Fredrik Mørk Røkenes
   Programme for Teacher Education
   Norwegian University of Science and Technology (NTNU)
   Email: fredrik.rokenes@plu.ntnu.no

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).
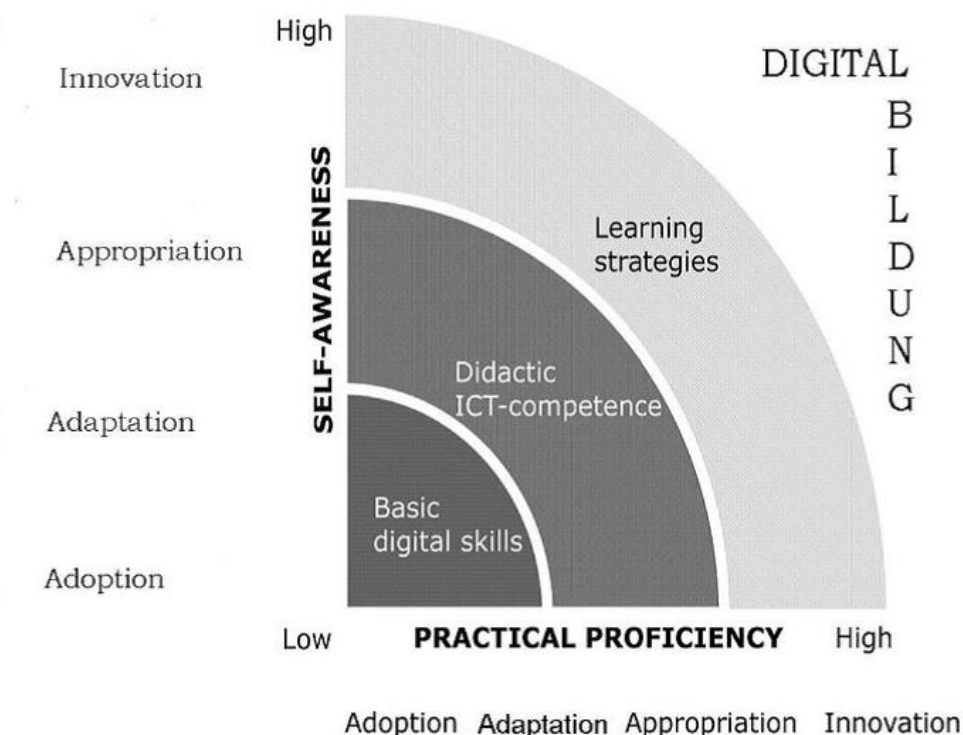

Figure 1. Model for student teachers' digital competence (Krumsvik, 2011, 2014).

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.