifies them to teach in the secondary school grade level (grades 8–13). The institution has a modern technological infrastructure with campus-wide wireless Internet, learning management system for posting information about classes and assignments, and lecture theatres equipped with overhead projectors and TV-screens. Student teachers have access to computer labs on campus, but most of them bring their own personal digital devices such as laptops and tablets to classes on campus as well as to their teaching during their school practicum. The institution does not have an overall technology plan, but teacher educators integrate ICT in their subject disciplines since courses in educational technology are not offered. Consequently, student teachers' formal teaching and learning experiences with ICT are mainly through prior schooling, didactics (methods) courses, and during their school practicum.

The learning objectives of the ESL didactics course, which is taken by about 70 student teachers each year, are to prepare student teachers for teaching ESL in secondary school by focusing on a variety of pedagogical and didactical approaches. This includes developing pupils' basic skills and competencies in language, communication, literature, and culture. Each term is organized into eight lectures (2×45 min), and also consists of a school practicum component which lasts six week during the fall semester and eight weeks during the spring semester.

3. Methods

This section briefly describes the research design employed in the study which involves case study research. Aspects regarding validity, generalization, and ethics are discussed.

3.1. Research design

The study followed a case study methodology (Creswell, 2013; Yin, 2009) where the "bounded system" (Merriam, 2009, p. 40) was an ESL didactics course at a Norwegian teacher education program. The study involved four cohorts of postgraduate student teachers taking a ESL didactics course, and was conducted over four academic semesters from fall 2012 until spring 2014. According to Yin (2009), a case study is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenology and context are not clearly evident" (Yin, 2009, p. 18). Both qualitative and quantitative methods were used for collecting data including participant observations (Merriam, 2009), surveys (quasi-statistics, Maxwell, 2013), and semi-structured interviews (Kvale & Brinkmann, 2009). Triangulation of methods was used to reduce bias and improve validity by including convergent, inconsistent, and contradictory evidence (Mathison, 1988). Thus, the study considers causal relationships, processes, and alternative paths that lead to the outcomes within the case (George & Bennett, 2005). Although the notion of making empirical generalizations in case studies have been debated (Flyvbjerg, 2006; Thomas, 2011), generalization in this study was tied to naturalistic (Lincoln & Guba, 1985; Stake, 1995), and reader- or user-generalizations (Firestone, 1993) through rich thick descriptions (Geertz, 1973). Ethical approval for the study was granted by the Norwegian Social Science Data Service (NSD), and participation was voluntary. Before the data collection started, the student teachers were informed about the purpose of the study and were provided informed consent forms which they had to fill out and return to the researcher.

4. Data collection and analysis

This section describes the methods used for collecting and analyzing data. In order to gain a broad as well as a deep perspective of the student teachers' digital competence, both quantitative and qualitative data were used to provide rich descriptions of the phenomenon, and to offer a more complete understanding of causal processes and relationships within the case (Maxwell, 2013; Yin, 2009).

4.1. Participant observations

The focus of the participant observations was on investigating how the student teachers worked with ICT in the ESL lessons, and how they integrated ICT in their ESL classroom lessons during the school practicum. ESL didactics lessons ($N = 20$, 2×45 min) and school practicum classroom lessons ($N = 18$, $45–2 \times 60$ min) from 4 different cohorts of student teachers were observed and documented through field notes (Emerson, Fretz, & Shaw, 2011) from fall 2012 until spring 2014. The observation activity was known to the student teachers, and the researcher assumed the stance as "observer as participant" in order to establish an insider's identity in the group without participating in the activities (Merriam, 2009). Finally, the

observations informed the design of the surveys and interview guide, and helped shed light on the quantitative and the qualitative data (Hatch, 2002).

4.2. Surveys

Two self-reporting surveys (quasi-statistics, Maxwell, 2013) based on prior research (Krumsvik et al., 2013), participant observations and Krumsvik's (2011, 2014) model for digital competence development were distributed electronically. The surveys were made up of three sections: 1) demographic information, 2) questions regarding self-perceived digital competence, and 3) statements regarding digital competence and use of ICT in teacher education. The purpose of the first survey (S1) was to examine digital competence development in ESL student teachers. S1 was performed 'live' with all of the teacher education's ESL student teachers ($N = 61$) using Student Response System (SRS) feedback clickers during an ESL didactic lecture in the fall semester 2012 ($n = 41$, female $= 32$, male $= 9$, response rate 67%) (cf. Ludvigsen, Krumsvik, & Furnes, 2015). Later, a second survey (S2) was designed to see if the findings from the ESL student teachers in S1 corresponded with the rest of the student teachers across subject-disciplines in the teacher education program. S2 was distributed electronically to all of the teacher education program's student teachers ($N = 270$) through a learning management system during the spring semester 2014 ($n = 112$, female $= 74$, male $= 38$, response rate 41%). Quantitative data were analyzed for descriptive- and quasi-statistics (Maxwell, 2013) including frequencies, means, standard deviation, and factor analysis using IBM SPSS 21 Statistics. Missing values and incomplete inputs were removed from the dataset before the analysis in order to maintain a complete respondent dataset (Tolmie, Muijs, & McAteer, 2011).

Demographic information is described in Table 1. Most of the student teachers had high grade point averages (GPA) from upper-secondary school, and were distributed between taking the five-year integrated teaching program and the one-year practical pedagogical education. The student teachers were highly motivated to do well in their studies (S1 $= 73\%$, S2 $= 67\%$). Also, a majority had not received a school laptop for free in upper-secondary school (S1 $= 80\%$, S2 $= 70\%$).

A confirmatory factor analysis was performed to check the validity of the variables in the digital competence model. One factor was revealed in both surveys which included six variables related to *student teachers' self-perceived digital competence* (S1, Cronbach's Alpha $= 0.705$, Mean $= 4.74$, SD $= 0.730$; S2, Cronbach's Alpha $= 0.795$, Mean $= 5.33$, SD $= 0.644$). The internal reliability for this factor was within an acceptable level (Cronbach's Alpha $= \geq 0.70$). Other scales were excluded from the analysis because of low reliability. Table 2 shows the variables included in the factor as well as mean differences, and standard deviations.

Table 1
Demographic information (S1, $N = 41$; S2, $N = 112$).

Question	S1		S2	
	n	%	n	%
Gender				
Female	32	78.0	74	66.1
Male	9	22.0	38	33.9
Age				
19–24 years	27	65.9	60	53.6
25–29 years	11	26.8	50	44.6
30 years or older	3	7.3	2	1.8
GPA from upper-secondary school				
3 or above, but below 4	2	4.9	3	2.7
4 or above, but below 5	18	43.9	63	56.3
5 or above, but below 6	21	51.2	45	40.2
6	0	0.0	1	0.9
Study program				
1-year practical pedagogical education	20	48.8	46	41.1
5-year integrated teaching program	21	51.2	66	58.9
Motivation to do well in studies				
Yes	30	73.2	76	67.9
To some extent	11	26.8	35	31.3
No	0	0.0	1	0.9
Laptop during upper-secondary school				
Yes	8	19.5	33	29.5
No	33	80.5	79	70.5
MA thesis subject area[a]				
Languages	–	–	23	21.5
Sciences	–	–	26	24.3
History	–	–	13	12.1
Geography	–	–	4	3.7
Social studies	–	–	21	19.6
Other (aesthetic education, sport science, pedagogy, religion, vocational, media)	–	–	20	18.7

[a] Question asked only in S2, and includes 5 missing values. Reported percentage is the valid percentage.

Table 2
Student teachers' self-perceived digital competence.

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 PowerPoint) 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
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).

Similarly to this study, Krumsvik el al. (2013) performed a factor analysis of variables related to teachers and pupils' self-perceived digital competence in their study of digital competence in upper-secondary school using the *Bergen Digital Literacy Scale*. While six variables were included in the scale for the teachers (Cronbach's Alpha = 0.86), five variables were included in the scale for pupils (Cronbach's Alpha = 0.82, excluding the question digital Bildung). The findings from the study also confirm high levels of internal reliability for this scale.

4.3. Interviews

The purpose of the semi-structured interviews was to follow up and explore in more depth observational and survey data. Fifteen student teachers ($N = 15$; female = 11, male = 4) and one teacher educator ($N = 1$, female) were interviewed over four academic semesters from fall 2012 until spring 2014 using purposeful sampling (Maxwell, 2013; Patton, 2002). A total of nineteen interviews were conducted (Table 3). Also, to further examine the process of digital competence development in more depth at different times during the ESL didactics course, four student teachers (Ellie, Jude, Mariam, and Tim) were followed up on campus and during their school practicum and interviewed twice (Table 3). As recommended by Maxwell (2013), the guide was first pilot-tested with two graduated ESL student teachers to improve and revise the interview questions. Five broad themes were explored: *1) Reflections on prior ICT experiences in- and outside of school, 2) Teaching and learning experiences with ICT during school practicum, 3) Use of ICT in the ESL didactics course, 4) ICT-usage in the general teacher education program, 5) Self-perceived digital competence development during the teacher education program.* Table 3 provides information about the purposefully sampled student teachers.

The interviews (each lasting between 45 and 120 min) were held a week after the last ESL didactics lecture, and were conducted in Norwegian by the researcher. Relevant passages were translated from Norwegian to English, and afterwards inspected by a native speaker. All participant names were replaced with pseudonyms.

4.4. Analysis

Observational and interview data were transcribed, imported, and analyzed using NVivo 10 (Bazeley & Jackson, 2013). The analysis process drew on strategies from grounded theory (Charmaz, 2014; Corbin & Strauss, 2008), and was guided using the constant comparison method (Corbin & Strauss, 2008) where segments of data are compared to each other in order to find similarities and differences in patterns (Merriam, 2009; Miles, Huberman, & Saldaña, 2014). Through an abductive approach (Reichertz, 2007), codes were first constructed both a priori from the literature and from the data through a process of open or initial coding and categorization (Corbin & Strauss, 2008; Saldaña, 2013). For example, a priori codes such as *didactical ICT-competence*, *learning strategies*, and *digital Bildung* were constructed based on Krumsvik's (2014) theoretical model, while initial codes and categories such as *modeling*, *barriers for ICT use*, and *learning by doing* emerged from the data. Next, through axial or a second cycle of coding, similar patterns of codes and categories were reorganized, reconfigured, and developed into substantial categories and themes (Corbin & Strauss, 2008; Miles et al., 2014; Saldaña, 2013). These were synthesized into categories discussed below.

5. Results and discussion

The categories reported and discussed in this section focus on how student teachers' digital competence development is both enabled and inhibited through teacher education, and provide suggestions from the data and from the research literature on how to overcome potential barriers. The focal point of the categories is mainly on the micro level which describes the local "actor's pedagogical practice" (Enochsson & Rizza, 2009, p. 4).

Table 3
Information about purposefully sampled student teachers.

Name	Gender	Subjects	Interviewed	Visits	Prior ICT experiences
Ellie	F	English, Norwegian	Fall 2012, Spring 2014	3	Personal use, research, gaming
Benny	F	English, Geography	Fall 2012	1	Personal use, research
Marilyn	F	English, German	Fall 2012	1	Personal use, research
Mariam	F	English, History	Fall 2012, Spring 2014	3	Personal use, research, programming
Jude	F	English, History	Fall 2012, Spring 2014	2	Personal use, research
Sarah	F	English, Mathematics	Spring 2013	1	Personal use, research, gaming, web design
May	F	English, Norwegian	Spring 2013	0[a]	Personal use, research
Eric	M	English, Social Studies	Spring 2013	2	Personal use, research
Tim	M	English, Religion	Fall 2013, Spring 2014	3	Personal use, research
Andrew	M	English, History	Fall 2013	0[a]	Personal use, research, web design
Fran	F	English, Norwegian	Fall 2013	0[a]	Personal use, research
Ron	M	English, History	Fall 2013	1	Personal use, research
Katie	F	English, Norwegian	Fall 2013	1	Personal use, research
Tara	F	English, Social Studies	Spring 2014	0[a]	Personal use, research, web design, business

[a] The researcher was not able to visit all of the student teachers during their school practicum. This was due to conflicts in the teaching schedule, illness, or unforeseen events resulting in school visit being cancelled.

5.1. Modeling didactical ICT-use for student teachers

Having the teacher educator and mentor teachers serve as a role model by sharing "relevant experiences, examples, and strategies" (Portner, 2008, p. 9) was pointed out by the student teachers as an effective approach to generate more ideas on how they could integrate ICT into ESL teaching. Particularly, observational and interview data showed that making "pedagogical reasoning for practice clear, explicit and understandable" (Korthagen, Loughran, & Russell, 2006, p. 1036) promoted the student teachers' didactical ICT-competence:

> We have been introduced to a few things [ICT] that we can use … Our teacher educator in ESL didactics has provided us with a few examples which she has used in her own lessons, and it has been reassuring to know that it actually works (Benny, fall interview, 2012).

> The ESL didactics teacher 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).

> During the school practicum I had a very enthusiastic mentor teacher who was responsible for its learning [LMS] at the school … I learned a bit from her, how to use its learning for conducting tests or surveys in the classroom where everyone [pupils] respond with their own laptops (Ron, fall interview, 2013).

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

> There were a few learning resources at the school where we had meetings every week. In one of those meetings we discussed new things that we could use in the classroom, and among those were Storybird [digital story] and Kahoot [quiz] as examples (Tara, spring interview, 2014).

Observation data from the 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. The teacher educator stated during the interview that this was an important aspect of promoting the integration of ICT in ESL teaching:

> I could make a 'resource bank' for them, and hopefully provide some incentives so that they can work with it further through instilling in them a form of curiosity (Teacher educator, spring interview, 2014).

Consequently, some student teachers were observed modeling the use of ICT in front of their pupils including critical use of social media and how to locate information by using search engines:

> I have finally come around to creating a Twitter account which I actually show to my pupils and teach them how to use it … We have visited my Facebook profile or my account in order to show them certain group that they can follow to get language input (Tim, spring interview, 2014).

> 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 didactics course the student teachers were observed passively listening to the teacher educator's instructions of how they could use ICT in ESL teaching. In the interviews, they expressed that they also

wanted to actively try out the different digital tools rather than being passive listeners, and further explore the didactical potentials that the tools could afford for teaching and learning:

> I do not want to just watch, I want to try it out for myself. If someone is showing something and we try and fail several times, then things are fine. But we do not learn anything by just sitting in a lecture. We must be given time to try out technical stuff (Ellie, fall interview, 2012).

> They 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 them in our school practice (Andrew, fall interview, 2013).

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 4). Likewise, a majority of them seemed to agree that there was also a need to develop digital competence in teacher educators (Table 4). Furthermore, observational data showed that during their school practicum, 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 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. 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).

Gill, Dalgarno, and Carlson (2015) found that at an early stage with little time assigned to the design of lessons using ICT, student teachers assume that the practices used by the lecturer regarding teaching with ICT such as lecturing with Power-Point are "appropriate practices for use in school classrooms" (Gill et al., 2015). Hence, teacher educators need to be reminded of their position as role models and to "teach as you preach" (Lunenberg et al., 2007, p. 590) as they might not be aware of the potential negative or unintended effects that mimicry can have on student teachers' teaching practice with ICT (Sutherland, 2004).

5.2. Scaffolding student teachers' learning experiences with ICT

Although the student teachers perceived modeling as helpful in developing their digital competence, they also noted a preference to 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).

> I've learned a lot from the podcasts that she [teacher educator] tipped us about and the digital stories, and also how to write texts and comics that you can use on the Internet (May, spring interview, 2013).

> We had a 'multimodal lesson', an example of a multimodal lecture which incorporated audio, video, and a bit 'PowerPoint Plus', i.e. not just PowerPoint with a new text- and picture slides, but also more of the other functionalities in PowerPoint (Katie, fall interview, 2013).

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

> In a lot of lessons there has been 'bring your own device' where she asks us to find things on our own. That is very exciting because we bring it with us (Ellie, spring interview, 2014).

Table 4
Teacher educators' digital competence.

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

Questions used a 7-point Likert Scale (1 = no skills*/no extent**/completely disagree***, 7 = very good skills*/high extent**/completely agree***).

Researchers argue that student teachers should experience how they can integrate ICT in their subject teaching through active learning in methods- and educational technology courses, workshops, mentor partnerships, and school practicum (Kay, 2006; Niemi, 2002; Polly, Mims, Shepherd, & Inan, 2010). For example, Tearle and Golder (2008) claim that "when trainees were able to actually use the ICT themselves, i.e. 'hands-on opportunities', was far the most useful; much more so than 'demonstrations' which had generally been the style of the taught sessions" (Tearle & Golder, 2008, p. 67). However, when hands-on activities are provided to student teachers, these must go beyond the mastery of basic digital skills towards the appropriation of didactical ICT-competence and learning strategies by focusing on the "pedagogy that technology enables and supports, rather than on the technology itself" (Ertmer & Ottenbreit-Leftwich, 2013, p. 175).

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 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 (Table 2). In addition, observational data also support these results where the student teachers' use of ICT in ESL didactics and during their school practicum was observed to be centered on instruction and content delivery. Nevertheless, confidence does not necessarily transfer into practice and might just come off as "talk" (Swain, 2006, p. 57). 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, and teacher education. Therefore, they saw little educational value for using ICT in their 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. Interestingly, survey findings also showed that a majority of the student teachers had not been provided with a school laptop in upper-secondary school, which could potentially affect how they perceived the usefulness of ICT in teaching (Table 1). Furthermore, several student teachers reported in the surveys and in the interviews a need to learn more about didactical use of digital learning resources, learning strategies, and other digital tools (Table 5). Although the ESL teacher educator was observed exemplifying how to use relevant digital learning resources for developing pupils' language skills such as the BBC Languages website, 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).

These findings point out the importance of providing student teachers with hands-on opportunities for mastery and appropriation of digital competence in teacher education (Instefjord, 2014). When enabled to directly see and experience what educational uses and potentials are afforded and constrained by ICT through hands-on learning, student teachers may be able to see the real affordances and how ICT can be used for teaching and learning. Consequently, these opportunities could help develop student teachers' digital competence as well as promote positive attitudes and self-efficacy towards teaching with ICT (Sang et al., 2010).

5.3. Teacher educator linking theory and practice

Student teachers discerned that it was helpful for them to see the didactical value in using ICT for teaching when the teacher educator explained, modelled, and embedded theoretical knowledge about ESL teaching with real classroom practices where ICT was a seamless part of the teaching. For instance, the ESL teacher educator was observed discussing how digital storytelling could be used to promote pupils' language skills as well as basic skills in ESL by linking the method to theories on language learning:

> We have seen a few examples of how you can touch upon the different [language] skills, and some of the examples have included the use of ICT … A lot of what you learn in theory you know does not work in practice, but if someone has tried it in practice, then at least you know that it works (Benny, fall interview, 2012).

