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ICT in Initial Teacher Training

Finland

Country report

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NEW MILLENIUM LEARNERS
ICT IN INITIAL TEACHER TRAINING
COUNTRY REPORT FINLAND
FOR OECD/CERI

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Abstract

In Finland initial teacher education for primary and secondary schools is presently at eight universities of which it was decided to choose, in present terms (January 2010), University of Helsinki (Department of Teacher Education) and University of Eastern Finland (School of Applied Education and Teacher Education) for this study. Also the teacher training schools associated with the respective Faculties co-operated and participated in the study. The questionnaires were translated from the English original to Finnish in an iterative process of several rounds checking some details from the Swedish version to ensure correct interpretations. A request to fill in the forms in the Internet was sent by e-mail to about 200 student teachers enrolled in the final teaching practice period (systematic sampling). Similarly, about 30 teacher educators and 30 mentor teachers were asked to fill in the respective forms at both universities. Another request to participate in the study was sent to about 500 student teachers (the next-year group) and all teaching staff and mentor teachers in November. Persons responsible for teacher education programmes at the two departments filled in the respective forms assisted by several staff members during the first round. They as well as representative groups of teacher educators, mentor teachers, and students were also interviewed (convenience sampling).

We may interpret that the survey data, combined with the interview, observation, and other data indicate that the motivation of teacher educators and mentor teachers to use information and communication technologies (ICT) in their teaching and guiding student teachers to use different technologies was high. Wishes for more co-operation of staff members at all involved institutions were expressed. Student teachers were also motivated to use modern equipment and innovative teaching methods, and reported help being available when needed. Peer support was seen very important. Student teachers gave mainly positive feedback, but some saw a problem in the reality of practice teaching being more conservative than expressed intentions of mentors and educators. Even if modern equipment and an Internet connection of high quality were generally easily available, some practical problems in the accessibility could be identified and the rapid technological development was seen as a major challenge. The situation was very dynamic altogether. At some subject areas there had been a few years earlier complete absence of ICT use, but now there was a major effort to update the equipment and to offer possibilities for versatile ICT use throughout the teacher education programmes. Both Departments involved in the study were active in research programmes focussing on ICT use in education and had a number of younger staff members enrolled in related doctoral studies.

Foreword

The Centre for Educational Research and Innovation (CERI) of the Organisation for Economic Co-operation and Development (OECD) launched in 2008 in the context of the New Millennium Learners (NML) project a comparative study ICT in Initial Teacher Training (for primary and secondary schools). The objectives of this study (IITT) were to provide a detailed picture of how technology is used in initial teacher training in OECD countries from a comparative perspective, analysing the views of the main stakeholders, and to issue a number of policy recommendations in this domain both for teacher training institutions and governments (a framework of the research plan is available at http://www.oecd.org/document/38/0,3343,en_2649_35845581_42418790_1_1_1_1,00.html). The IITT study includes an international review of the state of the art, new empirical data collected through surveys, and institutional case studies. Contributing countries have been Austria, Chile, Denmark, Finland, France, the Netherlands, Norway, Sweden, the United Kingdom and the United States. Except for the USA, all countries have used the same survey instrument translated into local languages when necessary.

When Finland was invited to participate in this study, Prof. Jari Lavonen of University of Helsinki (UH) participated as one of the invited speakers the expert meeting organised by OECD in Paris, October 28th-29th, 2008. This meeting focussed on getting feedback from several countries on the planned implementation of the study. In Finland, the Ministry of Education (ME) allocated funds for recruiting a part-time researcher as the co-ordinator of the national study. Further meetings of experts were organised 23th-24th February, 5th-6th October, and 9th-10th December, 2009 at OECD headquarters mainly for national co-ordinators Prof. Emer. Veijo Meisalo (UH) representing Finland in these meetings.

The questionnaires used in this study were originally formulated by OECD staff (available at http://www.oecd.org/document/38/0,3343,en_2649_35845581_42418790_1_1_1_1,00.html), but they were modified and refined on the basis of feedback from participating countries. When the project started, it was planned that the questionnaires were available quite early in the beginning of 2009. However, for different reasons it was difficult to organise necessary feedback from participating countries in short time, and the beginning of the questionnaire study was delayed from early spring towards the end of the academic year. This caused major difficulties especially in Finland. It was also understood too late that the study could be continued during the fall term 2009. We feel that the advance information on the project was a severe underestimation of the time, funds, and all the effort needed.

