Digital skills as a basis for TPCK

Abstract

Pupils in today's elementary and secondary schools are in need totally different skills than 40 years ago. When they finish school, they must deal with technology-dense communities that are more complex than previously and continuously changing. This places new demands on schools and their teachers. TPCK is a suitable model to describe the skills teachers need to provide adequate teaching for their students' future.

This paper presents results from research on newly qualified teachers about their digital literacy, their use of ICT in their work practices and various factors that may affect this. The survey focused particularly on teacher education.

In this paper, I argue that teachers' (and students') need for digital user skills are undervalued and under communicated with regards to pedagogical and content knowledge. The paper concludes that the emphasis on digital skills in teacher education will lead to graduated teachers having the ability to use technology intensively in their teaching and learning facilitation; in other words, they have TPCK.

Introduction

To what extent are newly educated teachers competent in teaching with ICT in various topics and levels in Norwegian primary and secondary schools? To what extent do they use digital tools in their daily work? To what extent does the teacher training programme offer adequate TPCK training to student teachers? What is the impact of the local infrastructure and the local school culture on teachers' work practices?

These questions form the basis of the study presented in this paper. I argue that skills using digital tools are crucial for teachers to obtain TPCK.

The paper is structured as follows:
First, I briefly present the school system and teacher education in Norway, including the new national curriculum for primary and secondary schools. This constitutes the background for the presented research. Part of the background is also the concept of digital literacy, which is present in both societal and school settings, and also discussed both in relation to the TPCK model and the school's obligation of formation (German "bildung"). Then I firmly present the research design and methodology before presenting and discussing the results. The paper concludes by emphasizing the digital skills necessary for teachers to achieve TPCK.

Schools and teacher training in Norway

The school system in Norway is unified, public and free. All students go through 10 years of compulsory education, corresponding to primary school and secondary school. Then, all have the right to a further four years of high school. In 2006, Norwegian schools received a new national curriculum called *Knowledge Promotion* (Ministry of education and research, 2006). According to this curriculum, teachers should integrate five basic skills in all subjects and at all levels: the ability to make use of ICT, the ability to express oneself orally and in writing, the ability to read and the ability to calculate. Each of these skills is associated with specific

learning goals for different levels of primary and secondary school. Training in ICT is not regarded as a specific subject, but should be integrated into all subjects and learning activities at all levels.

Teacher training for primary and secondary school also has a unified, common national curriculum offered at university colleges *(Ministry of education and research, 2009)*. The teacher training study programme takes four years. All teaching students study language, mathematics, religion and ethics, and pedagogy. They can also choose from a wide range of elective subjects, depending on their interests and the level at which they plan to teach in their future work practice. Thus, teacher training's study programme has a clear focus on educational and multidisciplinary knowledge.

The use of ICT in all subjects in primary and secondary school places great demands on teachers. Their expertise and skill using computers as tools in their pedagogical and didactic work is a prerequisite for implementing the intentions of the Knowledge Promotion. The Knowledge Promotion also challenges teacher-training programmes, which should not only integrate the use of ICT in all subjects, but also offer teacher students competence in ICT didactics and pedagogy.

The education department at Oslo University College is Norway's largest teacher training, with 200 to 250 students in each cohort, and 800 to 1000 students pursuing the teaching programme (Faculty of Education and International Studies).

Digital literacy and TPCK

Digital literacy

In this paper, I discuss the concept of digital literacy. We do not have this exact notion in the Norwegian language, and academic debate circles around different concepts that might be translated as digital skills, digital knowledge, digital competence and digital formation (German: '*bildung*'). The national curriculum works around the issue by applying the phrase, "the ability to make use of information and communication technology". One might argue that this notion is close to 'digital skills', and thus biased towards a narrow definition of technology.

Ola Erstad, an influential Norwegian researcher in the field, has made the concept of digital literacy operational by dividing it into basic skills and the ability to navigate in digital networks, to classify, compare and evaluate information, to produce digital materials and to use digital tools for communication (Erstad 2005).