Table 5
Student teachers' training needs (S1, *N* = 41; S2, *N* = 112).

Questions	S1		S2	
	n	%	n	%
Digital tools – what digital tools student teachers want training in for improving pupils' potential learning outcomes with ICT				
1) Basic digital tools for teaching subject discipline (e.g. Word, PowerPoint, Google, etc.)	3	7.3	7	6.3
2) Social media for teaching subject discipline (e.g. YouTube, Facebook, etc.)	0	0.0	3	2.7
3) Digital learning resources for teaching subject discipline (e.g. NDLA, digital textbooks)	16	39.0	37	33.0
4) Basic digital tool and social media for teaching subject discipline	1	2.4	2	1.8
5) Social media and digital learning resources for teaching subject discipline	6	14.6	14	12.5
6) Basic digital tools and digital learning resources for teaching subject discipline	10	24.4	3	2.7
7) I need education in using other digital tools	3	7.3	29	25.9
8) I do not need any education at all	1	2.4	8	7.1
9) I do not know	1	2.4	9	8.0

At the same time however, theories supporting the use of ICT in ESL and foreign language learning seemed to be missing in the ESL didactics course where instead the emphasis was observed to be on other theoretical aspects including developing language skills. Several student teachers also pointed out that they were missing a deeper theoretical justification and understanding for why they should use ICT in their ESL teaching:

> It would be relevant to look at the theories behind ICT, and get a justification for why you should use ICT as a supporting tool where you don't just argue that 'pupils must know how to use ICT because they need it in order to function in contemporary society' (Marilyn, fall interview, 2012).

> I have not seen any connections between theories of learning, teaching practices in school, or course curricula regarding ICT and learning (Ron, fall interview, 2013).

> I don't feel like I have learned why, what for or how to get pupils to. It has been more about concrete examples like 'Here is Kahoot [quiz]. You can use this.' But why? How? Appropriate ways of using it? What learning outcomes will the pupils get? How you can use it to assess pupils? How much lesson time should ICT take up? (Mariam, spring interview, 2014).

In addition, the student teachers noted a gap between what they were taught in teacher education and the practices they encountered during the school practicum. In particular, classroom management and ICT integration in ESL were recurring themes in the interviews, which involved changing pupils' off-task classroom activities with ICT to meaningful learning activities:

> You cannot have teacher-centered lessons when pupils have computers because then they will often visit Facebook and things like that (Jude, spring interview, 2014).

Classroom management in ICT-rich classrooms was also noted as a topic that should be dealt with more thoroughly in parallel to traditional classroom management, and was not observed to be a part of the ESL didactics course. Although in both surveys (S1 & S2) the student teachers see themselves able to set learning goals for how pupils should use ICT and give clear instructions on how pupils can use ICT to improve their potential learning outcomes (Table 6), they noted during the interviews that these areas were challenging:

> When you're [teacher educator] talking about theories for learning and motivation for learning and all these things that are very important, and then it is not mentioned that they [pupils] are sitting there with their laptops … And either they are entertained or frustrated then suddenly they are on the Internet doing something different. I think we should be more prepared for these kinds of things, how you can turn it around to something good and positive (Ron, fall interview, 2013).

> They [teacher educators] have not presented any guidelines for us, and they have not commented on how we should handle it with the pupils either. I do not think so. It is like a thing that you have to figure out for yourself … I do not think it is fun for anyone to enter a classroom and not get any attention because everybody is busy with their computers (May, spring interview, 2013).

Table 6
Digital competence in teacher education.

Question	S1		S2	
	Mean	SD	Mean	SD
Setting learning goals — to what extent student teachers agree that they can set clear learning goals for how pupils should use ICT in their subject disciplines	4.27	1.205	5.05	1.012
Enhancing potential learning outcomes — to what extent student teachers agree that they can give clear instructions on how pupils can improve their potential learning outcomes when using ICT in their subject disciplines	4.66	1.237	5.07	1.071
Lecturers' research knowledge — to what extent student teachers agree that their study's lecturers are familiar with research on how pupils in schools best learn with the use of ICT	3.59	1.117	3.98	1.200
Digital competence development - to what extent student teachers agree that the teacher education's campus teaching has contributed to developing their digital competence	2.59	1.466	3.07	1.631
Digital competence for teaching - to what extent student teachers agree that their digital competence is sufficiently developed to teach with ICT in today's schools	3.27	1.304	4.01	1.443
Digital competence through subject didactics[a] - to what extent student teachers agree that they have developed their digital competence through the subject didactics and subject didactic seminars compared to other aspects of the teacher education program[a]	—	—	3.65	1.717
Digital competence through school practicum[a] - to what extent student teachers agree that they have developed their digital competence through the school practicum compared to the teacher education program's campus teaching[a]	—	—	4.68	1.364
Teachers' professional digital competence[a] - to what extent student teachers agree that their professional digital competence is important for their future profession as a teacher[a]	—	—	5.99	1.095
Professional digital competence for pupils' learning[a] - to what extent student teachers agree that their professional digital competence is important for their future pupils' potential learning outcomes[a]	—	—	6.08	0.997

Questions used a 7-point Likert Scale (1 = completely disagree, 7 = completely agree).
[a] Question asked only in Survey 2.

Overall, these findings stand out because they are incongruent with the persisting criticism that teacher education is too theoretical, abstract, and disconnected from the teaching practices in schools (Darling-Hammond, 2010; Sjølie, 2014). While several studies point out that student teachers generally value practical experiences more highly than the theoretical components of their study (Allen, 2009; Smith & Lev-Ari, 2005), the student teachers in this study seem to request deeper theoretical and didactical justifications regarding how and why they should use ICT in ESL teaching. With regards to didactical use of ICT, an emphasis on classroom management in teacher education is pertinent as studies show that digitally competent teachers are more successful with classroom management in digitally dense learning environments, and pupils are more likely to perform better academically in school when they have digitally competent teachers (Krumsvik et al., 2013; Krumsvik, Ludvigsen, & Urke, 2011). Teacher educators should endorse innovative and student-active learning activities with ICT rather than teacher-centered instruction since research shows that it increases the risk of pupils and students performing off-task activities with their digital devices (Blikstad-Balas, 2012; Fried, 2008; Ragan, Jennings, Massey, & Doolittle, 2014). Findings from Tamim, Bernard, Borokhovski, Abrami, and Schmid (2011) suggest likewise arguing that "one of technology's main strengths may lie in supporting students' efforts to achieve rather than acting as a tool for delivering content" (Tamim et al., 2011, p. 17).

5.4. Raising student teachers' awareness through reflection

Having student teachers reflect individually or with others on what digital tools are available and how they could be used in ESL teaching was noted as a powerful way of raising their critical awareness surrounding didactical ICT-use, learning strategies, and digital Bildung:

> We had a big breakthrough with digital storytelling [workshop]. I think that was very wise because it made more student teachers start to open their eyes to what we could do with it [ICT] (Ellie, spring interview, 2014).

Through reflecting on didactical ways of using ICT for teaching their subject disciplines, student teachers become "reflective practitioners" (Schön, 1983). Furthermore, these reflections should focus on "*how*, not [just] *what*, technology should be used to achieve meaningful learning outcomes" (Ertmer & Ottenbreit-Leftwich, 2013, p. 175). For example, the interviews revealed that through their study student teachers became more critical to using ICT in their teaching:

> We had all heard that 'interactive whiteboards are so cool and it is incredible what you can do with them', but there weren't that many teachers at the school I was at who had any good suggestions for how to use it to achieve better pedagogical outcomes (Ron, fall interview, 2013).

Moreover, due to their studies, many had become more conscious of how they used ICT as students and as professional teachers. For example, few student teachers were seen using their laptops or mobile devices for notetaking during the ESL didactics course:

> I think that most of us are old enough to know that if we have it [laptop] up, then we we're not going to pay attention to what the lecturer is saying. Then I would be looking at Facebook or send e-mails or read 'Dagbladet' [newspaper] (May, spring interview, 2013).

> If you're showing things like pictures and music then there needs to be a real purpose and meaning behind it, and not that you're using it to do something fun during the lesson. Your pupils might think it's entertaining, but they're not gaining any subject knowledge from it (Ellie, fall interview, 2012).

> In a way, I feel that there should be a higher level of what you do in a teaching context than in your spare time, that you should really have a better competence (Mariam, fall interview 2012).

Furthermore, survey data (S1 & S2) showed that the student teacher felt confident in guiding pupils in assessment and being critical to digital sources (Table 7). The interviews also supported these findings where they reflected on their pupils' daily ICT-usage, notably how little their pupils knew about locating and being critical to information on the Internet:

> We might have taken it for granted, that is, we asked our pupils to find information online … And then we did not have so much time to talk about how they could find information online. We saw that it would have been very helpful to set aside some time to also talk about it, and at the same time learn a bit more about how to be critical to the sources that they used (Ron, fall interview, 2013).

> I noticed that the pupils were not as good with these things as I thought, so I also think that they can benefit from not only using their computers as a device for entertainment, but that they can also learn things and use it for learning (May, spring interview 2013).

Although the surveys (S1 & S2) indicated that the majority of student teachers felt digitally competent and confident (Table 2), some student teachers admitted during the interviews that their overall of digital competence was lacking after teaching ESL with ICT during the school practicum:

Table 7
Student teachers' didactical use of ICT (S1, $N = 41$; S2, $N = 112$).

Questions	S1		S2	
	n	%	n	%
Didactical ICT usage – in what way do student teachers use ICT didactically				
1) I use ICT so that pupils can remember subject content better (e.g. remember concepts and definitions)	1	2.4	6	5.4
2) I use ICT so that pupils both can remember and understand subject content better (e.g. visualizing theoretical subject content)	5	12.2	18	16.1
3) I use ICT so that pupils can remember, understand, and apply subject content better (e.g. for solving subject-related tasks)	12	29.3	39	34.8
4) I use ICT in a general manner so that pupils can attain better learning outcomes compared to if I had only used the text book	23	56.1	48	42.9
5) I do not use ICT in any of these ways (1–4)	0	0.0	1	0.9
Digital learning strategies – what digital learning strategies do student teachers master for guiding pupils				
1) I can guide pupils in reading screen-based texts on a basic level	3	7.3	8	7.1
2) I master #1, and I can guide pupils in reading screen-based texts with concentration, persistence, flow, and coherence	3	7.3	3	2.7
3) I master both #1 and #2, and I can guide pupils in searching, localizing, and compare information from different digital sources	5	12.2	9	8.0
4) I master #1, #2, and #3, and I can guide pupils in transforming and contrasting information from different digital sources	5	12.2	7	6.3
5) I master #1, #2, #3, and #4, and I can guide pupils in assessment and source criticism of digital sources	15	36.6	51	45.5
6) I master #1, #2, #3, #4, and #5, and I can guide pupils in interpretation and analysis of digital sources	8	19.5	27	24.1
7) I to no master any of the abovementioned statements (1–6)	2	4.9	7	6.3

> I have realized how bad my digital competence really is! I am good at using it [ICT] myself, but I am not so good at using it in my teaching. I have mainly used ICT as a tool, a basic writing tool. I have used its learning as a submission platform (Tim, fall interview, 2013).

Despite survey data (S1 & S2) showing high scores in digital Bildung (Table 2), the student teachers wanted more discussion during teacher education regarding digital Bildung including how to promote and maintain a professional and healthy online presence, and ethical issues online such as cyberbullying and plagiarism:

> 'Should I be friends with my pupils on Facebook?' There are several ethical questions that just do not get asked in my course (Eric, spring interview, 2013).

> We haven't really talked about cyberbullying and plagiarism. We talk a lot about source criticism, but it is more geared towards us as university students. You're reminded in several courses 'how to cite your sources correctly, when to cite and who' (Marilyn, fall interview, 2012).

Additionally, when asked whether their digital competence had developed as a result of their teacher education program and whether they felt prepared to teach in today's digital schools, the student teachers' answers were somewhat incongruent. This was also evident in the survey and interview data which showed varying of agreement (Table 5):

> We have learned a about a lot of ICT tools that we can use, but I don't feel like we have explored these things in depth (Ellie, spring interview, 2014).

> I think that I might have become more aware of things that exist rather than having to some extent developed my competence. But in a way, I have been told of many resources which I could have imagined being out there, but that I did not know existed (Katie, fall interview 2013).

By enabling student teachers to become "reflective practitioners" (Schön, 1983) with regards to teaching ESL with ICT, they become more capable of seeing the real affordances of the digital tools and the value added that ICT could bring to teaching the subject discipline (Røkenes & Krumsvik, 2014). Through tasks and activities with or without ICT such as discussions, reflective journals, and classroom observations, teacher educators could encourage student teachers to take a critical stance on what and how they could potentially use ICT in their teaching (Tondeur et al., 2012). Moreover, critical reflections on the role of ICT in education and society can cultivate digital Bildung among student teachers by raising their awareness of the possible ethical issues, dilemmas, and pitfalls involved with our increasing digital lifestyles.

5.5. Providing student teachers with access to resources and support

While on campus and in their school practicum, student teachers were observed to have access to a number of hardware and software resources and ICT support (technical and pedagogical) from the ESL teacher educator, mentor teachers, peers, pupils, and ICT staff which were important conditions for learning about integrating ICT in their teaching (Kay, 2006):

> I am not so technically proficient to set up things, but luckily many of my pupils are (Jude, fall interview, 2012).

> We were three student teachers on one interactive whiteboard, and then we went around and tried out different things. We got to try it out and see for ourselves for an hour until we were satisfied. Then our mentor teacher came back, had a look at each of us, and asked us if we had any questions (Ellie, fall interview, 2012).

Mentor teachers were also observed to showcase innovative ways for teaching ESL with ICT using for instance social media, and were pointed out as important supporters:

> In my case, the practice school I was at had a Facebook page where everybody was a member. If anybody found a useful web page then it got shared there. I think that is important because it is about exposure [to digital resources], and you will not have any use for something if you do share it with somebody else. We use Dropbox a lot (Andrew, fall interview, 2013).

However, these learning experiences were also inhibited by a number of barriers including: limited access to schools' laptop trolleys and computer labs, restrictions on the use of schools' learning management systems and software due to ICT regulations, issues with schools' Internet connections and technological infrastructure, a lack ICT support and training opportunities. Excerpts from the interviews showcase some of the challenges the student teachers encountered:

> We never got access to its learning because it was too much of hassle for the [school's] ICT staff (Jude, fall interview, 2014).

> 10th grade had their mock written and oral exams so they booked all of the PCs in the school. So then I did not get to use PCs (Jude, spring interview 2014).

> It [digital quiz tool] was great to use because I thought it would be a nice 'exit poll' where pupils could get immediate feedback. However, this was something the [school's] ICT staff could not do because they had to open up a port … And they were not allowed to do it according to county ICT regulations (Mariam, fall interview 2012).

On campus, access to and support in the use of interactive whiteboards and digital tools other than office software was observed to be lacking, and mentioned frequently in the interviews by the student teachers and the teacher educator:

> We have not received any training in the use of ICT, no training in the use of interactive whiteboards. During the program startup, we had a short course in PowerPoint. That is one thing that we master (Marilyn, fall interview, 2012).

> I commented a lot during my first years at the teacher education program that we should be 'room' for short workshops with it [interactive whiteboards]. Because now there are interactive whiteboard mounted in almost every classroom in the schools, and the most frequent use is simply as screen, in order to show PowerPoint (Teacher educator, spring interview, 2014).

The ESL teacher educator noted that making time in lectures for hands-on activities with ICT challenging due to course requirements and program complexities:

> There are just too few lessons in didactics so I have to try to work with what I have got even though I realize that there will never be enough time to work with it all. It is then about providing examples, ideas, and thoughts. It can be everything from for instance a web page, a learning resource, to showing pupils' work where they have used ICT (Teacher educator, spring interview, 2014).

Other student teachers claimed that even though there was sufficient access to resources, the support surrounding these was inadequate

> One mentor teacher turned on the interactive whiteboard and said 'Here, play around with it', and so we got to stand there and try it out. It was because he did not know how to use it himself (May, spring interview, 2013).

In addition, some of the requests for ICT support in schools were overlooked by mentor teachers who assumed that student teachers were already digitally competent:

> They said [mentor teachers and ICT staff] that we were already so good [in using ICT] since we were young, and that 'everything will be all right'. It was more like that kind of mentality (Jude, fall interview, 2012).

Often times, student teachers were frustrated with their mentor teachers since they did not know how to use the various digital tools available at the school even though they had been around for years. For example, data from the participant observations and the interviews revealed that almost all of the student teachers ended up using the schools' interactive whiteboards as projectors for lecturing and for giving instruction with PowerPoint in lack of knowing how to use the tool's real affordances:

> That was like the sad thing about the school, that my mentor teacher in English did not know how to use interactive whiteboards, and she did not show any interest in wanting to learn how to either. So in that classroom where there was an interactive whiteboard and no blackboard she also stood there kind of helpless and had nothing that she could use (May, spring interview, 2013).

Consequently, if student teachers are not provided access to resources and support, it will be challenging to use ICT for teaching in an effective manner and develop their digital competence (Kay, 2006; Tondeur et al., 2012). Teacher education programs and partnership schools should break down barriers which could potentially inhibit student teachers' digital competence development through, for instance co-planning a shared vision for how ICT should be used in education (Goktas,

Yildirim, & Yildirim, 2009). Teacher educators and mentor teachers must also be reminded of their important role as role models for supporting student teachers' use of ICT in teaching (Tearle & Golder, 2008; Twidle et al., 2006). Furthermore, there is a need for teacher educators to make explicit what is expected of mentor teachers and partnership schools with regards to supporting student teachers' digital competence development during school practicum (Judge & O'Bannon, 2007). Moreover, even though today's student teachers can be referred to as digital natives and are proficient in basic digital skills, they still need to be taught how they can teach with ICT (Lei, 2009; Ng, 2012). In order to make the most out of the limited amount of time during lessons, teacher educators and student teachers should consider adopting innovative pedagogical approaches to teaching such as flipped classroom which involves shifting the role from being a "sage on the stage" to a "guide on the side" (McWilliam, 2008).

5.6. Fostering student teachers' innovative assessment practices

Having the teacher educator promote new ways of assessing pupils' work in ESL with ICT in order to achieve school curriculum goals was frequently praised in the interviews as an effective learning strategy for their own digital competence development:

> We have gotten pretty good guidance in ESL didactics with how to conduct searches and how to use the Internet (Erich, spring interview, 2013).

> Our teacher educator in ESL didactics told us that when she assessed pupils' essays or digital stories, she made a video recording [screencast] of what she saw and said things like 'this was a nice sentence' … You get to speak in English and the pupils get to practice listening also when they get feedback and not just have it in writing (Ellie, spring interview, 2014).

