EMPIRICAL STUDY

Title:

Preparing beginning teachers for technology integration in education:

Ready for take-off?

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Abstract

The overall aims of this study are to explore 1) how beginning teachers integrate technology in their practice and 2) the connections between teachers’ technology uses and their pre-service education programs. Data of this follow-up study were collected through in-depth interviews with beginning teachers. The results revealed that all beginning teachers used a wide range of technological applications, mainly for structured learning approaches, while few created opportunities for student-centred technology use. Further, pre-service learning experiences that impact graduate teachers’ technology are identified. While teacher educators modelling technology use are an important motivator for beginning teachers to use technology in their own teaching, field experiences seem to be the most critical factor influencing their current practice. Based on the results of this study, recommendations about how to prepare and support pre-service and beginning teachers for technology integration are discussed.

1. Introduction

Preparing teachers to integrate technology in meaningful ways into the classroom is a challenge for most teacher education institutions (Polly, Mims, Shepherd, & Inan, 2010). Research also indicates that beginning teachers make little or no use of technology in their instructional practice (e.g., Gao, Wong, Choy, & Wu, 2011; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). Teacher education institutions (TEI) around the world have engaged in various efforts to re-shape their curriculum in order to prepare future teachers for the effective integration of technology (Tondeur, Pareja Roblin, van Braak, Fisser & Voogt, 2013). Additionally, research has identified a number of strategies that can successfully contribute to developing the competences future teachers need in order to integrate technology in teaching and learning (Kay, 2006; Tondeur, van Braak, Sang, Voogt, Fisser & Ottenbreit-Leftwich, 2012). However, the ways in which these strategies may ultimately contribute to technology integration in schools remains largely underexplored.

Most studies about beginning teachers have primarily focused on the teacher and school characteristics that facilitate or hinder the use of technology for teaching and learning
purposes (Slaouti & Barton, 2007; Starkey, 2010), and on the extent to which new teachers feel prepared to use technology in their educational practice (Dawson, 2008; Haydn & Barton, 2007). While these studies are important to gain a better understanding of whether and why beginning teachers are (not) integrating technology, they provide little insights on 1) beginning teachers’ actual use of technology (cf. Moore & Chae, 2007), and 2) how this use relates to the specific strategies adopted by their TEI. The goal of the current study is to address this lacuna by analysing beginning teachers’ learning experiences during their pre-service education, and the influence these experiences may have had on their educational use of technology in their early career. Before describing the empirical study, this paper will firstly draw on the literature underpinning the importance of pre-service teacher education. In particular, we concentrate on studies about the strategies used in TEIs to prepare beginning teachers to integrate technology in the classroom.

2. Background

2.1 Beginning teachers’ use of technology

Nowadays, most beginning teachers have grown up with digital technologies and typically enter the profession with a set of technical skills (Bate, 2010). According to Gao, Wong, Choy and Wu (2011) these teachers may be more open to using technology in their own teaching. As such it is reasonable to expect greater use of technology from graduate teachers. However, it has been found that in general, beginning teachers make little use of technology in their educational practice (Agyei & Voogt, 2011; Bate, 2010; Dawson, 2008). It seems that only a small number of beginning teachers are able to use technology in diverse and flexible ways to create student-centred learning environments (Gao et al., 2011). This is confirmed by Slaouti and Barton (2007) who found that graduate teachers used technology as a preparation tool with only a few using technology as a pedagogical tool.

Reasons for the limited uptake of technology by beginning teachers are often related to the difficult transition from pre-service education to actual professional practice. In this respect, a strand of studies has documented the phenomenon of the “reality shock”, also known as the “praxis shock” or “transition shock”, that beginning teachers encounter when entering the profession (Korthagen, Loughran, & Russel, 2006). This transition period may influence technology use. Research findings suggest a period of consolidation before beginning teachers explore the potential of technology to support their classroom practice.
In this respect, Mueller et al. (2008) argue that more experienced teachers have more time and resources to explore the educational value of technology and apply it to their already developed pedagogical and curriculum knowledge. Interestingly, recent studies suggest that sometimes beginning teachers are the ones who are leading the process of technology integration in their schools (e.g. Gao et al., 2011). It seems that some beginning teachers are motivated to exploit the potential of technology in education, while others do not share this affinity (Tondeur et al., 2013). There is a growing body of research that attempts to understand these differences and explain the factors that support and/or hinder technology integration by beginning teachers (Bate, 2010; Dawson, 2008; Prestridge, 2012; Starkey, 2010). These studies consider teacher characteristics such as pedagogical beliefs, innovativeness, or workload, as well as school characteristics such as ICT infrastructure and school culture as possible factors influencing technology integration (see also Hammond, et al., 2009; Muntaz, 2000; Veen, 1993). Bate (2010) for instance, identifies the lack of access to good infrastructure and a traditional school culture having a major impact on the extent to which beginning teachers were able to creatively use technology to support student centred learning.