The present report describes the outcome of the Finnish case study and surveys. In the following we describe also both recent developments of teacher education (TE) in Finland, as well as its organisation and structure to make some of our approaches more easily understandable. We have also contributed to the report of Caroline Rizza (2009) as to the Finnish system of TE (see http://www.oecd.org/dataoecd/33/52/42031754.pdf). We observe that the present study does not discuss problems related to vocational education, but focus on education of teachers of primary and secondary schools. The introductory and theoretical parts of this country report rely strongly on some of our previously published work (e.g., Lavonen, Juuti, Aksela, & Meisalo, 2006; Lavonen, Lattu, Juuti, & Meisalo, 2006; Meisalo, 2002; 2007; 2009; Meisalo, Lavonen, Juuti, & Aksela, 2007; Meisalo, Lavonen, Lattu, Juuti, & Lampiselkä, 2006). A revised version of this report (including the used questionnaire forms in Finnish) will be published in printed form in the report series of ME later.

This study has been a case of close collaboration of the authors at the University of Eastern Finland (UEF) and UH. Prof. Lavonen has been the project leader responsible for e.g., contacts with ME and different parties at UH as well as part of the analysis of the questionnaire data. Prof. Sormunen has correspondingly been the local leader in Joensuu organising the contacts at UEF. Prof. Meisalo has been the project co-ordinator and the principal researcher being responsible for data collection including the questionnaire study, interviews and observations as well as analysing the qualitative data and writing the

main part of the report. Dr. Vesisenaho has been the local co-ordinator in Joensuu taking care of practical organisation of the study at UEF Joensuu campus and contributed with the analysis of the questionnaire data as well as writing the description of TE at the UEF for the report. All authors have continuously commented the running of the study including e.g., the different versions of the Finnish questionnaire forms and the preliminary Country Report, the final version and especially the recommendations being accepted by all authors.

Introduction

Several paradoxes could be recognised in the research literature considering the use of Information and Communication Technologies (ICT) at school as well as in teacher education (e.g., OECD, 2006; Younie, 2006):

- national level ICT-strategies and national curriculum guidelines for ICT use have been prepared during the last two decades in several countries with having only minor influence for the visions and practice of the teachers on their use of ICT in education;
- there is research evidence about influence of ICT to learning and students' motivation, but teachers do not rely much on research-based evidence to identify good practices;
- students have rich experiences of use of technology outside of school, but do not use technology for learning at school;
- teachers are skilled technology users, but they are unable to take advantage of their competence and to apply it to the way they teach in school.
- ICT is available at school, but teachers' beliefs about teaching and learning (e.g., the belief about good practice in school) is not supportive to the use of technology at school;
- plenty of ICT material already exists, but teachers are not experienced at using these materials effectively within regular classroom activities and outside.

From research on policy implementation and reform in education, it is well known that change is either very slow or tends to fail. Implementation is a complex procedure, not a direct transfer from government policy to practice (Younie, 2006). There is also research-based knowledge about planning and implementing of ICT strategies in Finland and difficulties in this implementation (Lavonen, Lattu, Juuti, & Meisalo, 2006). Consequently, it is challenging to help student teachers or practicing teachers to adopt use of ICT in education. We will focus here mainly on initial teacher education (TE) according to the OECD *ICT in Initial Teacher Training* (IITT) project aims. The general framework of the study is presented at http://www.oecd.org/document/38/0,3343,en_2649_35845581_42418790_1_1_1_1,00.html .

In general, there is a broad agreement on reasons and methods why and how ICT should be integrated to TE. The importance of this area can be seen in that there are specific associations for promoting research in this area like the *Association for Information Technology in Teacher Education* and many more whose activities expend to this field like the *Finnish Association for Mathematics and Science Education Research* in Finland. Scientific journals devoted to ICT in education (see references at the end of this report) have an important impact and an example of a modern approach the portal WikiEducator Teacher Education Portal (www.wikieducator.org/Teacher_Collaboration), which is creating and maintaining teacher networking.

