Newly Qualified Teachers' Professional Digital Competence: Implications for Teacher Education

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Newly Qualified Teachers' Professional Digital Competence: Implications for Teacher Education.

The professional digital competence (PDC) of teachers is of growing importance in classrooms, now that digital resources and digital media are becoming important parts of teachers' everyday practice. This study explores how newly qualified teachers are prepared to use ICT in their initial teacher education (ITE). We present findings of a nationwide survey in Norway on 356 newly qualified teachers. It explores how these teachers' information and communication technology (ICT) self-efficacy is related to how they perceive the quality of, and contributions from, their ITE related to ICT and the development of their PDC. In general, newly qualified teachers report fairly poor quality and contribution of ICT training during their teacher education. We claim that it is necessary to look at ways to review the quality of ITE and contribute specifically to the development of PDC and developing ICT self-efficacy in ITE.
[word count 142]

Keywords: newly qualified teachers; professional digital competence; initial teacher education; information and communication technology (ICT); ICT self-efficacy [word count 7,735, excluding abstract and keywords]

Introduction

Like other professionals, teachers have experienced increased access to digital tools, media and digital resources in recent decades (Prestridge and Tondeur 2015). Students and teachers use various digital resources and social media networks in their teaching. This, in turn, influences pedagogy and how students and teachers interact and engage with learning (Burden et al. 2016). Based on the report from the Office for Standards in Education (2010), Haydn (2014, 455) claimed that findings from England show 'substantial variations in the extent to which new teachers are able to use new technology effectively in their teaching'. Other research claimed that pre-service teachers are expected to be proficient in their use of information and communication

technology (ICT) for teaching and learning; still, the use of ICT in the classroom remains below expectations (Gill, Dalgarno, and Carlson 2015; Tondeur et al. 2015).

ITE is constantly under criticism for disappointing outcomes (Ell, Haigh, Cochran-Smith, Grudnoff, Ludlow and Hill 2017; Sancho-Gil 2017) and is typically criticised of not preparing future teachers well enough for the complexity of the profession. Horn and Campbell (2015) present the dilemma of teacher education as whether to prepare student teachers for schools as they are or schools that should be. A recognised necessity is that ITE needs to provide student teachers the link between theoretical knowledge of campus seminars and their classroom practice (Harch, Shuttleworth, Jaffee, and Marri 2016; Kessel and Korthagen 2001; Darling-Hammond 2000). A longitudinal study following 110 student teachers from ITE into their early years of teaching (Hatlevik, 2017), revealed that student teachers anticipated competence in their role as teachers is important for "subsequent perceptions of professional competence as a schoolteachers" (Hatlevik 2017, p. 14). This was confirmed for both newly qualified teachers (working 2 or 3 years) and later for more experienced teachers (working 5 or 6 years). These findings indicate that experiences from ITE help student teachers to develop an important fundament for their future perceived confidence and professional competence as a teachers.

When it comes to ICT, faculty staff within ITE are expected to prepare student teachers for their future practice and to provide them with the necessary professional digital competence (PDC). Furthermore, teacher education is central in assisting student teachers in developing realistic understandings of their profession, preparing them for their future careers (Brouwer and Korthagen 2005; Sinclair 2008) and preventing any discrepancy in newly qualified teachers' expectations of their profession and the realities these teachers meet in the classroom (Rots, Aelterman, Devos and Vlerick

2010; Kessel and Korthagen 2001; Haydn 2014). Also, the early experiences of newly qualified teachers can be decisive in forming their attitudes toward and fostering endurance in the profession (Haggarty and Postlethwaite 2009).

In the research literature on PDC, some claim that researchers and policymakers have not sufficiently explored the role of teacher education programmes in affecting the knowledge levels of student teachers with respect to PDC (Tezci 2011; Albirini 2006). Internationally, we found literature on newly qualified teachers' varied experiences with their initial teacher education (ITE) and the use of ICT (Tondeur 2012; Sang et al. 2010; Tezci 2009). The comparative review of Usun (2009) provided an overview of how instructional technologies for global teacher education are utilised, pointing to the need for support and training to positively integrate technology into classroom practices. Other studies focussed on the lack of time to explore and support for newly qualified teachers when they use technology (McKinney et al. 1999, Morris 2010) or highlighted the importance of good role models and teachers' experiences of learning with ICT in ITE programmes (Valtonen et al. 2015). Yet others reported that student teachers and beginning teachers do not, in fact, use ICT in various ways (Tondeur et al. 2016).

In addition, numerous researchers have provided extensive reviews on different approaches to ICT integration within ITE (Kay 2006; Goktas, Yildirim, and Yildirim 2008; Usun 2009; Tondeur et al. 2012). However, according to Røkenes and Krumsvik (2014, 251), such reviews generally include macro- or meso-level analyses of how ITE programmes 'organize their student teachers' ICT-training with an emphasis on program technological infrastructure, policy, and barriers and enablers rather than on a micro- or interactional levels focusing on showcasing daily teaching practices and activities with ICT'.

