

IMPLEMENTING ICT IN EDUCATION — MORE THAN BUILDING THE INFRASTRUCTURE?

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Abstract

Since 1994 Sweden has carried out a number of initiatives for integrating ICT into education that are funded by the Government and other actors. Huge amounts of money have been invested in developing infrastructure. However, it seems that there is still a gap between the claims for ICT use in education and the current practice of using ICT in classroom. The intention of this paper is to present and analyze potential “barriers” that have brought about the ineffective use of ICT in classroom and to provide some backgrounds for suggesting models of Technology Enhanced Teacher Professional Development.

Introduction

IT is one of the most important political issues for the Swedish Government. In the statement of the Government Bill (Proposition 2004/05:175), the new goal for IT politics is that Sweden will be one of the outstanding countries of information society for all. Sweden will strive to be an outstanding IT nation with high use and great benefits of IT in all areas of the society and for all social groups. It is argued that the regulation system, education and infrastructure should give priority to increase confidence in IT, competence to use IT, as well as access to the services of information society in the aim of create a information society for all.

In the area of education, the European policies of ICT in education have had great influence on the Swedish policies of ICT in education system. One of the first policies in European context concerning ICT in education was issued by the Lisbon Council (European Council, 2000). Since then Sweden has been one of the countries in Europe at the leading position of the rapid transition towards the information society, in which to invest and develop integration of ICT into education systems has been the most important national strategy. Following the Lisbon Council policy of EU, Sweden has carried out a number of projects funded by the Government and other foundations such as the Knowledge Foundation (<http://www.kks.se/>). Most of these programs were nationwide. Huge amounts of money have been invested in developing infrastructure such as Internet access, e-mail use, hard- and software installation in classrooms, as well as in improving teachers' competence of using ICT in teaching and learning through cooperation among municipalities, universities/institutions and schools. Sweden ranks one of the best among the 27 countries in Europe in dealing with ICT infrastructure in

schools (European Commission Information Society and Media, 2006).

A recent commission staff working document (Commission of the European Communities, 2008) reports on how the use of e-learning has developed since the Lisbon Council. In the document it is stated that the impact on education and training has not yet been as great as expected, that embedding ICT in education requires further changes. Although ICT has the potential to support lifelong learning, this has not yet been realized. In the conclusions of the report, it is called for a renewed approach towards ICT for teaching and training. In this approach, one aspect is upgrading the digital competence and to shift from access to quality of use of ICT for learning. Some recent investigations also indicate that a majority of Swedish teachers actually do not use computers in classroom as much as they are expected to do. Knowledge about the use of ICT in teacher education is reported as being not good enough, and almost half of the students are not satisfied with the knowledge they got about IT use in their future teaching (European Commission Information Society and Media, 2006; Knowledge Foundation, 2005, 2006). In brief, in spite of political commitment and financial investment at national level, it seems that there is still a rhetoric-reality gap between the claims for ICT use in education and the current practice that reflects the complicated process of implementation.

This paper emphases on the issues of implementation of ICT in education in Swedish context with a special focus on demands on teachers and their professional development in relation to ICT practice in schools. Integration of ICT into education is actually more than a question of merely innovation of technology and its adoption in practice — it is dealing with all other aspects concerning teaching and learning. What are the conditions, at school and teacher level, that are necessary for a successful implementation of ICT in schools, and what can these be connected to the concern of effective models for teacher professional development aiming at promoting integration of ICT in education?

Background

Integration of ICT in education has been extensively studied in various sub-areas and in different perspectives during the last fifteen years. Some studies have focused on the important role of national policies (macro level) concerning ICT in education (Jones, 2003; Kozma, 2003). It is realized that strategic policies can serve functions such as providing rationales, goals, and visions for integrating ICT in education aiming at motivating change and coordinating disparate efforts so as to improve the nation's overall educational goals. Companion operational policies provide possibility to carry out programs and provide resources to enable these changes. Some studies have emphasized on measuring the impact of variables at

individual level (micro level) such as using ICT in classroom, teachers' and pupils' computer attitudes and experiences, as well as gender and ethic issues (Albirini, 2006; van Braak et al., 2004; Volman et al., 2005). Focus on the local conditions for ICT use in education and those school-related factors (meso level) such as variability between schools in organizational culture, policies/action plan, and innovation and performance capacity and contextual characteristics of schools are also presented (E-learning Nordic, 2006; Tondeur et al., 2008).