There have also been descriptions of best practices of staff development programs (e.g., Epper & Bates, 2001; Rowley, Dusand, & Arnold, 2005). However, it is obvious that on one hand, there are many necessary differences due to local circumstances in the adopted approaches with different types of national programmes or strategies and on the other, it takes time to gain the full effect of the ideas and implementation of these. There is plenty of evidence that ICT use in TE is in a very dynamic situation and there may be major changes in the situation even during the implementation of the present study. We shall proceed in the following first to theoretical considerations and a short description of Finnish TE before presenting the implementation of the 2009 OECD/CERI study on ICT in TE (IITT Project) in Finland.

Theoretical Background

In this section we describe first different uses of ICT in learning activities to get an idea of how it can be analysed as an innovation for TE (cf. Meisalo & al., 2007). Thereafter we discuss some ideas on production and use of digital learning resources (DLR), open and distance learning (ODL) approaches like use of web-based learning environments and learning management systems (LMS), as well as other communication and teaching/learning tools. Furthermore, we discuss the promoting of their use as a diffusion of innovations process as well as adoption of innovations (cf. Lattu, Lavonen, Juuti, & Meisalo, 2004).This analysis can be compared with the Chapter 'Systemic Innovation and ICT in Education' in the recent project report 'Beyond Textbooks' (OECD, 2009, 31-57). There the starting point in analysing factors in using ICT in TE is the Access, Competence, and Motivation (ACM) Model.

Use of ICT in teacher education from the point of view of learning

ICT is used in education for supporting students' learning or for development of competences, in other words for helping to reach the goals of education. The quality of learning depends on how ICT is used in learning. At the University of Helsinki (UH) these issues have been discussed in the context of TE (Löfström, Kanerva, Tuuttila, Lehtinen, & Nevgi, 2006). According to Bransford, Brown, & Cocking (1999) meaningful learning engages students in tackling the topic to be learnt in such a way that they create meaningful and understandable knowledge structures on the basis of a goal for learning. Based on them, it is possible to present an outline of learning with a specific focus on ICT use in learning.

Learning represents each individual learner's own personal knowledge construction process which presupposes each learner's active, goal-oriented and feedback-seeking role. The constituents of meaningful learning are the following: activity, intention, contextualization, construction, collaboration, interaction, reflection, and transfer. These serve as development and selection criteria when choosing teaching and learning activities emphasising ICT use.

Activity and intention mean that students take responsibility over their own learning. Thus they set, together with a teacher, their learning goals and proceed according to the plan to reach the goals they set. This process may be facilitated, for example, by guiding students to plan by themselves or in small co-operative groups. On the other hand, students neither master the logical structure of the subject nor recognise their own biased preconceptions, and therefore students' goal setting needs to be supported and guided by the teachers. Thus, activities that support co-operative planning and evaluating learning are important for learning.

Learning could also be enhanced by *self-evaluating* activities. Bransford and Donovan (2005) emphasise the role of self-evaluation in learning. They suggest that a teacher should provide support for students' self-evaluating for example by giving them opportunities to test their ideas by building things or making investigations and seeing then whether their preliminary ideas were working. Feedback is important for learning.

Reflection means that students examine their own learning and develop metacognitive skills to guide and regulate their learning. Metacognitive skills are necessary for planning and evaluating one's own work. These skills make also learning a self-regulatory process in which the student becomes less dependent of the teacher. For example, self-evaluating or evaluating in a small group, taking multiple-choice tests, doing exercises and consulting answer keys support developing reflective and, moreover, metacognitive skills.

Collaboration and interaction mean that students actively take part in group activities and support each other by discussing and sharing knowledge. Learning new concepts presupposes a dialogue both between the teacher and the students and amongst the students (explaining, debating, questioning).In

addition to face-to-face interaction ICT offers several possibilities to share ideas through newsgroups, e-mail, a LMS, or through social media like Facebook.

