Student Teachers Learning to Teach: The Mastery and Appropriation of Digital Technology

Trond Haugerud

English abstract

This article aims to shed light on the processes by which student teachers change and shape their understanding of ICT (Information and Communication Technology) as a tool for learning. Two types of processes are investigated. One is the process by which student teachers gain a technical proficiency, i.e. how student teachers benefit from their technical skills in a school context. The other process is concerned with how student teachers are able to integrate or combine a technical proficiency with a broader view on how teaching and learning should be conducted. The research reviewed indicates that an isolated technical proficiency is not sufficient for providing new teaching opportunities, and there seems to be a gap between technical knowledge and knowledge on how to employ technology in a learning context. In this light, student teachers need to develop a view on ICT that goes beyond the mere technical aspects. The concepts “mastery” and “appropriation” from Wertsch (1998) are employed to structure the discussion. These two concepts from Wertsch can inform us about the way in which student teachers approach ICT as a tool for learning and can help characterize this approach.

Keywords: Student teachers, ICT, learning to teach, mastery, appropriation.
Introduction

Research on the use of technology in education has indicated that computers themselves do not lead to the intentional restructuring of education (Riel 1989; Cuban 2001; Krumsvik 2009). In 1991, Becker stated that the way in which teachers teach is a product of their own schooling, training, and experiences as teachers. More recent research (Austin et al. 2010; Elik et al. 2010), in accordance with Wang (2002) and Pajares (1992), shows that teacher educators should pay more attention to the question of how to understand the beliefs of pre-service teachers in preparing them for their future role in teaching with computers. Thus, there is an explicit need to investigate how student teachers develop their understanding of teaching in a technology-saturated environment (Taylor 2003; Krumsvik 2009).

The aim of this review is to shed some light on the processes by which student teachers change and shape their understanding of ICT as a tool for learning. Two types of processes are investigated. One is the process by which student teachers gain a technical proficiency; in other words, how student teachers benefit from their technical skills in a school context. The other process is concerned with how student teachers are able to integrate or combine a technical proficiency with a broader view on how teaching and learning should be conducted. The research reviewed indicates that an isolated technical proficiency is not sufficient for providing new teaching opportunities, and there seems to be a gap between technical knowledge and knowledge on how to employ technology in a learning context. In this light, student teachers need to develop a view on ICT that goes beyond the mere technical aspects.

In this article, the two above-mentioned processes are seen in relation to two concepts from Wertsh (1998): mastery and appropriation. I will not go into detail as to how these concepts have been created; I will only describe them in a few words. “Mastery” is described by Wertsch as “knowing how to use a meditational means with facility” (Wertsch 1998:50), a way of using a tool in order to accomplish a task. “Appropriation” refers to the process of making something (an “attitude”, a process, a point of view) that belongs to others one’s own (Wertsch 1998).

The work reviewed in this article was selected in various ways. This review was started in 2004, and at that time, the aim was to find research that focused on how student teachers developed a personal view and understanding of ICT as a learning tool through formalized teacher education. Searches were conducted using the university’s database of subscriptions with the search phrases “ict”, “teacher education”, “student teachers”, “technology”, and “computers”. This resulted in a selection of research focusing – broadly speaking – on Computer-Supported Collaborative Learning (CSCL) on the one hand, and research focusing on student teachers’ beliefs and feelings about ICT as a tool for learning on the other hand. In this second stage of the review, worked out in 2010–2011, research studies were selected in two ways. First, a search was performed with the same search phrases as in 2004, and studies were selected in terms of relevance. Second, a broader search on the Internet was performed, using the titles of the articles found in 2004 as search phrases. This resulted in research that, to some extent, built on these articles and that could provide a kind of continuity between the two stages of writing. Searches performed during the two stages of writing this review produced a total of 171 hits on articles related to the search terms. From these 171 articles, one specific criterion was applied in the subsequent process of selection: that the articles – at least to some degree – would take up the question about how student teachers view their own building of competence in using ICT as a tool for teaching.
In her review of nine papers published in *Teaching and Teacher Education* from 1988 to 2009, Ben-Peretz (2011) finds that the focus on research regarding teacher knowledge and teacher education has changed. During this period, an increasing context awareness had been observed. Ben-Peretz finds that what student teachers learn in their field experiences are generally built more upon – and more extensively researched – towards the latter part of the review period. There is a variety of contexts involved in the shaping of student teachers’ knowledge, such as the action context, the socio-professional context, and the supervisory context (Tang 2003). Ben-Peretz notes that “the closer we come to the present time, the more demands are made on the knowledge required by teachers” (2011: 8). Holden and Hicks (2007) start their paper with the difficult question, “What is it that teachers need to know if they are to help pupils make sense of the world in the early 21st century?” (p. 13). Multiculturalism and globalization are among the fields that teachers have to make strategies for in order to stay updated, and an interesting finding in the study is that information about these topics lies outside the traditional school curriculum (ibid). In other words, teachers need to bring general society into the school context, making developments in society relevant as points in student learning. This need is evident not only with regard to the use of digital technology as tools for learning, and not only in a school perspective per se, but also as a foundation for lifelong learning in society.

