Integrating ICT without throwing the baby out with the bathwater

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Abstract: This paper presents a case study of how novice schoolteachers experience the usefulness of ICT skills in their work context as professionals in compulsory schools in Norway. The first part describes the general framework for teaching ICT in schools in which ICT is one of five basic prioritised skills and introduces the analytical framework that we apply in our analysis. This framework has three dimensions: technology, pedagogy and organisation. To guide our analysis, we use the critical-constructivist theory on categorical formation. The second part is an empirical analysis of the conditions for teaching ICT in schools. This analysis describes novice teachers, their digital literacy, their teaching practice with ICT, and how they experience the conditions in which ICT is used to support learning activities in classrooms. The findings are discussed in relation to the manner by which society incorporates ever more integration of ICT into all different areas of life. More specifically, the way that the Norwegian school system has tried to meet this challenge through the ideal of integrating the use of ICT in teaching and learning activities in schools is documented. This paper provides insight into the interplay between student teachers' ICT training and novice teachers' work context.

Introduction

Since the introduction in 2006 of a new curriculum for primary and secondary schools in Norway (The Ministry of Education and Research 2006), the issue of digital literacy has attracted a great deal of interest among both researchers and policy makers. The new curriculum has emphasised five basic skills, including those related to the use of ICT. In Norway, ICT is not an independent subject in primary and secondary schools, but is an integrated part of all subjects and teaching activities. Consequently, schoolteachers' skills in using computers as pedagogical tools are obvious prerequisites for implementing ICT in an adequate manner (Beck and Øgrim 2009 (forthcoming); Hakkarainen et al. 2001). This becomes a challenge for teacher education: not only must we integrate ICT throughout the entire teacher training program, but we must also prepare our students with the skills necessary for fulfilling curriculum obligations when they start working as teachers.

From the schools' point of view, integrating ICT in all subjects is also challenging. ICT is supposed to support all learning activities. The need for practical ICT skills among teachers and pupils is evident as these skills are required for supporting other learning activities. In addition, digital literacy is seen as a quality on its own, allowing pupils to function as future citizens.

This paper presents and analyzes data from an ongoing study focused on understanding how novice schoolteachers experience the usefulness of ICT skills in their work context as professionals. At a more general level, our study examines whether the teacher-training program is solid enough to meet the political initiatives and expectations behind the curriculum reforms for compulsory education in Norway. Our research questions are tied to the ambition of improving our teaching in ICT-supported learning as well as improving novice teachers' pedagogical use of ICT in schools.

Framework for teaching ICT in schools

As we pointed out initially, ICT is defined as one of five basic skills in the 10-year compulsory school and in upper secondary school system in Norway. Schools are to prioritise the cultivation of basic skills in all subjects. This is seen as an important foundation for all other learning. These basic skills are:

- The ability to express oneself orally
- The ability to read
- The ability to do arithmetic
- The ability to express oneself in writing
- The ability to make use of information and communication technology

One of the challenges faced when it comes to integrating ICT in teaching is the organisational issue, since all the other basic skills can somehow be identified with a specific subject. 'To do arithmetic' is identified as doing mathematics, 'to express oneself in writing', 'to read', and 'to express oneself orally' to performing language skills. However, ICT is not in associated with any specific subject in school and is therefore in need of extra organisational and pedagogical considerations.

Recent research in school practice in Norway (primary and secondary schools) shows that schoolteachers have increased their ICT competence (Arnseth et al. 2007; Engen et al. 2008; Ludvigsen and Rasmussen 2006). On the other hand, they mostly use ICT to prepare lectures, and not as an integrated part of their interaction with pupils. There are also international studies that underline a gap between teachers' ICT knowledge and their skills in using it to support pupils' learning in classroom settings (Cuban 2001; Granger et al. 2002; Pope et al. 2002). There are, to the best of our knowledge, no established theories on how technology-enhanced classroom learning practice can guide such efforts.

Teachers still have problems in integrating ICT with other learning resources in a fruitful way. At university, teacher students attend courses that concentrate on learning common software, such as word processing, spreadsheets, and user friendly html applications for making blogs or home pages. Obviously, mastering these kinds of software is necessary for students to be able to use ICT to support learning. However, digital literacy involves more than simply using a computer to support learning. Digital literacy includes skills in using computers and other ICTs, knowledge about technology as such, and understanding of the dialectical relationship between technology and society. In the school context, digital literacy also (and perhaps first and foremost) includes pedagogical knowledge on how to use ICT to enhance learning and how to teach digital skills and competence to students.