Increased access to ICT and its potential advantages in teaching and learning have been realized and discussed in many countries around the world. Research has found that ICT is under-used in many schools and the potential of ICT is not being realized (Abrami, 2001; Conlon & Simpsons, 2003; E-learning Nordic 2006; European Commission Information Society and Media, 2006). The potential barriers to a successful and effective integration of ICT in schools are identified by previous research, in which both environmental variables and individual characteristics of teachers are regarded as the critical factors. Environmental barriers concern equipment and resources issues such as limited access, technical problems, lack of time and support; while barriers at individual teacher level deal with issues such as individual differences in beliefs, attitudes, perceptions, knowledge and skills of integration of ICT in education among teachers (Ertmer, 2005; European Schoolnet, 2006; Mishra & Koehler, 2006; Mueller et al., 2008; Wood et al., 2005).

Giving importance to the environmental and organizational conditions in facilitating implementation of technology innovations in education, Ely (1999) also lays stress on factors and conditions at teacher level. According to him, dissatisfaction with the status quo could be an innate feeling or an induced state that calls for change. Existence of knowledge and skills is another important factor that influences the direction and process of implementation in the area of technology innovations, but new knowledge and skills are also needed to make implementation of technology innovation possible and individuals who involve in innovations need thus time and opportunity to renew their knowledge and get new skills. Active participation through shared decision-making and good communication among all parties is also seen as of being crucial. Briefly, these conditions reflect the characteristics of teacher profession in the new technology age and thus claim a new perspective on teacher professional development (TPD), as well as new systems and models of TPD (Villegas-Reimers, 2003). Teachers' ICT training connected to school subject specific practices and immediately and continuous support is regarded as an important influence on how well ICT is embraced in the classroom (Baylor & Ritchie, 2002).

National ICT Policies and Initiatives

In spring 1994, the Government appointed a Commission to promote widespread use of information technology in Sweden. The Commission had a great influence in society during its first years. One of its mayor initiations was the project of National Action Program for ICT in Schools (ITiS) launched by the Swedish Government (Regeringens skrivelse 1997/98:176).

ITiS was an ICT-project as well as a school development project. It included all educational actors in pre-school, compulsory school, special school, sami school, upper secondary school and municipal adult education. All Swedish municipalities chose to participate in all parts of the program. Four guiding principles underpinned the planning of the program and informed the implementation in the municipalities. Equal standards between schools and quality for pupils, as well as the dimension of school development were stressed. A Delegation was formed to take the responsibility of distributing state grants to the municipalities to improve the Internet access of schools, creating opportunities for all pupils and teachers to have e-mail addresses, offering in-service training activities for about 75.000 teachers in teams (about 60% of the total number of teachers in Sweden), making computers available for home use by the teachers who have obtained an ICT certificate, supporting the development of the Swedish Schoolnet and the European School-net, and making special arrangement for functionally disabled students.

Swedish Schoolnet was another initiative carried out to develop ICT access and use in Swedish schools (from 2008 ICT for teachers). It was an online framework for teachers, educators and students with the overall goal to stimulate and support active and collaborative learning by using IT in schools. In the beginning (since 1994) it was provided by the Swedish National Agency for Education (since 2003 by the National Agency for School Improvement) and financed by the government. The Schoolnet had the objective to provide a platform for the development of new educational approaches opened up by the Internet and new multimedia technologies. One of the important functions for Schoolnet was also to give information and to support the decision makers at regional and municipal levels in developing suitable products for use in schools. It functioned also as an information centre, a library and a news agency. Schoolnet was supposed to be a useful forum for communication and activities of teachers and students to set up a network of contacts and initiate discussions with each other all over the world (www.skolverket.se).