Section one: Student teachers’ technical competence

The use of ICT in teacher education has often been informed by the documented constraints of ICT use in school contexts, and according to what knowledge and attitudes active teachers feel are needed in order to make the most of the technology. Knezek and Christensen (2002) make a summary of quantitative research based on the Teachers’ Attitudes Toward Computers (Christensen & Knezek 1996) and Teachers’ Attitudes Toward Information Technology questionnaires (Knezek & Christensen 1998). This work was carried out in several schools in the USA and other parts of the world. Some of the main findings are relevant to this study. These include: (1) how teacher competence and confidence with respect to ICT are the principal determinants of effective classroom use by students (Collins et al. 1996); (2) that successful technology integration in a classroom environment appears to require will, skill, and access to technology tools on the part of the teacher (Knezek et al. 2000); and, finally, (3) how teacher advances in technology integration appear to proceed through a set of stages, where the highest stages require changes in attitude more than skills (Knezek & Christensen 2000). In their review, Knezek and Christensen (2002) convey these findings as fairly general, but what they indicate may be elaborated by some more qualitatively oriented studies.

In the first finding mentioned above, Knezek and Christensen (2002) state that teacher competence and confidence with respect to ICT are the principal determinants of effective classroom use. Other studies conducted in the UK (Monaghan 1993; Watson 1997; Murphy & Greenwood 1998; Murphy 2000; Spendlove et al. 2010) and elsewhere (van Velzen & Volman 2009) indicate that the use of ICT in teaching during school practice will provide student teachers with an opportunity to develop this competent and confident use of ICT. These findings also indicate that lack of contextualized use will mean that future teachers will make little use of ICT in their own teaching. The importance of the engagement student teachers have with ICT during their teacher education program, and ultimately how they are able to make effective use of ICT in the classroom, is emphasized by two conditions in a Norwegian example. The first condition is suggested by studies indicating that teachers functioning as mentors to students in their school placement seldom use ICT in their teaching (Kløvstad & Kristiansen 2003). The other is that pupils voluntarily use...
resources from the Internet in their homework, but often struggle to benefit from the fragmented information provided by that medium (Torgersen 2004). These studies indicate that pupils who are interested in using the Internet and other digital sources of information in school-related work are dependent on the teacher to help them use it in a relevant and meaningful way. Other studies (Easdown 1994; Summers & Easdown 1996; Bell & Biott 1997; Galanouli & McNair 2001; Pearson & Naylor 2006; Austin et al. 2010) have indicated results that point in the same direction as those in Norway, in that the teacher is responsible for providing opportunities for the pupils to help them utilize their technical skills in an educationally productive way.

The other two findings referred to by Knezek and Christensen (2002) above point to the importance of focusing on teachers’ and student teachers’ skill, will, and attitude towards the use of technology in different contexts. A study by Drenoyianni (2004) has found that even if student teachers have some technical knowledge about ICT, they lack the ability to use their ICT skills in an educational context. In her study, student teachers went through an ICT literacy course. This course was implemented in a Greek teacher education program in order to give the students a technical foundation for their pedagogical use of ICT. Her study indicates that although student teachers’ technical skills were easily acquired, many encountered problems finding information on the Internet owing to the absence of a focused and suitable search plan. They had problems in finding and selecting search terms and phrases, and problems when evaluating the relevance and the value of the sources retrieved. Drenoyianni found that students’ general approach to information even after the course was significantly influenced by the idea that all information is true and that information exists to be memorized and reproduced.