Analytical framework

We apply the critical-constructivist theory on *categorical formation*, presented by Wolfgang Klafki (Klafki 1963; Klafki 1993), developed through a thorough discussion of the notion of formation (German 'bildung'). According to Klafki, the starting point in teaching should be with the simple, elementary phenomena that give the pupils the possibility to create and form concepts and categories for structuring and analysing their ideas about their surroundings, drawn from their own experiences. The students 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 be focused on problems that are related to daily life but, at the same time, are 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. The 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.

We 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 is made 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. This is well in line with the idea of integrating the use of ICT in all subjects at school. The exemplary cases should, at the same time, be examples of fundamental categories in the culture of technology and in the dialectical relation between technology and society. This implies that teachers should have a developed understanding of technological phenomena, and their possible categories.

In a recent paper, Beck and Øgrim discuss digital literacy for pupils and their teachers, and conclude that there are three main categories in this phenomenon (Beck and Øgrim 2009 (forthcoming)). The ability to use ICT is one main category, along with technical knowledge and the understanding of the dialectical relation of technology and society. In addition, the teachers are in need of pedagogical and didactical competence.

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 be given guidance in their investigations. As a consequence, their teachers should be more competent, or, in Klafki's terms, they should be further advanced in their own technological formations.

Data collection

In order to investigate the research questions mentioned in the introduction, we carried out a survey and approximately 30 in depth interviews during the spring of 2008 with novice teachers educated at Oslo University College.

In total, there were approximately 170 graduate students in the spring of 2007, out of which approximately 45 % responded to our questionnaire. More than 30 interviews were conducted over a twelve week period. The research was thematically centred on aspects that related to the respondents' experience with ICT as teacher students, how they considered their own skills in using ICT in connection to the work context as novice teachers and their impression of the students' ICT literacy in schools.

Results from our questionnaire have been discussed in more detail elsewhere; for an in depth discussion, see (Engen et al. 2008). In the context of the present paper, we will therefore just give some general background statistics.

Table 1.   *Distribution of teachers allocated to primary, upper primary and lower secondary schools*

Distribution of novice teachers (N=71)

- 33 % — Primary school
- 36 % — Upper primary school
- 20 % — Lower secondary school
- 11 % — Other
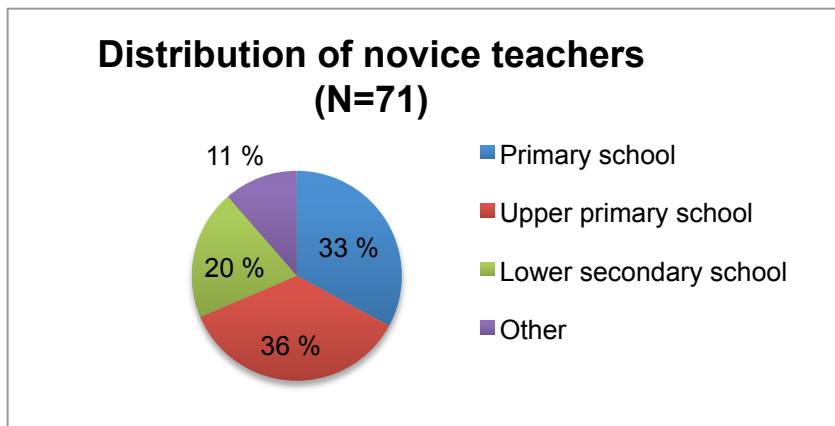
The chart above shows the distribution of novice teachers in our study, as allocated to primary, upper primary and lower secondary schools. Of the total, 69 percent are teaching in primary schools and 20 percent are teaching in lower secondary schools. With regard to gender, 75 percent of the respondents are females and 25 percent are males. They teach in all different subjects.

The choice of the 30 participants for the interviews from this cohort where based on their major area of study during their last two years of teacher education. The distribution is as follows:

- 10 participants with a major in ICT
- 10 participants with a major in social studies or natural science
- 10 participants with a major in subjects other than those mentioned above

Our findings confirm a relatively strong connection between exposure to ICT in the study context and later use of ICT in a work context. The group of teachers with a major in ICT-supported learning can be characterised as having a deeper understanding of, and skills in using, ICT for the purpose of teaching and learning; more so than the average teacher. In this paper, we therefore concentrate on this group of participants. This group is characterised by a higher level of technological formation than the average. They are more likely than the others to use ICT extensively in their work, as well as in their classrooms with their pupils, and their reflections show signs of their specialisation in the field ICT-supported learning. This group of novice teachers has every precondition to implement ICT as a tool for teaching and learning in the interplay with pedagogy and content. These teachers also teach other subjects like arithmetic, language, sports and science. In addition, they are also trained in pedagogy from their teacher education.

Our choice of participants does not give a representative image of how the average teacher may be using ICT to support teaching activities. However, the reflections of this cohort of participants provide us with an opportunity to construct images of what is possible within a contemporary framework in Norwegian schools.

