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Educating online student teachers to master professional digital competence: The TPACK-framework goes online

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ABSTRACT

In this article we study how online teacher education programmes may enhance innovative ways of teaching and learning with Information and Communication Technology (ICT). We explore how online teachers are practising professional digital competence, in general and within subject areas, and to what extent they encourage student teachers to develop their own professional digital competence. Based on online teacher education programmes at two distinct higher education institutions (HEIs), we applied mixed method design including quantitative and qualitative approaches to illuminate the aims and the scope. Our study revealed that even if online teacher education programmes represent good avenues for stimulating teachers and student teachers to develop digital competence for pedagogical purposes, this aspect is poorly integrated within the actual programmes, although some interesting examples were demonstrated. By looking at the origins of the discourses on online education and on digital competence, we found that they derive from different stakeholders: while the discourse on online education originated from the management side at both HEIs, the discourse on digital competence derived from certain teaching staff at the two HEIs. Our study indicated that there is still some way to go to innovative solutions and to develop the potential of professional digital competence in online teacher education programmes.

1. Introduction

Teacher education programmes in Norway and Sweden are based on national curricula, which include digital competence (Norwegian Ministry of Education and Research, 2010; SFS 2010:541). Student teachers are obliged to master the use of information and communication technology (ICT) for pedagogical purposes as part of their education. However, recent findings confirm that this aspect is poorly integrated within teacher education programmes (Enochsson, 2010; Granberg, 2011; Tømte, Hovdhaug & Solum, 2009). Nonetheless, more than half of the Higher Education Institutions (HEIs) in Norway, and more than a third of the HEIs in Sweden, offer teacher education programmes that include various versions of online solutions (Tømte, Kårstein, & Olsen, 2013). This means that ICT is implemented at some stage within many teacher education programmes. However, being able to follow an online class does not necessarily equip students to teach by using digital media and learning resources (Enochsson, 2010), but these online settings might serve as good avenues for developing digital competence for the teaching profession, since the students develop their general digital competence (Enochsson, 2010).

Nordic nations are the most frequent users of the internet in Europe. Norway, Sweden and Iceland are the countries with the highest percentage of the population with internet and computer skills (Digital Agenda Scoreboard, 2013). Most Norwegians and Swedes use the internet every day (Findahl, 2013; SOU, 2014). In Norway, most employees and students, along with the population with higher education, use the internet; their frequency of use, including use for educational purposes, has increased over the years (Ørnes, Wilhelmsen, Breivik, Solstad, Aure & Abelsen, 2011). In other words, the technological infrastructure and the generic digital skills in these countries are

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considered good for HEIs and for future students in the teaching profession to further develop their digital competence for professional purposes.

Online education derives from distance-based education or distance learning, which existed long before modern information and communication technology (ICT) was introduced (Bates, 2014; Casey, 2008). One approach to understand the diversity in online teaching would be to distinguish between four axes that group content and approach in online education, as suggested by Bacow et al.: 1) purely online versus hybrid approaches that also include face-to-face interaction; 2) self-paced systems versus systems where all students participate simultaneously in teaching within established schedules; 3) systems that rely on social games/peer based approach versus systems oriented towards individual learners; and 4) Massive Open Online Courses, (MOOCs), i.e. large-scale teaching generated by hardware, versus approaches that require significant efforts of teaching staff to ensure interaction with students (Bacow, Bowen, Guthrie, Lack, & Long, 2012). Many institutions have also developed their own training packages (and sometimes entire educational programmes) exclusively based on online teaching, usually with little or no face-to-face interaction between students and teaching staff or students themselves. Nevertheless, most of these training packages represent imitations of traditional campus education. The main difference between these courses and campus-based education is that educators interact with students through technology (Bacow, Bowen, Guthrie, Lack, & Long, 2012). The attempt by Bacon and colleagues to group content and approach in online education is useful in the way that it demonstrates the complex landscape of online learning. However, to make such categories will often call upon exceptions; as in our case studies covering two online teacher education programmes. Our teacher education programmes comprise both parts of 1 and 2 in the indexing above; they involve face-to-face interaction as described in 1, in mandatory campus based meetings, and they are systems where all students participate simultaneously in teaching within established schedules. These practices are carefully described in the method section of our paper.

1.1. Aim of the article

The online teacher educational programmes at Telemark University College (TUC) and Karlstad University (KAU) represent institutions, which started out by imitating campus education, since the need has been to reach students in remote areas. Based on empirical findings from the study of these two online teacher education programmes in Norway and Sweden, we explore the ways in which online teachers are practising digital competence, in general and within subject areas, and the extent to which they encourage student teachers to develop their own professional digital competence. Moreover, we explore how online teacher education programmes may enhance innovative ways of teaching and learning with ICT. We consider these perspectives as valuable to the research community for several reasons: first because online education and learning is expanding worldwide and due to its complexity in content and pedagogical approaches, as demonstrated by Bacon and colleagues and in our two case studies, it would benefit from new insights from research; second, because teacher education institutions, at least in the Nordic countries, are to include digital competence in their curricula; and third, because there seems to be little research on digital competence development for teacher staff at higher educational institutions, as will be demonstrated in the research review.