Drenoyianni’s study raises important and critical questions concerning what has become known as “ICT literacy”. According to Drenoyianni,

“ICT literacy is using digital technology, communication tools, and/or networks to access, integrate, evaluate and create information in order to function in a knowledge society” (EST 2002: 2).

This definition focuses on ICT literacy as an integration of cognitive and technical proficiency in order to access, manage, integrate, evaluate, and create information. Drenoyianni makes a distinction between the “acquisition of basic technical skills” on one hand, and a “competent and effective use of a range of ICT applications” on the other. In many ways, the distinction Drenoyianni is making in the study is between the isolated use of an application (for instance, how to write a document in Microsoft Word) and the use of this application in a specific context (for instance, how an activity or a practice has to change for this application to become a useful tool).

The studies above point to a need for student teachers to be guided into a setting where ICT as a relevant learning tool is mediated through established practice. The leap between the use of technology in personal learning and an understanding of how technology might contribute to pupils’ learning has to be guided by a more experienced teacher. Thus, the distinction between skill as a technical proficiency and will as an element required for actually understanding a digital learning environment has to be developed further.

Section two: ICT as a resource in student teachers’ practice

In research on student teachers’ use of technology, there have been a number of studies that have analyzed student teachers’ attitude and self-assessed levels of personal skill in using ICT (see, for
instance, Strudler & Wetzel 1999; Cuckle et al. 2000; Paraskeva et al. 2008; Gialamas & Nikolopoulou 2010). Acikalin (2009) has studied pre-service elementary teachers’ beliefs about the use of the Internet in the social studies classroom, and he found that the overwhelming majority of pre-service teachers in a large Turkish university believed that the Internet is a very effective tool for collecting information. At the same time, they acknowledged the disadvantages and negative aspects of the use of the Internet as a tool for teaching, especially focusing on the need for reliability checking and purposeful searches for the Internet to be an effective tool.

However, while the studies above focus on student teachers’ views at a given point in time, an equally interesting topic of research is the question of how student teachers actually change their views and approaches to ICT in teaching through the teacher education program. Several studies focus on what factors influence student teachers’ views on the use of ICT as a learning tool (see, for instance, Doering et al. 2003; Taylor 2003; Jang 2008).

Laffey (2004) investigated how early childhood student teachers appropriated, mastered, and/or resisted learning to use technology in teaching. The study used the survey data of all the students (approximately 300) in one particular program, in the focus group interviews, and in case studies with two of the students. Laffey’s findings indicate that the student teachers used technology frequently and appeared to appropriate technology as a tool for themselves as students. Furthermore, certain competencies, such as software evaluation, were developed, appreciated, and were anticipated to be valuable tools in teaching. In addition to this, the student teachers were exposed to a wide range of applications, such as software for building web pages, PowerPoint™ presentations, etc. However, although the use of technology by students was widespread, for most students this use did not go beyond a level of administration. Laffey indicates that using word processors, sending e-mail, doing web-based searching, or preparing PowerPoint™ slides by teachers might not be sufficient to help pupils use technology for representing, analyzing, and communicating about the world.

In Laffey’s study, the student teachers made use of technology to communicate with peers and teachers, to prepare lesson plans and teaching materials, to create multimedia presentations for the work at the university, and to meet university requirements for technological proficiency. The study indicates, however, that even though the student teachers plan to use technology as teachers outside the classroom, they resist seeing technology as a part of their relationship with children. Most of the student teachers were seeking to become more competent in using technology, by both mastering the technologies and building a self-image as technology users. But at the same time, many students were struggling with the incompatibility between classrooms they could imagine teaching in and the fear of having the computer come between them and the children they wanted to teach.