Construction means that students combine their earlier knowledge with the new topics to be learnt and thereby tailor information structures that they can comprehend. Therefore, the teacher should encourage students to bring up their previous views and beliefs and thereby construct new knowledge on the basis of this shared information. For example, prior to starting reading or writing, students need to be guided to bring up their prior views on the subject to be dealt with. Respectively, before an investigation or other practical activity students should be encouraged to present his or her prediction or even supposition.

Contextualization means that learning takes place in real life situations or in situations simulating real-life instances. This in turn presupposes that the learning setting allows for authentic and real-life learning experiences. For example, when using a search machine (Google), students should be encouraged to look information in different sources. This enables them to treat the concepts in various contexts and thereby deepen the meanings these concepts acquire. It pays off also to keep in mind that the quality of all Internet-based sources needs to be checked carefully to ensure that the facts are right (source criticism). From the point of view of interestingness, the context in which science ideas are learned, rather than the ideas themselves, has important influence on learning. For example, when writing it is crucial that students write to prospective readers other than their teacher.

Learning is *cumulative* and, therefore, students are aided in noticing how a new concept or skill is related to other already familiar concepts or the network of concepts or skills. Learning of science process and of ICT skills are similar processes. In both areas there are low level and high level skills. For example, before a student learns to use a LMS he or she should learn to use word processing and a search machine. Consequently, students should be supported in learning new skills and in internalising the new concepts and in building conceptual networks in the given field.

The previous characteristics of learning activity may be realized through the use of ICT. For example, by employing the Internet in the inquiry-based learning, students have access to meaningful information of the topic. When looking up information in varied sources, students at the same time actively structure the flow of information they encounter into meaningful entities in order to be able to complete tasks. Similarly, this exploration of information in varied sources forces students to evaluate the reliability of both the information and the sources they use. Within an activity students could be encouraged to work together and also to systematically evaluate their activities. Several studies have indicated that information processing, inquiry-based learning, and exploring resources via networks, are beneficial for education (Linn, 2003).

Use of ICT in teacher education from the point of view of motivation

ICT could be used in education for supporting the development of students' motivation. The concept '*motivation'* in TE is by no means trivial, it has been used here to describe the factors within an individual (including an interaction with the environment) which arouse, maintain and channel behaviour towards the aims of the developed DLRs. We note that the project report 'Beyond Textbooks' (OECD, 2009) does not include a definition or an analysis of this concept.

There are many concepts that can be used to describe *motivational aspects of teaching and learning.* Here we base our analysis on Self Determination Theory (SDT) (Ryan & Deci, 2000) and Theory of Interest (Krapp, 2007). According to SDT, a student's way of thinking has an important role in the process of motivation. Motivated behaviour may be (i) *self-determined* or (ii) *controlled* and they involve different reasons for behaving. Self-determined or autonomous behaviour is behaviour which arises freely from one's self. Controlled behaviour, in contrast, means that the behaviour is controlled by some interpersonal or intrapsychic force, like a curriculum or a task. The motivation styles in SDT are: (i) *amotivation*, (ii)

extrinsic motivation and (iii) *intrinsic motivation*. Intrinsic motivation has positive effects on learning, in particular, to the quality of learning. Intrinsically motivated behaviours are based on the need to feel competent and self-determined (Deci & Ryan, 2000). Extrinsically motivated behaviour is instrumental in nature. Such action is performed for the sake of some expected outcome or extrinsic reward or in order to comply with a demand.

Central to SDT is the concept of basic psychological needs assumed to be innate and universal. These needs are the *need for autonomy*, the *need for competence*, and the *need for relatedness (need to belong to a group)*. The fulfilment of need for competence is especially problematic in the case of ICT because the required studies are perceived as being difficult. This perceived lack of competence has an effect on interest and motivation. Furthermore, the *interest* of the student in a learning activity has an effect to motivation. Consequently, the features of a learning activity and behaviour of a teacher (trainer) could increase the motivation of a learner (student teacher). This is because self-determined learning occurs when a learning activity itself supports fulfilment of basic psychological needs or development of interest. A closer analysis on motivational aspects is based on SDT: ICT is used for motivating or for increasing students' interest for learning. How motivating learning with ICT is for students depends on how ICT is used in this context. Next these issues, which have an influence to the students' motivation and interest, are shortly described as they are presented in TE.