The article opens with a research overview where recent contributions on theories of digital literacy and digital competence are introduced, along with a discussion on how these may be embraced within teacher education and within online educational programmes in general and within online teacher education programmes. In this, various theoretical contribution are introduced, such as the Technological-Pedagogical-Content-Knowledge (TPACK) framework. This is followed by the introduction of two cases, which provide the empirical data for this article; this section also includes the methods and data applied in the case studies. The next section presents findings, and discusses how these may relate to the previous research literature. The final section draws conclusions from the findings and discusses these in the context of professional digital competence and online learning.

2. Research overview

2.1. ICT and education

Information and Communication Technology (ICT) in education has for many years been important in the Nordic countries and elsewhere. ICT in education is often associated with increased opportunities for flexibility, efficiency and availability. Technology can for example help to reach out with education for more and new groups of students, and to increase flexibility for institutions, staff and students. In addition, technological solutions to administrative tasks along with communication activities have been highlighted at educational institutions. Such arguments have often dominated when ICT in education has been on the agenda (e.g. Norwegian Ministry of Education, 2013). Another important aspect that has been stressed is to provide students with relevant education for a knowledge society where technology continues to gain ground (ibid.). Furthermore, ICT in education also means that different technologies, media and resources are increasingly used in educational teaching and learning contexts in education. In this numerous studies suggest that to teach with ICT requires diverse areas of competence, such as pedagogical, technological and subject related ones (Eshet, 2004; Koehler & Mishra, 2008; 2009; Krumsvik, 2011; Mishra & Koehler, 2006; Shafer, 2008; So & Kim, 2009). In the following paragraphs we elaborate on what previous studies suggest as important avenues for understanding what kind of competencies would be relevant for teachers' pedagogical use of ICT and how teachers might be trained to allocate these kinds of competencies and skills.

In the earliest years of ICT and education, teacher training was mainly offered as isolated courses purely concentrating on how to use technology. To master diverse software and hardware was stressed more than how these could be integrated didactically within the subjects (Enochsson, 2010; Mishra & Koehler, 2006). Along with these discussions, researchers recognised that teachers ought to possess awareness for context in order to integrate technology into pedagogical practice (e.g. Graham et al., 2009). In these discussions the terms 'digital literacy' or 'digital competence' emerged. Several researchers have elaborated on what it takes to be digital literate or digital competent. Among these are Lankshear and Knobel (2006) and Buckingham (2006). While 'digital literacy', with some exceptions (e.g. Ferrari, 2012), seems to be the concept most commonly used internationally, 'digital competence' is the most commonly used concept in the Scandinavian countries in educational contexts. In these countries Krumsvik (2007; 2008; 2009) has been an important contributor to the development of

the term 'digital competence' when defining 'digital competence' as: 'the teachers' proficiency in using ICT in a professional context with good pedagogical-didactical judgement and his or her awareness of its implications for learning strategies and the digital *Bildung* of pupils and students' (Krumsvik, 2007). However, in an international context, the TPACK-framework (Koehler & Mishra, 2006) has emerged as an important avenue for understanding teachers' abilities to combine diverse fields of competence. During the years numerous studies have explored empirically and theoretically possibilities and constraints within this framework, including the Nordic countries (e.g. Engelien & Stundal, 2010; Tømte et al., 2009). These works are carefully presented in reviews (e.g. Abbitt, 2011; Voogt, Fisser, Pareja Roblin, Tondeur, & van Braak, 2013). An interesting observation from Voogt et al. (2013) would be that there seems to be mutual observation confirming that the TPACK-framework derives from Schulman's theory of PCK; 'pedagogical content knowledge' (Shulman, 1986), in where PCK thus lies in 'the ways of representing the subject that make it comprehensible to others' (Shulman, 1986, p. 9).

2.2. The TPACK-framework

Voogt et al. present the emergence of three different understandings of the TPACK framework, but all stemming from Shulman's (1986) PCK; T(PCK) as extended PCK; TPCK as an unique body of knowledge and TP(A)CK as the interplay between the three domains and their intersection (Voogt et al. 2013, p 11). Another interesting observation was that even if student teachers get experience in the design of technology-enhanced lessons they continue to lack experience in enacting technology-based lessons (Voogt et al. 2013). Following this, Prestridge (2012) makes an interesting observation as she claims that digital pedagogies support student active learning more than teacher centred approaches. This may support the idea that student teachers would learn from their own teaching and learning practice as actively involved in these processes.

Moreover, a positive attitude towards the use of technology is recognised as an important point of departure for teachers to develop their digital competence (Avidov-Ungar & Eshet, 2011). A similar approach is presented through what is referred to as 'digital pedagogy'. Within this regime researchers consider learning and teaching activities as parts of a seamless process where ICT is almost transparent and contributes above all to support the various learning strategies (Prestridge, 2012). Krumsvik supports this aspect as he highlights teachers' digital competence as an example of their professional digital literacy. This way, teachers have both the ability to use ICT in various disciplines or subjects while they also perform as role models within the teaching profession (Krumsvik, 2008). Prestridge refers to the 'Second order barriers', which relate to teachers' self-concept and self-esteem in how to apply ICT in their own teaching. In her studies, she found that confidence and sense of achievement in itself was not enough for teachers to practise what we have seen as 'digital pedagogy', i.e. seamless use of ICT in teaching and learning activities; on the contrary such a teaching approach was associated with teachers' practice of a student active pedagogy, where students also contributed as active producers of digital content (Prestridge, 2012).