In addition to the technical component looked at in the previous section of this article, a pedagogical view on the use of technology is also needed for student teachers to promote the productive use of ICT in classrooms (Krumsvik 2009). Teachers are one of the core agents in educational change and the professionals often closest to the process of their students’ learning. Several studies have investigated student teachers’ views on the potential learning benefits of using ICT in the classroom. In their study, Sang et al. (2010) produced empirical evidence to argue that student teachers (a) holding strong constructivist teaching beliefs, (b) strong teaching efficacy, (c) computer self-efficacy, and (d) more favorable attitudes toward computers in education are more interested in integrating computers into their future practices as teachers. Among these variables, attitudes toward computer use in education seem to be the strongest predictor of prospective computer use.
The studies reviewed in this section indicate that even though a technical proficiency is present amongst student teachers, obstacles in the process of employing this proficiency in a way directly related to teaching are identified. In the next section, studies focusing on how student teachers change their views on ICT during a process of learning are elaborated more extensively.

Section three: Student teachers’ approach to bridging contexts

Being young in a Western society today means growing up surrounded by a variety of technologies. However, even though the everyday life of the current “student generation” involves using different kinds of technology for personal reasons (Krumsvik 2006), employing the technological competence in different and not-so-familiar contexts seems to be far from easy. The integration of ICT into teachers’ practices is a difficult process that demands time and constant effort (Baron & Harrari 2005; Kalogiannakis 2010). But still, this particular integration between student teachers’ personal experiences and competence in using ICT on the one hand, and sound and relevant pedagogical considerations on the other, is of crucial importance. The competence in using digital technology developed in a home or personal context might be shaped by the kind of activity that holds a high status in those particular contexts. But, as Drotner (2001) reminds us, if the activities of children and today’s youth are taken as guidelines for technology used in schools, we may get a situation where Big Brother and PlayStation are eventually legitimized as learning activities. This underlines the importance for student teachers of not indulging in familiar technologically based activities merely for the sake of ease or pleasure. Instead, they must break with the common and familiar and transfer only the personal experiences that are relevant to the learning situation at hand.

The aim of a study conducted by Doering et al. (2003) was to understand how a group of student teachers, before and after participating in a teacher education program, envisioned the use of technology within their future classrooms. In addition, the study sought to understand student teachers’ ability to identify the uses of content-based technology in their future roles. The study aimed to capture any change in the student teachers’ abilities to communicate (a) knowledge of technologies that can be used effectively in the classroom, (b) examples of technology use within their content area, and (c) elements of the classroom environment that facilitated technology integration during student teaching. Three sets of interviews were conducted at six-monthly intervals and with ten participants. In the first interview, the student teachers generally dismissed technology use as an option because they were skeptical about technology resource allocation. Further, they felt technology should be introduced and used only after students had learned concepts and skills without technology. They indicated that given limited budgets in schools, expenditures should not focus on technology, as it was not “authentic”. Doering et al. have stated that this concern with authenticity is rooted in the participants’ feeling that teaching and learning without technology were more authentic. In addition, the student teachers utilized technology primarily for information retrieval and record keeping. Technology was merely seen as a vehicle to deliver information and was associated with a notion of passive learning through direct instruction. After the completion of the educational technology course, Doering et al. reported reduced student teacher skepticism, as they offered a range of ideas for technology use in their future classrooms. These ideas were grounded in activities from the educational technology course. However, student teachers were worried that technology might malfunction and, therefore, reduce their inclination to use the technologies. This argument rose from their own experiences with technology in the course, where equipment did not work properly. In the last set of interviews, after the students had completed their teaching experience, the participants reflected on their abilities to use technology during their student teaching. In these reflections, three issues emerged. The first issue was related to availability,
accessibility, and support of technology at the school. Eight of the ten participants noted that access to and the age of the computers at the school played a major role in successful integration. Typically, there were two or three pupils to each computer. The second issue was about classroom management when using technology. For a new teacher already challenged by a potentially unstructured classroom, additional and different classroom management issues in the computer lab were overwhelming. Third, there was an issue of the teacher’s technology experience. The teacher played a major role in the student teachers’ perceived success of technology integration. The student teachers felt their success was hindered when their teacher did not use technology. However, student teachers who were placed in classrooms with teachers who used technology often perceived themselves as being more supported and more successful in their technology integration. Even so, the student teachers’ perspective on educational technology had somehow changed compared with before the course, as the students felt technology assisted learning and realized it was important to put technology into the students’ hands.