> It looks like the blog was motivating for most of my pupils … I see that many have improved their writing capabilities to a whole new level (Tim, spring interview, 2014).

However, assessment with ICT was pointed out during the interviews as difficult and lacking in teacher education, especially how to assess pupils' digital compositions and online learning strategies as the student teachers were used to traditional forms of assessment. Yet these results were incongruent with data from both surveys (S1 & S2) where a majority of the student teachers reported that they mastered guiding pupils in assessment and source criticism of digital sources (Table 6):

> It's challenging to develop their [pupils'] written competence without them copying something that is better … I think we need to work a lot more with encouraging them to use the Internet to develop themselves, look up words, and learn new things, but also to risk writing your own things (May, spring interview, 2013).

> I thought that was very difficult, with sources, because most [pupils] go straight into Google and then they find Wikipedia … You should be critical to sources, but then I discovered that many of them didn't know what 'critical' really means (Ellie, spring interview, 2014).

> Digital assessment, I use way too much time on it. I have 2 'text heavy' subject disciplines. I want tools that make it easier for me to assess texts (Tim, spring interview, 2014).

Also, a few student teachers noted a mismatch between assessment practices at university and in schools which negatively affected their use of ICT in ESL teaching. For instance, many student teachers did not find it worthwhile to take notes with laptops on campus nor have their pupils take notes on their computers or use online dictionaries during the school practicum, because university exams were hand written and for that they needed to practice their hand writing skills. These statements also correspond with observation data from the ESL didactics course and school practicum visits:

> We were told to use paper-based dictionaries for the exam … We are then kind of encouraged not to use digital tools really (Mariam, fall interview, 2012).

Interestingly, the student teachers suggested alternative ways of working with assessment practices and learning strategies with ICT as a way of promoting digital competence:

> Podcasts are great for those who are shy because they really want to talk to me, and then they can just record in on a podcast … And then as a teacher you have a better opportunity to plug in your headphones and listen afterwards, and give them feedback on what they are saying and how they are saying it (May, spring interview, 2013).

> You could turn things a bit upside down and worked with assignments at school when the teacher is available, and then listen to or watch stuff which is more lecture based when you're at home (Ron, fall interview, 2013).

> Maybe replace a mandatory written essay assignment with hand in exercises that are digital using some form of digital tool. I think that's a way of working more with it because in a way it is 'learning by doing', but without it going so rapidly that you don't have time and you become demotivated (Katie, fall interview, 2013).

> Its Learning is a tool with a lot of potential … It is extremely underused, and it has become an information portal … Or it is a portal for grades and assignments. Just the fact that I used multiple-choice tests on its learning was new to my peers (Tim, spring interview, 2014).

Encouraging student teachers to move from traditional assessment to appropriate innovative ways of evaluating pupils' performance and attainment with ICT could benefit their digital competence development (Erstad, 2008; Røkenes & Krumsvik, 2014). Student teachers should be presented new ways of doing assessment with ICT, and expected by teacher educators to use digital tools as integral part in solving, presenting, and assessing tasks and assignments in teacher education (Dexter & Riedel, 2003). However, contradictory assessment practices such as those found in this study between the teacher education program and practicum schools need to be addressed so that student teachers are not discouraged to use ICT.

5.7. Encouraging collaborative learning among student teachers

During school practicum visits, student teachers were sometimes observed teaching ESL in pairs and helping each other out with technical issues related to ICT. Moreover, before and after lessons, they were sometimes seen spending time together with peers or with their mentor teacher discussing ICT-integration in ESL teaching. As stated in the interviews, collaborations among peers and mentor teachers was perceived as valuable for digital competence development as it helped lower the threshold for exchanging experiences about relevant digital learning resources for classroom use and asking for help to resolve technical issues:

> We would perhaps make a quiz together in PowerPoint and then we would use it in multiple grades even though we have different grades and we are different teachers (Erich, spring interview, 2013).

> I told the others that I used Storybird. [Reaction of peers] 'Wow, they are that young! How does it work?' The school did not have Storybird and my mentor teacher was like 'Superb, this is great!' (Sarah, spring interview, 2013).

> If we talked about digital stuff, it was often about Kahoot [quiz] and Prezi [presentation]. We used that a lot. It was perhaps a bit more exciting than PowerPoint so we talked a bit about it. And we talked a fair bit about technical stuff, like I showed them 'My computer has this port. What cable do I need?' and so we talked about that and figured out what we needed (Ellie, spring interview, 2014).

Curiously, the student teachers seemed to avoid using the teacher education's learning management system in their online collaborations, and instead preferred to collaborate through social media and cloud-based services as a way of sharing resources and experiences. These findings could correspond to the survey data (S1 & S2) where findings show high scores in elementary and basic digital skills including social media and office software (Table 2):

> It is very common that we use Google Docs so that we can simply write together online and everybody has access to it. You then have the possibility to edit what the others are writing and the others can also edit what you are writing (Erich, spring interview, 2013).

> Regarding my use of Dropbox, I think it is an amazing way of sharing information between different people and in now with my peers. We have agreed to write a summary each and then upload it there (Andrew, fall interview, 2013).

> We have our own Facebook group for our partnership where those who want to have shared resources. Last time I was in there, I shared something related to language teaching (Tara, spring interview, 2014).

One student teacher in particular expressed that it was difficult to initiate online collaborations, and she missed explicit initiatives from the ESL teacher educator that could break the feeling of isolation during the school practicum:

> It would be an idea to use the discussion forums [referring to its learning] more actively. For instance, if you have done something during your school practicum that worked really well with one school grade then you could write it there so that others could try it out, because in ESL … It was just me and my mentor teacher (Benny, fall interview, 2012).

Affording student teachers with opportunities and spaces for collaborating with ICT could allow them to exchange experiences, seek help with overcoming technical and didactical challenges, and explore innovative ways of using collaborative learning with ICT in their ESL teaching (Tondeur et al., 2012).

6. Implications, limitations, and further research

The section describes and discusses the main contributions of the study in terms of empirical, theoretical, and methodological implications. The section ends with some concluding remarks by discussing study limitations and providing recommendations for further research.

6.1. Implications for teacher education

The main contribution of this study is new knowledge on how ESL student teachers in Norwegian teacher education develop digital competence. The findings have empirical, theoretical, and methodological implications. The main empirical implication of the study is the contextualization and application of different approaches to developing digital competence in ESL didactics in teacher education. The research literature point out several general approaches as to how student teachers should be prepared to teach with ICT in teacher education (Kay, 2006; Røkenes & Krumsvik, 2014; Tondeur et al., 2012). This study has attempted to examine and show how these approaches can be applied on a micro level through the context of ESL didactics and Norwegian teacher education.

First and foremost, the results presented and discussed in this study underscore the importance of systematic and reflexive thinking around how ICT integration is conducted in teacher education. In particular, the observational and interview data point out the importance of modeling ICT-integration in teaching by the teacher educator and mentor teachers. If teacher education programs want to prepare ESL student teachers to teach ESL in innovative ways with ICT, then teacher educators and mentor teachers need to reflect on how they use these digital tools in their own teaching practice. Data from both surveys (S1 & S2) show that only half of the student teachers consider the teacher educators to be digital role models for their own teaching, and that a majority of them see a need to develop their own and the teacher educators' digital competence (Table 4). These findings imply that teacher educators and mentor teachers need to be reminded of their function as digital role models for integrating ICT in ESL teaching (Krumsvik, 2014). Moreover, the results point out that student teachers need opportunities to experience and critically reflect on the educational value of ICT through hands-on activities such as through collaborating with peers and reflective activities. In this study, the ESL student teachers highlighted getting time in the ESL didactics course to work with digital storytelling and online learning resources as valuable for their own digital competence and future ESL teaching. Through working with relevant ICT-related teaching activities in ESL the student teachers might be able to fulfill some of their training needs regarding didactical use of ICT in their subject discipline as observed in the survey data (Table 5). Furthermore, an important condition for enabling these types of activities is providing student teachers with access, time, and support to technology on campus and during the school practicum placements. Kay (2006) supports the assertion that if access is insufficient, then "it is unlikely that other strategies will work" (Kay, 2006, p. 394). In other words, not only does this include providing ESL student teachers with access to appropriate tools, but also access to pedagogical support and time to experience how ICT can be used in their own teaching (Tearle & Golder, 2008). Finally, the focus of relevant ESL teaching activities with ICT in teacher education should go beyond the mastery of basic digital skills and aim for the appropriation of innovative teaching practices (Instefjord, 2014). Although the survey data (S1 & S2) show that the student teachers' self-perceived digital competence and didactical use of ICT are rated relatively high (Table 2 & Table 7), the observational and interview data paint a different picture where elementary and basic digital skills seem to dominate their teaching practices in ESL. Thus, the preparation of ESL student teachers should also involve promoting the more complex dimensions of digital competence including didactic ICT-competence, learning strategies, and digital Bildung. Taken together, these elements make up teachers' professional digital competence, which has become an important prerequisite for teaching in today's increasingly digitalized school (Krumsvik, 2014; Lund et al., 2014; Tømte et al., 2015).

The overall empirical contribution of this study is the specific focus on student teachers and ICT integration in ESL didactics rather than focusing on general ICT-skills development and application of educational technology in isolation of subject disciplines. The latter seem to be a recurring theme in studies on ICT training in teacher education (cf. Kay, 2006). Moreover, by focusing on ICT-integration in ESL didactics and Norwegian teacher education with student teachers qualifying to teach ESL in grades 8–13 in Norwegian secondary school, this study is an original empirical contribution to the research literature where currently no similar studies exist in Norway (see Instefjord, 2014; Tømte, 2013; Tømte et al., 2015 for studies of grades 1–7 and 5–10). Finally, the results from the first survey (S1) seem to follow similar patterns as to the second survey (S2) in terms of the student teachers' self-perceived digital competence, views on digital competence in teacher education, and training needs in teacher education for didactical use of ICT. These findings might suggest that the perceptions of the ESL student teachers and their experiences with ICT-integration in ESL didactics fit with the rest of the student teachers across subject disciplines in the teacher education program. In turn, these results could inform teacher educators in other subject disciplines about how they can improve their teaching with ICT.

A theoretical implication of this study is the application of a digital competence model as research lens for analyzing both qualitative and quantitative data. In particular, the model draws on Norwegian educational policy and steering documents including the national curriculum (Ministry of Education and Research, 2006a, 2006c), and is developed through studies on ICT in Norwegian school and teacher education (e.g., Almås & Krumsvik, 2007; Krumsvik, 2011, 2014). Hence, the model takes into consideration perspectives and terminology (e.g., competence, didactics, Bildung) that are relevant in a Norwegian educational context. Consequently, applying the model as an analytical lens can provide better insight into Norwegian student teachers' digital competence development compared to other frameworks, which are developed in other educational and cultural contexts such as the Technological Pedagogical and Content Knowledge framework (Mishra & Koehler, 2006), the Technology Acceptance Model (Teo, 2009), and UNESCO's ICT competency framework (UNESCO., 2011).

A methodological implication concerns the study's methodological transparency. This includes rich descriptions of research design, methods, and instruments for collecting and analyzing data. The transparency of methods in this study could allow for other researchers to possibly replicate the procedures for use in other settings. Another methodological contribution regards the use of SRS feedback clickers as a way of collecting self-reported survey data 'live' during a lecture. Arguably, this

practice could be considered a methodological innovation in research on Norwegian teacher education. Although other studies have employed the method with other populations including pupils and teachers in upper-secondary school (cf. Krumsvik et al., 2013), and students in higher education (cf. Ludvigsen et al., 2015), no study has used SRS feedback clickers to collect data from student teachers. Thus, the study demonstrates the potential of SRS feedback clickers as part of formative assessment practices to investigate digital competence in student teachers, and in turn inform teacher educators' teaching with ICT.

6.2. Limitations and recommendations for further research

Certain limitations can be identified in the study. One limitation is that the survey data is based on self-reported measures and might reflect the student teachers' perceptions more than the actual situation at the teacher education program (Swain, 2006). Future studies should continue to build on mixed methods research designs, which allow for the investigation of digital competence development in teacher education both on a broad and deep scale. A general recommendation is that more studies should compare digital competence development of student teachers qualifying to teach in secondary school (Røkenes & Krumsvik, 2014), and that these studies are conducted across several online and face-to-face teacher education programs using both quantitative and qualitative approaches (e.g., Tømte et al., 2015). In addition, as recommended by Sang et al. (2010), longitudinal studies could help track competence development over time in relation to how it affects student teachers' integration of ICT during and after graduating from teacher education. In Norway, more studies should investigate and compare digital competence across subject disciplines in several teacher education programs, which could improve the generalizability of the findings to other institutions.

Acknowledgements

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Paper III

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Digital storytelling in teacher education: A meaningful way of integrating ICT in ESL teaching

Abstract
The purpose of this study is to examine how the use of digital storytelling (DST) in teacher education can help develop digital competence in secondary school English as a second language (ESL) student teachers, and promote the innovative use of information and communications technology (ICT) in ESL teaching. Following a case methodology and a design-based research approach, the study reports on two iterative design cycles of a DST workshop held at a Norwegian teacher education program where the aim was to promote secondary ESL student teachers' digital competence and showcase innovative ways of integrating ICT into ESL teaching. A digital competence model is used as a research lens for the data analysis where data come from a quantitative survey, participant observations, reflection logs, digital artifacts, and semi-structured interviews. Findings point to a number of approaches that can be used in the workshop design such as modeling ICT integration and assessment, scaffolding student-active learning experiences with ICT, and linking theory and practice through reflection. Implications for teacher education are discussed.

Keywords: professional digital competence, digital storytelling, student teachers, teacher educators, teacher education, ESL didactics

Sammendrag
Hensikten med denne studien er å utforske hvordan bruken av digitale fortellinger i lærerutdanningen kan bidra til å utvikle lektorstudenters digitale kompetanse og fremme innovativ bruk av IKT i engelskundervisningen. Gjennom bruken av kasusstudie og en design-basert forskningstilnærming beskriver denne studien to gjennomføringer og design-sykluser av et verksted med bruk av digitale fortellinger ved en norsk lærerutdanning hvor det overordnede målet var å vise innovative og hensiktsmessige måter å integrere IKT i engelskundervisningen. En digital kompetansemodell er brukt som linse i dataanalysen hvor datamaterialet kommer fra en kvantitativ spørre-undersøkelse, feltobservasjoner, refleksjonslogger, digitale artefakter og semi-strukturerte intervjuer. Studiens funn viser en rekke tilnærmingsmåter som kan tas i bruk i gjennomføringen av verksted i digitale fortellinger, slik som modellering av integrering av IKT og vurdering med IKT, stillasbygging ved studentaktive læringsopplevelser med IKT, og brobygging mellom teori og praksis gjennom refleksjon. Implikasjoner for lærerutdanningen blir diskutert.

Nøkkelord: profesjonsfaglig digital kompetanse, digitale fortellinger, lærer-studenter, lærerutdannere, lærerutdanning, engelsk fagdidaktikk

Introduction

In the last decade, information and communications technology (ICT) has permeated foreign language teaching in Norwegian schools (Drange, 2014). Because the national curriculum lists digital competence as one of five basic skills (Ministry of Education and Research, 2006; Norwegian Directorate for Education and Training, 2012), teachers are expected to integrate ICT at all levels in all subjects, including English as a Second Language (ESL). Researchers on foreign language teaching have noted that the availability of digital resources has altered teaching strategies and teaching activities. They have found that ICT may positively enhance pupils' language learning (Golonka, Bowles, Frank, Richardson, & Freynik, 2014; Zhao, 2003). For example, Golonka et al. (2014) and Zhao (2003) found that online chat, automatic speech recognition, and video have positive effects on foreign language learning; in particular, such technologies can improve pronunciation, provide effective feedback, and increase language production and complexity. In Norwegian research on ICT in ESL teaching, Rasmussen and Lund (2015) reported a growth in "hybrid practices" in secondary schools where online resources challenge the textbook's dominant position as the only source of information. However, the integration and innovative use of ICT in ESL education relies on teachers' professional digital competence; consequently, teacher education plays a critical role in preparing future teachers to teach ESL with technology in schools (Lund, Furberg, Bakken, & Engelien, 2014). Hence, ESL student teachers should be afforded ways to develop their digital competence in ESL didactics[1] during teacher education programs through relevant teaching activities like video editing (Bruce & Chiu, 2015), podcasting (Kim, 2011), and creating wikis (Brox & Jakobsen, 2014).

Despite the demonstrated benefits of ICT in ESL teaching, research has shown that ICT in teacher education is dominated by traditional teacher-centered pedagogy, which often limits its use to administrative tasks, office technologies, content delivery, and instruction (Blin & Munro, 2008; Clark, Zhang, & Strudler, 2015; Drent & Meelissen, 2008). In Norwegian teacher education, studies have revealed that the uptake of ICT is slow, and that student teachers learn to integrate ICT in their teaching in a tool-oriented rather than an innovative manner (Gjerdrum & Ørnes, 2015; Tømte, 2013). This situation contradicts a finding by Tamim et al. (2011) that "one of technology's main strengths may lie in supporting students' efforts to achieve rather than acting as a tool for delivering content" (Tamim et al., 2011, p. 17). Consequently, Haugerud (2011) reported a need for teacher education programs to move beyond technical proficiency aims and instruct student teachers in innovative and student-active ways to integrate ICT in teaching.

One way to showcase the purposeful integration of ICT in teacher education and promote ESL student teachers' digital competence is through digital

storytelling (DST) (Heo, 2011). In an educational context, digital stories (DS) are short videos (90–120 seconds long) composed of a series of still images with overlaying narration using basic video editing tools such as Movie Maker and iMovie (Ohler, 2013). These basic but powerful desktop tools have been proven to be user-friendly, accessible, and easy for learners to master (Istenic Starčič, Cotic, Solomonides, & Volk, 2016). Also, this sociocultural (Säljö, 2001) way of learning can support reflection on subject knowledge, problem-solving, creativity, and critical thinking skills (Malita & Martin, 2010) through a "rich authentic learning experience, encouraging student autonomy and ownership, and meaningful student roles and interactions" (Kearney, 2011, p. 169). In turn, these aspects surrounding DST could potentially increase the likelihood that ESL student teachers will master and appropriate digital competence in teacher education (Instefjord, 2014).