On the other hand, Norwegian researcher Svein Østerud defines digital literacy as the ability to competently participate in situations in society in which, "the written language or other symbolic ways of mediations are involved" (Østerud 2004).

To combine the ideas of the two preceding definitions, I have translated one from Bjarnø et al.(2008), which is not as detailed and specific as Erstad's, yet not as general as Østerud's:

"Digital literacy involves the skills of using digital equipment and the understanding of the technology necessary for democratic participation in society".

In this definition, digital literacy is relative to time and age. The "understanding necessary for

democratic participation" is obviously different for a 10-year-old and a 30-year-old, and different in 1980 than 2010. The definition also takes the area of application into account, since necessary digital literacy is different for a bank accountant and a pre-school teacher. It is also different for a student and a teacher.

In general, digital literacy can be operationalized into three elements: digital skills (or use skills), technological knowledge (more substantial understanding of how the technology works), and understanding of the dialectical relationship between technology and society. In addition, teachers need contextual competence, so-called pedagogical ICT competence (Beck and Øgrim 2009). This includes competence both in using digital tools in teaching, and teaching technology itself.

Digital skills, or use skills, include the ability to use digital tools in the study or work context and in daily life. It includes, for example, everything from using a word processor to transmitting and processing a digital image, to creating a digital presentation, to finding and evaluating information from the Internet. Digital skills are essential to make use of technology both in teaching and learning.

Computer technology, and especially the new social services on the Internet (such as Wikipedia, Facebook, blogs and Twitter), has great democratic potential. Young people can spread their messages to the world, no matter how nonsensical or important. The technology provides new venues for communication, dissemination of information and knowledge from the grassroots, and non-state channels for cooperation and mobilization of local, national and even global actions. The school must provide teaching in these important technologies for a democratic development.

Pedagogical methods

Teaching methods involve both the use of digital tools in the teaching of content and the teaching of technology itself. In a recent paper, Beck and Øgrim discuss digital literacy for pupils and their teachers, concluding that there are three main categories in this phenomenon (Beck and Øgrim 2009). The ability to use ICT is one category, along with technical knowledge and the understanding of the dialectical relationship between technology and society. In addition, teachers need pedagogical and didactical competence.

Teaching with ICT requires the teaching of ICT. To put it banally: no one can use digital tools to write a text without skill in using a word processor. No one can make a digital video without the skills to use a camcorder and edit a movie. Skills are essential to make use of digital tools.

A fundamental challenge characterizes teaching in ICT: students need sufficient skills to master ICT in school while they acquire principled and durable knowledge. In other words, what should the relationship be between concrete, practical skills on one hand, and understanding and long-term expertise on the other? Understanding and long-term competence require competent teachers, who can set good examples.

Using digital tools in teaching includes a wide spectre of methods and activities. Digital tools can be used for researching phenomena in nature and society (for instance, one might search the Internet for information or use software to simulate growth in the population or the curve of a mathematical function). Pedagogical software can be used for instructions, training and exercises. Office tools and other software are useful for the students to produce their own

texts, and Internet services are useful for communication. The use of digital tools for these tasks contributes to motivation and variation, and in many cases, the learning is more effective with than without the use of digital tools.

TPCK

Shulman (1986, 1987) introduces the concept of Pedagogical Content Knowledge (PCK) to separate the teachers from the experts. The teacher programme in Norway is built around such PCK. All subjects in the study have a relatively comprehensive didactic component. An expansion, submitted by Mishra and Koehler (2006), is somewhat longer. The extended model includes knowledge of technology so that the core of the model is the interface between the three knowledge areas and disciplines, pedagogy and technology. The transition from PCK to TPCK therefore stresses the importance of technologic expertise. This transition is not yet well internalized in teacher education.

TPCK reflects the importance of seeing the complex areas of competence in context. The Knowledge Promotion curriculum makes demands on the teacher regarding digital skills that can be transformed into the integration of digital tools in all subjects; in other words, the teacher possesses a complete knowledge of TPCK.