Interest is a content-specific motivational variable (Krapp, 2007). Interest is approached from two major points of view. One is interest as a characteristic of a person (p*ersonal interest*) and the other is interest as a psychological state aroused by specific characteristics of the learning environment (*situational interest*). Personal interest is topic specific, persists over time, develops slowly and tends to have long-lasting effects on a person's knowledge and values (Hidi, 1990). Pre-existing knowledge, personal experiences and emotions are the basis of personal interest (Schiefele, 1991). *Situational interest* is spontaneous, fleeting, and shared among individuals. It is an emotional state that is evoked by something in the immediate environment and it may have only a short-term effect on an individual's knowledge and values. Situational interest is aroused as a function of the interestingness of the topic or an event and is also changeable and partially under the control of teachers (Schraw & Lehman, 2001).

Although students themselves primarily produce their motivation, it can be enhanced and learned. In practice, a teacher can offer optimal challenges and rich sources of motivating stimulations through choosing the learning activities. Therefore, in addition to previously discussed features of self-determined and controlled behaviour of a learner, it is appropriate to analyse also features of a learning activity which could increase motivation of a learner. This is because self-determined learning occurs when learning activity itself is considered as interesting, enjoyable, or personally important by a learner. From the point of view of the SDT, the motivational features of a learning activity could be classified in five categories:

I *autonomy-supporting activities/teacher*, through

- choosing student-centred learning methods like "open ended" inquiry and other tasks where students have some choices how to plan or study,
- collaborative learning activities which support feeling of autonomy,
- co-planning of the learning activities.

II *Use of ICT* where students have

- choices, possibilities for planning and evaluating ones own activities, and
- support to the feeling of effectiveness and importance of working.

III *Support to students' feeling of competency*, through

- choosing inquiry and other tasks, which are possible for the student to solve;
- choosing and using constructive evaluation methods, like self assessment, portfolio evaluation, and informal discussions, which help students to recognise that they are good at an activity or do the activity well, and
- giving support to the feeling that the activity has some value or use for the student.

IV *Support to students' social relatedness*, through

- choosing tasks, collaborative learning activities, co-planning, and ICT use which help students to feel close to peers and
- giving support to the feeling that the students can trust each other and feel themselves close to each other,
- supporting the formation of learning communities over social media and various forms of networking.

V *Support to interest and enjoyment*, through

- waking up curiosity by choosing surprise-evoking inquiry and other activities or tasks,
- organising enjoyable, fun-evoking and interesting activities, like through choosing interesting web pages or simulations,
- choosing activities which hold attention, as well as
- *interesting content* (new materials or new knowledge) and *context* (human being, occupations, technology, or history).

To summarize, it is important for motivation to promote autonomous learning activities in TE, related even to the attainment of competence in ICT use, but also to support learning communities and other forms of positive social networking.

ICT use and DLRs, ODL approaches, LMSs, etc. as innovations

The concept *ICT use* can be considered here as the crucial innovation to be analysed and e.g., the needed *competence* will be related to it. We categorise ICT use here into *(A) tool applications or tool software* and *(B) ICT use in study and learning (learning through ICT)* (cf. Webb, 2002). In the *tool category (A)*, ICT is treated as a set of available software enabling students and teachers to accomplish their tasks in a more efficient way. Typical examples of tool software are related to school or course administration or to office software (text processing, spreadsheets, graphics, etc.).

A teacher can use tool applications in several ways. In addition to the previously mentioned, he or she can prepare assignments, tests, and other resources for teaching and learning. A video- or data-projector can be used as a tool in several ways for classroom presentations and it can be connected for example to a document camera or a microscope. A new interesting tool teachers have started to use in Finnish schools as well as elsewhere in Europe is an *interactive whiteboard* (numerous commercial brands like Cleverboard, AKTIVboard, SMART Board, etc.) although there have been controversial opinions e.g., due to needed high investment expenses. The touch-sensitive display connects computer and digital projector and then computer applications can be controlled directly from the display. It is possible to write notes in digital ink and save one's work to continue or to share later. Most interactive whiteboards also have specially designed software that includes a range of useful tools. Advantages of the interactive whiteboard are: documents and software can be accessed from the screen without having to move away to a laptop, it is easy to move between screens to return to earlier work and furthermore, the drag and drop facility can be used to move contents across windows. The advantages including positive motivational effect of modern

equipment have proved more important than associated problems when interactive whiteboards have been made available. However, it seems that too little effort has often been put on teacher training in this context.