From 2008 the National Agency for School Improvement no longer exists, and the content and responsibility for ICT in education was again transferred to the Swedish National Agency for Education. In the Agency's support for

improvement, IT in schools is one area. The Agency now provides a new website, ICT for teachers, for teachers with common interest in using ICT as a tool for education. Through the new website teachers have access to several resources, among which the professional development tool PIM (Practical IT and Media skills) with a purpose of enhancing teacher skills in using Information Technology in schools is worth noticing. PIM is an online platform for teachers with common interest in using ICT as a tool for teaching and learning. Through the website, teachers have access to several resources. PIM is a combination of supervisions on Internet, study circle and daily support. The project is a part of a mission of the Swedish National Agency for Education given by the government. It consists of ten guides in a range of fields covering all kinds of topics. Materials can be used for both individual teachers and teacher teams. The supervisions can even be used in daily work, for instance, when teachers and students need direct help and support in using some programs. All materials are of free use for all educators in Sweden. In autumn 2007 PIM engaged somewhat 30,000 teachers. In addition, teachers are guided to the eTwinning partnership through the website, with a purpose to collaborate through the Internet with partner schools in 27 European countries (<http://pim.skolverket.se/>).

In 2005, The Swedish Knowledge Foundation started the greatest investment in Sweden on IT in schools and education since the ITiS project. About a hundred million Swedish crowns should be invested in a program to strengthen IT in teacher education during a ten-year period. One reason for this program is the results from the 2005 investigation of the attitudes, access and use of IT of student teachers where it was reported that ICT was not integrated good enough into teacher education and that teachers were not prepared with sufficient knowledge and skills concerning ICT that was needed in their classroom practice (Knowledge Foundation, 2005). The first step in the Knowledge Foundation program has been to initiate three projects (LIKA: Learning, Information, Communication and Administration; KompLIT: Competence development in Teacher Education through IT; Ung Kommunikation: Young Communication), intended to run between 2006 and 2010, to highlight certain areas of teacher education. These projects are to be carried out in cooperation with the municipalities concerning in-service teacher training, as well as with other actors such as industries and institutions. The next step already in progress is to build a network among all teacher educations in Sweden that intends to support experimentation and development of joint projects aimed at increasing the use of ICT in teacher education at large.

ICT Infrastructure in School and Use of ICT in Teaching

One major outcome of these national policies and initiatives in the area of ICT in education is the greater extension of access to IT equipment in Swedish schools. By 2006, all teachers have access to computer in which 45% have own computers in schools. 96% teachers and school leaders have access to Internet and e-mail (Knowledge Foundation, 2006). According to a survey in mission of European Commission (European Commission Information Society of and Media, 2006), all Swedish schools use computers for teaching, and have Internet access by the year 2006. 89% of schools use the Internet via a broadband connection. In fact, in the aspect of infrastructure of ICT in school, Sweden ranks at the top of the 27 countries in Europe according to the survey.

In using of ICT in schools, it is reported that more than 90% Swedish schools have integrated ICT into teaching subjects in one or another way (European Commission Information Society and Media, 2006). However, ICT use by teachers in classroom in Sweden is not the most frequent and intensive in Europe, if comparing to Finland for instance. 54% of teachers use computers in less than 10% of all lessons. The majority of Swedish teachers are satisfied with the technical access means at their schools, but they also state the problems to find adequate learning materials (62%) and argue that the existing materials are of poor quality (54%). In this respect, no other countries in European Union have reached such high figures, which need to have further studies to identify the underlying reasons for this phenomenon (European Commission Information Society and Media, 2006).