Analysis of results

The new teachers with majors in ICT-supported learning view themselves as digitally literate and confident. In fact, they consider themselves to be among those with the best technological competence at their work place. They also find that their employer and colleagues have expectations of them in guiding and supporting their workmates, and sometimes of them carrying the entire burden of teaching ICT skills to the pupils. They also often participate in developing local plans and strategies related to ICT.

Pedagogical use of ICT

The novice teachers use ICT both in interaction with their pupils in the classroom, in preparation, in cooperation with colleagues, and in contact with parents. In particular, MSOffice (or similar products) and the Internet are much used.

Classes dedicated to ICT training seem to be less common than previously. Even if learning in a realistic context is useful, for instance as according to Klafki, the ideal of ICT training integrated into all subjects may lead to dissolved responsibility, as well as a lack of systematic and varied training tied to necessary progression.

Many practical understandings[1] of ICT portray it as a context-free or neutral tool. Terms for using ICT to support teaching and learning are easily reduced to aspects like planning documents, motivation, skills, etc. This represents a kind of abstraction from both the organisational and user situated context. We argue that what really shapes and leads to a successful use of ICT for the purpose of teaching and learning must, and will, always be rooted in concrete and local conditions, in line with Klafki. Similarly, generalised ICT plans are worthless if they are not accompanied and supplied with concrete local practices. As one teacher said:

> *You know, working with general ICT plans – it disappears – the more general aspects disappear in every day work.*

The absence of connection between general plans and ICT strategies and daily work also has consequences for how ICT is taught. While some schools have dedicated computer labs, others have portable computers that are moved around when needed. Findings indicate that computer labs stimulate teaching ICT skills, while portable computers in ordinary classrooms stimulate learning *with* ICT. As a novice teacher explains:

> *We are located in the classroom and then we have to move to another room- often because we are finished with other tasks. And the pupils think of this as a reward of some kind. It's very chaotic.*

> **If you were able to decide, how would it be then?**

> *I would like more computers in my classroom. ..[..].. I feel really resigned. Computers and printers are not working. Most of my colleagues don't even know how to connect a printer. And it's difficult to acquire such skills when you are in a teaching situation with a classroom full of pupils.*

Obviously, ICT is seen as little integrated in daily teaching and learning activities at school. The cause of this situation is not so much explained by teachers' skills in using the equipment, but is a more general organisational problem on how to integrate ICT seamlessly with other teaching tools such as paper, pencil, blackboard, etc.

Timothy Koschmann (Koschmann 1995) has suggested that ICT-supported learning should be organised according to a strategy that he calls 'learning *with* computers', as opposed to 'learning from computers' or 'learning through computers'. By this, he means that ICT should be treated as equal to, and as an alternative to, other learning resources such as textbooks and classroom-based instruction. Koschmann's suggestions relate to what we may characterise as an ideal teaching and learning situation and what may be described as a "gap closing" activity (Eklund et al. 2009; Engeström and Toiviainen 2009), which is inevitable in a complex teaching context. However, pupils also need to learn *about* computers in order to be able to use ICT as a learning tool.

Technological knowledge

All citizens need to know something about the most important technology in society. This makes changing of models and versions easy, and provides tools for democratic participation in the technological society. In addition,

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[1] The term 'practical understandings' aims at ways of thinking which can be interpreted of what people do and which is often contradictory to what kind of thinking they say they have (Argyris and Schön 1974).

knowledgeable persons are better off in an error situation, and technological understanding also may prevent user-triggered errors.

Teachers need to find new, engaging ways to convey a pedagogical understanding of the technology (see Mishra and Koehler 2006). Whether the responsibility for this lies in the subject of social sciences, natural sciences, or a dedicated technology subject is not important, but competent teachers need to keep their hands on this side of the pupils' formation, which should be developed throughout their time at school.

Last, but not least, the pupils need to gain experience in how technology acts as a part of society. This can make the basis both for understanding technology in a societal perspective and for developing opinions on and gradual democratic participation in the technological society.

The dangers of exposing oneself on the Internet and issues of privacy and copyright are factors that should be in focus at school. These are necessary elements, but there are more.

Kristen Nygaard, a well known researcher in informatics, used the concept of *perspective* to stress the point that no technology is context-free or neutral (Nygaard 1986; Nygaard and Sørgård 1987). Since technology is created by humans, it is based on human ideas and visions of applicability, user context and user behaviour. All technology is developed from a purpose, to support specific interests. Uncovering what interests are implicit in a technology can help the users to understand this specific technology, and thereby to obtain freedom in deciding how to use it. Every technology is characterised by the developer's perspective, whether this is done on purpose or not. To gain awareness of the perspective enables a critical distance from the users, in line with Klafki's ideas on categorical formation. The perspective decides, according to Nygaard, what qualities (or categories) are to be emphasised in a specific situation, and thereby also what qualities are not emphasised. In particular, the perspective decides what concepts and representations are used in the interpretation of the chosen qualities (or categories).