To 'teach as they preach' will, according to Krumsvik (2011), serve as a guide for the formation of digitised learning environments for students, and also serve as an avenue for teachers to perform as good role models for the teaching profession. However, studies have indicated that teachers at the HEIs and at schools where student teachers are practising may not have the necessary competence or belief on how to teach with ICT (Tømte et al., 2013). This is critical as these teachers are important role models (Mutton, Mills, & McNicholl, 2006; Twidle, Sorensen, Childs, Godwin, & Dussart, 2006).

According to Voogt and colleagues, only a very few studies include discussions on how to adopt the TPACK-framework in specific subject domains. Following this, they suggest a continuing process of effectuation of what TPACK-framework would mean in specific subject-domains (Voogt et al. 2013). Moreover, they suggested involving student teachers in course design that includes various aspects of ICT as a major strategy in their TPACK development, since it would provide them with experience on how these courses work. Furthermore, based on recommendations from Polly, Mims, Shepherd, and Inan (2010), these researchers also suggest that student teachers should be linked with practising teachers and that both groups should be supported by the teacher training institution. This approach may also be adjusted for online courses. Nevertheless, research has documented that such an approach is rarely adopted when designing online courses; on the contrary, a teacher-centred approach is most likely preferred in these online designs (e.g. Valtonen, Kukkonen, & Wulff, 2006). Another observation is that studies that review previous studies on the TPACK-concept are mostly concerned with primary schools. Following this, Rienties, Brouwer and Baker (2013) claim that research on how to implement the TPACK-framework and its validation in a higher education context remains limited.

A key starting point for this paper, drawn from the various studies on the TPACK-framework and teachers' digital competence, is the importance of focussing on the interaction between technology, pedagogy, and content knowledge, as well as the importance of attitudes and role models in teaching and learning in technology-rich environments.

3. Research design, data and methods

The study is based on a mixed method design including data from two online teacher training programmes; one at Karlstad University, Sweden and one at Telemark University College, Norway. These online teacher training programmes serve as two distinct cases and illuminate diverse approaches towards appropriation of digital competence within online teacher education programmes. A case study approach may involve several perspectives. Thomas (2011) defines a case study as an analysis of the people, events, decisions, projects, periods, policy fields, institutions or a system approached holistically through one or more methods. In this way the cases are in the centre of the study – which requires an analytical framework to illustrate and explain the findings. A case study that includes two case studies; two online teacher training programmes offered at HEIs in two different countries, Norway and Sweden, gives us the opportunity to study various experiences of teacher training offered as online programmes.

Both case studies applied the same mixed methodological design, though adjusted to the local contexts of the HEIs. The survey instruments and qualitative approaches in the two case studies included mostly identical items but also some more context-bounded. KAU uses Itslearning and TUC uses Fronter. However, even if they have different LMS-providers adjusted to their institution; the overall structure is the same in both LMS, and could be identified and summed up in Table 1.

Table 1
Learning management systems at TUC and KAU.

Options	**Learning management systems: Fronter (TUC) Itslearning (KAU)**	
	Log in with personal ID	
	Discussion board	
	Information board	
	Links to curricula, learning resources	
	e-mail	
	Dedicated areas/rooms for the programme	Link to videoconference
	Dedicated areas/rooms for student groups	Link to videoconference
	Personal room for the student	
	Personal room for the teacher	

The similarities and variations within the two case studies are explained in the following paragraphs. These open with a brief introduction of both case studies, followed by a presentation of the methods used in each case study, then by a discussion of methodological constraints.

3.1. Case study 1: Telemark University College

In 2010, Telemark University College (TUC) introduced a Teacher Education Programme for Years 1–7, and in 2011 for years 5–10. Both programmes were offered to campus students, online students, and to students affiliated to a study centre near their homes. Online students participated using personal computers at home. Students at study centres and online students participated in instruction based on real time videoconferences broadcast from campus, together with campus students. Online students and study centre students participated in mandatory campus-based meetings, but compared with other teacher training programmes in Norway, these meetings were quite few. The programmes alternated the instruction between lectures, seminars and tutorials, all in real time videoconferencing, mainly held at fixed times twice a week. In the following paragraphs the term 'online students' includes both home-based online students and study centre students, mainly due to the fact that they all followed instruction online. There were staff with a special responsibility for online students and students affiliated to study centres. These particular staff had pedagogical competence and ICT expertise and served as 'translator' between technological opportunities and didactic challenges associated with teaching online. In addition, the ICT staff worked closely with the online teacher education programmes, both in terms of operations, procurement and ICT technical support to students and teachers. A special feature of the online primary teacher education at TUC was that it recruited students from across the country; no other teacher training programme could equal its geographical distribution of online students. Each cohort comprised around 50 students, most often females. Within each cohort students choose between two differentiated teacher training programmes, one covering grade 1–7 and the other for grades 5–10. The case study 1 included both qualitative and quantitative approaches. The data covered interviews, observations, a survey and document studies. Several groups involved in the online teacher education programme have been interviewed: students, leadership, teachers and staff that work directly with issues related to ICT and pedagogy. In addition, staff related to in-service training, along with principals and teachers at selected schools were interviewed. Interview guides tailored to the different informant groups and operationalised questions were developed for each group.