Currently, DST is a popular approach for integrating ICT in education (Niemi et al., 2014; Sadik, 2008). In Norway, most studies on DST in education have focused on pupils' (Silseth, 2013) and teachers' use of DST in school (Aagaard, 2014). However, no studies have examined the use of DST as a method in Norwegian teacher education with secondary school[2] student teachers in subject didactics such as ESL. Therefore, the purpose of this study is to investigate the use of DST in Norwegian teacher education for developing secondary school ESL student teachers' digital competence. The research question is: *How can a DST workshop in teacher education promote secondary school ESL student teachers' digital competence?*

Digital competence in ESL teaching
In Norway, digital competence is generally understood as "skills, knowledge, creativity, and attitudes required to use digital media for learning and comprehension in a knowledge society" (Erstad, Kløvstad, Kristiansen, & Søby, 2005, p. 8, my translation). This competence involves more than mastering basic digital skills. It comprises using ICT to support learning through appropriating complex digital learning strategies and ethical judgment online including gathering and processing information, being critical of sources, and developing knowledge about copyright and privacy (Erstad, 2010; Krumsvik, 2007). For instance, digital competence as a basic skill in the English subject curriculum means "being able to use a varied selection of digital tools, media and resources to assist in language learning, to communicate in English and to acquire relevant knowledge in the subject of English" (Ministry of Education and Research, 2006). Further, pupils should "experience English texts in authentic situations" which "involves gathering and processing information to create different kinds of texts" and "using digital sources in written texts and oral communication and having a critical and independent attitude to the use of sources" (Ministry of Education and Research, 2006). Finally, pupils should be "developing
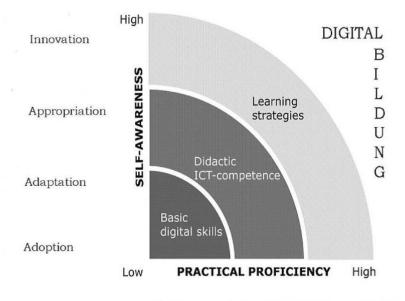
knowledge about copyright and protection of personal privacy" (Ministry of Education and Research, 2006).

   Also, while some of the competence aims are quite explicit about the use of ICT for language learning, others are more implicit. As an illustration, two of the competence aims after year 10 express that pupils should be able to:

- select different digital resources and other aids and use them in an independent manner in own language learning; and
- create, communicate and converse about own texts inspired by English literature, films, and cultural forms of expression

   (Ministry of Education and Research, 2006)

Thus, the use of ICT in the English subject curriculum puts demands on teachers, resulting in the need for teacher education to prepare ESL student teachers to integrate ICT in a pedagogic-didactic way to meet these curricular demands (Krumsvik, 2014).

Figure 1. Model for student teachers' digital competence (Krumsvik, 2011, 2014).

In the last decade, several Norwegian studies have focused on teachers' professional digital competence as being different than that of other users of technology because of their focus on teaching and learning (Almås & Krumsvik, 2007; Guðmundsdóttir, Loftsgarden, & Ottestad, 2014; Tømte, 2013). Accordingly, Krumsvik (2011) has offered the following definition describing

digital competence in teachers and teacher educators: "Digital competence is the teachers/TEs' (teacher educators') proficiency in using ICT in a professional context with good pedagogic-didactic judgement and his or her awareness of its implications for learning strategies and the digital Bildung[3] of pupils and students" (Krumsvik, 2011, pp. 44–45). Krumsvik (2011, 2014) proposed a model to promote understanding and reflection about digital competence development (Figure 1). In this study on student teachers, the model[4] is used as a research lens in the data analysis.

The term *basic digital skills* refers to the student teachers' elementary or informal use of ICT for everyday tasks and entertainment such as social media, as well as their basic use of ICT tools like word processors, presentation tools, spreadsheets, and learning management systems. *Didactic ICT-competence* is linked to Shulman's (1987) pedagogical content knowledge (PCK) and Mishra and Koehler's (2006) technological pedagogical and content knowledge (TPACK). As such, didactic ICT-competence describes the student teachers' integration of ICT for teaching the subject discipline in a pedagogical and didactical manner. *Learning strategies* focus on student teachers' awareness of the impact that ICT has on their own and pupils' learning strategies, metacognition, and professional development in the subject through "reflection-on-action" (Schön, 1983). *Digital Bildung* highlights the student teachers' ethical and moral awareness of how ICT affects different aspects of "human development: communicative competence, critical thinking skills, and enculturation processes, among others" (Søby, 2003, p. 8). Both the horizontal and vertical axes in the model describe different stages in practical proficiency and self-awareness with ICT through the dimensions of *adoption*, *adaptation*, *appropriation*, and *innovation*. These dimensions are related to Wertsch's (1998) concepts of mastery and appropriation of cultural tools where *adoption* and *adaptation* (i.e. mastery) refer to knowing how to use a cultural tool while *appropriation* and *innovation* point to "the process is one of taking something that belongs to others and making it one's own" (Wertsch, 1998, p. 53). However, the model does not correspond directly to reality as the categories are socially constructed (Hacking, 1999). As a research lens, this model can help describe student teachers' development of digital competence by making visible their "tacit knowledge" (Polanyi, 1966).

Method

The study used a case study methodology (Yin, 2009), which works well with combining various sources of data to conduct an empirical inquiry that "investigates a contemporary phenomenon within its real-life context" (Yin, 2009, p. 18). The study object in this case was a DST workshop aimed at promoting secondary school ESL student teachers' digital competence

development. The study's design-based research methodology (Anderson & Shattuck, 2012; DBRC, 2003) can be understood as "a series of approaches, with the intent of producing new theories, artifacts, and practices that account for and potentially impact learning and teaching in a naturalistic setting" (Barab & Squire, 2004, p. 2). Design-based research has direct links between research and practice, thereby enhancing the chances that the study will have a meaningful impact. This is accomplished through collaboration between researchers and practitioners in identifying, designing[5], and redesigning solutions to problems in teaching and learning (DBRC, 2003). Based on these aspects, the study followed a three-step design process:

1. *Survey phase*: Review research literature, survey student teachers' existing digital competence, and develop theoretical perspectives, solutions, and models based on results.
2. *Intervention phase*: Trial and execution of the focus area of the study through multiple workshop iterations.
3. *Evaluation phase*: Assessment of study findings.

Participants and research setting
One cohort of secondary school ESL student teachers participated in an electronic survey during the fall semester of 2012 (Survey phase). Two cohorts of student teachers[6] qualifying to teach English and other language disciplines participated in a workshop on DST that took place as part of a Norwegian teacher education program during the spring semester of 2013 (1st workshop iteration) and the following spring semester of 2014 (2nd workshop iteration). In the 1st iteration, a total of 110 student teachers studying language disciplines participated in the workshop; of the participants, 62 were ESL student teachers. The 2nd iteration involved a total of 120 student teachers, with 67 of them studying to teach ESL. The ESL student teachers from the survey phase ($N = 41$), who were participating in a 5-year integrated teacher education program (5LU), attended the 2nd workshop iteration. There, they were joined by other ESL student teachers ($n = 23$) who were taking a 1-year postgraduate practical pedagogical education (PPU). None of the student teachers were familiar with DST. Table 1 gives a summary of the different study phases and workshop iterations.

Table 1
Summary of DST workshop iterations.

Phase/iteration	Semester	Total number of student teachers	Number of ESL student teachers	Duration (hours)
Survey phase	Fall 2012	41	41	1
1st iteration	Spring 2013	110	62	3
2nd iteration	Spring 2014	120	67	3

The teacher education program examined in this study had been using DST for language teaching for several years, where they had adapted the Center for Digital Storytelling's "seven steps of digital storytelling" (Lambert, 2013, pp. 53–69). A workshop was arranged every spring semester before the student teachers entered their school practicum, and they brought their own laptops to the session. The learning objective of the workshop was to familiarize the student teachers with the DST method. However, the previous workshops had not been systematically rooted in current research on learning with ICT and the promotion of digital competence in teacher education. In addition, teacher educators were reporting before the study that the student teachers lacked ICT skills and did not use the DST method during their school practicum. In response, an intervention study was conducted in an attempt to understand and improve on the workshop design to develop the student teachers' digital competence, promote didactical and innovative use of ICT, and encourage use of DST during their school practicum. The organizers chose Movie Maker and iMovie as video editing tools because previous studies have shown that these digital tools are easy to master and appropriate (Istenic Starčič et al., 2016). In addition, researchers have noted the benefits of "utilizing the same technology tools for professional development that teachers are able to use in their classrooms" (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012, p. 434).

Data collection and analysis
To triangulate the study, both quantitative and qualitative data were collected and analyzed (Maxwell, 2013). Quantitative data consisted of an electronic survey performed 'live' during a plenary lecture in ESL didactics using audience response system feedback clickers with ESL student teachers ($N = 41$). Participants responded to statements and questions about digital competence in teacher education. The items were measured using a 7-point Likert scale where 1 indicated "no skills" and 7 indicated "very good skills". Data were collected during the fall semester of 2012 and were analyzed for quasi-statistical purposes using statistical software SPSS 21. Results are presented in the *survey phase* section below (see also Røkenes & Krumsvik, in review).

   Different kinds of qualitative data were collected. First, the researcher collected ethnographic field notes (Emerson, Fretz, & Shaw, 2011) through participant observations (Merriam, 2009) of ESL didactics lectures and student teachers' school practicums (from spring 2012 until spring 2014) and the two DST workshops (spring 2013 and spring 2014). Second, the student teachers' digital stories, reflection logs, and the teacher educators' prepared instruction materials were collected for document analysis (Merriam, 2009). Finally, the researcher conducted semi-structured interviews (Kvale & Brinkmann, 2009) with eight ESL student teachers from both cohorts (spring 2013, $n = 3$; spring 2014, $n = 5$) and the teacher educator in ESL didactics ($n = 1$). Participants were

purposefully sampled to ensure varied and information-rich cases related to the workshop (Maxwell, 2013). Survey results and observations were used as a backdrop for the interview guide. All interviews were held at the end of the student teachers' school practicum 3 months after the workshop. Interviews were conducted and transcribed in Norwegian, and then relevant passages were translated into English and validated by a native English speaker. The data were imported and analyzed using qualitative data analysis software NVivo 10. Observations and passages from the reflection logs and interviews were analyzed using descriptive coding in order to identify what, how, and why the student teachers acted and reflected during and after the workshop. Overlapping codes were merged and developed into meaning bearing categories (Miles, Huberman, & Saldaña, 2014).

Generalization of the study was tied to naturalistic (Lincoln & Guba, 1985; Stake, 1995) and reader- or user-generalizations (Firestone, 1993) through the use of thick description (Geertz, 1973). Before data collection began, the researcher informed the student teachers and teacher educators about the purpose of the study. Study participation was voluntary, and all participants completed informed consent forms. The Norwegian Social Science Data Service (NSD) granted ethical approval for the study.

Results

The three phases described above guided the organization of the results section with the primary emphasis on the study's *intervention* and *evaluation* phases.

Survey phase
Analysis of survey data (Table 2) revealed that, even though the cohort of ESL student teachers examined in the fall semester of 2012 had good elementary and basic digital skills, they seemed to lack didactic ICT-competence, digital learning strategies, and digital Bildung (Røkenes & Krumsvik, in review). In particular, the student teachers wanted to learn more about digital learning resources and innovative, student-active ways of integrating ICT into ESL teaching (Table 3).

Table 2
Student teachers' self-perceived digital competence (*N* = 41).

Questions	Survey	
	Mean	**SD**
Elementary ICT skills – How well do you master the use of laptops and digital tools (e.g., online banking and social media) in your spare time (outside of work and school)?	6.00	0.949
Basic ICT skills – How well do you master the use of digital tools (e.g., learning management systems, Word, Excel, and PowerPoint) in your studies in a coherent way?	5.39	0.919
Didactical ICT skills – How well do you master the use of digital tools (e.g., digital learning resources in ESL) for teaching and potentially enhancing pupils' subject learning?	4.44	0.950
Digital learning strategies – How well do you master guiding pupils in reading screen-based texts with concentration, persistence, flow, and coherence?	3.49	1.247
Digital Bildung – How well do you 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
Overall digital competence – Based on the previous questions, how well do you assess your digital competence for teaching?	4.68	1.011

Note: A 7-point Likert scale was used (1 = no skills, 7 = very good skills). Mean: measure of central tendency. SD: standard deviation or amount of variance of sample.

Table 3
Student teachers' educational ICT needs (*N* = 41).

Question	Survey	
	n	*%*
Digital tools – What digital tools would you like to learn to improve pupils' potential learning outcomes with ICT?		
Basic digital tools for teaching subject discipline (e.g., Word, PowerPoint, Google, etc.)	3	7.3
Social media for teaching subject discipline (e.g., YouTube, Facebook, etc.)	0	0.0
Digital learning resources for teaching subject discipline (e.g., NDLA, digital textbooks)	16	39.0
Basic digital tools and social media for teaching subject discipline	1	2.4
Social media and digital learning resources for teaching subject discipline	6	14.6
Basic digital tools and digital learning resources for teaching subject discipline	10	24.4
I need education in using other digital tools	3	7.3
I do not need any education at all	1	2.4
I do not know	1	2.4

Note: *n*: Distribution of participants in sample. %: Frequency distribution measured in percent. NDLA: Norwegian Digital Learning Arena.

Overall, the survey results revealed that the ESL student teachers' professional digital competence was lacking and there was potential to promote this competence in the teacher education program. The ESL teacher educator was concerned that few student teachers used ICT in their teaching beyond instruction and content delivery. A review of the literature (Røkenes & Krumsvik, 2014) and a case study (Røkenes & Krumsvik, in review) revealed a number of approaches that could be implemented in teacher education to promote student teachers' digital competence; in particular, these approaches include modeling, scaffolding student-active learning experiences, and linking theory and practice. In collaboration with the teacher educator, the researcher

adapted these approaches into the new redesign of the DST workshop which was trialed and evaluated through two workshop iterations in the teacher education program.

First workshop iteration – intervention and evaluation phase
The workshop lasted three hours and was organized into three sections: 1) introduction to the DST method, 2) production of digital stories, and 3) sharing of stories. The main task required the student teachers to produce a DS about the use of literature in ESL teaching. Before the workshop, the student teachers were asked to prepare a written manuscript about the content of their stories and collect fitting images in order to construct a DS. Observation data showed that the teacher educator started the workshop with a PowerPoint presentation introducing the DST method through a plenary lecture by referring to didactical perspectives on language teaching, ICT-integration, and curriculum aims. Using a projector, the teacher educator shared and modeled video editing tools, authentic examples of DSs from pupils in schools, and suggestions of how to assess DSs. Afterwards, the student teachers were seen working independently on their laptops or in pairs to create their own DS while being supported by the teacher educator and peers. At the end of the workshop, the teacher educator organized a plenary viewing session where participants shared their completed DSs and listened to audience comments. After the viewing, the teacher educator encouraged the student teachers to upload the finished DSs to the learning management system (LMS) along with a reflection text on their work process and the learning potential that the method could have for pupils' language learning.

According to interview data, student teachers perceived mastering basic video editing tools, increased awareness of didactical use of ICT, and promotion of student teachers' and pupils' digital competence as major benefits and innovation in terms of using DST in ESL teaching:

> It was great to learn about Movie Maker. I had never done it before or seen the possibilities that lie in it, and that's important or else I would have stuck to PowerPoint and stayed there. (May, 2013)

> When making digital stories, they [pupils] will usually include all of the five language skills … They have to write a text to have a manuscript, speak and then also listen to themselves or others, edit themselves, use photos and similar things. (Sarah, 2013)

Student teachers also mentioned the benefits of experiencing learning ESL with ICT from the pupils' point of view during the workshop. This stimulated reflection on the didactical dimensions of using DST in their future teaching, and promoted mastery of the more complex dimensions of digital competence such as learning strategies and digital Bildung:

> It was very good to get the possibility to be a pupil and try it out from that standpoint. "What kind of work does it require from my end? What kind of prior knowledge does it demand from me?" (Erich, 2013)

> I got stuck finding photos, legal photos. (May, 2013)
> If they [pupils] want to use music or pictures, then they need to be cautious that this belongs to somebody else. (Sarah, 2013)

One of the main challenges noted by the teacher educator in the first iteration was encouraging student teachers to submit and share their DSs and personal reflections surrounding the work process and learning potential that this method could have for pupils' development of subject knowledge, basic skills, and language skills. The student teachers remarked that, since it was not a part of their subject assessment, they felt no reason to come prepared with a manuscript to the session or complete their stories, even though they saw it as a good learning experience with ICT. Also, lack of time and support during and after the workshop made them prioritize other obligatory assignments. Finally, participants mentioned discomfort in sharing their personal stories, speaking English, and listening to their own voice in front of all of the student teachers.

Second workshop iteration – intervention and evaluation phase
In spring 2014, a number of changes in the design of the second iteration of the DST workshop were made based on the evaluation of the first iteration. First, submission of the DS and reflection log was made a part of the student teachers' subject assessment. Second, student teachers were encouraged to collaborate in pairs to create a DS. Third, sharing and discussing the DS in the plenary viewing session was done in smaller groups.

The workshop design changes resulted in higher numbers of finished DSs and reflection logs submitted to the LMS, as well as more student teachers being willing to share their stories in the plenary viewing session. In addition, more student teachers reported that they felt more confident in their digital competence beyond mastering basic digital skills and had set aside time to try out DST during their school practicum as a result of the workshop. One student teacher was observed appropriating the workshop design in her upper secondary school practicum where she stood out as a digitally competent role model for her pupils:

> It was a lot easier in upper secondary because here everybody has a laptop, and so it was more natural to use it. So I used DST and showed my own video … Then they [pupils] got to work on their own afterwards and shared them. (Ellie, 2014)

Even though lack of time was still noted as an obstacle, student teachers were now observed spending time after the workshop to complete their stories and reflection logs because these would be assessed by the teacher educator:

I wrote the manuscript and gathered almost all of the photos, but I was not able to do the editing until after the workshop. There was simply not enough time. (Tara, 2014)

Furthermore, the student teachers commented during the workshop session and in the interviews that the given task was crucial in seeing the real affordances of integrating ICT in ESL teaching. They also found the task a useful means for reflecting on the relationship between theory and practice:

I felt that it opened my eyes to the possibilities that were available, and I enjoyed watching the examples. (Mariam, 2014)

I never thought of it as a method for learning, and I never thought that you could make videos like these as a part of teaching ESL. (Ellie, 2014)

For the reflection part and for actually using it [DST] in the classroom, then there were a lot of useful articles posted [LMS], and I used them actively in my reflection after the production. (Tim, 2014)

Participants also highlighted collaborating with peers as helpful and efficient for completing the DS. After being asked to collaborate, more student teachers were observed working together and finishing their stories compared to the first workshop iteration. In addition, there seemed to be less need for technical assistance and more emphasis on the didactical aspects of ICT-integration:

We didn't need so much help, I think. I felt that, when we were two people working together, then we worked it out. (Ellie, 2014)

It was great because we found our own photos. We were so scared because we could not use copyrighted photos, so we only used our own photos. (Jude, 2014)

As in the first iteration, the student teachers in the workshop raised the issue of increased awareness in the editing process regarding locating credible online information and copyrighted photos. Participants also frequently noted this matter in the interviews:

I could not just search for images online and take them. I needed to learn about the advanced search settings [Flickr], Creative Commons licensing, and what this meant. (Tim, 2014)

In sum, the second iteration of the DST workshop tried to address some of the challenges from the first iteration, such as getting more student teachers to complete their DSs and reflection logs, providing more support during and after the workshop, and encouraging plenary sharing of stories. Moreover, when the focus of the support was switched from solving technical issues to didactical considerations, the quality of the student teachers' DSs and reflections seemed to improve.