2.2 Teacher education and technology use

The quality and quantity of pre-service technology experiences has been identified as a crucial factor influencing new teachers’ adoption of technology (Agyei & Voogt, 2011; Ottenbreit-Leftwich et al., 2010). TEIs are expected to provide new teachers with the necessary competencies to integrate technology in their lessons. To address this challenge, many institutions have included introductory technology-courses in their curriculum (Polly et al., 2010). Primarily focused on the development of technological knowledge and skills, these courses aim to equip pre-service teachers with ICT-competences they can transfer to their future teaching practice (Tondeur et al., 2013). However, empirical evidence shows that pre-service teachers still do not feel adequately prepared to effectively integrate technology into their classrooms (Kay, 2006). Koehler and Mishra (2009) concluded that pre-service teacher education should not only focus on how to use technology but also how technology intersects with pedagogical and content knowledge, as directed by the concept of Technological Pedagogical Content Knowledge.

Further research into the development of TPACK capabilities of pre-service teachers, identifies that technology should be infused into the entire curriculum so that pre-service
teachers learn to understand the educational reasons for using technology, and also experience how it can support teaching and learning in a multi-disciplinary approach (Sang, Tondeur & Chai, 2014). Without such integrated approaches, Polly et al. (2010) predict that the knowledge and skills pre-service teachers gain are likely to remain isolated and unexploited. Practical experiences worldwide reveal the considerable potential of such integrated approaches as well as the difficulties associated with their implementation (Tondeur et al., 2012). Recent calls have indicated that to prepare pre-service teachers for effective technology integration, TEIs need to help them to bridge the gap between knowledge of pedagogical practice, technical skills, and content knowledge (Koehler & Mishra, 2009).

2.3 Strategies to prepare future teachers for technology use

Most researchers agree that technology needs to be integrated in teacher education curricula, and numerous strategies have been proposed in the literature to facilitate such integration (e.g. Angeli & Valanides, 2009). Synthesizing findings from qualitative studies, Tondeur et al. (2012) found that teacher educators acting as role models proved to be an important motivator for future technology integration in the classroom (see also Hammond et al., 2009). However, simply having pre-service teachers watch examples of ICT applications is helpful but not sufficient. Pre-service teachers must be able to interpret these examples in a specific educational context. Observing, discussing and reflecting collaboratively upon successful uses of technology might help them see the utility, value and feasibility of using a particular technology and/or teaching strategy (Lim & Chan, 2007) furthering their ability to differentiate between action and purpose, enabling deeper and more critical thinking around integration.

Besides the importance of role models and reflection, research suggests that providing the opportunity to learn about technology integration by evaluating, and (re-)designing curriculum materials can also be a promising strategy (Angeli & Valanides, 2009; Valtonen et al., 2014). In different studies, pre-service teachers stated that technology integration required additional planning and preparation because they had no prior knowledge and experience about the design of ICT-supported learning activities (e.g., Polly et al., 2010). Many studies strongly support group work when designing technology-related curriculum materials (Angeli & Valanides, 2009; Lee & Lee, 2014; Tearle & Golder, 2008). According to Angeli and Valanides (2009) collaboration with peers appeared to provide a low threatening learning environment for pre-service teachers, thereby reducing anxiety and failure avoidance. Pre-
service teachers may also acknowledge the importance of applying their knowledge about educational technology in authentic settings (Tearle & Golder, 2008; Valtonen et al., 2014). Moreover, previous research indicates that on-going and process-oriented feedback is beneficial to build pre-service teachers’ abilities to use technology in the classroom (Tondeur et al., 2012).

2.4 Purpose of the study

There is a growing body of research that attempts to explain beginning teachers’ technology use by identifying the factors that support or hinder technology integration (e.g., Dawson, 2008; Starkey, 2010). As stated before, less attention is given to beginning teachers’ uses of technology (cf. Moore & Chae, 2007) and to how these may relate to the specific approaches adopted by their pre-service teacher education institutions. Previous studies call for greater attention to how the efforts of teacher education programs shape new teachers’ use of educational technology (cf. Starkey, 2010). Given the lack of a comprehensive understanding about this relationship, the overall aims of this study are to explore 1) how beginning teachers with less than three years of teaching experience integrate technology in their instructional practice and 2) the connections between beginning teachers’ educational uses of technology and the strategies adopted by their pre-service education programs. More specifically, we analysed beginning teachers’ pre-service learning experiences pertaining to technology integration, as well as the influence these experiences may have had on their current uses of technology. It is important to note that technology in this manuscript is restricted to digital technology. ‘Technology use’ and ‘ICT use’ are used as interchangeable concepts.

3. Research method

3.1 Longitudinal research design

The current study builds on previous research aimed at understanding the strategies for technology integration adopted by three TEI in Flanders, the Dutch speaking part of Belgium (see Tondeur et al., 2013). Each TEI adopted a different strategy to prepare pre-service teachers for technology integration. TEI 1 decided to move from a separate technology course towards a more integrated approach. The ICT coordinator, previously responsible for supporting the development of pre-service students’ technical skills through an ICT course,
now teaches exemplary ICT-rich lessons across different subject areas. The goal of these lessons is to connect technology with content. In TEI 2, a course on the use of technology was introduced in the first year of the program. This course centres specifically on the development of technological skills. In TEI 3, the ICT team decided to move from a separate technology course to integrate technology across the curriculum; however, the results of a previous study indicate that student teachers and teacher educators perceive that there was no so much evidence of educational ICT-use in the program (for a detailed overview of the place of technology in the three TEIs, see Tondeur et al., 2012).