In general, the student teachers that participated in this teacher education program developed, to a limited extent, what can be called a “thinking with technology” perspective (Doering et al. 2003). In the introduction to the study, Doering et al. point out that it is less important for student teachers to develop complex technology projects than to develop “discriminating thinking skills”. By this, they mean that setting up a teaching environment with extensive use of software and hardware does not necessarily mean that pupils’ learning experiences are enhanced. What student teachers need is to be able to think differently inside the teaching environment and to see clearly what technology might prove useful in the particular task at hand. However, the perspective that values discriminant thinking is little short of a paradigm shift in teacher education (ibid), and honoring this shift may prove very difficult. As the students initially conceptualize “authentic” teaching in a way that has made the use of technology difficult, and because of the principle that subject matter should be learned in advance of the use of technology, the work required by the students to re-conceptualize their understanding of teaching and learning may be time-consuming and difficult.

In a study conducted by Taylor (2004), 44 student teachers’ existing understanding of ICT and the way it changes as they learn to teach in geography is examined in three ways: (1) two essays about the use of ICT in the classroom that the students produce throughout the year; (2) a questionnaire at the end of the autumn semester; and (3) a subsequent follow-up of nine of the students through interviews at the end of the year. Taylor found that the students went through a three-stage process. The first stage is an uncritical stage where they easily accept the ideas of others and have awareness of issues only on a general level. The second is where they begin to challenge and question their own and others’ work and acknowledge complexity. The final stage involves reflection and theorization, with the students suggesting explanations and solutions based on deeper analysis and an understanding of the complexity of teaching and learning. Not all the students reached this final level. In the study, she identifies three processes driving this change from one stage to the next. First, there is a process of increasing personalization of the issues concerning teaching and learning in the use of ICT. She argues that the process of personalization progressed from generic thinking to specific thinking, resulting in generalization from personal experience. The second process is one of growing pedagogical sensitivity, where the student teachers not only noticed major incidents in the classroom, but also grew more and more capable of seeing details and subtleties. The third process driving this change is the development of contingent thinking ability. With this, the student teachers became increasingly able to recognize the complexity and situated nature of the teaching activity. The study indicates that the actual planning and practice in a school context are a worthwhile exercise for the students in order to develop an enhanced level of ICT use. One interesting indication Taylor makes
in her study is that there are actually no relationships between the development of student teachers’ personal ICT skills and their understanding of how to teach using ICT. In fact, she argues that if a student’s level of sophistication in thinking about learning does not at least keep pace with the level of their ICT skills, they may end up focusing on the technical possibilities rather than on learning.

Jang (2008) finds that pre-service teachers develop new ways of integrating ICT in teaching most efficiently through personal experience as learners. In this study, pre-service teachers were exposed to an online learning environment as part of the teacher education program. As a result, Jang found that the pre-service teachers’ participation in the online learning spaces not only provided the students with a way to construct knowledge in the various subjects, but also a good teaching strategy to promote the utilization of ICT in their own teaching. In the teacher education program referred to in this study, the students were given an opportunity to experience the benefits of ICT in their own learning, and this was beneficial for the students in constructing a personalized view of how ICT could best be employed as a learning tool. This is consistent with findings in a study by Drent and Meelissen (2008). They show that teacher educators who use ICT innovatively in their own learning processes are characterized by a specific combination of knowledge, skills, attitudes, or competencies that are advantageous to the innovative use of ICT. Looking at all factors in this study, a teacher educator focused on combining technology and pedagogy might have the following profile:

1. Willingness to keep extensive contacts with colleagues and experts in the area of ICT for the sake of his own professional development.
2. Capacity to see and experience the advantages of the innovative use of ICT in his education.
3. The pedagogical approach can be described as student-oriented.
4. ICT competence complies with his pedagogical approach.

The studies reviewed in this section point to the need to consider student teachers’ views of what constitutes a productive learning context. As Doering et al. (2003) point out, holding a view that ICT as a tool renders the learning context less authentic and creates an unnecessary distance between the teacher and the pupil makes it difficult for student teachers to see the potential benefits of employing ICT. However, as both Doering et al. (2003) and Taylor (2004) show, it is possible to challenge those views through focused teacher education programs.