Discussion and conclusion

The purpose of this article was to explore how a DST workshop in teacher education could promote secondary school ESL student teachers' digital competence. According to the findings from the three design phases, the ESL student teachers seemed to develop their digital competence through the workshop, as mirrored in Krumsvik's (2011, 2014) model, and to learn about innovative ways of integrating ICT into their future ESL teaching. These developments were prompted through the implementation of several approaches (Røkenes & Krumsvik, 2014) into the workshop design, including having the teacher educator model DST and exemplify assessment of DSs, scaffolding and supporting student teachers' learning with ICT through active engagement and collaboration in creating DSs, and encouraging the student teachers' reflection-on-action and linking of theory and practice through the writing of a reflection text (Røkenes & Krumsvik, in review).

By analyzing the data using the digital competence model as a research lens, one of the main findings from the survey phase and workshop iterations suggests that the different cohorts of student teachers were starting to move beyond mastery of basic digital skills towards appropriating complex dimensions of digital competence such as didactic ICT-competence, learning strategies, and digital Bildung (Krumsvik, 2014; Wertsch, 1998). Specifically, observational and interview data showed that most student teachers were able to master the video editing tools through their DS submissions and in their reflection logs, where they expressed how the tools were seen as familiar and easy to use, and as purposeful didactical means for integrating ICT into ESL teaching (Istenic Starčič et al., 2016). Though several student teachers pointed out in their reflection logs that using DST in school required extensive planning, most focused on the key affordances and benefits of using DST for pupils' language learning, such as enabling pupils to record and listen to their own voice, to be active producers of knowledge instead of passive consumers, and to learn about locating, gathering, and referring to copyrighted materials online. The student teachers' need for support regarding didactical considerations rather than solving technical problems also suggests a low technical sophistication with the digital tools used to create the DSs. Taken together, these elements might encourage them to use DST in their future teaching. In addition, student teachers benefitted from their experience with authentic examples from schools as well as from their work with and reflection on the learning potential for using digital tools in ESL teaching. Based on these experiences, student teachers perceived DST as a purposeful way to meet several of the English subject curriculum's competence aims for promoting pupils' language learning with ICT, such as being able to "select different digital resources and other aids and use them in an independent manner in their own language learning" (Ministry of Education and Research, 2006). Moreover, in line with other research (Shin, 2015), the student

teachers' learning strategies and digital Bildung developed in the process of gathering materials for their DSs in the form of understanding the complexities of searching for, gathering, and assessing information online, and gaining increased critical awareness of copyright protected materials online and personal privacy. When taking on the pupil's role and perspective, the student teachers demonstrated how DST could function as a way to promote student-active learning instead of teacher-led instruction in the school setting, allowing students to shift from consumers to producers of knowledge. Finally, Ellie's use of DST in her school practicum illustrates how she was able to master and appropriate the method into her ESL teaching (Instefjord, 2014), and suggests a development of her professional digital competence (Lund et al., 2014).

Empirically, the study's findings contribute to the field of teacher education by showcasing how teacher education can efficiently utilize basic video editing tools through DST to promote student teachers' digital competence and to foster innovative ways of integrating ICT into ESL teaching. As a theoretical contribution, the study shows how a digital competence model can be used as a research lens to support the design of a DST workshop in teacher education and to critically reflect on student teachers' digital competence development and the complexities of digital competence in ESL teaching. Furthermore, the transparency of the study design and methods bears methodological implications as it gives information to other researchers of how to apply the workshop procedures to other research contexts. It also lowers the threshold for other teacher educators to potentially implement the DST workshop in their own teacher education programs. Although care should be taken when making generalizations from case studies, findings from this study suggest that the DST workshop design can be applied to other teacher education programs and subject areas other than ESL. Using design-based research in studies on technology in teacher education might solve issues with developing student teachers' digital competence. Further, such studies might encourage collaborative partnerships between researchers and practitioners in finding innovative student-active ways of teaching ESL with ICT.

Study limitations and possible solutions include increasing the number of workshop iterations trialed and assessed in order to further refine the didactical design. Also, examining the student teachers' DSs in-depth through multimodal analysis is an interesting path to further study their formation of professional identity as ESL teachers (Tendero, 2006). DST projects should also be implemented with student teachers across subjects in teacher education such as mathematics (Istenic Starčič et al., 2016). In general, there is a need for more research on didactical and subject-related use of ICT in Scandinavian teacher education (Røkenes & Krumsvik, 2014). Additionally, longitudinal research is needed to study student teachers' mastery and appropriation of professional digital competence after graduating from teacher education to see if they have implemented innovative ways of teaching with ICT such as DST. Such a study

could uncover whether ICT training in teacher education aligns with the newly graduated student teachers' integration of ICT in schools (Guðmundsdóttir et al., 2014).

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[1] Didactics can be understood as "the field of educational theory that provides guidelines and tools that are used to develop the practice of teaching" (Laursen, 1994, p. 125), and as a "science and theory about teaching and learning" (Gundem, 1998, p. 6). In this study, the focus is on subject-didactics which is the "Didaktik produced and delivered inside the boundaries of school subjects" and which "almost every student teacher has compulsory training in" (Hopmann & Riquarts, 2000, pp. 9–10). Didactics provides teachers with reflective tools to consider the essential what, how, and why questions which involve "*their* teaching of *their* students in *their* classrooms" (Westbury, 2000, p. 17).

[2] Secondary school student teachers study to teach in the lower and upper secondary school grade levels in the Norwegian education system (grades 8–13).

[3] Bildung regards "ethical and moral issues of *being*" and can be attached to student teachers' and pupils' moral development over time (Krumsvik & Almås, 2009, p. 113). Klafki (2000) described Bildung as a "qualification for reasonable self-determination [...] for autonomy, for freedom for individual thought, and for individual moral decisions" (Klafki, 2000, p. 87).

[4] See Almås and Krumsvik (2007) and Krumsvik (2014) for a discussion of the model's theoretical foundation.

[5] Design is understood as an orchestration of resources as well as planning of teaching and learning activities in a learning environment, which "affords the unexpected but is enacted without resorting to mere improvisation or rigid planning" (Lund & Hauge, 2011, p. 259).

[6] The student teachers followed a postgraduate Masters in Language Studies with Teacher Education program studying subject disciplines such as Norwegian, English, German, French, and Spanish for teaching in secondary school. This study focused only on the ESL student teachers.

Appendices

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Fredrik Mørk Røkenes
Program for lærerutdanning
NTNU
Låven, Dragvoll gård
7491 TRONDHEIM

Vår dato: 07.09.2012	Vår ref:31177 / 3 / IB	Deres dato:	Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 17.08.2012. All nødvendig informasjon om prosjektet forelå i sin helhet 27.08.2012. Meldingen gjelder prosjektet:

31177	*Adressing the second digital divide: Multiple case studies of development of student teachers' digital competence in English didactics*
Behandlingsansvarlig	*NTNU, ved institusjonens øverste leder*
Daglig ansvarlig	*Fredrik Mørk Røkenes*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/forsk_stud/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 30.06.2016, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Vigdis Namtvedt Kvalheim

Inga Brautaset

Inga Brautaset tlf: 55 58 26 35
Vedlegg: Prosjektvurdering

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Meldingen gjelder et doktorgradsprosjekt der formålet er å undersøke og forstå utviklingen av lærerstudenters digitale kompetanse.

Datainnsamling skjer over en periode på ca. to år. Forsker vil observere forelesningene som lærerutdannere gir lærerstudentene, data registreres da kun i form av feltnotater (jf. telefonsamtale 22.08.12). Et utvalg lærerstudenter og lærerutdannere inviteres til intervju, som skjer individuelt og i grupper, med videoopptak. I tillegg gjøres videoobservasjon av enkelte praksistimer der lærerstudentene underviser elever i skolen, med påfølgende intervjuer av lærerstudent, samt individuelle/gruppeintervjuer med elever. Det er også aktuelt å samle inn oppgaver skrevet av hhv. lærerstudenter og elever.

Rekruttering skjer ved at forsker møter opp på seminar for lærerstudenter, eller ved at studiestedet formidler informasjon om studien. Elever rekrutteres av lærerstudentene når de er i praksis. Det innhentes tillatelse fra rektor til gjennomføring av datainnsamlingen.

Utvalget får skriftlig informasjon om prosjektet, og de som ønsker å delta samtykker skriftlig til behandlingen av personopplysninger. Personvernombudet finner informasjonsskrivet datert 27.08.12 tilfredsstillende utformet i henhold til personopplysningslovens vilkår.

Elevene går i ungdomsskolen eller videregående skole. Etter personvernombudets vurdering kan elever over 15 år samtykke på selvstendig grunnlag til deltagelse i dette prosjektet. Det vises til barneloven som fastslår at ungdom skal gis økende selvbestemmelse med alder og modenhet, og selv kan velge utdanning fra fylte 15 år. Det er grunn til å tro at ungdommene er godt i stand til å forstå hva deltagelse i dette prosjektet innebærer. En forutsetning for at samtykke skal være gyldig, er at frivilligheten understrekes, slik at ungdommene ikke opplever noe press om å delta.

For barn under 15 år innhentes samtykke fra foreldrene. Barnet skal likevel få alderstilpasset (muntlig) informasjon om prosjektet, og barnets aksept er nødvendig for gjennomføringen. Det innebærer at frivilligheten understrekes for barnet, og at forsker har selvstendig ansvar for å avbryte filming/intervju dersom barnet viser motvilje.

Elever som ikke vil delta i prosjektet, får undervisning i et annet rom mens opptakene pågår. Utvalget informeres om dette før samtykke innhentes.

Det skal ikke innhentes opplysninger om identifiserbare tredjepersoner (feks. elever). Vi anbefaler at forsker instruerer lærerstudenter og lærerutdannere om dette ifm. intervjuer og innsamling av studentoppgaver.

Personvernombudet legger til grunn at forsker setter seg inn i og etterfølger NTNU sine interne rutiner for datasikkerhet, spesielt med tanke på bruk av mobile lagringsenheter (som bærbar datamaskin og minnekort) til oppbevaring av personopplysninger.

Forsker opplyser at det kan bli aktuelt å fremvis enkelte utdrag av videomaterialet i forskningssammenheng (konferanser ol.). Dette vil skje i prosjektperioden, og kun etter samtykke fra den enkelte. Den enkelte vil få anledning til å se filmutdraget og godkjenne det før fremvisning.

Prosjektet avsluttes innen 30.06.2016, og innsamlede opplysninger skal da anonymiseres (jf. informasjonsskriv til utvalget). Anonymisering innebærer å bearbeide datamaterialet slik at det ikke er mulig for noen å gjenkjenne enkeltpersoner. Det gjøres ved å slette direkte personopplysninger (som navn/koblingsnøkkel), fjerne eller grovkategorisere indirekte personidentifiserende opplysninger (dvs. kombinasjoner av bakgrunnsopplysninger som f.eks. yrke, alder, kjønn, skole mm.), samt slette eller sladde lyd-/videoopptak.

NSD

Fredrik Mørk Røkenes
Program for lærerutdanning
NTNU
Låven, Dragvoll gård
7491 TRONDHEIM

Vår dato: 08.11.2012   Vår ref: 31177 IB/LR   Deres dato: Deres ref:

OPPFØLGING AV ENDRINGSMELDING: NYTT DELPROSJEKT

Vi viser til endringsmelding mottatt 02.11.2012 med påfølgende korrespondanse, vedrørende prosjektet:

31177   *Adressing the second digital divide: Multiple case studies of development of*
student teachers' digital competence in English didactics

Meldingen gjelder et nytt delprosjekt av doktorgradsprosjektet.

Det skal gjennomføres en spørreundersøkelse blant ca. 70 studenter i engelsk fagdidaktikk. Formålet er å kartlegge lærerstudenters oppfatning av sin egen læring og lærerutdanningens digitale kompetanse.

Undersøkelsen gjennomføres i siste del av en undervisningstime, ved hjelp av "Turnpoint clicker". Det skal ikke registreres direkte personopplysninger om respondentene (som navn eller epost-/IP-adresse), men det må tas høyde for at kombinasjonen av bakgrunnsopplysninger i spørreskjemaet kan identifisere den enkelte indirekte (kjønn, alder, studiepoeng, studieretning, om de har vært i praksis på grunnskole eller videregående skole).

På forhånd innhentes skriftlig samtykke fra deltagerne basert på skriftlig informasjon om prosjektet. Personvernombudet vurderer informasjonsskrivet datert 08.11.2012 godt utformet iht. kravene i personopplysningsloven.

Opplysningene fra spørreundersøkelsen anonymiseres ved prosjektslutt 30.06.2016.

Anonymisering innebærer å bearbeide datamaterialet slik at det ikke er mulig for noen å gjenkjenne enkeltpersoner. Det innebærer å slette direkte personopplysninger (navn/samtykkeerklæringer), samt fjerne eller omskrive/grovkategorisere indirekte personopplysninger (identifiserende bakgrunnsopplysninger).

Ta gjerne kontakt dersom noe er uklart.

Vennlig hilsen

Vigdis Namtvedt Kvalheim

Inga Brautaset

Kontaktperson: Inga Brautaset tlf: 55 58 26 35

Fredrik Mørk Røkenes
Program for lærerutdanning
NTNU
Låven, Dragvoll gård
7491 TRONDHEIM

Vår dato: 21.01.2013   Vår ref: 31177 IB/LR   Deres dato: Deres ref:

TILBAKEMELDING PÅ ENDRINGSMELDING

Vi viser til endringsmelding mottatt 02.01.2013 og 21.01.2013, samt telefonsamtale 21.01.2013, vedrørende prosjektet:

31177   *Addressing the second digital divide: Multiple case studies of development of student teachers' digital competence in English didactics*

Endringsmeldingen gjelder ny datainnsamling i form av dokumentinnsamling. Datamaterialet vil bestå av studentproduserte digitale fortellinger og oppgaver som skrives i forbindelse med en årlig forelesning/workshop ved universitetet. Det kan bli aktuelt å intervjue noen av studentene i etterkant.

Utvalget vil bestå av to kull (totalt ca. 50) lærerstudenter med engelsk som undervisningsfag ved NTNU.

Studentene får skriftlig informasjon om undersøkelsen i god tid før det innhentes skriftlig samtykke fra de som ønsker å delta (jf. telefonsamtale 21.01.2013). Personvernombudet finner informasjonsskrivet tilfredsstillende forutsatt at følgende presiseringer foretas:
  - Setningen "Alle personidentifiserende opplysninger vil bli anonymisert" (første avsnitt) slettes. Det bør heller presiseres at digitale fortellinger/intervjudata i prosjektperioden vil være knyttet til navn via kode som viser til en adskilt navneliste/koblingsnøkkel.
  - Setningen "De innsamlede opplysningene vil ikke ha noen innflytelse på lærerstudentenes arbeid eller sluttresultat" (første avsnitt) endres til: "Det vil ikke ha noen innflytelse på ditt forhold til NTNU om du ikke vil delta i prosjektet."

Personvernombudet ber om å få tilsendt det reviderte informasjonsskrivet før dette distribueres til utvalget.

Innsamlede data knyttes til studentens navn via en kode som viser til en koblingsnøkkel. Koblingsnøkkel lagres fysisk adskilt fra øvrige opplysninger. Datamaterialet oppbevares på passordbeskyttet datamaskin tilknyttet NTNUs nettverk, som befinner seg i låsbart rom. Kun stipendiat

Avdelingskontorer / District Offices:
OSLO: NSD. Universitetet i Oslo, Postboks 1055 Blindern, 0316 Oslo. Tel: +47-22 85 52 11. nsd@uio.no
TRONDHEIM: NSD. Norges teknisk-naturvitenskapelige universitet, 7491 Trondheim. Tel: +47-73 59 19 07. kyrre.svarva@svt.ntnu.no
TROMSØ: NSD. HSL, Universitetet i Tromsø, 9037 Tromsø. Tel: +47-77 64 43 36. martin-arne.andersen@uit.no

Fredrik Mørk Røkenes og veiledere Tale Guldal og Rune Krumsvik vil ha tilgang til personopplysningene som innhentes til forskningsformål.

Ved prosjektslutt 30.06.2016 skal datamaterialet anonymiseres. Anonymisering vil innebære å bearbeide datamaterialet slik at det ikke er mulig for noen å gjenkjenne enkeltpersoner. Det gjøres ved å slette direkte personopplysninger (som navn/koblingsnøkkel), og fjerne/grovkategorisere indirekte personopplysninger (dvs. identifiserende kombinasjoner av bakgrunnsopplysninger som f.eks. institusjon, studieretning, alder, kjønn mm.).

Personvernombudet har registrert de innmeldte endringene. Det forutsettes at prosjektopplegget for øvrig er uendret.

Ta gjerne kontakt dersom noe er uklart.

Vennlig hilsen

Vigdis Namtvedt Kvalheim

Inga Brautaset

Kontaktperson: Inga Brautaset tlf: 55 58 26 35

NTNU

Fakultet for samfunnsvitenskap og teknologiledelse
Program for lærerutdanning

Til lærerstudenter

Vil du delta i en kartleggingsundersøkelse om lærerstudenters digitale kompetanse?

Lærerstudenters digitale kompetanse er et doktorgradsprosjekt hvor jeg, Fredrik Mørk Røkenes, universitetsstipendiat ved NTNU, ønsker å lære mer om lærerstudenters digitale kompetanse. Jeg ønsker å undersøke hvordan lærerstudenter utvikler sin digitale kompetanse. I denne delen av prosjektet ønsker jeg å gjennomføre en kartleggingsundersøkelse i en undervisningstime på campus med klikkere. Undersøkelsen tar ca. 30 minutter og det innhentes kun data fra dem som samtykker til å delta i prosjektet. Opplysningene vil ikke knyttes til ditt navn, men ut fra bakgrunnsopplysningene du gir i besvarelsen er det mulighet for at du kan gjenkjennes indirekte. Deltakelse i undersøkelsen er frivillig og du kan på hvilket som helst tidspunkt trekke deg og få opplysningene anonymisert. Jeg ber om at signert svarslipp returneres til foreleser eller forsker. De innsamlede opplysningene vil ikke ha noen innflytelse på lærerstudentenes arbeid eller sluttresultat. Prosjektet er meldt til Personvernombudet for forskning, Norsk Samfunnsvitenskapelig Datatjeneste (NSD).