Two years later, all the beginning teachers who participated in the initial study as student teachers (n=16) were contacted again for this follow-up study in order to explore the connections between their instructional uses of technology and their pre-service learning experiences (see Fig. 1). Based on the results of telephone interviews with the 16 beginning teachers, six cases were selected for in-depth exploration of the connections between beginning teachers’ instructional uses of technology and their pre-service learning experiences. Selection criteria included: 1) reported regular (i.e., daily or weekly) use of technology to support learning and instruction; 2) representation of two beginning teachers graduated from all teacher education institutions involved in the previous study; 3) diversity in teaching experience, grade level, and gender; and 4) willingness to participate in the study. Table 1 provides an overview of the background characteristics of the six teachers who participated in the current study.

3.3 Instruments

Data were collected through in-depth interviews consisting of three groups of open questions concerned with 1) the background characteristics of the beginning teachers; 2) the purposes for and ways in which they use technology, and 3) the perceived influence of pre-service education on how technology is used. Examples of interview questions are presented in Table 2.
3.4 Data analysis

All interviews were audio recorded and then transcribed into a text file by a trained student researcher. These files were imported to Atlas-ti, a qualitative analysis software. Next, data was analysed for each case individually (within-case analysis) resulting in portraits of how beginning teachers use technology and their perceptions about what pre-service education experiences may have contributed to shape their current practice. A technique of inductive thematic analysis was used. Inductive codes were assigned to segments of data that described a new theme observed in the text (Miles & Huberman, 1994). Two coders individually coded one interview from the same teacher. Subsequently, the coded units were compared in order to discuss disagreements and develop a shared coding scheme. Finally, patterns and differences across beginning teachers from the same and different TEIs were identified through constant comparisons.

4. Results

In this section we first present the results with respect to beginning teachers’ actual use of technology in teaching and learning processes. Subsequently, we focus on the analysis regarding the relationship between this use and their pre-service learning experiences. To illustrate key distinctions, it was decided to present the sample teachers by TEI. In Table 3, an overview of the key findings of the six cases is presented.

4.1 Technology integration (TEI1)
4.1.1 Ben’s case (BT1)

After working as an interim teacher in different schools, Ben started as a full time teacher in a small Catholic school (S1). Next to his teaching responsibilities in grades 5 and 6, he was recently appointed as an ICT coordinator at the school. In this function he is responsible for teaching basic technology skills to pupils from all grades and providing support to other teachers with regard to the use of technology. As a young teacher, he
perceived that other teachers in his school somehow expected him to be knowledgeable with technology.

The school principal advocates the integration of ICT in the school and actively encourages teachers to make use of the PC-lab at least once a week. Together with Ben, the principal is continuously considering how to improve the ICT infrastructure in the school. Recently, the school bought a data projector and a laptop for each classroom. Ben reported that he made active use of these technologies in his teaching practice. He uses the new data projector to display Power Point presentations, to show pictures in order to clarify concepts, etc. This can be illustrated by the following quote:

“I must say that personally I work a lot with the computer and the beamer… just to show a picture to clarify or for small things”
[Ben, TEI1/S1]

Ben also uses the PC-lab to engage pupils in project-based activities such as the preparation of a power point presentation about their hobbies, or to work on a Webquest about the solar system, an application he had learned about during his pre-service education.

“A while ago I gave a lesson about the solar system, and then I actually let them [pupils] work on a Webquest … and I think that they really enjoyed it because they could learn more, in their way, [and search for] extra information about all the planets”
[Ben, TEI1/S1]

In Summary, Ben appears eager to use technology in his teaching and is focusing on curriculum outcomes as well as developing technical skills in students. He has taken on a leadership role in his early career.

4.1.2 Joanna’s case (BT2)

Joanna is a fifth grade teacher in a large Catholic school (S2). She is also active in her school as an ICT-coach. She reported that she often helped other teachers by answering questions or sharing ideas about technology use. For example, she created exercises using ‘Hot Potatoes’ (an application she had also learned during her pre-service education), and shared these on the school website so that other teachers from the same grade could use them. Her teaching colleagues look towards her for fresh ideas for the use of technology.

“If I bring something new, then they (other teachers) were always enthusiastic, especially if it was related to ICT. I have two colleagues that are a bit older, and they always find it nice when I bring something along or I when make exercises for the computer”
The principal in S2 is leading the process of technology integration, for example, by promoting the evaluation of pupils’ technology use and by ensuring the necessary conditions, such as good infrastructure. The fact that the principal in her school actively encouraged the integration of technology in the classroom may have provided an extra motivation for Joanna to apply what she had learnt in pre-service education with regard to ICT.