3.1.1. Survey of students

A survey of online student teachers was distributed in spring 2012. The survey included eight items;

1. background variables such as gender, age, affilitation to the educational programme (grade 1–7 or 5–10) and their motivation for application;
2. the online programme's organisation;
3. students' collaboration practices;
4. the quality and relevance of the educational programme; such as teachers and teaching, subject-areas, supervision;
5. information and communication from the HEI to students;
6. the professional scope;
7. students' digital literacy and
8. students' social life on the internet.

The survey was sent via e-mail to all students admitted to the course in 2010 and 2011. The teacher training institution assisted in obtaining contact information for respondents. A total of 129 students were invited, of whom 98 responded. This represents a response rate of 75 per cent. Of the 98 respondents, 94 completed the entire survey. Two of the respondents almost completed the entire survey, and these are included: we therefore use 96 responses as a basis for presenting and analysing the findings from the survey. The results of the survey formed the basis for monitoring students through interviews and observations on the mandatory campus-based meetings, and through online participation. For example, results from the survey revealed that students were participating from all over the country, and an important motivation for choosing and applying to this particular online teacher education programme was the low number of mandatory campus-based gatherings. Moreover, student teachers indicated that they were overall satisfied with the content and organisation of the programme. These findings made a good point of departure for the interviews with students, staff and schools in that we were able to elaborate on what and why they appeared to be content with this educational programme.

Interviews. Several groups of informants were interviewed. Students were in two rounds, in spring 2012 and spring 2013. In both rounds nine groups of students were interviewed, with about 3–5 participants in each group. The groups included student teachers on both teacher education programmes, 1–7 grade and 5–10 grade, and they were separated into groups according to their affiliation to their programme. The average age of students was 33 years old, and most were female. About 44 out of 55 students reported to have previously studied, but

only a few reported having a university degree. The survey included an open text field for students to fill in previous education, and various backgrounds and subjects were reported, such as nursing, history, pedagogics, philosophy, biology, photograph etc.

To ensure continuity, the same groups of students were involved in both rounds, which we conducted during the mandatory meetings on campus: interviews were semi-structured. Topics such as quality, organisation, relevance, communication and professional scope were raised. In the second round we were able to ask follow-up questions from the first round along with elaborating on our observations from the participant observation from online sessions.

Teaching staff was interviewed in four separate groups organised by subject (Maths, Social studies, Norwegian and Pedagogics) in spring 2012. Each group included 3–4 teachers. The aim of these interviews was to get an idea of how teachers find it to teach online, and to get an insight into the academic staff's reflections on how each subject works didactically online. Each group consisted of teachers with experience of teaching online, while others were relatively new to the activity. Each group of teachers was interviewed on the same topic areas: on their experience with online pedagogy; their contact with online students; their dissemination and development of knowledge in the subjects; the subject premises on the web and on their preparation and monitoring of students. Moreover, all groups of teachers were asked if they were used to share learning resources; and how they collaborated with the practice schools. At the Department of teacher education the programme coordinator and two college professors were interviewed. The last two were responsible for the educational use of ICT and the operation of the online programme. The interview covered such topics both related to the overall perspectives on the online primary teacher training, recruitment and drop out and more ICT-related topics such as information flow, educational use of digital tools, skills and practices. We also interviewed staff at five schools, at each school 2–3 from the staff participated. The topics of the interview at schools included identification of tasks for student teaching practice, the supervision of practice, collaboration with teachers and the practice office at the TUC.

3.1.2. Participant observation

The purpose of participant observation was to study and describe what individuals say and do in contexts that are not structured and controlled by the researcher. In this case study, we wanted to observe interaction on campus-based meetings and online in real time videoconferencing. We followed online instruction in subjects. In advance of each observation session we agreed with the academic staff of the respective subjects about our online presence, while teaching unfolded. Beyond participating in the online teaching sessions, we participated in two campus-based gatherings. This gave us a comparative basis in relation to online sessions, and contributed to the foundation of the study of academic staff and students.

3.1.3. Learning management platform (LMS)

We had access to the LMS and could follow the activity for each of the cohorts. This was done in conjunction with our observation of the online teaching; we were logged on in the pre-and post each teaching session we observed, to monitor the flow of information and any discussions and other posts. We were also logged on randomly to monitor the flow of information, assignments, discussions, and more. The goal of these observations was to grasp the activity in the LMS in order to visualise multiple dimensions of interaction and learning that takes place between staff and students.

3.2. Case study 2: Karlstad University

Distance education has been part of the teacher education in Karlstad since the beginning of 1990s, supported some years later by study centres in small towns where a small group of students have met for half a day a week for videoconferencing with the university. As regards secondary teacher education, there have been too few students in each subject to use this organisation, and in August 2012 a new organisation started for those students via Adobe Connect, so it is now possible to follow the courses from home. This started a year after a new teacher education system was launched in Sweden. More than 150 students were accepted in Karlstad this first year. In the education programme for secondary teachers at Karlstad University, students can choose to study the same programme on campus or by distance learning. For the latter there are two or three mandatory campus-based gatherings per semester. The education builds on the use of a learning platform (LMS) and a videoconferencing system. The aim is to deliver the same courses to all students, but the videoconferencing is used differently. In some courses the camera is in the room with the campus students, and in others there are two versions of the course. Yet others have a mix of the two, but there is always same content and the same examinations. In combination with this, the LMS allows sharing information (texts, images, videos etc.) and asynchronous discussions, written and oral, with the help of webcams. There is also an inbuilt system for quizzes and tests, and when the students hand in written assignments, there is an option for checking for plagiarism. This platform is used in different ways and to a different extent in the courses. As in the case study of TUC, there are staff with a special responsibility to support online students and teachers using the technological equipment required for teaching and learning. The study of case study 2 included qualitative and quantitative approaches. The data covered individual interviews, group interviews, observations and analyses of policies, regulations, course documents and web sites (e.g. LMS-sites).