The main uses of *ICT in studies and learning in TE (B)* can be divided into three different uses for directly supported learning: (i) Computer-assisted learning (CAL) is any interaction between a student and a computer system designed to help the student learn. CAL includes, for example, simulations (Applets in the Internet) and virtual-reality environments. (ii) Computer-assisted research is the use of ICT as an aid in collecting information and data from various information sources with the emphasis on the use of ICT in data analysis supporting scientific reasoning. Typically, these investigative activities are conducted in small collaborative groups where ICT is used as an agent for interaction with an information source, like Internet or nature, or in schools and in TE, often in Microcomputer-Based Laboratories (MBL). (iii) Computer-assisted interaction: ODL has evolved in a natural way from using only regular mail to using all available IT services adjusted to fully facilitate student learning. Thus, modern ODL solutions are based on a wide range of communication technologies, such as course management systems (e.g., Blackboard, WebCT, or moodle), and two-way audio/video teleconferencing. New social media offer here many possibilities not yet fully activated in learning.

Now all school life involves more and more ICT-based interaction channels including e-mail, chat, Facebook, wikis, etc. Indeed, the Web 2.0 ideology is being more and more implemented in TE for example through wikis and blogs. The wide definition of DLR (OECD, 2009) adopted in the *NML Project* is obviously supposed to cover all the above uses of ICT, but it is quite easy to focus on some limited aspect only if further refined analysis is neglected. It is no more necessary to speculate on claims that ICT use has been able to make learning more versatile, goal and investigative oriented as well as activate students in acquiring, handling and evaluating information and, furthermore, increase collaboration, contextuality and creativity in TE. ICT use is an integral part of life of the New Millennium Generation (NMG) and teachers must be prepared to use these tools (cf. e.g., Sardone & Devlin-Scherer, 2008). The above interpretation has been challenged by several researchers (e.g., OECD 2009, p. 34), we see anyway the obvious need of the NMG to be able to utilize versatile facilities offered by a modern learning environment in school.

Diffusion and adoption of ICT innovations

Wiesenmayer and Koul (1999) suggested that implementation of ICT strategies must be organized as based on research. Agreeing with this, we maintain that general research-based knowledge about diffusion and adaptation of innovations has to be taken into consideration. It is known that there may be many barriers: an ICT use might be too complicated for beginners, staff do not easily collaborate or network with each other or with experts, they feel that they do not have enough time for experimenting, they might have negative attitudes towards innovations (no motivation to adopt them), there may be no support available and, furthermore, people are naturally resistant to new ideas or innovations. Variables that influence the uses of ICT in education are consistent with other research findings regarding innovations and diffusion or adaptation of innovations. In our study, the diffusion is a process by which the versatile uses of ICT in TE (*innovatio*n), is communicated when implementing the ICT strategy, the staff development program and development of ICT facilities (*communication channels*) over a period of several years (*time*) among the staff of the TE unit (*social syste*m) (cf. Rogers 2003). Rogers differentiates the *adoption process* from the *diffusion process* and defines the former as an individual's mental process through which he or she passes from first hearing about an innovation to final adoption. The adoption process can be divided to several stages, for example: awareness, interest, evaluation, trial, and adoption. Individuals who are members of the society adopting the innovation can be categorized to adopter categories: innovators, early adopters, early majority, late majority, and laggards.