Content Knowledge (CK) is knowledge about the subject to be taught. Through training, teachers get content knowledge in several subjects. Pedagogical Knowledge (PK) is generally covered well in Norwegian teacher education. All students have at least a half-year programme in pedagogy. Technological Knowledge (TK) includes various educational technologies in addition to knowledge of and ability to acquire new teaching technology as it launches.

The interface between knowledge areas is considered the most important area in the model. In addition to technical knowledge and pedagogical knowledge, all subjects within the teacher-training programme include didactics—no subjects are taught ‘purely’.

Formation

According to Klafki (Klafki 1963; 1993), the starting point in teaching should be the simple, elementary phenomena that give pupils the ability to create and form concepts and categories for structuring and analysing their ideas about their surroundings, drawn from their own experiences. The pupils then, in turn, can use these categories and concepts to understand their society, their culture, and themselves. This continuous building of concepts, categories, and structures is what Klafki denotes as categorical formation.

According to this theory, teaching should focus on problems that relate to daily life but, at the same time, provide examples of fundamental categories in society and culture. By establishing categories, the pupils begin to achieve knowledge regarding the field they are investigating. Not only do they fit single phenomena together in categories using special characteristics, but they also learn to identify special phenomena as belonging to this or that category. Categorical formation is fulfilled when the pupil is able to understand these categories as social and historical patterns of consciousness, decided and shaped from individual and collective interests. In this way, teaching can contribute to the pupils’ understanding of the historical and societal conditions in which they live.

I interpret the kernel of Klafki's theory on categorical formation as the ability both to understand and to question the categories that build a phenomenon. To sum up, Klafki sees formation as a result of dialectical processes of the subjects and objects of cognition. These dialectics can be understood in this way: A society that becomes an object of our cognition affects us and decides our formation at the same time as we, as cognitive subjects, are acting in and transforming that society.

Applying this theory indicates that ICT should be introduced and taught through cases close to the pupils' daily lives. The exemplary cases should, at the same time, be examples of fundamental categories in the culture of technology and in the dialectical relationship between technology and society. This implies that teachers should have a developed understanding of technological phenomena, and their possible categories.

In order for a school to fulfil its obligations, the pupils should have the opportunity to investigate possible categories of this complicated phenomenon. They should also receive guidance in their investigations. As a consequence, their teachers must be more competent, or, in Klafki's terms, they should be further advanced in their own technological formations.

This requires competent teachers who can identify good examples the pupils can use as components in their building of categorical formations.

Research methods

The research is conducted through the Ballast project (Ballast, Engen et al 2009, Engen et al 2008, Engen and Øgrim 2009). The purpose of this research project is to achieve a closer link between teaching in the use of ICT in teacher education and teaching in and with ICT in primary schools based on Knowledge Promotion. The first phase, which is presented here, examined how students' knowledge and skills in the pedagogical use of ICT influenced their teaching practice as newly qualified teachers.

This paper presents and analyzes data from a survey and interview study on digital literacy among teachers qualified from Oslo University College in spring 2007. Through the study, we have, among other things, sought to find out what digital skills the teachers had and how they used those skills in the classroom with pupils.

The data collection was conducted during spring 2008 and included a questionnaire sent to all graduated teachers from 2007, and qualitative interviews with 30 selected graduated teachers. The 30 interviewees were selected based on the degree of their exposure to training in digital literacy during their education.

Around 170 students completed their teacher training at OUC in the spring of 2007, and about 45% of these responded to the questionnaire.

The purpose of this study was to determine how newly qualified teachers assessed their own digital competence in the use of ICT in their professional practice and to what extent they felt that the Oslo University College had helped build this expertise. In this paper, I have chosen to concentrate on three research questions:
1. To what extent do newly qualified teachers feel that they have sufficient expertise to carry out teaching with the educational use of ICT?
2. To what extent, and in what manner, do graduated teachers conduct their teaching with the educational use of ICT?

3. What seem to be the most important factors in relation to the teachers' use of digital tools in their work practices?

Results

Both parts of the survey indicate that the schools has adequate digital equipment and do not consider lack of computers a critical factor with regard to the pedagogical use of ICT. On the contrary, the schools seem to arrange flexible solutions regarding access to computers. Computers are placed in classrooms, group rooms and computer rooms. Some schools also have trolleys with laptop computers.