Som forsker og lærer er jeg underlagt taushetsplikt. All informasjon vil bli behandlet konfidensielt. Kun jeg og mine veiledere har tilgang på dataene. Prosjektet skal avsluttes våren 2016, og da skal alle personopplysninger slettes. Resultatene av undersøkelsen ønsker jeg å bruke videre i prosjektet mitt, presentere på konferanser og gjennom publikasjoner i nettbaserte tidsskrift. Ingen enkeltpersoner vil kunne gjenkjennes i resultatene når disse publiseres. Ved samtykke til deltakelse i undersøkelsen gir du tillatelse for at forsker kan bruke dataene i doktorgradsprosjektet, presentere resultatene av undersøkelsen på konferanser og gjennom publikasjoner i nettbaserte tidsskrift.

Prosjektet, som er finansiert av NTNU, er ledet av Fredrik Mørk Røkenes, universitetsstipendiat ved NTNU, Program for lærerutdanning (PLU) og veiledet av Tale Guldal, førsteamanuensis ved NTNU og Rune Krumsvik, professor ved Universitet i Bergen (UiB).

Jeg søker med denne undersøkelsen å lære mer om hvordan vi kan forstå og utvikle lærerstudenters- og framtidige læreres digitale kompetanse. Størst mulig deltakelse fra studentene er viktig så jeg håper på positiv respons. Jeg er takknemlig for hjelpen jeg får dersom du vil delta i undersøkelsen.

Vennlig hilsen,

Fredrik Mørk Røkenes

Universitetsstipendiat

PLU, NTNU

Vår dato   Vår referanse

Norges teknisk-naturvitenskapelige universitet

Svarslipp:

Angående deltakelse i kartleggingsundersøkelsen om lærerstudenters digitale kompetanse.

Jeg har mottatt og forstått den skriftlige informasjonen, og jeg er villig til å delta i undersøkelsen:

(bruk blokkbokstaver)

Navn:_____Dato:_____

Svarslipp kan leveres til foreleser eller forsker. Eventuelle spørsmål kan også sendes på e-post til Fredrik Mørk Røkenes: fredrik.rokenes@plu.ntnu.no.

NTNU

Fakultet for samfunnsvitenskap og teknologiledelse
Program for lærerutdanning

Til rektor og praksislærer

Vil du delta i PhD-prosjektet mitt om lærerstudenters digitale kompetanse?

Lærerstudenters digitale kompetanse er et doktorgradsprosjekt hvor jeg, Fredrik Mørk Røkenes, universitetsstipendiat ved NTNU, ønsker å lære mer om lærerstudenters digitale kompetanse. Jeg ønsker å undersøke hvordan lærerstudenter utvikler sin digitale kompetanse og gjennom prosjektet vil et utvalg av lærerstudenter og lærerutdannere samarbeide med meg. Undersøkelsen foregår ved at jeg samler inn forskjellige typer data. Jeg ønsker å gjennomføre observasjon i form av feltnotater av enkelte undervisningstimer undervist av lærerstudenter. Opplysningene som jeg får fra disse opptakene vil være de samme som lærere normalt får gjennom vanlig arbeid. De innsamlede opplysningene vil ikke ha noen innflytelse på elevenes arbeid eller sluttresultat. Prosjektet er meldt til Personvernombudet for forskning, Norsk Samfunnsvitenskapelig Datatjeneste (NSD).

Jeg ber om tillatelse fra skolens rektor og praksislærer om å få observere utvalgte lærerstudenter ved skolen. Deltakelse i prosjektet er frivillig og det vil ikke påvirke forhold til lærerskolen. Det innhentes ikke personidentifiserbare data. Prosjektdeltakere kan også på hvilket som helst tidspunkt trekke seg og få opplysningene anonymisert.

Som forsker og lærer er jeg underlagt taushetsplikt. All informasjon vil bli behandlet konfidensielt. Dette innebærer at alle navn vil bli anonymisert med pseudonym eller et nummer. Kun jeg og mine veiledere har tilgang på personopplysninger og opptak. Prosjektet skal avsluttes våren 2016, og da skal alle personopplysninger slettes og opptak slettes/sladdes. Resultatene av prosjektet ønsker jeg å presentere på konferanser og gjennom publikasjoner i nettbaserte tidsskrift.

Prosjektet, som er finansiert av NTNU, er ledet av Fredrik Mørk Røkenes, universitetsstipendiat ved NTNU, Program for lærerutdanning (PLU) og veiledet av Tale Guldal, førsteamanuensis ved NTNU og Rune Krumsvik, professor ved Universitet i Bergen (UiB).

Jeg søker med dette prosjektet å lære mer om hvordan vi kan forstå og utvikle lærerstudenters- og framtidige læreres digitale kompetanse. Størst mulig deltakelse fra studentene er viktig så jeg håper på positiv respons. Jeg er takknemlig for hjelpen jeg får dersom du vil delta i prosjektet. Ved spørsmål kan jeg nås på epost fredrik.rokenes@plu.ntnu.no eller telefon: 735 98 148/958 30 078.

Vennlig hilsen,

Fredrik Mørk Røkenes

Universitetsstipendiat

PLU, NTNU

NTNU

Fakultet for samfunnsvitenskap og teknologiledelse
Program for lærerutdanning

Til lærerstudenter

Vil du delta i doktorgradsprosjektet mitt om lærerstudenters digitale kompetanse?

Lærerstudenters digitale kompetanse er et doktorgradsprosjekt hvor jeg, Fredrik Mørk Røkenes, universitetsstipendiat ved NTNU, ønsker å lære mer om lærerstudenters digitale kompetanse. Jeg ønsker å undersøke hvordan lærerstudenter utvikler sin digitale kompetanse. I denne delen av prosjektet ønsker jeg å undersøke lærerstudenters bruk av digitale fortellinger. Undersøkelsen foregår ved at jeg samler inn studentproduserte digitale fortellinger og logger. Det kan også være aktuelt å intervjue et utvalg av lærerstudenter hvor det vil bli gjort lydopptak. Det innhentes kun data fra dem som samtykker til å delta i prosjektet. Alle personidentifiserende opplysninger vil bli anonymisert. Deltakelse i prosjektet er frivillig og du kan på hvilket som helst tidspunkt trekke deg og få opplysningene anonymisert. Jeg ber om at signert svarslipp returneres til foreleser eller forsker. De innsamlede opplysningene vil ikke ha noen innflytelse på lærerstudentenes arbeid eller sluttresultat. Prosjektet er meldt til Personvernombudet for forskning, Norsk Samfunnsvitenskapelig Datatjeneste (NSD).

Som forsker og lærer er jeg underlagt taushetsplikt. All informasjon vil bli behandlet konfidensielt. Kun jeg og mine veiledere har tilgang på dataene. Prosjektet skal avsluttes våren 2016, og da skal alle personopplysninger slettes. Resultatene av undersøkelsen ønsker jeg å bruke videre i prosjektet mitt, presentere på konferanser og gjennom publikasjoner i nettbaserte tidsskrift. Ingen enkeltpersoner vil kunne gjenkjennes i resultatene når disse publiseres. Ved samtykke til deltakelse i prosjektet gir du tillatelse for at forsker kan bruke dataene i doktorgradsprosjektet, presentere resultatene av undersøkelsen på konferanser og gjennom publikasjoner i nettbaserte tidsskrift. Hvis du gir tillatelse for at forsker kan foreta intervju, må du krysse av for dette i boksen på svarslippen.

Prosjektet, som er finansiert av NTNU, er ledet av Fredrik Mørk Røkenes, universitetsstipendiat ved NTNU, Program for lærerutdanning (PLU) og veiledet av Tale Guldal, førsteamanuensis ved NTNU og Rune Krumsvik, professor ved Universitet i Bergen (UiB).

Jeg søker med denne undersøkelsen å lære mer om hvordan vi kan forstå og utvikle lærerstudenters- og framtidige læreres digitale kompetanse. Størst mulig deltakelse fra studentene er viktig så jeg håper på positiv respons. Jeg er takknemlig for hjelpen jeg får dersom du vil delta i undersøkelsen.

Vennlig hilsen,

Fredrik Mørk Røkenes

Universitetsstipendiat

PLU, NTNU

Norges teknisk-naturvitenskapelige universitet

Svarslipp:

Angående deltakelse i prosjektet om lærerstudenters digitale kompetanse.

Jeg har mottatt og forstått den skriftlige informasjonen, og jeg er villig til å delta:

(bruk blokkbokstaver)

Navn:_____Dato:_____

Telefonnummer:_____

E-post:_____

Fag A:_____Fag B:_____

Jeg er villig til å bli intervjuet av forsker:

JA   ☐

NEI   ☐

Svarslipp kan leveres til foreleser eller forsker. Eventuelle spørsmål kan også sendes på e-post til Fredrik Mørk Røkenes: fredrik.rokenes@plu.ntnu.no.

The SRS live survey

Lærerstudenters digitale kompetanse

Del I
Demografisk data om informanten

Er du kvinne eller mann?

1. Kvinne
2. Mann

3

Hva er din alder?

1. 19-24 år
2. 25-29 år
3. 30-32 år
4. 33 år eller eldre

4

Hva er karaktergjennomsnittet ditt fra videregående skole?

1. 2 eller over, men under 3
2. 3 eller over, men under 4
3. 4 eller over, men under 5
4. 5 eller over, men under 6
5. 6

5

Hvilket studieløp ved lærerutdanningen tilhører du?

1. 1-årig PPU
2. 5-årig lektorutdanning

6

Hvor var du sist i praksis?

1. Grunnskolen (5-10)
2. Videregående skole

Hvor mange studiepoeng har du fra høyere utdanning?

1. 0
2. 1-59
3. 60-119
4. 120-179
5. 180-239
6. 240-299
7. 300 eller mer

Hva er din mors høyeste utdannelse?

1. Grunnskole
2. Fullført videregående opplæring (allmennfag, studieforberedende)
3. Fullført videregående opplæring (yrkesrettet)
4. Universitet/høyskoleutdanning (inntil fire år)
5. Universitet/høyskoleutdanning (fire år eller mer)

9

Hva er din fars høyeste utdannelse?

1. Grunnskole
2. Fullført videregående opplæring (allmennfag, studieforberedende)
3. Fullført videregående opplæring (yrkesrettet)
4. Universitet/høyskoleutdanning (inntil fire år)
5. Universitet/høyskoleutdanning (fire år eller mer)

10

Er det viktig for deg å gjøre det bra i utdanningen?

1. Ja
2. Til en viss grad
3. Nei

Hadde du tilbud om skole-PC (egen bærbar PC) da du gikk i videregående skole?

1. Ja
2. Nei

Del II
Kartlegging av din digitale kompetanse

13

Begrepsavklaring:

• «Digital kompetanse er din evne til å bruke digitale verktøy og digitale læremiddel faglig og være bevisst på hva denne bruken har å si for elevens læringsutbytte i fagene».

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Digital kompetanse består av fem deler:

5. Digital dannelse
4. Digitale læringsstrategier
3. Didaktisk IKT-bruk
2. Grunnleggende ferdigheter i bruk av digitale verktøy
1. Elementære ferdigheter i bruk av digitale verktøy

Forklaring:

1. Elementære ferdigheter i bruk av digitale verktøy på fritiden

Med **elementære ferdigheter i bruk av digitale verktøy** menes hvordan du mestrer å bruke en PC og digitale verktøy (for eksempel nettbank og sosiale medier) på en enkel måte i fritiden (utenfor arbeid og studieliv).

Hvordan mestrer du de elementære ferdighetene i bruk av digitale verktøy (på fritiden)?

1. (ingen ferdigheter)
2. .
3. .
4. .
5. .
6. .
7. (svært gode ferdigheter)

Forklaring:

2. Grunnleggende ferdigheter i bruk av digitale verktøy i studiet

Med **grunnleggende ferdigheter i bruk av digitale verktøy** menes hvordan du mestrer å bruke digitale verktøy (for eksempel læringsplattform, Word, Excel og Powerpoint) i studiesammenheng på en grunnleggende måte.

Hvordan mestrer du de <u>grunnleggende ferdighetene</u> i bruk av digitale verktøy i studiet?

1. (ingen ferdigheter)
2. .
3. .
4. .
5. .
6. .
7. (svært gode ferdigheter)

Forklaring:

3. Didaktisk IKT-bruk

Med **didaktisk IKT-bruk** menes hvor godt du mestrer å bruke <u>digitale læremiddel</u> (for eks. digitale læremiddel i engelsk) i undervisningen for å heve elevenes læringsutbytte i fagene.

Hvordan mestrer du <u>didaktisk IKT-bruk</u>?

1. (ingen ferdigheter)
2. .
3. .
4. .
5. .
6. .
7. (svært gode ferdigheter)

Hvordan er din didaktiske IKT-bruk i undervisningen din?

1. Jeg bruker IKT for at elevene skal <u>huske</u> fagstoffet bedre (f.eks. huske begrep og definisjoner)
2. Jeg bruker IKT for at elevene både skal <u>huske</u> og <u>forstå</u> fagstoffet bedre (f.eks. visualisering av det teoretiske fagstoffet)
3. Jeg bruker IKT for at elevene skal <u>huske</u>, <u>forstå</u> og <u>anvende</u> fagstoffet bedre (f.eks. til å løse oppgaver i fagene)
4. Jeg bruker IKT på en helhetlig måte for at elevene skal få bedre læringsutbytte enn dersom jeg bare hadde brukt læreboken
5. Jeg bruker ikke IKT til noen av disse (1-4)

Forklaring:

4. Digitale læringsstrategier

•Med **digitale læringsstrategier** menes i hvilken grad du kan veilede elevene i lesing av skjermbaserte tekster med konsentrasjon, utholdenhet, flyt og sammenheng.

Hvordan mestrer du veiledning av elevene i digitale læringsstrategier?

1. (ingen ferdigheter)
2. .
3. .
4. .
5. .
6. .
7. (svært gode ferdigheter)

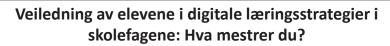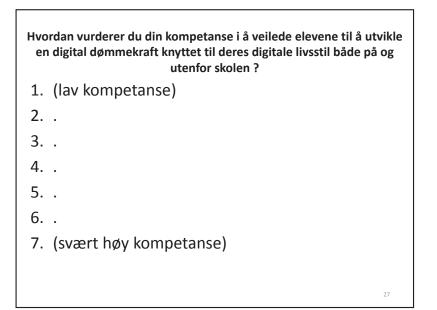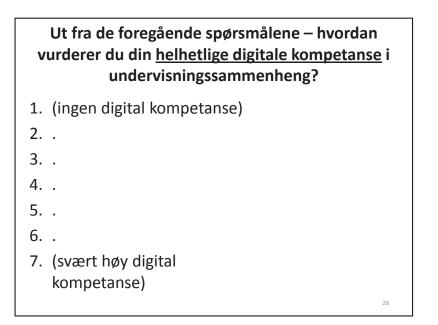## Veiledning av elevene i digitale læringsstrategier i skolefagene: Hva mestrer du?

1. Jeg kan veilede dem i lesing av skjermbaserte tekster på et enkelt nivå
2. Jeg mestrer punkt 1, samt at jeg kan veilede dem i å lese skjermbaserte tekster med konsentrasjon, utholdenhet, flyt og sammenheng
3. Jeg mestrer både punkt 1 og 2, samt at jeg kan veilede dem i å søke, lokalisere og samstille informasjon fra ulike digitale kilder
4. Jeg mestrer både punkt 1, 2 og 3, samt at jeg kan veilede dem i å omforme og kontrastere informasjon fra ulike digitale kilder
5. Jeg mestrer både punkt 1, 2, 3 og 4, samt at jeg kan veilede dem i vurdering og kildekritikk ved bruk av digitale kilder
6. Jeg mestrer både punkt 1, 2, 3, 4 og 5, samt at jeg kan veilde dem i fortolking og analyse av digitale kilder
7. Jeg mestrer ingen av disse punktene (1-6)

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Forklaring:

5. Digital dannelse:

Med **digital dannelse** menes din evne til å veilede elevene til å utvikle digital dømmekraft knyttet til etiske utfordringer (f.eks. digital mobbing, «klipp og lim», nedlasting og lignende) som deres digitale livsstil byr på.

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Hvordan vurderer du din kompetanse i å veilede elevene til å utvikle en digital dømmekraft knyttet til deres digitale livsstil både på og utenfor skolen ?

1. (lav kompetanse)

2. .

3. .

4. .

5. .

6. .

7. (svært høy kompetanse)

Ut fra de foregående spørsmålene – hvordan vurderer du din <u>helhetlige digitale kompetanse</u> i undervisningssammenheng?

1. (ingen digital kompetanse)

2. .

3. .

4. .

5. .

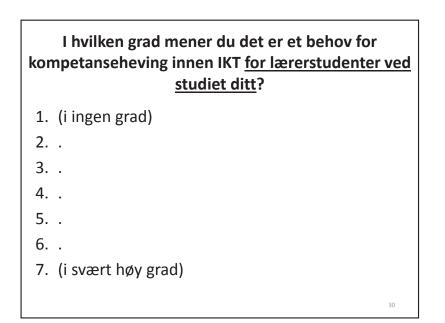6. .

7. (svært høy digital kompetanse)

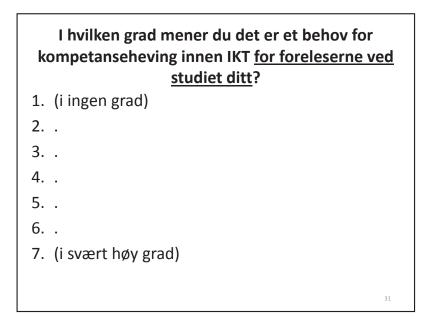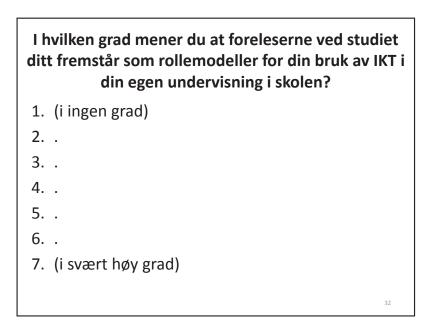**Ut fra de foregående spørsmålene – hvordan vurderer du forelesernes <u>helhetlige digitale kompetanse</u> i studiet ditt?**

1. (ingen digital kompetanse)
2. .
3. .
4. .
5. .
6. .
7. (svært høy digital kompetanse)

I hvilken grad mener du det er et behov for kompetanseheving innen IKT <u>for lærerstudenter ved studiet ditt</u>?