“We must work with ICT and reach our attainment targets, and this happens from the first grade […] last year he [the principal] bought a digital board for every teacher. He is really into it, and he also wants us to use it and that we bring children in contact with ICT as much as possible”

[Joanna, TEI1/S2]

All teachers have access to an interactive whiteboard (IWB) in the classroom. Joanna uses the IWB on a daily basis to deliver instruction (e.g., show pictures to demonstrate or clarify concepts, or play a short video). Her pedagogy is teacher directed, focused on content delivery with less emphasis on student centred experimentation as indicated in this excerpt:

“[I use] the digital board and the laptop every day […]. The digital board is mainly used for real teaching, so exercises and workbooks. The children can come to the board, but there is not always time for that”

[Joanna, TEI1/S2]

In addition to these more conventional uses of technology, Joanna also reported to have used technology for project-based activities. For example, during the hours she had been assigned by the school to make use of the PC-lab, Joanna asked her pupils to work independently on small project tasks such as the design of an advertisement:

“In the computer classroom they are working completely on their own, so everyone at the same time working on exercises, or I ask them to make an advertisement and search for photos on the internet, so they are really busy with individual work”

[Joanna, TEI1/S2]

When the PC-lab is available, the children use the technology for creative tasks whereas in the classroom Joanna is limited to a digital board so this becomes her primary teaching tool. The fact that the principal in her school actively encouraged the integration of technology in the classroom may have provided an extra motivation for Joanna to apply what she had learnt in pre-service education with regard to ICT.
"We must work with ICT and reach our attainment targets, and this happens from the first grade […] last year he [the principal] bought a digital board for every teacher. He is really into it, and he also wants us to use it and that we bring children in contact with ICT as much as possible."

[Joanna, TEI1/S2]

In summary, Joanne like Ben advocates and plans specifically for the integration of ICT in her instructional activities as well as directing students to engage in ICT tasks. She has a supporting and enabling school culture.

4.1.3 Influence of teacher education (TEI1)

TEI 1 decided to move from a separate technology course towards a more integrated approach. The ICT coordinator, previously responsible for supporting the development of pre-service students’ technical skills through an ICT course, now teaches exemplary ICT-rich lessons across different subject areas. The goal of these lessons is to connect technology with content. Both sample teachers from TEI1 believe that their pre-service education motivated them to use technology in their current practice by providing them with an overview of various types of technologies and their educational affordances:

“All the ICT-applications we’ve learned there (in TEI), I don’t use them every day, but when I do use them I’m happy that I know how to use them"

[Joanna, TEI1/S2]

Both beginning teachers from TEI1 are using the ICT-applications they learned about during their pre-service education. Ben and Joanna claimed that they benefited from an ICT-coordinator’s providing lectures in different subject areas that demonstrated the teaching and learning potential of specific ICTs. This inspired them to use those applications, such as Hot Potatoes or WebQuests with their pupils.

“We’ve got tips about, for instance that WebQuest, that exists, [and] you can use it. In case you don’t use it, no problem. In case you use it, it’s an added value. And I’ve experienced it as an added value.”

[Ben, TEI1/S1]

Additionally to these explicit examples provided by the ICT-coordinator, both teachers also stressed the importance of experimenting and exploring different technological applications during their pre-service education. Each semester they had to complete an ICT-related assignment task. Ben, for example, stated that during his pre-service education he
learned how to make Interactive Excel assignments which supported his own ICT competencies as well as his use of this ICT application in his beginning practice.

Because we’ve made all these assignments (in our TEI), for example [work with] Interactive Excel, we’re able to use it now in our [teaching] practice.

[Ben, TEI1/S1]

“I’ve tested it during my internship, that was actually a big risk, and since then it turned out well I’m now able to use it here.”

[Ben, TEI1/S1]

The familiarity and competencies gained during their pre-service education through targeted subject ICT illustrations as well as building personal ICT competency through specific ICT assignment led to transference in Ben and Joanna’s classrooms.

Although both beginning teachers felt additional support was needed, they valued the opportunity to apply their knowledge about ICT in authentic experiences during the internship. Additionally, in TEI1 students were required to develop ten technology-rich lessons during their last internship. According to Joanna, all student teachers had to make explicit why they integrated technology in that specific lesson.

“We had to make files about our ICT-integrated lessons. To succeed in your internship you had to make five of them”.

[Joanna, TEI1/S2]

Ben also underscored the role of mentor teachers in providing feedback since they were always present in the classroom. Apart from the mentor, Ben acknowledged the importance of peer feedback and support:

“*I understood less about Audacity compared to my classmate and he was not so good in using PowerPoint, so we helped each other.*”

[Ben, TEI1/S1]

At the same time Joanna and Ben reflected that it would have been interesting to receive additional support on how to integrate the different ICT-applications in teaching and learning processes:
“They (teacher educators) tell us how it (ICT) works, but it would have been better to receive support in how to use it in a real lesson (...), to show us how you, as a teacher, can use it.”

[Joanna, TEI1/S2]

Joanna has identified a gap in the pedagogy at TEI1, in that, ICT-applications are presented in subject context, however, the actual teaching associated with using these tools was missing. This could have been part of the opportunities taking place in the internship. Finally, both teachers refer to a website with up to date educational innovations in the field of ICT. They report that this website still provides them with helpful information about how to use new ICT-applications in their classroom.