3.2.1. Survey of students

A student teacher survey was sent out via e-mail in autumn 2012. The survey included five items, identical to the items in the TUC-case study;

1) background variables such as gender, age, affilitation to the educational programme (grade 1–7 or 5–10) and their motivation for application;
2) information and communication from the HEI to students;
3) the professional scope;
4) students' digital literacy;
5) students' social life on the internet.

However, as a contrast to the TUC case study, which included eight items, three items were excluded in the KAU-survey. Those three items were the online programme's organisation, students' collaboration practices, and the quality and relevance of the educational programme. The main reason for excluding these three items were that the survey at KAU were launched only a short period after the students had started on the educational programme. The three items that were left out in the survey were instead followed up in qualitative interviews with the students later on when they had accumulated necessary experiences.

All 154 students received a questionnaire and 61 students answered, representing 7 subjects (Biology, English, History, Social studies, Spanish, Swedish and Mathematics). The distribution for subject, gender and age was quite representative for the total population. Together with the questionnaire was a request for follow-up interview, to which 14 students responded positively.

3.2.2. Interviews

Five students participated in two group interview sessions via Adobe Connect, which has an inbuilt option to record the sessions. The fact that the interviews were conducted through a videoconferencing system can be seen both as an advantage and a constraint. It made it possible to interview those people really studying at a distance, but could not be as dynamic as a face-to-face group interview. The aim of the interviews was to get a more developed view of the students' experience of the first semester of their courses. Five interviews were conducted with course leaders in the teacher training programme representing the subjects English, History, Spanish, Swedish and Maths. The interviews were conducted on campus over a span of two weeks, and each lasted between 60 and 75 min. The overall aim was to get a sense of how teacher trainers generally find it to teach online, and to get an insight into their reflections on how each subject works in an online learning environment. Another aim was to get an insight into their thoughts about preparing students to work with ICT in their future classrooms.

3.2.3. Learning management system (LMS)

The researchers had access to the LMS and followed the activity for each of the five subjects also included in the interview part of the study. We were logged on and were able to analyse the course design, assignments, information flows, discussion boards and so forth. The goal of the LMS observations was to map out the interaction and learning that took place between staff and students.

3.3. Two case studies– two designs – and how to ensure validation and reliability

As shown above, the two case studies comprise various data even if most methods, except observations, are applied in both case studies. Moreover, even if both case studies are based on a mixed method design including both qualitative and quantitative data, and most of these methods are used in both case studies, certain differences appear in the methods used within each case study. This surely puts certain challenges on how to ensure validation and reliability to the study. The next paragraphs elaborate on these aspects. A first step would be to consider validation and reliability on the data collected within in each case. The next would be to discuss in which ways the datasets from each case study might be compared, in the light of validation and reliability. Both case studies include mixed method design including quantitative and qualitative methods, these are previously carefully presented. As for both case studies, data deriving from the various sources point to the same direction, we did not observe any findings that appear contradictory. We interpret this with regard to validation. As for reliability, we have demonstrated an approach involving several sources of data, which all are carefully explained within the presentation of the case studies.

As described, the survey instruments and the qualitative approaches varied for the two HEIs, and this complicates generalisability between the two HEIs; i.e. as it complicates the use of the data for the purpose of comparison. Our solution to this would be to identify topics that emerge in both case studies, and to see how these topics are elaborated within each case study. This gives us an opportunity to compare certain aspects of the teacher education programmes, most likely aspects that illuminate how the programmes handle the digital competence issue.

Moreover, these variations on methods and methodological constraints for comparative purposes must be taken into account when following our arguments within the present article. Nonetheless, the differences in methods used should not lead to misunderstanding or uncertainty about our conclusions.

4. Findings and discussion

As seen in the literature review, several aspects are relevant in preparing student teachers to use ICT in a pedagogical/didactical way. The findings section starts by describing the teacher trainers' attitude to, and skills in, teaching online, followed by the way teacher trainers use ICT to facilitate or enhance student teachers' own learning, and thereby working as role models, including the pros and cons. The previous chapter described our mixed method approach and our various sources of data that both cases studies are based on. As demonstrated, the survey instruments in both case studies mainly served as a way to map the educational landscape within the two teacher training programmes and to develop interview guides and guides for observations. Consequently, when presenting and discussing our findings we will mainly draw on data deriving from these latter sources, mainly due to their aspects of details. We will link our findings to the sources of data, whenever relevant.