In the field of ICT in teacher education, several Nordic researchers have contributed to research on PDC. Põldoja et al. (2011) presented a model focussed on teachers' PDC development in Finland. Arstorp (2015) claimed that technology does not seem to be a prioritised theme in Danish teacher education, Jóhannsdóttir and Jakobsdóttir (2014) explored the history of ICT integration in Icelandic teacher education and Krumsvik (2015) reported on the potential that new technology offers in teaching and research to increase the quality of teacher education. Furthermore, Røkenes and Krumsvik (2014), Lund et al. (2014), Instefjord (2015) and Instefjord and Munthe (2016) have added to the emerging research and knowledge on PDC in teacher education in Norway.[1]

Against this backdrop, the main purpose of this study is to explore newly qualified teachers' professional digital competence and how teachers believe that their teacher education has prepared them to use ICT in their teaching practice. The study addresses how newly qualified teachers' ICT self-efficacy is related to - controlling for gender - their perceptions of the quality of ICT training in ITE, PDC developed through ITE, usefulness of ICT and distraction from using ICT.

The paper is structured as follows: Following this introduction, we take a brief look at the theoretical and conceptual background of the study. Thereafter, we give an account of the design and methods used to collect the empirical data used in the study. We then present the results and discuss the contribution of the study as well as some of

[1] It is also appropriate to recognise the extensive work of Marijana Kelentric and colleagues at the Norwegian Centre for ICT in Education on the national framework of professional digital competence for teachers (see in Norwegian: http://iktsenteret.no/ressurser/rammeverk-laererens-profesjonsfaglige-digitale-kompetanse-pfdk). The Norwegian Centre for ICT in Education also initated and financed this present study.

the limitations. Also, we address implications of the results for teacher education and suggest a direction for further research.

Theories about ICT self-beliefs

Several theories can be used to investigate and identify the beliefs teachers have about using ICT in their teaching (Fanni et al. 2013; Teo 2014). These differ from self-reports about experiences or measures of actual achievement (Bandura 2015); instead, they are based partly on self-beliefs, which emphasise how teachers perceive and what they believe about using or benefitting from using ICT.

ICT self-efficacy

Tschannen-Moran and Johnson (2011) underpin the importance of developing and sustaining teachers' self-efficacy beliefs as they have an effect on teachers' motivation, their teaching and students learning. Krumsvik (2011) distinguished between teachers being confident about using ICT as a tool and teachers being confident about using ICT in their own teaching. In our opinion, more research is required on both of these topics. In this paper, we therefore examine the concept of being confident about using ICT in teachers' own practice, since this topic is unique to teacher education, whereas the topic of ICT as a tool can be covered in various courses.

The theory of self-efficacy identifies several characteristics of people who are confident about their own capability to achieve (Bandura 1997). First, one assumption of the self-efficacy theory is that people are active learners and that they have the option to develop their own careers (Sâinz and Eccles 2012). Second, the task or activity is assumed to have value for the learner. Third, there is a distinction between general self-efficacy and more domain-specific self-efficacy. It can be easier to give a more realistic answer to a domain-specific question (i.e. 'Are you able to use a computer as part of

your own teaching?') compared with a more general question ('Are you a good teacher?').

Perceived usefulness of ICT

Perceived usefulness is part of a person's belief system (DeLone and McLean 2003). The perceived usefulness of ICT concerns what a person (e.g. a teacher) believes about the benefits of using ICT (Liaw and Huang 2012). This theory conveys that using ICT can be helpful for achieving curriculum goals and meeting the expectations of school leaders. The theory of perceived usefulness focusses on the benefits of ICT; however, some theories also focus on the drawbacks or negative aspects of ICT. The theory of perceived distraction from using ICT focusses on the negative aspects of ICT (Campbell and Henning 2010) and can nuance our perspective on the consequences of ICT use (Goundar 2014).

In teaching, perceived usefulness and perceived distraction do not have to be mutually exclusive. For example, a teacher may believe that there are both benefits and drawbacks in using ICT. Using both concepts as a part of the research design provides better insight into teachers' perceived usefulness of ICT and what teachers consider to be the potential of ICT in education (Langford, Narayan, and von Glahn 2016).

Perceived PDC developed through ITE

Several conceptual models have been used to explain the integration of ICT in classroom practices and how this influences teachers' pedagogical practice. One of these is the Technological Pedagogical Content Knowledge (TPACK) model, which Mishra and Koehler (2006) expanded from the original concept of Shulman (1986, 1987). In the 1980s, Shulman argued that schools should combine pedagogy and

content, thus proposing the concept of *pedagogical content knowledge* (Shulman 1986, 1987).