The frameworks for using ICT in teaching became even clearer when we asked the novice teachers how they experienced the transition from education to the work context. In a contextual perspective, the transition from education to work will always be challenging (Eraut 2004). Several studies stress that newly educated teachers find themselves in the crossfire between education and the workplace context (Nygren 2004). Previous studies have also indicated that when schoolteachers are beginning their careers, they are often focused on using the theories and pedagogical models from their teacher training as a basis for analysing their own pedagogical practice (Flores 2002; Jordell 1982). Based on this background, we were interested in how they understood the potential for using ICT in teaching practise.

> It was very exciting. At last, to meet the kids ..[..].. It's much better now than when I was a pupil. We didn't even have computers at school. In a way it is like I expected ..[..].. and my colleagues don't use ICT much – they are not interested in using ICT either. They need help to accomplish the most basic tasks. On the other hand, I think there a relative good infrastructure when it comes to ICT at this school.

> **And how do you consider your opportunities to use your pedagogical ICT skills achieved from teachers college?**

> I felt it useful – but – I felt it more resource demanding since I had to organise everything myself. Because I had to – it wasn't really arranged for using ICT at this school.

As seen from the extracts above, the teacher's utterance reflects ambivalence. On the one hand, the teacher is expressing enthusiasm towards starting a professional life and using ICT in teaching. At the same time, the participant starts to reflect over the situation: First, on the teaching staff's more or less resignation to use ICT in their teaching activity; and second, on how ICT supported teaching and learning is organised at this particular school.

Organisational conditions

We asked all our participants a general question on how they were using ICT in preparation, teaching and supplementary work. As one novice teacher said:

> I'm using it a lot. To support teaching, in preparation of teaching, to support evaluation of my pupils ..[..].. I also teach ICT to our pupils. But I'm not supposed to do that next year. I think it's problematic according to the new curriculum.

The teacher starts with information on how ICT is used in work practice, but ends up reflecting on more generalised conditions for teaching with and about ICT at this particular school. The most interesting utterance in the quotation is the interpretation of the new curriculum. Throughout the interview, the teacher is expressing uncertainty

if it is compatible with the new curriculum to provide the pupils with dedicated teaching in ICT. Among the teachers at this school, there is a belief that they are not allowed to teach practical ICT skills, as ICT is supposed to be integrated in teaching other subjects.

Other novice teachers at different schools have, to more or less of a degree, the same interpretation of the new curriculum. On the one hand, teachers are indeed supposed to teach pupils practical skills in using ICT, while on the other hand, this kind of training is to be given in parallel with the teaching of other subjects. In the concrete teaching context, these teaching activities feel contradictory.

Although we see some variations between schools when it comes to access to ICT tools, the main challenge for integrating ICT in concrete teaching and learning activities occurs at an organisational level. The novice teachers also point out a large gap between visions, ideas and objectives in curriculum plans and how the preconditions for implementing these in a concrete teaching context actually function.

An important condition for using ICT to support learning and teaching activities is, of course, an integration and adaptation to different learning and teaching contexts. However, this does not necessarily mean exclusion of teaching of the practical use of ICT. Preliminary findings from our study indicate that (or at least raise the question whether) ICT should be an independent subject in primary and secondary schools, in line with arithmetic, reading and writing.

Summary and directions for further work

As society develops, there is ever more integration of ICT in all different areas of life. The Norwegian school system has tried to meet this challenge through the ideal of integrating the use of ICT in the teaching of all subjects. This is a splendid idea that corresponds to Klafki's ideas of taking simple, elementary phenomena as the starting point in teaching.

However, if the pupils' experiences with simple, elementary daily phenomena are to have the desired effect, namely to contribute to categorical formation, the teachers must have a technological overview and the teaching must be organised in a way that allows the teachers to explain simple phenomena as examples of fundamental categories.

The title of this paper is warning about throwing the baby out with the bathwater. We see digital literacy and technological formation as the 'baby', which should be nursed and cared for throughout the school years. We see the integrated use of ICT in all subjects as the 'warmed and oiled bathwater', an important ingredient in baby care. However, we warn that the integration may lead to dissolution of responsibility, so that nobody really will be taking care of the totality of the pupils' technological formation. Thus, the baby is in danger of being thrown out with the bathwater.

The school then misses out on two important aspects: First is the possibility of introducing the pupils to more elements of the technology; ones that are specific and that do not necessarily fit into other subjects. Second, without a specific focus on ICT, it is unclear how the teachers can develop competence in this area.

Competence in teaching ICT includes the three elements of digital literacy, in addition to specific competence in ICT didactics.

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