4.1. Preparing teachers

4.1.1. Attitudes towards digital competence

The main objective of any TPACK intervention is to prepare teachers to become ICT-integrating teachers. In this, teachers' attitudes towards ICT are crucial. As demonstrated in the research literature, a positive attitude is a key factor for a teacher to use ICT in education (Avidov-Ungar & Eshet, 2011). Throughout observations of online classes and in the interviews with students and teachers, we found in our two case studies various approaches to, and understanding of, teachers' adoption of digital media and resources in teaching. Where most teachers had a kind of tool-based approach to digital resources and media, only a few were interested in seeing how different technologies

and digital resources could support the educational processes. The latter correspond with the TPACK-framework and its exploration of activity types which involves a 'taxonomy' of subject-related content-based activities, which again relate to various technologies that may enhance instruction (Harris, Mishra, & Koehler, 2009).

In the interviews with teacher educators at KAU and TUC, we found that they consider themselves as competent in a purely technological way using the tools, but are less confident when it comes to theoretical and didactical aspects related to digital media. There are different views on the role of the teacher educator. Some teacher educators think there is not enough time to think of the didactics from a student's point of view. There are examples of assignments where students are supposed to use their existing knowledge, with the idea that the students learn from each other. This is quite similar to the view from one of the teacher educators that if the students know how to handle the technology they will be able also to use it in the classroom, which means that special didactics in relation to ICT is not necessary. This statement from interview was confirmed in the observations from online classes. So and Kim (2009) found in their study that even if teachers may have the knowledge and skills to use technology (referred to as *espoused* TPACK) they were not capable of using it in practice (referred to as *in use* TPACK). This underlines the situated nature of teachers' thinking and the important role of context in teacher decision making as an important starting point for developing strategies to develop TPACK in teacher education. At KAU this was for example expressed in interviews when teachers of mathematics claimed the need to intertwine subject and didactics, and that a class in mathematics for student teachers is about students learning both mathematics and how to be a mathematics teacher, including technology.

4.1.2. Attitudes to, and skills towards teaching online

As revealed in previous research, there are certain aspects of teaching excellence unique to online education, for example the online teachers' ability to establish classroom presence, and to challenge and support students. At TUC one teacher in Pedagogics explains how to get students involved in an online dialogue as well as to become more active in their own learning process: 'I ask some students ahead of class, and these students vary from class to class, to use their webcam and ask questions and make comments on my lecture' (interview). Furthermore, quality online instruction cannot rely on content or technological expertise alone; the development of reflection and understanding of the online teachers' TPACK profiles may provide insight into professional development needs and a more systematic way to look at one's knowledge in these areas. This aspect became evident both in the surveys and in the other sources of data collected.

An initiative at TUC in this respect was the organisation of expert group meetings and cross-disciplinary seminars for online teachers. These have been organised since the introduction of the online teacher education programme, but more *ad hoc* than systematically. However, from late 2012, a fixed scheme was introduced where experienced online teachers were mentoring new online teachers. This initiative opened up to achieve systematic exchange of experience and expertise particularly for online teaching. In the interviews, online teachers at TUC also highlighted the value of teamwork when working online; this ensured input from fellow teachers on their teaching practices. At KAU there is no forum for sharing ideas, except for a few workshops occasionally. However, even if initiatives as described in the TUC case sound promising, we did not find any systematic overview, descriptions or reflection on what constitutes good online teaching practices for the teaching profession. Moreover, our interviews and observation of teaching in online classes indicate that most teachers were unaware of the pedagogical potential that is provided by online contexts. As shown in the research literature there is a strong belief in that transition from face-to-face learning to online learning is a simple task, such as merely requiring some technology skills training (Schmidt & Gurbo, 2008). This observation seems to be echoed in our cases, in that we did not find any clear strategies on excellence or best practice in online teaching within teacher education programmes at KAU and TUC, nor did teacher trainers themselves demonstrate such insights.

Valtonen et al. (2006) found that the majority of teachers who designed online courses opted for the design of teacher-centred courses. They concluded that although the affordances of technology may easily support a learner-centred approach, teachers tend to choose familiar teacher-centred pedagogical solutions when they design online courses. In our case studies we found similar trends; most online teachers supported a teacher-centred approach, even if there were exceptions, as will be demonstrated later. When lecturing online, teachers revealed limited technical skills; e.g. some apparently forgot the presence of their online students while giving classes to campus students and online students at the same time. In these situations online students notified campus students to remind the teacher to keep his/her head in front of the camera as some tend to 'fall out' of the camera angle, both interviews with students and teachers underscored this aspect. Some of these teacher trainers reported it to be hard to adjust themselves to these new communicative settings. As a teacher-trainer from KAU states:

> *What I particularly noticed is that when I am lecturing I must sit down with a headset and see myself on camera. There have been problems for colleagues who are walking around in the classroom when they are online … there has been discussion among students about that problem (interview).*

Most teachers interviewed at KAU and TUC recognised the need for further training in online teaching, although many were uncertain about what they needed. One teacher at TUC puts it like this: 'We get help when we ask, but we do not always know quite what to ask for.'

4.2. Designing online courses

Teachers at TUC and KAU agree that teaching online brings a seamless variety of opportunities in teaching, which are not easily adaptable to campus-based teaching. However, to succeed in this requires that teachers possess adequate self-confidence. Another important dimension is teachers' sense of achievement to be able to use ICT and to integrate this seamlessly in their own teaching practice, and to open up for interesting ways of engaging students. An important observation from previous studies in this respect would be that student-focused approaches to teaching are more likely to stimulate students to adopt deeper learning (Gow & Kember, 1993; Prosser & Trigwell, 1999). In our case studies we observed some interesting examples in this respect. Some of these are to be presented in the following paragraphs.