In sum, Ben and Joanna actively use ICT as part of their teaching and learning sequences in their classrooms. They draw on familiar ICT applications explored at TEI to support curriculum outcomes. Leadership, experimentation and a certain level of confidence are evident in their description of their use of ICT as a learning tool. The strategies of embedding the pedagogical use of ICT in lectures, curriculum content and assessment at TEI1 in coursework and in field practice appears to have influenced Ben and Joanna’s use of ICT in their classrooms. It is evident that it has provided TPACK understanding and has mirrored their use of technology. Moreover, both beginning teachers work in a school environment that supports technology integration and therefore encourages them to apply what they have learned in their pre-service education.

4.2 Technology integration (TEI2)

4.2.1 Eline’s case (BT3)

Since graduated from the TEI, Eline has been working as a fourth grade teacher in a medium-sized Catholic school (S3). School 3 has a diverse student population with a large percentage of pupils who do not speak Dutch as a first language. Although the new principal is planning to invest in ICT infrastructure, currently there is only one computer available in each classroom making the integration of ICT challenging:

“It’s difficult to use only one computer for 19 pupils. (...) Our new principal is ICT-minded but it’s expensive for our small school to buy extra laptops. They (extra laptops) will come but it will take some time.

[Eline, TEI2/S3]
Despite the limited ICT infrastructure and support, Eline reported the use of technology for differentiation purposes. The one computer in the classroom is often used to provide personalized learning activities for language learners or children with learning difficulties.

“In my classroom, on this computer, there is constantly one pupil, especially my language learners. They can work with a headset, connect words with pictures […] and I see that they can do it better than when they work with the book and they have to write down these exercises, then it is not so easy for them, but these exercises in Bingel (educational website) they can do”

[Eline, TEI2/S3]

Less frequently, Eline uses technology to deliver instruction by, for example, showing a short video to illustrate or demonstrate something.

“For example, we did the dance against bullying, and I thought ‘how am I going to do that!’ because I am not good at dancing. But on the Internet there is a film from Ketnet (TV) that very slowly, step by step, teaches you [how to do it]. Then I said, ‘okay kids, all 19 around the computer’, I moved this table aside, and this how we learned it”

[Eline, TEI2/S3]

Beyond these uses, Eline acknowledged little application of technology in the classroom because of the limited availability of hardware and software. She is not using ICT as a core part of her teaching and much of her use could be considered as a ‘tutor’ for language development.

4.2.2 Fiona’s case (S4)

Fiona, a grade 3 teacher, works in a large public school (S4). As a beginning teacher, she received general support from a mentor in the school and ICT-related support from an ICT coordinator. School 4 has an ICT school policy plan, including clear expectations for teachers to make regular use of technology to support learning and instruction. Apart from the PC-lab, each classroom has an IWB and 3 computers available.

Fiona reported regular use of the computers she had in the classroom during children play in learning corners. She prepared links to various websites with exercises for language and mathematics, so that children could practice what they had learned in a playful way.
Fiona also used the computers in the classroom for differentiation (i.e., propose personalized learning activities to children with learning difficulties) or, though less frequently, to show a short video to illustrate concepts:

“I have a child that has motoric limitations, so I asked him to type the words on the computer.”

[Fiona, TEI2/S4]

“Once I also let them watch a video about the day and the night because that was actually about the earth and the sun... and also a couple of times I showed experiments for science education, or on a Wednesday to do one of those dances with movements”

[Fiona, TEI2/S4]

Fiona like Eline uses technology as a tutor for various foundational building exercises. There is limited application to general instruction and or student curriculum tasks.

4.2.3 Influence of teacher education (TEI2)

In TEI 2, a course on the use of technology was introduced in the first year of the program. This course centres specifically on the development of technological skills. However, Eline and Fiona, both from TEI 2, felt they were not well prepared to make use of ICT in the classroom, even though at TEI 2 students had to complete an ICT module as part of their curriculum studies. The quote below illustrates this:

“I cannot think about ICT in the second and third year (in TEI). Only in the first year: that was purely word processing and making things in Excel.”

[Eline, TEI2/S4]

Unlike TEI1 that demonstrated a range of ICT embedded coursework and field work, TEI2 provided only a skill based first year courses. As previously discussed, to develop a sound understanding of TPACK, TEIs need to help students make the connections between pedagogical practice, technical skills, and content knowledge. Although the use of technology during internships was not compulsory in TEI2, Eline and Fiona acknowledged the importance of these early experiences with technology use. For example, Eline had to use an IWB for the first time during her last internship. Based on this experience she felt the need to further develop her technical skills, particularly with regard to the use of the IWB. Also Fiona refers to hands-on experiences with technology during her internship. The results again
clearly demonstrate the role of the primary schools and mentors during the internship, as illustrated by the following comment:

“During my last internship I’ve used the two computers in my classroom. This primary school expected that you integrate them (ICT) in regular subject areas.”