In their TPACK model, Mishra and Koehler (2006) expanded on the model of Shulman (1986, 1987) by integrating an additional area of focus. The TPACK model, thus, includes the following: technical knowledge, pedagogical knowledge and knowledge of content. In this model, we see the importance of teachers mastering both the traditional academic disciplines and the digital aspects of the teaching subject(s).

In this study, we use a three-pillar model of PDC (Gudmundsdottir and Ottestad 2016) as our conceptual framework. The TPACK model and the combination of content, pedagogical and technical knowledge inspire it. The three-pillar model of PDC incorporates:

a) *generic digital competence*, which cuts across disciplines and specifies general knowledge, skills and attitudes that teachers, teacher educators and student teachers need in order to teach and learn in digital environments. This dimension is often connected to basic operational skills and the Norwegian framework for basic skills (The Norwegian Directorate for Education and Training 2012).
b) *subject/didactic digital competence*, which captures what is specific to each subject when taught with and through ICT. It is through this dimension that characteristic differences in subject didactics can be observed. By synthesising the subjects with technology, we can achieve a combination of the various features of digital tools and methods in relation to the educational objectives of the lesson or the curriculum.
c) *profession-oriented competence*, which includes various aspects related to and supporting teaching in technology-reach environments. This pillar includes

school-home communication, the psychosocial learning environment, classroom management and relational skills, and teachers' own research and continuous professional development in the field of ICT.

Perceived quality of ICT training in ITE

The concept of quality in teacher education has been a matter of international debate for a long period of time (Brun and Hinostroza 2012); thus, how the quality of ICT training in ITE is experienced manifests itself in different ways. Wang et al. (2011) identified several paths that define quality in ITE. One of these suggests that teachers' knowledge, skills and disposition predict teaching quality. However, according to these authors, the empirical support for this claim is scant. Moreover, teacher education programmes traditionally do not follow a unified or concrete conception of teaching quality (Sykes, Bird, and Kennedy 2010). We therefore found it interesting to examine newly qualified teachers' perception of ICT-related services offered by ITE during their pre-service training. Newly qualified teachers' retrospective perceptions about ICT-related services could provide useful and valuable information about the perceived quality of their ITE. When studying how newly qualified teachers in retrospect appreciated the preparation in their post-graduate certificate course in education, Roness (2011, 633) found that the majority of teachers valued the course as important, but they were less positive about the relevance of the course 18 months after the course than at the time they completed the course.

Contextual background—the case of Norway

In Norway, access to digital technology is widespread. Primary and secondary schools generally have access to interactive technology, such as interactive whiteboards (Dalaaker et al. 2012), and 1:1 technology is the common practice in upper secondary

schools throughout the country. Despite this good access, the pedagogical use of ICT for teaching and learning varies both between schools and within schools (Hatlevik et al. 2013; Hatlevik and Gudmundsdottir 2013; Hatlevik and Throndsen 2015). A recent international comparison also reveals that the use of ICT in Norwegian classrooms is mediocre compared to that in other countries (Hatlevik and Throndsen 2015). In teacher education, Tømte, Kårstein, and Olsen (2013) reported that initiatives relating to ICT use and competence development in teacher education are fragmented. Furthermore, technological enthusiasts often drive the development of PDC within ITE, but teacher educators report a general lack of professional digital competence (The Norwegian Association of Researchers 2016; Tømte, Kårstein, and Olsen 2013).

Digital competence has been on Norway's national education agenda for quite some time, and in 2006 (Ministry of Education and Research 2014), digital skills were defined as a basic competence area for all learners. This suggests that, together with reading, writing, oral communication and mathematics skills, digital skills should be an integral part of every subject at every grade level. Furthermore, the framework for basic competence for students in grades 1 through 13 outlines a skills progression that is operationalised in four areas of competence: *search and process*, *produce, communicate* and *digital responsibility* (The Norwegian Directorate for Education and Training 2012). These form the fundamental aspects of digital competence that teachers in Norway should be able to incorporate into their teaching.

The present study

Norwegian student teachers are trained in schools in which they encounter a curriculum requiring the development of pupils' digital skills. However, few studies have been published on the experiences of newly qualified teachers with the use and training of ICT in their teacher education. This study seeks to address this gap. The overall

objective of this paper is to examine how newly qualified teachers' ICT self-efficacy is related to the a) perceived quality of ICT training in initial teacher education, b) perceived digital competence developed through initial teacher education, c) perceived usefulness of ICT and d) perceived distraction from using ICT. These indicators are also controlled for gender (see indicators in Figure 1).