Section four: Discussion

Drent and Meelissen (2008) argue that, in general, three objectives are identified for the use of ICT in teacher education: (1) learning about ICT in order to enable students to use ICT in their daily life (the use of ICT as object of study); (2) learning about more subject-specific applications for use in primary education (the use of ICT as an aspect of a discipline or profession); and (3) learning about the ways in which ICT can enhance or change the learning process (ICT as a medium). As the reviewed research indicates, it is not enough for student teachers to know how to use a program on a computer; they have to be able to contextualize it in a teaching environment. Students are often encouraged to search for additional field-related information on the Internet, but using the appropriate technology to conduct these kinds of searches requires more than just the technology itself; for example, it also includes knowledge about what search strings are the most appropriate (Drenoyianni 2004). The students can retrieve a satisfactory result from this activity only if they know something about the subject they are about to search for information on and have an
understanding of the subject that is compatible with a field that employs digital technology. This means that preparing students for a technology-rich environment not only involves teaching them specifically about the technology, but also conducting the teaching of the various subjects in the curriculum in ways that makes the students able to use their knowledge in different kinds of situations later on.

All research on ICT must have a clear view of what kind of artifact ICT constitutes, and which of its aspects are considered central to the research. In this respect, Haydn and Barton (2006) argue that although there is now a considerable body of research on trainee teachers’ use of ICT, much of the research surrounding ICT in education has tended to ignore or underplay the ways in which different ICT applications might be of varying utility depending on the subject involved. Amongst the points made in the study, Haydn and Barton show that most trainees participating in the study exhibited a clear preference for activities that had a direct relationship with teaching their subjects. Differentiation and depth were preferred over breadth, meaning that the trainees gained more from participating in processes that developed focused and specific knowledge about ICT in one particular field than they did when learning about ICT as a generic tool for learning and teaching. Concrete knowledge about the field or subject of teaching is necessary in order to see the possible benefits of using ICT. An understanding of the possible benefits of using ICT in teaching does not come from a technical proficiency, but from an integrated view of both technology and subject matter.

Many of the articles reviewed here indicate that the competence required to make use of technology somehow differs from the competence of being able to design usage of the technology for learners. Wertsch’s (1998) distinction between mastery without appropriation and appropriation without mastery might be interesting in this respect. For one, Laffey (2004) indicates that mastery without appropriation is demonstrated when the students complete tasks with technology, but do not see the technological accomplishment as personally valuable. One example of this was when students struggled to publish their web-based portfolios for assessment. In order to publish these portfolios, the students had to use an overly complex publishing system that required some technical knowledge, but as this knowledge was specific to the system, the students did not appropriate it in order to make it their own. Appropriation without mastery was shown when the students evidently valued a practice without being able to carry it out themselves. This appropriation of an activity, however, provided the motivation for trying to develop the competence that the activity required.

In general, the concepts of mastery and appropriation might shed light on the conflicts that student teachers experience.

There seems, then, to be a complex relationship between appropriation, mastery, and the use of ICT inside and outside of the classroom. What has to be appropriated in order for the students to be able to use ICT efficiently as teachers is not only the use of technology in isolation or in personal situations. The extent to which the student teachers are using ICT on campus, or the quality of their ICT-related activity, seems to be an unreliable indicator as to whether the student teachers will be competent in using ICT when they teach.

This review has shown a variety of different views that student teachers might hold in relation to ICT as a tool for teaching and learning. The studies reviewed further show that the competence in ICT developed by student teachers prior to entering a teacher education program can be utilized as a resource for teaching and learning, but steps have to be taken on the part of the teacher educator. This means that the teacher educator has to implement ICT as a tool for teaching in more than a
theoretical way, or only as a subject for discussion. In order for the student teachers to make relevant use of ICT in a school context, they will need to have experiences of how ICT might be used, and they have to be given opportunities to develop a personal understanding of this use. The process of bridging the gap between student teachers’ technical knowledge and knowledge on how to employ technology in a learning context has to consider the views that the student teachers hold on pedagogy, as well as on technology.

References