E-learning Nordic 2006, which involved four Nordic countries (Finland, Sweden, Norway and Denmark) is the first inter-Nordic study concentrated on the impact of ICT on education. The aim of the study is to discover and document the perceived impact of ICT on education by teachers, pupils, headmasters and parents within three key areas such as performance of the pupils, teaching and learning processes and knowledge-sharing, communication and home-school cooperation. It is assessed by pupils, teachers and parents that ICT generally has a positive impact on teaching and learning, but it was also expected that ICT could and should have more revolutionary impact on teaching and learning processes in schools. The study indicates that the potential of ICT is not being fully realized at all schools and the use of ICT as a tool for pedagogical development is not in focus. ICT has been used in improving knowledge-sharing, communication and home-school cooperation in many schools, but it is not moderate and it is believed that it could and should be a more powerful tool in these areas (E-learning Nordic 2006).

The Knowledge Foundation has, for more than 10 years, supported and developed the use of ICT in schools. During this period the Foundation has continually investigated pupils', teachers' and school leaders' attitudes on ICT use in schools. The latest investigation was conducted in 2006, in which 1200 teachers, 600 headmasters and 1200 upper secondary school pupils participated in the survey. The major results show that a great majority of pupils and many teachers assess the pedagogic usefulness by using ICT in school assignments. However, almost one fifth of the teachers state that they do not use computers in the lessons at all. Teachers who have taken part in ITiS use computers in higher extension than other teachers, and elder teachers use computers in their lessons more than younger teachers do. The result also shows that the IT supported communication has greatly increased. Seven of ten teachers communicate with pupils via e-mail. Six of ten teachers communicate with the parents via e-mail. Generally, using computers in communication, administration and information searching in school context by teachers are more frequently than directly using in teaching (Knowledge Foundation, 2006).

Swedish teachers have positive attitude towards using IT in teaching (83%), but comparing to headmasters (94%) and pupils (89%), this percentage is lower. More than half of teachers realize the usefulness and advantages of integrating IT in teaching as pedagogical tool, i.e. in facilitating information searching, computer practice, and learning, increasing pupils' motivation and stimulating the process of writing and critical thinking, and making easier for communication between teachers and pupils. But on the other hand, more teachers than school leaders and upper secondary pupils realize the difficulties or barriers for using ICT in teaching (Knowledge Foundation, 2006). Major barriers concerned by the teachers were poor equipment (60%) such as too little computers (69%) and too slow computers (51%), as well as teachers' lower competence of using IT (61%). Development of technology is too fast that the teachers (42%) feel that they are not able to keep up with updating their knowledge is another reason given by the teachers. About a half stated that they have had too little time for using IT in teaching. Moreover, concern of wrong use of Internet by pupils and wrong or false information on Internet has also been the reason that teachers do not give priority to integrating ICT in teaching.

In 2005, the Knowledge Foundation conducted a large study on student teachers. The results show that the access to computers and Internet among the students is high, but their use is more frequent at home than at the university. They report having enough knowledge about emailing, information seeking, and word processing, areas in which they use IT in teacher education as well, but their knowledge on using software for presentations is not enough. Only three of ten students report that teacher education has dealt with new skills in the use of IT, and a majority believes that the teacher educators' ability to use IT was not

enough. Knowledge about the use of IT in teacher education is not good enough, and almost half of the students report that they are not satisfied with the knowledge they got about IT use in their future teaching (Knowledge Foundation, 2005).

Discussion

In over ten years, the Swedish Government has had sustainable commitment and substantial investment in promoting ICT in schools and encouraging teachers to use ICT. Both strategic and operational policies are provided at the national level. The strategic policies provide common visions of significant expenditures required for employing ICT in education; while operational policies, which usually frame as action plans, programs or projects, offer the opportunities to enable these visions to be reached (Kozma, 2003). Some positive outcomes of this national effort have been the development of ICT infrastructure in Swedish schools, cooperation between schools, municipalities, industry and teacher education, and providing teacher training, especially in-service training that emphasizes on teachers' knowledge and skills needed in using ICT in classroom. In this respect, the effectiveness of a degree of top-down initiatives and companions in putting ICT-related change into the large context of educational innovation and school reforms, especially at the beginning, have been proved.