These teachers' attitudes about or beliefs in their own use of technology are also important for understanding how teachers perceive their working conditions. We therefore examine teachers' positive and negative beliefs and teachers' perceived usefulness of ICT. Also, ICT self-efficacy is a key concept in this study because it provides information on teachers' self-confidence in their use of ICT. We need more knowledge of the factors that explain variations in teachers' ICT self-efficacy and therefore we explore which factors explain their self-efficacy when these teachers meet the expectations of the curricula, school leaders and colleagues.

To achieve these objectives, we explore the following three research questions:

(1) How do newly qualified teachers experience the quality of ICT training in ITE and their development of PDC?
(2) How do newly qualified teachers perceive the usefulness of ICT in their teaching practice?
(3) To what extent can the above-mentioned concepts explain newly qualified teachers' ICT self-efficacy?

A model (Figure 1) has been developed to describe the association between the concepts. The model — when controlled for gender — shows that the quality of ICT training in teacher education, the development of digital competence, the perceived usefulness of ICT and the perceived distraction from ICT can explain variations in newly qualified teachers' ICT self-efficacy in teaching.

[INSTERT FIGURE 1 HERE]

Figure 1. Model illustrating research question 3, including the quality of ICT training in teacher education, the development of digital competence, the perceived usefulness of ICT and the perceived distraction from ICT predicting newly qualified teachers' ICT self-efficacy in teaching (when controlling for gender).

Research design

Procedure

The data used in this study were based on a national survey sent to newly qualified teachers.[2] We defined 'newly qualified teachers' as teachers who have been teaching for two years or less and who graduated less than two years prior to the time of the study. All of them graduated from the general teacher education programme (*almennlærerutdanningen*), which aims to qualify teachers for primary and lower secondary school teaching. Due to data privacy issues, we could not gather the names or contact information of newly qualified teachers directly from the teacher education institutions. Instead, our first step was to call schools' principals in a nationwide random sample of schools to get lists of their employed newly qualified teachers and corresponding e-mail addresses. In total, we gathered 1,016 names and contact information for newly qualified teachers, but only 925 proved to be valid. The data collection was conducted by TNS Gallup from early November 2013 to mid-December 2013.

[2] According to the official database concerning higher education in Norway, a total of 2,077 students graduated with initial primary/lower secondary school teacher education during the 2011 to 2012 period (http://dbh.nsd.uib.no/). According to the primary and lower secondary schools' information system (Norwegian Directorate for Education and Training 2014), as of June 2013, there were 3,116 primary and lower secondary schools in Norway in the study's target group of teachers.

Sample and data collection

The second step was to send a questionnaire to the e-mail addresses of the 925 newly qualified teachers. Following the dispatch of the questionnaire in early November 2013, only 157 answers were received. To increase the response rate, telephone calls were made to 703 teachers who were identified by name via their e-mail addresses and linked to their schools' telephone numbers. At the conclusion of the recruitment phase in mid-December 2013, of the 1,016 teachers' e-mail addresses collected from 581 schools, we received responses from a total of 375 teachers. The answers of 19 teachers whose primary workplaces were upper secondary schools were excluded from the analysis. As a result, the underlying data presented here comprise 356 responses from newly qualified teachers of grades 1 through 10.

Measures

In order to address the research questions, we asked about ICT self-efficacy, development of digital competence through ITE, quality of ICT training in ITE, perceived usefulness and perceived distractions of using ICT (all questions presented in Table 1). Inspired by the three-pillar model (Gudmundsdottir and Ottestad 2016), we gave teachers 10 questions about how they experience *development of PDC through their ITE.* Moreover, deriving from Roness (2011), we gave teachers 10 questions about how they in retrospect judge *the quality of ICT training in their ITE.* Both these concepts were measured on a 4-point scale (from 1 = very poor to 4 = very good). *Perceived usefulness of ICT* (Liaw and Huang 2012) was measured with four questions, and *perceived distractions from using ICT* (Goundar 2014) were measured with three questions. A 4-point scale was used to measure these seven questions (from 1 = disagree to 4 = agree). Based on Fraillon et al. (2014), *ICT self-efficacy* was measured

with two statements on a 4-point scale (from 1 = very small extent to 4 = very large extent).

Analysis

Research questions 1 and 2 were answered in two steps. First, structural equation modelling (SEM) was used to identify the four concepts, and second, the mean scores of the items were examined in order to check for how the newly qualified teachers experienced the statements. The model-based research question 3 (Figure 1) was tested with SEM (Brown, 2006). SEM makes it possible to combine a confirmatory factor analysis of the five factors with a test of how the four factors and gender can explain variation in ICT self-efficacy.

Four indices were used to evaluate how well the tested model fit the data: the comparative fit index (CFI), the Tucker-Lewis fit index (TLI), the root mean square error of approximation (RMSEA) and the standardised root mean square residual (SRMR). CFI and TLI levels close to or above 0.95, RMSEA values below 0.08 and SRMR values below 0.06 were considered acceptable (Brown, 2006; Hu and Bentler, 1999).