[Fiona, TEI2/S3]

Both teachers felt that concrete examples of technology use were missing in their pre-service training. More specifically, the interviews suggest that the ICT-applications used during lectures at TEI2 were unlikely to be used in primary education:

“They [teacher educators] stood in front of an IWB or a beamer, but that was not how they wanted us to use ICT in primary schools. They expect that children use it (ICT).”

[Fiona, TEI2/S3]

Eline and Fiona use ICT mainly for drill and practice activities that support specific children’s needs. Both appear to be limited in their knowledge of ICT applications and focus on hardware (e.g. IWB) rather than the pedagogy and learning that technology affords. However, they have positive dispositions for using technologies as they indicate the support it provides to students with special needs. What is not evident is their ability or inclination to go beyond this level of integration. The limited use of ICT in coursework at TEI2 with little support for connecting pedagogy, content and skill, but the expectation required by both the TEI and their fieldwork may have shaped these teachers’ ICT capabilities.

4.3 Technology integration (TEI3)

4.3.1 Walter’s case (BT5)

Walter currently works as a full-time first grade teacher in a large Catholic school (S5). Although the use of ICT is supported by the principal, the school does not have an ICT policy plan. Every classroom in the school has two computers to be used by the children. The school also has one data projector which teachers can use through previous reservation. Walter’s experiences during his internship and as an ICT coordinator in a previous school encouraged him to make regular use of the data projector in his teaching practice. He also actively motivated other teachers in the school to make use of technology and started an initiative to
create classroom blogs as a way to communicate with parents. While this idea was not sustained, it inspired other teachers to experiment with ICT.

“None of us could make a website so the idea of a blog came quickly. I have tried it once to test it, and that was nice but I kept it only very short because you must do it after work, and then you quickly let it fall”

[Walter, TEI2/S5]

This particular use of technology, though valuable, is difficult to sustain as it is external to the curriculum and demands extra time, whereas Walter’s use of the data projector is more relevant to curriculum outcomes. He reported to make regular use of the data projector to support instruction delivery by, for example, showing a short film to his first year class after a new word was learned. Walter values this use of ICT as purposeful and relevant to student learning outcomes and therefore invested in this use of time. Additionally, Walter often uses the computers in the classroom during learning corners as a way for children to practice what they have learned:

“With the computer they (the pupils) can practice what they learned… Before they start I look for the right applications.”

[Walter, TEI2/S5]

Similarly to Eline and Fiona, Walter values rote activities and uses technology as a tutor. This fundamental application fits neatly into the curriculum and requires little instruction. However, Walter demonstrates going beyond the basic uses of computers with his trail of a blog for communicating with parents.

4.3.2 Marie’s case (BT6)

Marie has been working for the same small (community) school (S6) since graduating from the TEI. She teaches a mixed group of first and second grade children. The school had recently decided to bring the computers from the PC-lab to the classroom so as to encourage ICT use. Every classroom has now access to three computers for children use. Although ICT use is stimulated, Marie reported that the school does not have an ICT policy plan and the support from the ICT coordinator is restricted to technical problems only.

“He (the ICT coordinator) is repairing computers or solving technical problems. Technical issues and nothing else.”
Marie regularly uses the three computers available in her classroom during playtime or when a child finishes a task early. The types of activities children would usually engage in during play in learning corners include math and language exercises, and/or activities to get familiar with basic ICT skills (e.g. how to use a word document or to search on the Internet). Marie emphasized that these activities allow for differentiation as she could select exercises, linked to the school textbook, according to the needs and level of her pupils.

“Now I try to use it [the computer] daily in the learning corners, and when this is not possible [at least] two or three times per week. So there is a website linked to the textbook we use in the class with math exercises and language exercises. The advantage of this website is that the children work on exercises that are linked to the textbook we use in the class. I can select beforehand which exercises the pupils must work on, so [this way] I can differentiate.”

[Marie, TEI2/S6]

Marie also mentioned the use of a forum on a website to present the work of the pupils and to exchange information with the parents. She is willing to integrate ICT more often in her educational practice for differentiation but points at the old infrastructure in the school as an important barrier.

4.3.3 Influence of teacher education

TEI 3 decided to move from a separate technology course to integrate technology across the curriculum; however, the results of the interviews with Walter and Marie reveal that the integration of technology across subject areas of their pre-service education was rather incidental. The search for an integrated approach in TEI 3 can be only illustrated by a couple of examples mentioned by Walter and Marie. To illustrate:

“We had to design a classroom setting with a favorable arrangement for ICT.”

[Walter, BT5/TEI3]

“We had to design a Mind Map and we also had to make a blog.”

[Marie, BT6/TEI3]

The pre-service teachers in TEI3 had to collaborate with their peers in order to help each other with these tasks. At the same time Marie stated that, while experimenting with new
applications, more support from the teacher educator was needed concerning how to use these applications in teaching and learning activities:

“Once we had to make a WebQuest, but that was just a 5 minutes explanation and then we had to try it out (...). It would have been better to receive some help: Did you try this? Or think about how you could tackle it…”

[Marie, BT6/TEI3]

As stated above, Walter refers to successful experiences during his internships. He reported that the pupils and the mentor encouraged him to use (more) technology in his lessons:

“Because both the children and the mentor were so enthusiastic I started to use it (ICT) more and more.”