1. (i ingen grad)
2. .
3. .
4. .
5. .
6. .
7. (i svært høy grad)

I hvilken grad mener du det er et behov for kompetanseheving innen IKT <u>for foreleserne ved studiet ditt</u>?

1. (i ingen grad)
2. .
3. .
4. .
5. .
6. .
7. (i svært høy grad)

31

I hvilken grad mener du at foreleserne ved studiet ditt fremstår som rollemodeller for din bruk av IKT i din egen undervisning i skolen?

1. (i ingen grad)
2. .
3. .
4. .
5. .
6. .
7. (i svært høy grad)

32

Ønsker du å ta videreutdanning innen IKT etter at du er ferdig med studiet ditt?

1. Ja
2. Nei

33

Påstander om IKT-bruk

- Setningene som kommer på de neste lysarkene er påstander som handler om digital kompetanse og bruken av IKT i skolesammenheng (studiet ditt, praksis og andre erfaringer som lærer).

- Du besvarer disse ved å si i hvilken grad du er enig i at påstandene stemmer med de erfaringene du har som lærerstudent i studiet ditt og i dine undervisningsfag.

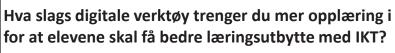- Du besvarer ved å ta utgangspunkt i det gjennomsnittlige inntrykk på tvers av fagene.

34

Jeg kan gi elevene <u>klare læringsmål</u> for sin IKT-bruk i skolefagene.

1. Helt enig
2. Svært enig
3. Litt enig
4. Verken eller
5. Litt uenig
6. Svært uenig
7. Helt uenig

35

Jeg kan gi elevene <u>klar beskjed</u> om hvordan de kan få et økt læringsutbytte når de bruker IKT i en faglig sammenheng.

1. Helt enig
2. Svært enig
3. Litt enig
4. Verken eller
5. Litt uenig
6. Svært uenig
7. Helt uenig

36

Hva slags digitale verktøy trenger du mer opplæring i for at elevene skal få bedre læringsutbytte med IKT?

1. Standardverktøy til faglig bruk (Word, Powerpoint, Google, etc.)
2. Sosiale medier til faglig bruk (Youtube,Facebook, etc.)
3. Digitale læremiddel til faglig bruk (f.eks. NDLA, digitale læreverk)
4. Standardverktøy og sosiale medier til faglig bruk
5. Sosiale medier og digitale læremiddel til faglig bruk
6. Standardverktøy og sosiale medier til faglig bruk
7. Jeg trenger opplæring i andre digitale verktøy
8. Jeg trenger ikke noen opplæring i det hele tatt
9. Vet ikke

37

Foreleserne på studiet mitt er oppdatert på forskning om hvordan elever i skolen lærer best av IKT.
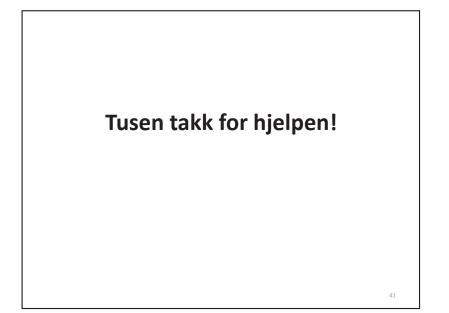
1. Helt enig
2. Svært enig
3. Litt enig
4. Verken eller
5. Litt uenig
6. Svært uenig
7. Helt uenig

38

Jeg har utviklet min digitale kompetanse gjennom lærerutdanningens campusundervisning.

1. Helt enig
2. Svært enig
3. Litt enig
4. Verken eller
5. Litt uenig
6. Svært uenig
7. Helt uenig

Min digitale kompetanse er utviklet tilstrekkelig gjennom studiet mitt til å undervise med IKT i dagens skole.

1. Helt enig
2. Svært enig
3. Litt enig
4. Verken eller
5. Litt uenig
6. Svært uenig
7. Helt uenig

Tusen takk for hjelpen!

Codebook for quantitative survey data (Survey items translated from Norwegian).

Variable 0.	ID – unique ID number assigned to each student teacher by survey software; from 166XXX-167XXX
Variable 1.	Gender – sex of the student; 1 = Female, 2 = Male
Variable 2.	Age – years of age of student teachers; 1 = 19-24, 2 = 25-29, 3 = 30-32, 4 = 33 or older
Variable 3.	GPA – grade point average from upper-secondary school; 1 = 2 or above, 2 = 3 or above, 3 = 4 or above, 4 = 5 or above, 5 = 6
Variable 4.	Study program – which study program the student teachers are enrolled in; 1 = 1-year practical pedagogical education (PPU), 2 = 5-year integrated teaching program (5LU)
Variable 5.	School practicum – where the student teachers had their last school practicum placement; 1 = lower-secondary (5-10), 2 = upper-secondary (11-13)
Variable 6.	Study points – how many study points the student teachers have accumulated from higher education; 1 = 0, 2 = 1-59, 3 = 60-119, 4 = 120-179, 5 = 180-239, 6 = 240-299, 7 = 300 or more
Variable 7.	Mom's education – student teachers' mother's highest education; 1 = primary + lower-secondary school, 2 = upper-secondary school (general studies), 3 = upper-secondary (vocational studies), 4 = university/university college (up to 4 years), 5 = university/university college (4 years or more)
Variable 8.	Father's education – student teachers' father's highest education; 1 = primary + lower-secondary school, 2 = upper-secondary school (general studies), 3 = upper-secondary (vocational studies), 4 = university/university college (up to 4 years), 5 = university/university college (4 years or more)
Variable 9.	Study motivation – whether the student teachers feel it is important for them to do well in their studies; 1 = yes, 2 = to some extent, 3 = no
Variable 10.	School laptop – were the student teachers offered a school laptop during upper-secondary school; 1 = yes, 2 = no
Variable 11.	MA thesis – in which subject area will the student teachers write their MA thesis; 1 = languages, 2 = sciences, 3 = history, 4 = geography, 5 = social studies, 6 = other (aesthetic education, sports science, pedagogy, religion, vocational, media)
Variable 12.	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); 1 = 0 (no skills), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very good skills)
Variable 13.	Basic ICT skills – how well student teachers master the use of digital tools (e.g. learning management systems, Word, Excel, and PowerPoint) in their studies in a coherent way; 1 = 0 (no skills), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very good skills)
Variable 14.	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; 1 = 0 (no skills), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very good skills)
Variable 15.	Didactical ICT usage – in what way do student teachers use ICT didactically; 1 = I use ICT so that pupils can remember subject content better (e.g. remember concepts and definitions), 2 = I use ICT so that pupils both can remember and understand subject content better (e.g. visualizing theoretical subject content), 3 = I use ICT so that pupils can remember, understand, and apply subject content better (e.g. for solving subject-related tasks), 4 = I use ICT in a general manner so that pupils can attain better learning outcomes compared to if I had only used the text book, 5 = I do not use ICT in any of these ways (1-4)
Variable 16.	Digital learning strategies – how student teachers master guiding pupils in reading screen-based texts with concentration, persistence, flow, and coherence; 1 = 0 (no skills), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very good skills)
Variable 17.	Digital learning strategies usage – what digital learning strategies do student teachers master for guiding pupils; 1 = I can guide pupils in reading screen-based texts on a basic level, 2 = I master #1, and I can guide pupils in reading screen-based texts with concentration, persistence, flow, and coherence, 3 = I master both #1 and #2, and I can guide pupils in searching, localizing, and compare information from different digital sources, 4 = I master #1, #2, and #3, and I can guide pupils in transforming and contrasting information from different digital sources, 5 = I master #1, #2, #3, and #4, and I can guide pupils in assessment and source criticism of digital sources, 6 = I master #1, #2, #3, #4, and #5, and I can guide pupils in interpretation and analysis of digital sources, 7 = I to no master any of the abovementioned statements (1-6)
Variable 18.	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; 1 = 0 (no skills), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very good skills)
Variable 19.	Overall digital competence of student teachers – based on the previous questions, how well student teachers assess their digital competence for teaching; 1 = 0 (no digital competence), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very good digital competence)
Variable 20.	Overall digital competence of teacher educator(s) – based on the previous questions, how well student teachers assess the digital competence of their study's teacher educator(s); 1 = 0 (no digital competence), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very good digital competence)
Variable 21.	Competence development of student teachers – to what extent student teachers see a need for competence development in the use of ICT for student teachers in their study; 1 = 0 (no extent), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very high extent)
Variable 22.	Competence development of teacher educator(s) – to what extent student teachers see a need for competence development in the use of ICT for teacher educator(s) in their study; 1 = 0 (no extent), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very high extent)
Variable 23.	Teacher educator(s) as role-model(s) - to what extent student teachers perceive their teacher educator(s) as role-model(s) for their own use of ICT in their teaching; 1 = 0 (no extent), 2 = 1, 3 = 2, 4 = 3, 5 = 4, 6 = 5, 7 = 6 (very high extent)
Variable 24.	Further education – whether student teachers wish to pursue further education in the use of ICT after graduating from their study; 1 = yes, 2 = no
Variable 25.	Setting learning goals – to what extent student teachers agree that they can set clear learning goals for how pupils should use ICT in their subject disciplines; 1 = completely agree, 2 = agree, 3 = agree to some extent, 4 = neither nor, 5 = disagree to some extent, 6 = disagree, 7 = completely disagree
Variable 26.	Enhancing potential learning outcomes – to what extent student teachers agree that they can give clear instructions on how pupils can improve their potential learning outcomes when using ICT in their subject disciplines; 1 = completely agree, 2 = agree, 3 = agree to some extent, 4 = neither nor, 5 = disagree to some extent, 6 = disagree, 7 = completely disagree
Variable 27.	Digital tools – what digital tools student teachers want education in for improving pupils' potential learning outcomes with ICT; 1 = Basic digital tools for teaching subject discipline (e.g. Word, PowerPoint, Google, etc.), 2 = Social media for teaching subject discipline (e.g. YouTube, Facebook, etc.), 3 = Digital learning resources for teaching subject discipline (e.g. NDLA, digital textbooks), 4 = Basic digital tool and social media for teaching subject discipline, 5 = Social media and digital learning resources for teaching subject discipline, 6 = Basic digital tools and digital learning resources for teaching subject discipline, 7 = I need education in using other digital tools, 8 = I do not need any education at all, 9 = I do not know
Variable 28.	Lecturers' research knowledge – to what extent student teachers agree that their study's lecturers are familiar with research on how pupils in schools best learn with the use of ICT; 1 = completely agree, 2 = agree, 3 = agree to some extent, 4 = neither nor, 5 = disagree to some extent, 6 = disagree, 7 = completely disagree
Variable 29.	Digital competence development - to what extent student teachers agree that the teacher education's campus teaching has contributed to developing their digital competence; 1 = completely agree, 2 = agree, 3 = agree to some extent, 4 = neither nor, 5 = disagree to some extent, 6 = disagree, 7 = completely disagree
Variable 30.	Digital competence for teaching - to what extent student teachers agree that their digital competence is sufficiently developed to teach with ICT in today's schools; 1 = completely agree, 2 = agree, 3 = agree to some extent, 4 = neither nor, 5 = disagree to some extent, 6 = disagree, 7 = completely disagree
Variable 31.	Digital competence through subject didactics - to what extent student teachers agree that they have developed their digital competence through the subject didactics and subject didactic seminars compared to other aspects of the teacher education program; 1 = completely agree, 2 = agree, 3 = agree to some extent, 4 = neither nor, 5 = disagree to some extent, 6 = disagree, 7 = completely disagree
Variable 32.	Digital competence through school practicum - to what extent student teachers agree that they have developed their digital competence through the school practicum compared to the teacher education program's campus teaching; 1 = completely agree, 2 = agree, 3 = agree to some extent, 4 = neither nor, 5 = disagree to some extent, 6 = disagree, 7 = completely disagree
Variable 33.	Teachers' professional digital competence - to what extent student teachers agree that their

	professional digital competence is important for their future profession as a teacher; 1 = completely agree, 2 = agree, 3 = agree to some extent, 4 = neither nor, 5 = disagree to some extent, 6 = disagree, 7 = completely disagree
Variable 34.	Professional digital competence for pupils' learning - to what extent student teachers agree that their professional digital competence is important for their future pupils' potential learning outcomes; 1 = completely agree, 2 = agree, 3 = agree to some extent, 4 = neither nor, 5 = disagree to some extent, 6 = disagree, 7 = completely disagree
Variable_re (25-34)	Indicates that the variable has been reverse coded; 1 = completely disagree, 7 = completely agree

Intervjuguide – Lektorstudenter engelsk fagdidaktikk

Phd.-prosjektet: *Lærerstudenters digitale kompetanse*

Tidsperiode: *Høsten 2012 – Våren 2014*

Utgangspunkt: *Kvale & Brinkmanns (2009) 7-stegs intervjuteknikk*

Oppstart: Stipendiaten bruker først litt tid på å bli kjent med informanten (slik som: «Fortell kort om deg selv»), og på å gjenta informasjonen om undersøkelsen. Informantene har tidligere skrevet under på et samtykkeskjema om at dataene kan bli brukt i avhandlingen og i publikasjoner. De blir igjen informert om at alle personidentifiserende opplysninger blir anonymisert, og at alle data blir behandlet konfidensielt av stipendiaten og stipendiatens to veiledere. Stipendiaten spør om det er greit at han skrur på lydopptakeren. Observasjonsnotater er medbrakt til intervjuet og kan bli brukt som grunnlag for spørsmål i intervjuet (for eksempel: «Hvorfor brukte du PowerPoint og YouTube i time X?»). Dersom det dukker opp temaer som kan være interessante å følge opp, noteres disse i feltnotatene, men stipendiaten skal hovedsakelig være fokusert på å lytte og holde samtalen i gang ved å vise interesse.

«Takk for at du kan stille til intervju. Intervjuet tar litt over 1 time og skal brukes i forbindelse med doktorgradsarbeidet mitt. Jeg har observert noen av dere i praksisperioden i første semester og deltatt i undervisningstimene på campus. Kanskje jeg også følger dere i andre semester dersom dere er interessert. Vi hadde jo også en kartleggingsundersøkelse i uke 46 hvor vi brukte klikkere etterfulgt av et elektronisk spørreskjema for de som ikke deltok. Jeg har forberedt noen spørsmål som er styrende, men jeg er interessert i å høre alt du har å si om det vi snakker om. Ikke føl deg bundet til det jeg spør om da dette skal være en åpen samtale, alt du har å bidra med er av interesse.»

1) Du har blitt observert i praksis hvor du ble bedt om å ta i bruk IKT i engelsk. Kan du fortelle litt hvordan du brukte IKT i praksis? Hva brukte du? Hvordan? Hvorfor? Gi noen eksempler fra praksis i engelskfaget.

2) I Kunnskapsløftet og læreplanene for alle fag er digital kompetanse eller «å kunne bruke digitale verktøy» den femte grunnleggende ferdigheten. Hvordan har dere arbeidet med denne ferdigheten i lys av læreplanen i engelsk fagdidaktikk? Gi noen eksempler fra studiet.

3) Hvilken erfaringsdeling er det blant lærerstudenter i forhold til faglig IKT-bruk? Er IKT-bruk et diskusjonstema blant lærerstudenter? Hva med blant lærerstudenter og lærerutdannere? Blant studenter og praksislærere?

4) Hvilken betydning mener du IKT har for elevenes læringsutbytte? Gi positive og negative eksempler.

5) Hvilken betydning mener du IKT har for ditt læringsutbytte ved studiet ditt? Gi positive og negative eksempler.

6) Jeg har analysert samtlige mappeoppgaver i engelsk fra høsten 2012 til og med høsten 2013, og ser at svært få har skrevet om IKT i engelskfaget. Hva mener du kan være grunnen til dette? Hva skrev du om i din oppgave?

7) Hvordan mestrer du de digitale forhåndskunnskapene som er krevd av deg i engelsk på lærerutdanningsstudiet? Hvordan mestrer du disse forkunnskapskravene i praksis?

8) Spørsmål til lektorstudenter i vårsemesteret: Dere gjennomførte en tre timers workshop i januar hvor dere lærte om digital storytelling. Hvordan opplevde du kursopplegget? Struktur og arbeidsform? Innhold? Utbytte? Hadde du kjennskap til metoden fra tidligere skolegang/utdanning?

9) Spørsmål til lektorstudenter i vårsemesteret: Dere fikk i oppgave å levere inn den digitale fortellingen deres samt en refleksjonslogg over arbeidsprosessen. Hvordan opplevde du dette arbeidet? Hva var meningsfylt for deg? Hvilket utbytte fikk du av å lage og levere inn din egen DST? Hvilket utbytte fikk du av å skrive refleksjonsnotat? Samarbeidet du med noen? Hvordan var det å jobbe med DST med tanke på bilde og musikkbruk?

10) Spørsmål til lektorstudenter i vårsemesteret: Hvordan arbeidet du med digital storytelling i skolepraksisen din i vår? Hvilke sammenhenger ser du mellom arbeid med digital storytelling og elevers læring i engelskfaget? For eksempel, hvordan kan DST brukes for å jobbe med de fem språkferdighetene (muntlig produksjon og interaksjon, skrive, lytte, lese) hos elevene. Kjenner du til andre måter på hvordan har jobbet med språkferdighetene på en faglig måte med IKT i engelsk fagdidaktikk?

11) Med tanke på definisjonen og innholdet i lærerens profesjonelle digital kompetanse (elementære og grunnleggende digitale ferdigheter, didaktisk IKT-bruk, digitale læringsstrategier og digital dannelse), hvordan opplever du at din digitale kompetanse som språklærer utviklet seg gjennom digital storytelling metoden? Hvordan har denne kompetansen utviklet seg helhetlig gjennom lærerutdanningsstudiet (fra første prasksisperiode - PPU1 til andre praksisperiode - PPU2)?

12) Vi har kjørt en survey på lærerstudenters digitale kompetanse. Her gjorde vi et skille mellom elementære digitale ferdigheter (IKT brukt på fritiden utenom skole og arbeid) og grunnleggende digitale ferdigheter (IKT brukt i skolesammenheng). Hvilke forskjeller ser du på bruk av IKT i fritidssammenheng og som lærer? Hvordan opplever du at dette blir behandlet i studiet ditt? Hvordan jobber dere med grunnleggende digitale ferdigheter ved studiet ditt? Gi noen eksempler.