When testing a model with latent variables, all questions loading on a specific variable should measure the same underlying construct (Kline 2011, p. 359). The number of observations are important when testing a model with variables developed from items and relationships between the variables. According to Tabachnick and Fidell (2007, p. 613), with reference to Comrey and Lee (1992), a sample size of 300 is considered as good for conducting a factor analysis. It is also necessary with positive and relatively high levels of associations between the items in order to compose a latent variable. Tabachnick and Fidell (2007, p. 649) are judging the cut-offs for factor loadings from 0.32 (poor), 0.45 (fair), 0.55 (good), 0.63 (very good) or 0.71 (excellent).

Limitations

The main methodological limitation of this study is its sample size. Our intention was to include a larger sample of teachers to ensure a representative distribution of the population. However, it was challenging to first identify teachers through their school principals, as well as to reach them later through e-mail and telephone to answer the survey. Furthermore, the participants in the study may have been those who are most interested in ICT in education. The composition of the group may, therefore, have impacted the results. Still, our sample included respondents who graduated from 19 (out of 21) different general teacher education institutions at the time and who worked in more than 300 different schools across Norway. Therefore, the case can be described as a country case, acknowledging the variety among schools and ITE programmes.

Results

Properties of the items

The data were analysed using IBM SPSS, version 22, and Mplus 7.0. All items were tested for normality in terms of kurtosis and skewness. Kurtosis describes the distribution of data (a flat or pointed curve), whereas skewness describes the distribution of items compared with the normal distribution. The analyses showed that the two items on perceived usefulness had a non-normal kurtosis, probably because these were questions that had answers on which most teachers could agree. All other items in the study had reasonable levels of kurtosis and skewness.

Characteristics of the participants

In total, 356 teachers (74.2% female and 25.8% male) participated in the study. The

answers showed that 48% of the teachers in the study were 25 years or younger. Furthermore, 39% of the teachers were between 26 and 30 years old, and 13% of the teachers were older than 30.

Approximately half of the teachers appeared to believe that their ITE had a very poor or fairly poor contribution to develop their professional digital competence. Furthermore, more than 80% of the teachers had positive beliefs about the usefulness of ICT, and approximately half of them believed that ICT could lead to distractions among students during teaching practice.

Psychometric properties: Examining the research questions by testing the model

All three research questions can be illuminated through testing the associations in Figure 1. The model converged with an acceptable solution (Brown, 2006; Hu & Bentler, 1999): Chi-square (χ_2) = 628, degrees of freedom = 390 and N = 356. Furthermore, CFI = 0.940, TLI = 0.933, RMSEA = 0.042 (LO 90 = 0.036 and HI = 0.047|) and SRMR = 0.047. All factor loadings were significant.

[TABLE 1 HERE]

Table 1. The results show the means, factor loadings and standard errors for all items in the structural equation model (N = 356, Chi-square = 627, degrees of freedom = 389, CFI = 0.940, TLI = 0.933, RMSEA = 0.042 [LO 90 = 0.035, HI 90 = 0.047] and SRMR = 0.046). Cronbach's alpha is reported for each of the five factors.

Considering the factor loadings for the items building the latent variables in the model, the two items used to measure the construct *ICT self-efficacy in teaching* have factor loadings above 0.75 (Table 1). This is considered excellent (Tabachnick and Fidell, 2007). Further, the ten items used to measure the construct *Development of*

digital competence through initial teacher training have factor loadings between 0.51 (fair) to 0.74 (excellent). When it comes to the ten items measuring *Quality of ICT training in teacher education,* the factor loadings are between 0.53 (fair) to 0.77 (excellent). The four items used to measure the construct *Perceived usefulness of ICT* have factor loadings between 0.51 (fair) to 0.78 (excellent). Finally, the three items measuring *Perceived distraction of ICT* have factor loadings between 0.46 (fair) to 0.80 (excellent) (Tabachnick and Fidell, 2007).

When it comes to gender differences, males are reporting higher levels of ICT self-efficacy for teaching compared with females.

Overall, the results of testing the model revealed that competence development (β = .48), perceived distraction (β = -.20) and gender (β = .21) explained 21% of the variation in ICT self-efficacy.

Figure 2. Tested model with regression coefficients and explained variation in the dependent variables, **p < .01.

[INSERT FIGURE 2 HERE]

We expand on these findings in the discussion.

Discussion

This paper addresses how newly qualified teachers perceive aspects of their recent ITE (i.e. regarding quality and the contribution to ICT training and student teachers' professional digital competence), as well as the association with student teachers' ICT self-efficacy.