At TUC the online teaching education programme draws on experts in relevant academic issues who respond directly to questions from teachers and students. For example, we found in our observations of online classes that in the subject of Pedagogy, teachers had organised a video meeting with a nurse who was also a trained sexologist, and who was to answer questions related to sex and relationships from the

teacher. This was probably a rare combination of skills. To organise this as an online meeting with online teacher and students opened up an opportunity to meet people with unique and relevant knowledge and/or experience in a simple and affordable way. Following the meeting, teachers facilitated an online meeting with the nurse where students via Chat[1] could ask probing questions. This approach could also be conducted on campus, but would require all students to bring their own computers and sign in to the LMS. For online students this represents their student experience.

Another example from the TUC case study and from the observation of online classes, derived from the subject of Social studies when the topic 'cultural landscape' was on the agenda. In this class students were told to take a photo of where they lived (and they live all over the country) and post it to the LMS, in order to give examples of geographical variations across the country. This was easily feasible for online students, while for campus students it would have been more time-consuming (e.g. bringing photos of the landscape surrounding their residences to campus, preparing for sharing etc.) and with a limited scale of variations. These examples indicate some of the potential of online teaching. Online teaching opens up numerous avenues for innovation in digital resources and tools due to students being geographically dispersed and virtually connected.

At KAU we observed that some of the mathematics courses are structured in a 'flipped' mode. Students watched recorded lectures at a self-selected time and pace with the possibility of repetition, and met up with the teacher in a class working together solving mathematical problems.

In the interviews, most teachers pointed out that it is difficult to improvise on the web, but not impossible, as demonstrated in our next example. The example derives from the TUC case study with Pedagogy and a session on learning theory that were observed: two teachers were responsible for the class, one appeared only at the beginning and at the end of the session. Meanwhile students were given the assignment to write a letter to this teacher explaining to him why it is important to teach learning theory. This served as one way for students in groups to summarise the essence of that day's lecture. The example shows how spontaneity can also be performed online and how professional reflection is possible even when students and teacher are physically separated. The example also demonstrates how student-active teaching may be effectuated in an online context.

The development of so-called activity types is launched by researchers in order to help teachers plan instruction with technology in different subject domains. Activity types are a set of 'classroom activities and interactions that have characteristic roles for participants, rules, patterns of behaviour, and recognisable materials and discursive practices related to them' (Harris et al., 2009, p. 404). Activity types may provide teachers to develop TPACK (Harris et al., 2009).

In the following paragraphs we will demonstrate how some subjects central to teacher education programmes are taught online and if, or to what extent, the aspect of activity types may be identified. The paragraphs are based on interviews with teachers and students.

4.2.1. Language

Languages were, because of their text-based structure, well suited for teaching online. Students could, for example, digitise audio-reading, and use the recording feature of the online technology to record literary conversations. At KAU the students in English got spelling assignments where they were supposed to produce digital voice and video recordings and published them in the LMS. The students could comment on each other's recordings and the teacher found it much easier to give good effective feedback when s/he can listen to the productions again and again at self-selected times. In the Norwegian classes at TUC students were organised in groups and each group presented their work to their teacher and peers during videoconferences. This opened for feedback from their teacher and peers, both orally and via Chat. Moreover, the subject Norwegian required discussion and reflection, which teachers solve by the use of Chat, but only for short inputs. Another possibility was through the use of separate online group rooms, where teachers and students could communicate via videoconference.

4.2.2. Mathematics

The mathematics teachers considered online teaching as restricting when teaching the role of the mathematics teacher. The main difference which these teachers highlighted was that when teaching online, it was no longer possible to see how students work, for example by walking around in the class, or by looking at facial expressions to assess if students understand, or need follow-up. To communicate with mathematics, teachers stressed the need to write by hand. It works very well using online drawing boards. The teachers claimed they were very conscious of being clear in everything they do. For example, by telling the students what the next step would be: 'now I open Excel' (interview, math teacher at TUC).

4.2.3. Social studies

Teaching online provided some opportunities in social studies. For example, taking advantage of the students' geographical dispersal to pull in knowledge from many different places was particularly relevant for the geography portion of the subject. Other areas of social studies experience, however, saw few differences between teaching online versus campus. Teaching European history online were not considered by teachers as to give other options than on campus; in both contexts, for example, students could visit online museums (interview, teacher trainer at TUC). Other parts of the subject required discussion and reflective practice and this was perceived as difficult to achieve online. In addition, the social studies topics could generate discussion arising from various opinions. In such contexts, it was difficult to achieve substantive and good discussion online. In the interview, the teacher trainer at TUC pointed to the challenges also recognised in relation to public online discussion boards; how to ensure good behaviour in online contexts where there is no editorial censorship, or in our example, no censorship conducted by teachers. There was one example where a student had made an insulting comment online, and immediately signed off, without the opportunity for remonstration. The teacher thought that this would probably not have occurred on campus, where students would have had to stand up for their statements in front of a teacher and fellow students. On the internet, the online student could sign out and disappear and it could be difficult to follow the person up afterwards. How to solve this in a good way was unclear.