Fullan (2001) categorized the properties of educational innovations that affect their acceptance in two general classes: Firstly, there are the properties of the innovation; in this case, the properties of the 'ICT use in TE' itself (e.g., different ways of ICT use practiced in TE, usability of ICT, and easiness of ICT use). However, the nature of this innovation is not simple. For example Watson (2001) argued that its adoption requires change in teaching style, change in learning approaches, and change in access of information. Secondly, Fullan emphasized that there are local characteristics, such as the pedagogical orientation of the staff, nature of collaboration and reflection between staff members, their beliefs about the usability of educational technology, administrative leadership, technical and pedagogical support available, and external factors such as funding, nature of training or staff development, as well as the nature of development projects in ICT use (Matthew, & al., 2002). Furthermore, external factors like a national ICT strategy and other different strategies in the institute (e.g., strategy development for teaching and training, library strategy, and research strategy) have an effect to the adaptation of the innovation. Different kinds of networking may foster the integration of ICT in education like collaboration with schools, with other departments and universities, as well as with working life (Moonen & Voogt, 1998). The contextuality of the implementation is another important aspect in this research.

In the recent project report 'Beyond Textbooks' there is an analysis of innovation (and diffusion of innovations) process. It includes four phases: Initiation, Implementation, Scale-up, and Monitoring and evaluation (OECD, 2009, 47-50). Furthermore, there are related issues like the knowledge base utilised in the innovation process as well as the stakeholders in innovation. This focuses on the viewpoint of the innovating process, less on the problems of adopting new innovations. We have in a number of cases producing DLRs found it important not to consider these processes as linear but iterative. We refer here to the tradition of design-based research (DBR). It can be considered as a methodology aiming to bridge the gap between educational research and praxis. It is a general framework for design, development, implementation and evaluation of learning resources and it uses a pragmatic frame (Juuti & Lavonen, 2006). DBR emphasises an iterative design process, producing an artefact, and novel educational knowledge (Design-Based Research Collective, 2003), which all fits well the process of designing DLRs.

Access

Access can be considered to be a concept associated with few or no controversy. Access to good quality DLRs is obviously most important to the advancement of ICT use in schools as well as in TE. However, too often related studies have been interested on technical aspects of access only, i.e. on the number of students per computer or on the quality of the available Internet connection, on societal level this approach is evident in ITU (2010). For example, in 1999 in some countries one in five teachers only used ICT in teaching to a significant degree (Hakkarainen et al., 2000). Respectively, there was of the order of one computer for every ten students in lower secondary schools (Pelgrum & Anderson, 1999). In most industrialized countries, schools have had already for a long time access to the Internet (Russell and Bradley, 1997). These are necessary but not sufficient conditions. A crucial problem of access is often the cost of learning materials as e.g., Finnish student teachers are not nowadays willing to invest in purchasing textbooks but expect course materials to be available as open educational resources over the Internet. There is great pedagogical value in having student teachers to develop DLRs themselves, but it is not feasible to expect to produce a major part of required course materials in this way. There is also a question whether the needed DLRs could be of the nature of PowerPoint slides, textbook chapters, or even teaching-learning sequences with detailed instructions to the learner. Anyway, materials accumulated over several years under supervision of professional experts and being updated systematically may solve quite a number of access problems in TE.

Competence, ICT skills

In many countries the development of main-stream initial teacher education has been slowed down by inadequate ICT skills of teacher educators and the fact that few units providing teacher education have drafted a strategy for the educational uses of ICT. Consequently, even many young school teachers have felt unprepared to use ICT in their classrooms. There has been a worldwide discussion about challenges set to teacher education concerning how to help teacher educators in using ICT in teacher education (e.g., Epper & Bates, 2001; Judge & O'Bannon, 2008). These challenges have been approached by developing ICT strategies toTE units and by implementing these strategies.

The development of teacher educators' competence could be promoted by developing up-to-date information and communication strategies, organizing and developing possibilities for studying in different environments including ODL and in general innovative approaches to ICT use in TE. National strategy goals have been in Finland, e.g., that more than half of the teachers should have a good competence in the educational use of ICT or that they can use a text processor, e-mail and an Internet browser well, make web-pages, use distance learning tools and that they also know pedagogical principles of using ICT. Such an educational policy has been quite common in all countries. However, the situation is more complex in practice and the implementation of ICT strategies for TE is more difficult than educational policy discourse implies (Kay, 2006). Especially, organizing an effective staff development programme, adequate guidance, and promoting ICT in education are not easy tasks. Already McFarlane and Sakellariou (2002) took a critical look for oversimplified strategies. They suggested that planning of uses of ICT should be based on addressing questions of what and for whom the TE programme is designed for and what successful navigation through that programme might look like. Kay (2006) pointed out that often strategies are issued, but there is little evaluation and follow-up of the impact of ICT strategies on TE. We shall analyse Finnish ICT strategies from the viewpoint of TE later in this study. Finally, we may note that the problem of staff competence and skills is challenging due to the rapid technical development in this field necessitating massive continuous brushing up of knowledge and skills.