Some teachers feel they are not able to use their ICT skills in school. More teachers with specialization in ICT express difficulty realizing the knowledge and skills they have within the existing conditions. For this group, using ICT in teaching comes naturally, but conditions related to the organisational culture of the specific schools limit their opportunities and freedom of action. This group also reflects that the lack of digital literacy among their fellow teachers makes it difficult to fulfil the intentions of the Knowledge Promotion in integrating ICT in all subjects at all levels.

Several interviewees in this group point out that the very goal of integrating ICT in all subjects and at all levels may be a barrier to conducting skill-oriented ICT teaching, due to unclear lines of responsibility and a lack of structure and continuity in the development of pupils' digital literacy.

Technological knowledge

E-mail, Web use, word processing and LMS stand out as areas where the respondents feel they have expertise. Most respondents state that they possess enough expertise in image processing and spreadsheet creation to use them in teaching. Only a few of the newly qualified teachers consider themselves competent in using new Web technologies and creating Web pages.

Office tools are also widely used in practice. Word processors are used frequently in the preparation of material, teaching and communicating in writing. Presentation programs are also used regularly, while spreadsheets are used to a lesser extent. The Internet is more intensively used in lesson preparation than in actual teaching, but the number who never uses this technology is small. Regarding the use of various services on the Internet such as e-mail, Web browsing and LMS, activity is high in both the preparation of teaching and the interaction with pupils in the classroom. The Internet is mostly used in the theoretical subjects, and it is also in these subjects that the new teachers are most confident in terms of pedagogical and didactic use.

The group with medium technological exposure does not only use ICT in preparation and follow-up work, but also uses ICT resources in interaction with pupils. The technological activity is not limited to use as such, but also has the ability to put digital tools into use in a pedagogical setting. The latter implies an understanding of ICT as a learning resource and that the pupils have developed their digital skills. Several interviewees in this group have particular ICT responsibilities in their school.

The group with heavy technological exposure is in a unique position. Most interviewees in

this group are assigned a special responsibility to train pupils in the use of ICT and to guide colleagues in their school. In addition, they take part in the work of the school's ICT strategies. This group integrates ICT into many of their tasks at the school, like teaching in language, mathematics og social sciences. ICT is an important component of their activities with pupils. Several interviewees said they use ICT in pedagogical development in both the design of teaching materials and in project work with pupils.

In other words, the tools teachers know best are most in use, both in relation to lesson preparation and teaching.

Many respondents feel that they have learned word processing through their studies. Although many could use a word processor before, they have learned a systematic and pedagogic use at OUC. Many also mention the LMS. Although many of the interviewees called for an introduction to the teaching functions of the LMS, they have a good foundation through using it systematically throughout the study period. In particular, one area is cited as positive despite the fact that it is little used in schools—namely, the ability to create Web pages. Very few teachers design Web pages in their school context, but particularly teachers with specialization in ICT experience could benefit from this expertise.

The digital tools that have been intensively and systematically used in the teacher training programme are the tools in which the newly qualified teachers report the highest competence and the tools that they use most often in work practices. These tools are used in both a pedagogical and a professional context.

On the basis of the data, there are good reasons to assume that there is a correlation between a teacher’s degree of exposure to ICT-based teaching and learning methods in the teacher education and her later use of these methods in the work context. Logically, what teachers know best, they use most in practice. Teaching students who have experienced learning situations with ICT throughout their training are more likely to transfer this experience and knowledge to their own practice as teachers.

The skill areas new teachers master to the greatest extent are those in which there has been systematic and continuous training and use in their studies. Similarly, we see that they have less mastery of the areas in which training has been more sporadic.

Conclusion

In relation to Norwegian educational conditions, with an integrated and interdisciplinary teaching education, we can draw the following conclusion: If training in technological knowledge is implemented systematically and continuously through teacher training, teachers will gain TPCK.

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