[1] The Chat serves as a way to communicate within online classes and is frequently used by student teachers and teachers.

4.3. The importance of practice

In teacher education both in Norway and in Sweden, students spend 100 days of teaching practice in schools in a four-year programme. These periods are considered as giving the students didactical experience. Many schools are involved and, like the students, they are spread all over the vast countries. The institutions have different systems to ensure the quality of this teaching practice.

Telemark University College has developed various strategies in order to compensate for the fact that the schools are dispersed; one is an online discussion forum on the TUC website where students can discuss their experiences and share their thoughts when they are out at schools. Moreover, various digital tools and media can contribute to support supervision and assessment, and to develop students' professional digital literacy. Such approaches relate to the TPACK-framework and the design experiments.

Karlstad University is working from an educational idea of continuity and deepening, to ensure progression. The use of digital portfolios is highlighted as important for students to be given the option of having the support of teachers formulating learning outcomes for their own development, and to document, evaluate and reflect on their own learning processes. The digital portfolio approach aims to support students in developing their capacity for self-assessment, to reveal their learning and putting it in relation to the course learning outcomes. Pedagogical and didactical goals related to ICT can be part of the course plan for the practice period, but all schools do not use ICT enough for the students to really practise and learn, and the didactical knowledge will be only theoretical (Enochsson, 2010).

4.4. Role models for student teachers

The research literature revealed that teachers who actively use ICT in teaching and who manage to include and combine various knowledge areas such as technology, pedagogy and subject, in other words teachers who practice the TPACK-framework within their own teaching, also serve as good role models for student teachers. This observation is recognised in our two case studies, in all sources of data. But there seems to be little reflection on what constitutes a good teacher in this respect. Another observation is that the number of digitally competent teachers is rather low; in general the aspect of digital competence is thus rather poorly integrated. Furthermore, as demonstrated in previous research, mentor-teachers are also important as role models in teacher education (Twidle et al., 2006) and their proficiency with ICT in teaching may influence student teachers' development of digital competence.

5. Concluding remarks

The aims and scope of the present text have been to explore the ways in which online teachers are practicing digital competence, in general and within subject areas, and the extent to which they encourage student teachers to develop their own professional digital competence. Moreover, we have explored how online teacher education programmes may enhance innovative ways of teaching and learning with ICT.

Teachers at KAU and TUC demonstrated various beliefs and self-efficacy regarding the use of ICT for pedagogical purposes. While a few online teachers included ICT seamlessly in class, most were more tool-oriented and supported a teacher-centred rather than a student-centred approach when designing online courses. However, when practicing TPACK in their own teaching, both teachers and student teachers became aware of the value that technology brings to pedagogies. Still, few teachers seemed to highlight the importance of being a good role model when practicing digital competence; this seemed to be a sort of tacit knowledge more than explicit demonstration by teachers to student teachers. In the research review, Krumsvik stressed that it takes a 'competence journey' to develop digital competence as representing a kind of 'Bildung' level, and that journey consists of a process of adoption, adaptation, appropriation and innovation. In our study, we identified teachers and student teachers at all these stages, but few teachers reached the level of innovation. Moreover, even if those teachers would have been good examples in this respect, we did not find anything that indicated that this was well communicated to student teachers in terms of role models. In the research literature, Voogt et al. (2013) found that student teachers did get experience in the design of technology-enhanced lessons through such an approach, but they still lacked experience in enacting technology-based lessons. It was therefore suggested to link student teachers with practising teachers and to support both of them. In our studies, neither student teachers nor schools reported on this. Several studies also demonstrated that modelling and design experiments may support (student) teachers in their TPACK development. In this, 'teach as they preach' (Krumsvik, 2011) may represent an important guide for the formation of digitised learning environments for teacher educators and student teachers. At KAU, maths teachers used the flipped classroom method in their teaching, and this method might serve as an example in this respect. Nonetheless, the overall picture that emerges from our studies is that there are only very few activities that can be identified as design experiments.

Our study has revealed that even if online teacher education programmes represent good avenues for stimulating teachers and student teachers to develop digital competence for pedagogical purposes, this aspect is poorly integrated within the programmes at TUC and KAU, although some interesting examples are demonstrated. Several aspects might explain this: here we will elaborate on two possible explanations, namely by looking at the origins of the discourses on online education and on digital competence. Where the first discourse, on online education, originates from the management side at both TUC and KAU, the second, on digital competence, comes from certain teacher staff within the two HEIs. Online education has been flagged as opening important avenues for future education, in recruiting new groups of students, along with offering more flexible solutions to existing students and future students. In this, prospects of efficacy and economic advantage represent important drivers. On the other side, to develop digital competence mainly seems to be flagged by a limited number of teaching staff; teachers who are driving forces within this field of competence. These teachers are interested in digital competence as part of their professional development, more than as part of an overall strategy implemented at their institution. The discourse that covers online learning and the discourse on digital competence thus derive from different stakeholders. We have explored how these can connect and see what the opportunities would be. Our study reveals that even if this connection gives some interesting opportunities, there is still some way to go to exploit the potential that such a connection would represent. Following this, there is still a further way to go to make innovative solutions and to develop the potential of professional digital competence in online teacher education programmes.

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