[Walter, TEI3/S5]

Marie, from the same TEI, emphasizes the role of the mentor in the process of technology integration and comments:

“One of the mentors obliged me to teach the children how to use Google Earth, for instance to search for buildings and this sort of things, but this was not something my TEI was expecting.”

[Marie, BT6/TEI3]

As a result of the encouragement and opportunities provided by the mentors to experiment with different technologies during the internship, both teachers appear to have been motivated to start integrating technology in their practice. An interesting finding is the gradual process of becoming confident in using technology in education.

“At the end of my pre-service education I used more ICT. You feel more confident, you dare to use it (ICT), and you also score [with it]!”

Marie and Walter also stress the importance of teacher educators and students in the conversation about the role of technology in education. However, the results from the
interviews seem to confirm that moving from a separate technology course towards the integration of technology across the curriculum was not fully realized in TEI3. In this respect both beginning teachers stressed the need for more authentic tasks wherein they could explore the possibilities of technology while designing lessons. The two teachers indicate that their teacher educators lacked the competencies to model the educational use of ICT as the main reason for their lack of and rudimentary use of technologies.

5. Cross-case analysis and discussion

This study aimed to provide an insight into the educational technology use of a group of beginning teachers during their first three years of teaching. The interviews also provided an in-depth understanding of how pre-service learning experiences may have shaped beginning teacher’s uses of technology. In this section the results of the cross-case analysis are discussed in three parts: 1) beginning teachers’ technology use, 2) the influence of pre-service experiences on their use of technology, and 3) challenges for teacher education institutions. Figure 2 provides an overview of themes identified as important for preparing beginning teachers for educational technology use.

5.1 Beginning teachers’ technology use: Ready to take off?

All beginning teachers displayed positive attitudes towards technology and valued its use in the classroom. Even though beginning teachers used a wide range of technological applications (see Table 3), they were mainly using structured learning approaches. The most common were the use of ICT to deliver instruction with a data projector or IWB (BT1, 2, 5) (see also Hammond et al., 2008), to exercise knowledge and skills (BT 3, 4, 5, 6) and, much less often, to support project-based activities (BT 1, 2). There was no evidence indicating that beginning teachers were using technologies to facilitate collaboration, creativity or critical thinking (i.e. using technology to support 21st century learning). This is in line with the literature indicating that beginning teachers tend not to take full advantage of the potential of technology in education (e.g., Hu & McGrath, 2011; Moore & Chae, 2007). The Hu and McGrath (2011) study for instance indicate that ICT-integrated lessons were limited and traditional. Interestingly, the use of technology seems to be related with grade level (e.g., Tondeur et al., 2008). To illustrate, fifth and sixth grade teachers in this study (BT1, 2) are more likely to provide opportunities to use technology as an information tool (e.g., for project-based activities). It could be argued that this represents a “higher order use” of technology and that this might be related to the curriculum of fifth and sixth graders (cf.
Tondeur et al., 2007). The beginning teachers in grade level one and two (BT5, 6) are mostly using technology as a learning tool to exercise knowledge and skills (e.g. Math exercises).

Even though evidence suggests that the selected beginning teachers appear to have more positive attitudes towards technology use, it seems that only a limited number of exemplary beginning teachers are able to create opportunities for student-centred use of technology (cf. Bate, 2010). A possible reason for the limited uptake of student-centred technology use can be related to the difficult transition from pre-service education to actual professional practice, also known as the “reality shock”. Workload as well as school culture are possible factors influencing this transition period (Bate, 2010). In this respect, Starkey (2010) found that beginning teachers became part of a complex organisation and faced several barriers as they sought to use technology in their educational practice. Additionally, evidence points at pre-service experiences as a crucial factor (for an overview see Kay, 2006). This brings us to the next section.

5.2 Influence of pre-service experiences on beginning teachers’ technology use

When we look at the strategies used in the different TEIs (Fig. 2), the findings illustrate that the beginning teachers in TEI1 had access to more learning opportunities with technology during their pre-service education. These teachers (BT 1 and 2) also report that their pre-service education provided them with an overview of technological applications they could use in the classroom. More specifically, an ICT-expert illustrated the educational possibilities of various types of technologies in the context of specific content areas (cf. Ottenbreit-Leftwich et al., 2010). According to Haydn and Barton (2007), it seems that teacher educators using technology in coursework are an important motivator for pre-service teachers to integrate technology in their own teaching. The pre-service teachers in TEI1 confirmed the relevance of these lessons, welcoming the concrete examples of how technology can be used across various subject domains (Tondeur et al., 2012, see also Angeli & Valanides, 2009).

The results reveal that student teachers of TEI2 and 3 perceive that there was not so much evidence of educational technology use in their program. For the beginning teachers from these TEIs, technology use during internships was one of the most critical factors influencing beginning teachers’ current practices. According to Sang et al. (2009) these types of engaging experiences can lead to a better understanding of the link between theories about the role of technology and teaching practice (see also Tondeur et al., 2012). In this respect,
Koehler and Mishra (2009) advocated collaborative design of curriculum materials to foster the development of TPACK. Moreover, results from the current study clearly demonstrate that the beginning teachers are using in their current teaching practice the same types of ICT-applications they used during their internship.