First, our study showed that nearly half of the newly qualified teachers in the study found that the quality of their ICT training was fairly poor and that ITE had a

fairly poor contribution to the development of their PDC (RQ1). This finding was also in line with another Norwegian study showing that developing PDC had a low priority in Norwegian ITE (Tømte et al. 2013), despite being defined as a basic skill for all pupils in primary and secondary education. Low priority of PDC in Norwegian ITE applies to findings from studies on ICT in ITE in other countries as well (Arstorp 2015; Tondeur et al. 2016; Usun 2009). A review of international research on ICT in ITE (Røkenes and Krumsvik 2014) revealed that most research studies emphasise the organisation and infrastructure of ICT training, without examining the process of learning how to use ICT for teaching purposes or the coherence between theory and hands-on knowledge in practice (Kessel and Korthagen 2001, Darling-Hammond 2000). This could explain why there is little evidence from ITE about how to prepare student teachers for teaching with ICT in the classroom.

Second, our study showed that more than 80% of the teachers had positive beliefs about the usefulness of ICT. Nonetheless, approximately half of them had negative beliefs and answered that ICT led to distractions during their teaching practice (RQ2). The findings indicated that many newly qualified teachers were aware of both the advantages and disadvantages of ICT and that they critically reflect on their own use of ICT in their teaching practice. This result is in line with findings from international studies, such as ICILS (Fraillon et al. 2014), showing that teachers from 18 countries, including Norway, reported both positive and negative attitudes toward using ICT. Also, as shown by Langford et al. (2016), digital technology in education is a controversial topic that arouses both positive and negative attitudes in teachers and can be seen as one of the conflicting areas in debating about the content of schooling (Cohrain-Smith 2005). Nonetheless ICT competence is an area teachers claim they need

more competence in as two of the last Teaching and Learning International Survey (TALIS) studies clearly indicate (OECD 2008, 2014).

Third, we found that teachers' development of PDC during ITE, teachers perceiving ICT as a distraction and being male had a significant association with ICT self-efficacy (RQ3). There was a positive association between the development of PDC during ITE and ICT self-efficacy. This finding could indicate a relationship between ICT-related activities during ITE and the beliefs newly qualified teachers have about their own opportunities for using ICT. This is in line with recent research showing that student teachers' perception of their own competence during ITE has a strong association with how they perceive their professional competence as newly qualified teachers (Hatlevik, 2017). These findings modify the critical remarks about the shortcoming of ITE (Ell et al., 2017), and it indicates that ITE can play an important role for preparing student teachers for their forthcoming practise. One implication is therefore to focus on how ITE can prepare the student teachers by assisting them to advance as professional teachers in general and to develop ICT self-efficacy in teaching in particular.

Perceiving ICT as a distraction has a negative relationship to ICT self-efficacy. Recent studies showed that using ICT is associated with isolation (Bowden 2011), disconnection (Bauerlein 2008 in Langford et al. 2016), less critical thinking (Greenfield 2009) and lower achievements (Junco and Cotton 2012). In general, Bandura (1997) pointed out that positive experiences could be important to strengthen self-efficacy. It could be that poor experiences of ICT in education (i.e. perceiving ICT as a distraction) could weaken newly qualified teachers' confidence and prevent them from developing higher levels of ICT self-efficacy. Those teachers who perceived ICT as a distraction also had greater difficulties fulfilling school/curriculum goals connected to

ICT use. To address these issues and adding to the implications of this study, it is necessary for teacher educators to serve as good role models, demonstrating the exemplary use of ICT and ways to critically assess the appropriateness of ICT. Further implications for teacher education is the importance to provide relevant PDC in ITE and with that to prepare student teachers for the *school to be* (Horn and Campbell 2015).

Moreover, males respondents claim to be more confident in using ICT than females. It does not necessarily mean that males are more capable ICT users, because previous research has shown that males tend to over-report their own ICT capabilities (Hargittai and Shafer 2006). Similarly, this could indicate that females impose stricter demands on themselves as compared to what males do.

Finally, this study contributed by clarifying some of the aspects connected to the self-efficacy of newly qualified teachers when they used ICT and how ITE influenced the development of their PDC, which may influence their use of and attitudes towards ICT when starting their teaching practice. The PDC of teachers is of increasing importance in a classroom where digital resources and digital media are a part of teachers' everyday practice. By demonstrating the exemplary use of ICT in ITE and giving student teachers opportunities to experiment with and practice using ICTs in ITE, student teachers can expand their PDC and reduce a possible theory-practice gap (Edwards 2009, Darling-Hammond 2000). Such practice does not only apply to their generic digital competence but also applies to their subject-related digital competence as well as the profession-oriented digital competence (Gudmundsdottir and Ottestad 2016). Newly qualified teachers need to be exposed to various digital tools and methodologies in order to get hands-on experience in their ITE prior to their use of ICT in the classroom. Early experiences of newly qualified teachers are often decisive in forming attitudes toward and fostering endurance in the profession. Emphasising the

development of PDC in ITE can influence newly qualified teachers' positive experiences and self-efficacy related to ICT when starting their classroom practice. Their hands-on experience during their ITE can benefit their classroom practice by increasing learning outcomes of their learners. Moreover, emphasising PDC within ITE is important in order to prepare newly qualified teachers to become good role models for their future learners and to fulfil curriculum aims and demands of future workplaces.