13) Ved spørsmål i surveyen på lærerstudentenes didaktiske IKT-bruk i undervisningen sin svarte samtlige studenter at de brukte IKT på en helhetlig måte for å få bedre læringsutbytte enn om de bare hadde brukt læreboken. Hvordan blir dette temaet behandlet i studiet ditt? Hvordan ser du din egen praksis i lys av en slik helhetlig IKT-bruk?

14) Hvilken skolering/kursing innenfor IKT har dere fått ved lærerutdanningen dette semesteret bortsett fra DST workshop? Hvordan var disse organisert (individuell, gruppevis eller i plenum)? Fikk du skolering/kursing når du var i praksis? Hva kunne du

tenkt deg av kursing gjennom studiet ditt? Hvilke arbeidsmåter foretrekker du i en slik setting? Kunne du tenkt deg etterutdanning innenfor didaktisk bruk av IKT?

15) I surveyen observerte vi stor etterspørsel etter mer opplæring i digitale læremidler til faglig bruk (for eksempel NDLA, digitale læreverk) og standardverktøy (for eksempel læringsplattform, PowerPoint, Word). Hva er ditt inntrykk av det? Hvordan jobber dere med digital læremidler ved studiet ditt? Gi noen eksempler. Hvilke digitale læremidler og standardverktøy til faglig bruk kunne du tenkt deg mer opplæring i? Ønsker du annen opplæring knyttet til IKT til faglig bruk (for eksempel spesifikke metoder eller digitale verktøy)?

16) Som lærere så forsøker å gjøre elevene bevisste på gode læringsstrategier for at de skal bli selvstendige lærende individer slik som hvordan de kan lese en tekst på en bedre måte eller hvordan de kan jobbe ut i fra tilbakemeldinger. Mye av elevenes digitale læringsstrategier går ut på å lese skjermbaserte tekster, gjøre informasjonssøk på Internett og tolke digitale kilder. Hvordan føler du at du mestrer veiledning av elevene i digitale læringsstrategier for eksempel å være kildekritisk? Hvordan jobbet dere med digitale læringsstrategier i engelsk fagdidaktikk?

17) Hvordan kan du bruke IKT for å legge til rette for tilpasset opplæring for å øke elevenes læringsutbytte? Hvordan jobber dere med tilpasset opplæring med IKT i engelsk fagdidaktikk?

18) Dannelse er et begrep og dimensjon i skolen som er blitt tatt opp på lærerutdanningen. Med IKT så har digital dannelse blitt en ekstra viktig dimensjon knyttet til etiske dilemmaer (for eksempel plagiering, piratkopiering, personvern og nettmobbing) i elevenes digitale livsstil. Hvordan vurderer du din kompetanse til å veilede elevene til å utvikle god dømmekraft knyttet til deres digitale livsstil både i og utenfor skolen? Hvordan jobber dere med dømmekraft i engelsk fagdidaktikk?

19) Ut i fra surveyen observerte vi at lærerstudentene anså sin digitale kompetanse til å være høyere enn forelesernes digitale kompetanse slik som fra forrige survey. Har du noen synspunkter på dette? Hvordan påvirker dette ditt læringsutbytte i studiet?

20) Å gi elevene tydelige læringsmål og klar beskjed om hvordan de kan få økt læringsutbytte er et kjernepunkt i vurdering for læringstekningen, også med tanke på bruk av IKT. I surveyene så vi at lærerstudentene mente de var i god stand til å gi elevene tydelige læringsmål og klar beskjed om elevene kan bruke IKT til å lære bedre i skolefaget sitt. Gi noen eksempler fra praksis på hvordan du gav elevene beskjed om hvordan de kan lære bedre i engelskfaget med IKT. Hvordan jobbet dere med denne praksisen i studiet ditt?

21) I surveyen så vi at lærerstudentene mente at det i høy grad var behov for kompetanseheving innen IKT både for lærerstudenter og for foreleserne ved studiet. Hvordan er dette for faglæreren deres i engelsk fagdidaktikk? Hva med andre faglærere ved studiet? Hvilke områder innenfor IKT mener du foreleserne trenger kompetanseheving i for å bruke det i undervisningssammenheng på campus og i skolen?

22) Vi observerte i surveyen at lærerstudentene i liten grad anså at foreleserne framstod som gode rollemodeller for sin egen bruk av IKT i egen undervisning i skolen. Hvordan opplever du at faglærer i engelsk fagdidaktikk var en rollemodell for din egen IKT bruk? Hva med andre faglærere?

23) Evnen til å se sammenhengen mellom teoriundervisningen og skolepraksis (for eksempel teori om motivasjon i campusundervisningen og observasjon av motivasjon i praksis) er noe studiet forsøker å utvikle hos lærerstudentene. Foreleserne skal være oppdaterte på aktuelle forskningsfelt og formidle denne forskningen til lærerstudentene. Dette gjelder også forskning på hvordan elever lærer best av IKT i undervisningen. I surveyen så vi at lærerstudentene var uenige i påstanden at foreleserne var oppdaterte på forskning om hvordan elever lærer best av IKT. Hvordan mener du faglærer i engelsk fagdidaktikk er i forhold til denne påstanden? Hva med andre faglærere? Hvilken pensumlitteratur har dere om bruk av IKT for læring i engelskfaget? Hvilke læringsteorier fra pedagogikken og didaktikken kan koble opp mot elevers læring med IKT?

24) Lærerstudentene svarte at studiet i liten grad bidro til å utvikle deres digitale kompetanse og at de i større grad har utviklet sin digitale kompetanse gjennom skolepraksis enn gjennom studiets campusundervisning. Hvordan føler du at din digitale kompetanse har blitt utviklet gjennom campusundervisningen? Hva med i praksis? Hva kan gjøres annerledes i utdanningen?

25) Lærerstudentene svarte at de er delt når det gjelder hvor forberedt de føler seg til å undervise i dagens teknologirike skole. Hvordan stiller du deg til denne påstanden?

26) Hvordan er din profesjonelle digitale kompetanse viktig for deg som lærer, og viktig for dine fremtidige elevers læring?

27) Har du noe du vil tilføye? Har du noen spørsmål til meg? Var det noe som var uklart?

«Takk for intervjuet. Hvordan følte du at det gikk?». Lydopptaker skrues av. Opplysninger som kommer fram i samtalen etter intervjuet blir skrevet ned sammen med feltnotatene.

Intervjuguide – Lærerutdanner engelsk fagdidaktikk

Phd.-prosjektet: *Lærerstudenters digitale kompetanse*

Tidsperiode: *Våren 2014*

Utgangspunkt: *Kvale & Brinkmanns (2009) 7-stegs intervjuteknikk*

Oppstart: Stipendiaten bruker først litt tid på å bli kjent med informanten (slik som: «Fortell kort om deg selv»), og på å gjenta informasjonen om undersøkelsen. Informantene har tidligere skrevet under på et samtykkeskjema om at dataene kan bli brukt i avhandlingen og i publikasjoner. De blir igjen informert om at alle personidentifiserende opplysninger blir anonymisert, og at alle data blir behandlet konfidensielt av stipendiaten og stipendiatens to veiledere. Stipendiaten spør om det er greit at han skrur på lydopptakeren. Observasjonsnotater er medbrakt til intervjuet og kan bli brukt som grunnlag for spørsmål i intervjuet (for eksempel: «Hvorfor brukte du PowerPoint og YouTube i time X?»). Dersom det dukker opp temaer som kan være interessante å følge opp, noteres disse i feltnotatene, men stipendiaten skal hovedsakelig være fokusert på å lytte og holde samtalen i gang ved å vise interesse.

«Takk for at du kan stille til intervju. Intervjuet tar litt over 1 time og skal brukes i forbindelse med doktorgradsarbeidet mitt. Jeg har observert noen av dere i praksisperioden i første semester og deltatt i undervisningstimene på campus. Kanskje jeg også følger dere i andre semester dersom dere er interessert. Vi hadde jo også en kartleggingsundersøkelse i uke 46 hvor vi brukte klikkere etterfulgt av et elektronisk spørreskjema for de som ikke deltok. Jeg har forberedt noen spørsmål som er styrende, men jeg er interessert i å høre alt du har å si om det vi snakker om. Ikke føl deg bundet til det jeg spør om da dette skal være en åpen samtale, alt du har å bidra med er av interesse.»

1) Du har blitt observert i engelsk fagdidaktikk over fire akademiske semester. Kan du fortelle litt hvordan du har brukt IKT i campusundervisningen din? Hva har du brukt? Hvordan? Hvorfor? Hvordan har IKT bruken din utviklet seg siden du begynte på lærerutdanningen?

2) I Kunnskapsløftet og læreplanene for alle fag er digital kompetanse eller «å kunne bruke digitale verktøy» den femte grunnleggende ferdigheten. Hvordan har dere arbeidet med denne ferdigheten i lys av læreplanen i engelsk fagdidaktikk?

3) Hvilket læringsfokus og pedagogisk rasjonale har du hatt i didaktikktimene dine med tanke på lærerstudentenes bruk av IKT i engelskundervisningen? Hvilke strategier og metoder benytter du? Hvordan har du lært deg disse strategiene og metodene?

4) Hvordan var lærerstudentenes IKT bruk når du besøkte dem i praksis? Hva overrasket eller skuffet deg av lærerstudentenes IKT bruk? Hva var nytt og hva var gammelt? Hvilken utvikling ser du hos lærerstudentenes IKT bruk?

5) Hvilken erfaringsdeling er det blant lærerutdannere i forhold til faglig IKT-bruk? Er IKT-bruk et diskusjonstema blant lærerutdannere? Hva med blant lærerstudenter, lærerutdannere og praksislærere?

6) Hvordan arbeidet du med IKT da du var lærer i skolen?

7) Hvilken betydning mener du IKT har for elevenes læringsutbytte? Gi positive og negative eksempler.

8) Hvilken betydning mener du IKT har for ditt læringsutbytte i arbeidet ditt som lærer og lærerutdanner? Gi positive og negative eksempler.

9) Jeg har analysert samtlige mappeoppgaver i engelsk fra høsten 2012 til og med høsten 2013, og ser at svært få har skrevet om IKT i engelskfaget. Hva mener du kan være grunnen til dette?

10) Hvilke forhåndskunnskaper innenfor IKT-bruk stilles ovenfor deg av lærerutdanningen og hvordan mestrer du disse?

11) Dere gjennomførte en tre timers workshop i januar hvor dere underviste om digital storytelling. Hvordan opplevde du kursopplegget? Struktur og arbeidsform? Innhold? Lærerstudentenes utbytte? Hadde du kjennskap til metoden fra tidligere utdanning?

12) Lærerstudentene fikk i oppgave å levere inn den digitale fortellingen deres samt en refleksjonslogg over arbeidsprosessen. Hvordan opplevde du dette arbeidet når du vurderte studentenes oppgaver? Hvilke tilbakemeldinger gav du dem? Hvilket utbytte mener du de fikk av å lage og levere inn din egen DST? Hvilket utbytte mener du de fikk av å skrive refleksjonsnotat? Hvilket utbytte mener du de fikk de som samarbeidet?

13) Det ble gjort en rekke endringer i år med DST workshoppen med tanke på krav til innlevering fra studentenes hold. Hvordan opplevde du DST workshoppen i år (intervensjonen) sammenlignet med tidligere år?

14) Hvordan arbeidet du med digital storytelling i undervisningen ved din skole? Hvilke sammenhenger ser du mellom arbeid med digital storytelling og elevers læring i engelskfaget? For eksempel, hvordan kan DST brukes for å jobbe med de fem språkferdighetene (muntlig produksjon og interaksjon, skrive, lytte, lese) hos elevene. Kjenner du til andre måter på hvordan har jobbet med språkferdighetene på en faglig måte med IKT i engelsk fagdidaktikk?

15) Med tanke på definisjonen og innholdet i lærerens profesjonelle digital kompetanse (elementære og grunnleggende digitale ferdigheter, didaktisk IKT-bruk, digitale læringsstrategier og digital dannelse), hvordan opplever du at din digitale kompetanse som språklærer utviklet seg gjennom digital storytelling metoden?

16) Vi har kjørt en ny survey på lærerstudenters digitale kompetanse. Her gjorde vi et skille mellom elementære digitale ferdigheter (IKT brukt på fritiden utenom skole og arbeid) og grunnleggende digitale ferdigheter (IKT brukt i skolesammenheng). Hvilke forskjeller ser du på bruk av IKT i fritidssammenheng og som lærer? Hvordan jobber dere med grunnleggende digitale ferdigheter i engelsk didaktikk?

17) Ved spørsmål i surveyen på lærerstudentenes didaktiske IKT-bruk i undervisningen sin svarte samtlige studenter at de brukte IKT på en helhetlig måte for å få bedre

læringsutbytte enn om de bare hadde brukt læreboken. Hvordan blir dette temaet behandlet i didaktikken? Hvordan ser du din egen praksis i lys av en slik helhetlig IKT-bruk?

18) Hvilken skolering/kursing innenfor IKT har du fått i skolen og ved lærerutdanningen? Har du fått kursing utenom jobben? Hvordan var disse organisert (individuell, gruppevis eller i plenum)? Hva kunne du tenkt deg av kursing gjennom studiet ditt? Hvilke arbeidsmåter foretrekker du i en slik setting? Kunne du tenkt deg etterutdanning innenfor didaktisk bruk av IKT?

19) I surveyen observerte vi stor etterspørsel etter mer opplæring i digitale læremidler til faglig bruk (for eksempel NDLA, digitale læreverk) og standardverktøy (for eksempel læringsplattform, PowerPoint, Word). Hva er ditt inntrykk av det? Hvordan jobber dere med digital læremidler i didaktikken? Hvilke digitale læremidler og standardverktøy til faglig bruk kunne du tenkt deg mer opplæring i? Ønsker du annen opplæring knyttet til IKT til faglig bruk (for eksempel spesifikke metoder eller digitale verktøy)?

20) Som lærere så forsøker vi å gjøre elevene bevisste på gode læringsstrategier for at de skal bli selvstendige lærende individer slik som hvordan de kan lese en tekst på en bedre måte eller hvordan de kan jobbe ut i fra tilbakemeldinger. Mye av elevenes digitale læringsstrategier går ut på å lese skjermbaserte tekster, gjøre informasjonssøk på Internett og tolke digitale kilder. Hvordan føler du at du mestrer veiledning av elever i digitale læringsstrategier for eksempel å være kildekritisk og hvordan du kan lære dette bort til lærerstudenter? Hvordan jobber dere med digitale læringsstrategier i engelsk fagdidaktikk?

21) Hvordan kan du bruke IKT for å legge til rette for tilpasset opplæring for å øke elevenes læringsutbytte? Hvordan jobber dere med tilpasset opplæring med IKT i engelsk fagdidaktikk?

22) Dannelse er et begrep og dimensjon i skolen som er blitt tatt opp på lærerutdanningen. Med IKT så har digital dannelse blitt en ekstra viktig dimensjon knyttet til etiske dilemmaer (for eksempel plagiering, piratkopiering, personvern og nettmobbing) i elevenes digitale livsstil. Hvordan vurderer du din kompetanse til å veilede elevene til å utvikle god dømmekraft knyttet til deres digitale livsstil både i og utenfor skolen samt hvordan du kan lærer dette bort til lærerstudenter? Hvordan jobber dere med dømmekraft i engelsk fagdidaktikk?

23) Ut i fra surveyen observerte vi at lærerstudentene anså sin digitale kompetanse til å være høyere enn foreleseres digitale kompetanse slik som fra forrige survey. Har du noen synspunkter på dette? Hvordan påvirker dette lærerstudentenes læringsutbytte i studiet generelt? Merk at lærerstudentene nevnte spesielt deg som et unntak i intervjuene.

24) Å gi elevene tydelige læringsmål og klar beskjed om hvordan de kan få økt læringsutbytte er et kjernepunkt i vurdering for læringstekningen, også med tanke på bruk av IKT. I surveyene så vi at lærerstudentene mente de var i god stand til å gi elevene tydelige

læringsmål og klar beskjed om elevene kan bruke IKT til å lære bedre i skolefaget sitt. Hvordan jobber dere med læringsmålsetting gjennom IKT i didaktikken?

25) Slik som sist survey så vi at lærerstudentene mente at det i høy grad var behov for kompetanseheving innen IKT både for lærerstudenter og for foreleserne ved studiet. Hvilke områder innenfor IKT mener du foreleserne trenger kompetanseheving i for å bruke det i undervisningssammenheng på campus og i skolen? Merk at dette gjaldt ikke spesielt i engelsk fagdidaktikk, men generelt andre faglærere ved studiet ifølge intervjuene.

26) Lik forrige survey observerte vi at lærerstudentene i liten grad anså at foreleserne framstod som gode rollemodeller for sin egen bruk av IKT i egen undervisning i skolen. Hvordan opplever du deg selv som en rollemodell for lærerstudentenes IKT? Hva med andre faglærere?

27) Evnen til å se sammenhengen mellom teoriundervisningen og skolepraksis (for eksempel teori om motivasjon i campusundervisningen og observasjon av motivasjon i praksis) er noe studiet forsøker å utvikle hos lærerstudentene. Foreleserne skal være oppdaterte på aktuelle forskningsfelt og formidle denne forskningen til lærerstudentene. Dette gjelder også forskning på hvordan elever lærer best av IKT i undervisningen. I surveyen så vi at lærerstudentene var uenige i påstanden at foreleserne var oppdaterte på forskning om hvordan elever lærer best av IKT. Hvordan opplever du egne fagkunnskaper i forhold til denne påstanden? Hva med andre faglærere? Hvilken pensumlitteratur har dere om bruk av IKT for læring i engelskdidaktikken? Hvilke lærings- og språklæringsteorier fra pedagogikken og didaktikken kan koble opp mot elevers læring med IKT?

28) Lærerstudentene svarte at studiet i liten grad bidro til å utvikle deres digitale kompetanse, og at de i større grad har utviklet sin digitale kompetanse gjennom skolepraksis enn gjennom studiets campusundervisning. Hvordan kan campusundervisningen bidra til å utvikle lærerstudentenes digitale kompetanse? Hva med praksisfeltet? Hva kan gjøres annerledes i utdanningen?

29) Lærerstudentene svarte at de er delt når det gjelder hvor forberedt de føler seg til å undervise i dagens teknologirike skole. På hvilken måte forbedrer lærerutdanningen lærerstudentene til fremtidens skole?

30) Hvordan er lærerstudentenes profesjonelle digitale kompetanse viktig for dem som fremtidige lærere? Hvordan er det viktig for deres fremtidige elevers læring?

31) Har du noe du vil tilføye? Har du noen spørsmål til meg? Var det noe som var uklart?

«Takk for intervjuet. Hvordan følte du at det gikk?». Lydopptaker skrues av. Opplysninger som kommer fram i samtalen etter intervjuet blir skrevet ned sammen med feltnotatene.