While exposure to technological applications for education seems relevant, the respondents indicated that it was important to explore how new technologies can be used for educational purposes. Three out of six beginning teachers (BT1, 3, 6) also indicate that encouragement, the possibility to experiment with technology, and feedback from their mentors during internships was beneficial to build their confidence and competencies to use technology in the classroom (cf. Hammond et al., 2009; Ertmer & Ottenbreit-Leftwich, 2010). Also important but less prominent was the feedback and support from peers during pre-service training (e.g., BT1). According to Angeli and Valanides (2009), collaboration with peers appears to provide a low threat learning environment for pre-service teachers, contrary to many technology learning experiences that can induce anxiety and failure avoidance (cf. Banas & York, 2014).

5.3 Challenges for teacher education institutions

This study presents some preliminary evidence of the potential influence of TEIs on beginning teachers’ technology integration practices (cf. Veen, 1993). However, our findings also reveal serious challenges. One of the main problems reported by the beginning teachers from TEI 2 and 3 was the lack of concrete examples of how to use technology to support teaching. In other words, beginning teachers experienced the need to learn how to teach with technology rather than merely getting acquainted with existing technology applications (Dawson, 2008). It seems that pedagogical knowledge, content knowledge and technological knowledge (Koehler & Mishra, 2009) were not addressed in inter-related ways at the TEIs. One of the reasons, according to the participants of this study, is that teacher educators do not feel adequately prepared to effectively integrate technology into their classrooms (see also Kay, 2006). In this respect, the discussion about how to implement and sustain programs to
prepare pre-service teachers to integrate technology in their education practice should be seen as part of the development of the entire TEI (Tondeur et al., 2012).

The beginning teachers in this case study also felt that their pre-service education did not give them sufficient opportunities to engage in authentic tasks wherein they could apply their knowledge about technology to the design of concrete activities that could be useful in their later practice (Angeli & Valanides, 2009; Lee & Lee, 2014). In that matter, discussing and sharing with peers seems to be important (Agyei & Voogt, 2011). The literature is rich on the impact of pre-service teachers’ collaboration on ICT tasks where there is sharing of ideas, critique and feedback (Barton & Haydn, 2006). The beginning teachers’ overall comments indicate that assessment and feedback with respect to technology use was one of the main problems they experienced in their TEI (cf. Tondeur et al., 2012). Online resources have been suggested as a way to meet the variety of beginning teachers’ needs (Moore & Chae, 2007). According to Boulton (2014) ePortfolios seemed to be useful in giving pre-service teachers a forum to discuss and exchange points of view with others. Furthermore, in her study the ePortfolios could continue to support the professional development of teachers during their teaching career (Boulton, 2014; Prestridge, 2010).

5.4 Limitations of the study and suggestions for future research

Although the current study provides in-depth explorations of the links between BT technology uses and their pre-service learning experiences, it also reflects some shortcomings. Firstly, the results of this qualitative study have a limited generalizability. The added value of this study lies in the richer account with respect to the connections between beginning teachers’ technology use and their pre-service experiences, but the extent to which BT apply what they have learned at TEI appears to be influenced by the school context (see Fig. 2), such as the support of the principal, a positive school culture, and access to good infrastructure (cf. Hammond et al., 2009; Starkey, 2010). These factors are linked together, and therefore it is very difficult to address them separately. While this was beyond the scope of the current study, future research may examine these connections in relation to the complex realities of daily teaching with technology in a specific context. Schools differ, for example, with respect to their capacity and strategies for integrating technology in teaching and learning activities. This indicates that further studies might be needed to analyse the combined
6. Conclusion

The results of this study revealed that beginning teachers want to use technologies and see them as important tools for teaching and learning but they do not always feel fully prepared to start integrating technology effectively. All beginning teachers made efforts to use technologies they were familiar with, some with a greater understanding of TPACK. Furthermore, it seems that the beginning teachers from the teacher education institution that provided the greatest preparation in technology enabled their graduates to integrate technologies more proficiently. Another major impact was the support, direction and demonstration received from mentors while these teachers were on their internship acknowledging the importance of real life training and the role of schools and mentors in pre-service teacher education. The main issue emerging seems to be the lack of relationship between what beginning teachers learned in their pre-service education and what is needed in order to make progress in using technology in the classroom. Therefore, teacher education institutions need to actively help future teachers to make the link between technology, pedagogy and content knowledge in all aspects of their education and field work.

7. References


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*Focus of this study

Fig. 1. Data collection time line
Fig. 2 Framework for preparing beginning teachers to integrate technology.

- Pre-service training
  - Teacher educators as role models
  - Exploring ICT applications in subject domains
  - ICT assignment tasks

- Internship
  - Designing ICT-rich lessons
  - Authentic experiences
  - Mentor support and feedback

- Early career
  - Supportive leadership
  - Enabling school culture
  - Access to infrastructure