Conclusion and further research

The main findings from this study are the focus on newly qualified teachers and how they perceive the quality of, and contributions from, ITE regarding ICT training. In general, newly qualified teachers report fairly poor quality of and contribution from ICT training during their teacher education. There is a need for more research on how to prepare student teachers for using ICT in their ITE and their teaching practice.

Newly qualified teachers have both positive and negative experiences with ICT in education. Future research is required to understand how teachers develop their negative experiences with ICT and what can be done to assist these teachers to see the potential of ICTs rather than the restrictions.

In our study, we explored aspects of ITE in connection with ICT (i.e. gender, perceived usefulness of ICT, perceived distraction from ICT, quality of and contributions of teacher education). A clear limitation of the study is that we were not able to include and examine all possible aspects that do influence the development of teachers' PDC. It is therefore desirable to conduct further research that includes other aspects that can be associated with teachers' ICT self-efficacy. Furthermore, our findings showed that newly qualified teachers have positive attitudes toward the use of ICT, yet they are critical of the potential distractions that technology can bring to the

classroom. To best utilise and maintain teachers' positive attitudes toward ICT, further research on classroom management in technology-rich environments can be identified as an important aspect of ICT training in ITE.

The strong correlation between the newly qualified teachers' beliefs concerning the quality of ICT training in ITE and the contribution of ITE to the development of their PDC reveals the continuous need for teacher education to look at ways to review the quality of ITE and contribute specifically to the development of the PDC of the student teachers.

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Table 1. The results show the means, factor loadings, and standard errors for all items in the structural equation model (N = 356, Chi-square = 627, degrees of freedom = 389, CFI = 0.940, TLI = 0.933, RMSEA = 0.042 [LO 90 = 0.035, HI 90 = 0.047], and SRMR = 0.046). Cronbach's alpha is reported for each of the five factors.

Questions	M	St.D.	Loading	SE
ICT self-efficacy in teaching (Cronbach's alpha = 0.76)				
To what extent do you find that…				
You are able to meet the expectations of your school concerning the use of ICT in teaching?	3.01	0.76	0.76	0.06
You are able to follow the guidelines for the use of ICT in curriculum subjects?	2.92	0.76	0.81	0.06
Development of digital competence through initial teacher training (Cronbach's alpha = 0.85)				
How do you assess the following aspects of your teacher education in relation to expanding your digital competence?				
Introduction to the pedagogic use of ICT in classroom practice	2.14	0.79	0.74	0.03
Experiences from practice (in partner schools) using ICT in the classroom	2.40	0.85	0.56	0.03
Motivation to use ICT in the classroom	2.58	0.86	0.60	0.04
Teacher educators' active use of ICT in teaching—being a good role model	2.46	0.78	0.57	0.04
Training in assessing the appropriateness of using ICT for various lesson plans	2.05	0.77	0.67	0.03
Training in the use of digital exams/tests for the assessment of learners	1.57	0.70	0.60	0.04
Obligatory work requirements in the pedagogic use of ICT	2.17	0.86	060	0.04
Training in administrative tasks involving the use of ICT in school	1.72	0.75	0.62	0.04
Use of ICT and digital resources to obtain academic knowledge	2.84	0.84	0.51	0.04
Use of ICT and digital resources to systematise academic knowledge	2.31	0.84	0.53	0.04
Quality of ICT training in teacher education (Cronbach's alpha = 0.91)				
What are your views on the following aspects of your teacher education and the use of ICT?				
Expansion of own skills in the use of ICT tools	2.25	0.78	0.67	0.03
Training in good search strategies on the Internet	2.27	0.84	0.67	0.03
Training in the production of multi-modal texts	2.34	0.82	0.62	0.04
Training in the use of digital communication tools for various professional/didactic needs	2.13	0.76	0.77	0.03
Training in using the Internet for online communication in own work (ethics, e-safety)	2.40	0.88	0.65	0.04
Training in managing learners' use of the Internet for online communication (ethics, e-safety)	2.20	0.84	0.73	0.03
Training in reflecting on own and others' digital practice	2.19	0.83	0.72	0.03
Use of ICT for adaptive/personalised learning	1.92	0.84	0.75	0.03