However, central policies and reforms do not automatically lead to practical changes in classroom. The top-down initiatives should follow a greater attention to local conditions to ensure a successful implementation of policies. Furthermore, implementation involves far more than a mechanical application/translation from goals and initiatives into routine procedures and actions. School and individual efforts, initiatives, interpretations and attitudes play an important role in this process. It is argued that school factors such as school policies, resources, leadership, and collaborative teacher team seem to be positively related to improvement of ICT in schools (Baylor & Ritchie, 2002; E-Learning, 2006; Ely, 1999; Tondeur et al., 2008). In the Swedish case, the reasons teachers give to explain the lower level of use of ICT in their teaching are mostly those concern conditions at organizational/school level such as poor quality of ICT equipment and limited resources of time and money etc. The majority of teachers now have access to and use IT on a regular basis, but the issue could be that at school level, there is absence of long-term plans for continual and sustainable investment and development in improving ICT environment in schools. Innovation of technology goes rapidly and it is needed to renew both equipment and knowledge to keep up in line with the advance of technology (Ely, 1999; European Schoolnet, 2006; Wood et al., 2005).

In the area of classroom innovation related to ICT, it is teachers who are the key determinants of implementation. In using ICT, teachers cannot deny the existence of technology in schools, but how often the technology is used and in what way the technology is used is heavily dependent upon individual teachers. Poor attitude toward technology or fear of using technology could cause teachers to avoid using IT in lessons, which have been evidenced by many studies (e.g., Ertmer, 2005; Mishra & Koehler, 2006; Mueller et al., 2008). The investigation indicates that the majority of Swedish teachers have positive attitudes towards ICT impact in teaching and learning, but they are not satisfied with their competence and capacity in using ICT in teaching. Today's teachers are more familiar with computer and Internet in general, but to integrate ICT in teaching is something more than only the issue of being able to use technology. Having no confidence in using ICT in classroom might depend on lack of ability and the skills of integrating computer technology in their instruction in classroom practice. Furthermore, there is no doubt that teachers' perceptions, experiences, pedagogical beliefs and philosophy have significant effects on their way of teaching. Teachers' acknowledgement of using ICT as a learning/cognitive tool in knowledge construction and the beliefs of own capability of implementing technology successfully in classroom are important prerequisites for ICT practice (Abrami, 2001; Wozney et al., 2006).

In Sweden, it seems that ICT has shifted the focus from policies and programs on providing infrastructure and promoting use of ICT to effectively use by teachers in classroom in order to enhance their teaching and thereby the learning of their pupils, which puts new demands on teacher education and teacher professional development. It is stated in Government Directive (2007:103) by the Committee for a renewed teacher education in Sweden that the new teacher education should ensure teachers the skills needed in concerning and choosing ICT and media for learning. In 2008, the government issued an additional directive (Government Directive 2008:43) relating teacher education to the eight key competencies for lifelong learning stated by the European Union (European Union, 2006), and giving especially importance to the responsibility of teacher education, teachers and schools for developing a digital competence for the future Europe. In autumn 2008, the Committee had presented its inquiry for a new teacher education program (SOU 2008:109), in which it is stated that ICT should be involved in all teacher education programs and ICT should be used as an educational resource.

The lesson Sweden has learnt is that a successful and effective integration of ICT into education needs not only commitment and intervention of the central government, but also full support and initiative participation of the locals and individuals, in which teachers knowledge and skills on ICT and their attitudes, beliefs, as well as ability of ICT use in teaching and learning play a crucial role. ICT competence should be a central part of the teacher's profession. ICT should

not only be a content of TPD that teachers should learn as their knowledge and skill basis, but also a means of promoting an effective TPD. The power of a bottom-up, long-term, reflective, differential, contextualized, collaborative, and pedagogical approach related models of teacher professional development has been stressed recently (Hargreaves, 2006; Villegas-Reimers, 2003), in which a technology enhanced teacher professional development (TETPD) model could be one of them.

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