Use of ICT to develop learners' collaboration skills	1.85	0.73	0.70	0.03
Use of ICT for ICT-based school–home cooperation	1.83	0.79	0.53	0.03
Perceived usefulness (Cronbach's alpha = 0.77)				
To what extent do you agree or disagree with the following statements?				
Using ICT makes it easier to differentiate my teaching	3.17	0.67	0.51	0.05
ICT helps make my teaching more varied	3.67	0.57	0.77	0.03
I use ICT to increase my learners' interest in the subject	3.59	0.64	0.78	0.03
Using ICT makes it easier to engage and motivate my learners	3.36	0.73	0.72	0.04
Perceived distraction using ICT (Cronbach's alpha = 0.58)				
To what extent do you agree or disagree with the following statements?				
When using ICT, I need to spend a lot of time monitoring what the learners are doing	2.60	0.78	0.80	0.08
When using ICT, clearer classroom management is needed than when teaching without ICT	2.75	0.92	0.49	0.06
Using ICT interferes with the teacher–learner dialogue in the classroom	2.17	0.80	0.46	0.06

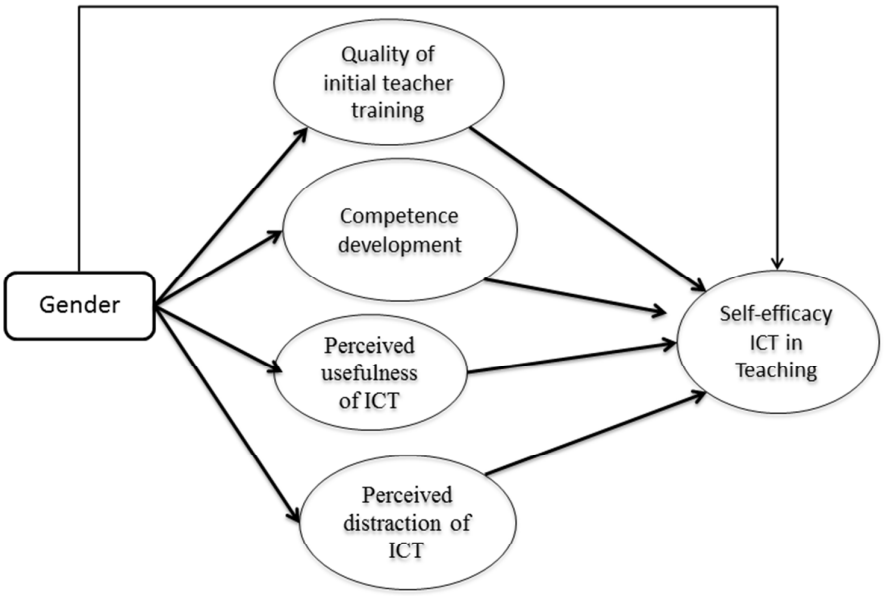

Figure 1. Model illustrating research question 3, including the quality of ICT training in teacher education, the development of digital competence, the perceived usefulness of ICT and the perceived distraction from ICT predicting newly qualified teachers' ICT self-efficacy in teaching (when controlling for gender).

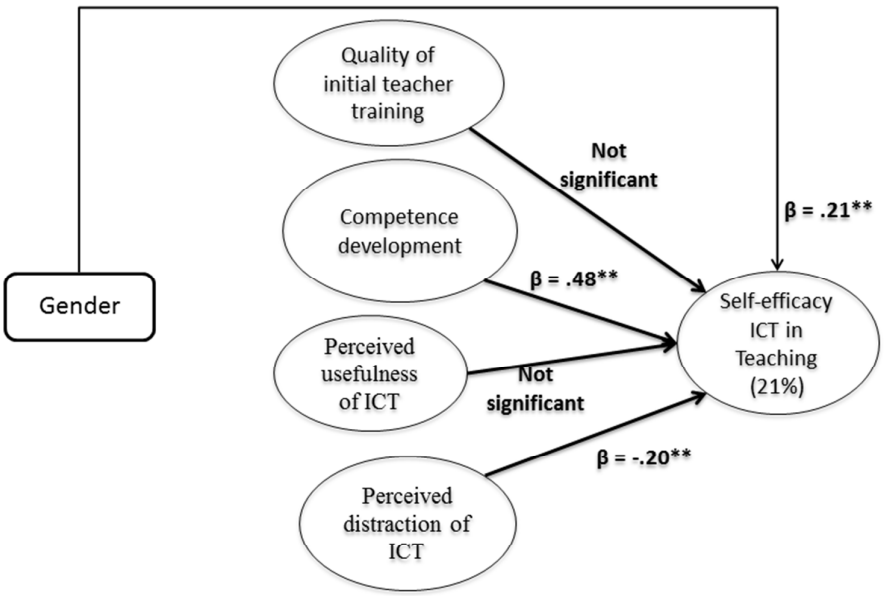

Figure 2. Tested model with regression coefficients and explained variation in the dependent variables, **p < .01.