The development of teacher education at universities in Finland

The road up to research-based teacher education

The major upgrading of TE was implemented in Finland starting the academic year 1974-1975. During the first year it meant integrating these studies in the university system (home economics and textile handicraft teacher education following one year later). Primary school TE for Master's level started 1979 in the context of the general renewal of university studies in Finland. (Kindergarten teacher education joined the development in mid eighties, but it is not discussed in the present context.) This development can be described as the Finnish road towards research-based TE. Research-based teaching is the key issue on the university level and it brought challenges demanding essential upgrading of staff competences. There are several indicators pointing to the benefits of this development. They include the high standards of recruited students in TE programmes – they are among the best of each age group. Also the good results of Finnish students in international comparative studies like PISA have been accredited at least partly to competent teachers.

To understand the renewal of TE in the seventies, we have to consider first the planning processes of the renewal of the TE systems and of the introduction of the TE institutions within the previously existing university structure. The political decision (Law 844/71) was made in the Parliament of Finland after a preparation process involving several committees in parallel of or in the aftermath of introducing the comprehensive school system. The general framework and common grounds for the design process and decision making were planned on national level with much vivid discussion on possible alternatives.

Important aspects were the personnel structure and staff qualifications as well as integration into the traditions of research-oriented universities.

All pre-service TE for schools in the general education sector was assigned with these decisions to seven previously existing autonomous universities (eleven localities). The units of TE were formed as Faculties of Education including departments of TE with teacher training schools for organising teaching practice. This development has been summarized in the compendium edited by Tella (1996). Finnish universities have had autonomy in designing their curricula, thus no detailed "curriculum of TE" covering all universities in Finland has developed. The process of integrating pedagogical studies in subject teacher education with more traditional university studies began in the renewal of 1970's. Pedagogical studies were now included in the university degrees, but only as extraordinary studies, not equivalent with studies at subject departments. Other faculties and the whole university administration were rather critical of the practical orientation and the lack of research tradition at the new and rather large departments of teacher education.

Further integration of educational studies and teaching practice was implemented in the reform of the academic degree system after 1978, when also the Master's degree became the basis for teacher qualification even in primary and lower secondary schools. It is to be noted that in spite of their academic freedom, there are some principles and general outlines that have been followed by all TE institutions in curricular development. These have been partly due to recommendations by ME and partly to an agreement of the Deans of the Faculties of Education and the Directors of the Departments of TE, who are supposed to have regular contact with the Ministry and with each others. ME has had full confidence in the departments and faculties involved in TE so that there have been no external examinations for teacher qualification. On the other hand, there are differences in pedagogical studies between subject areas and especially in arts-oriented universities there have been special features differing from the curricula followed in most other faculties and universities.

Strategies guiding the development of TE

Although the universities in Finland are autonomous, their development has been guided by national strategies. These strategies have generally emphasised a research orientation and teaching based on research. Universities have planned and implemented their own strategies based on the national framework. When TE became part of the university system, there were many difficulties in the process of fusion. However, gradually the universities saw clearly the importance of (especially subject) teacher education in their mission and this was seen as one of the important means of contributing to the welfare of the society (a new task given to universities). For instance, the importance of subject teacher education was expressly indicated in the General Strategy of the University of Helsinki for 2004-2006. The strategy listed subject teacher education as one of the key areas of development and stated that 'subject teacher education will be remodelled by organising jointly planned pedagogical and subject-related studies and by creating a continuum from basic teaching through teacher training schools and field schools to in-service training' (Strategy, 2004, p. 28). Somewhat earlier TE strategies had been published at the University of Turku (Strategy Turku, 2000), the University of Oulu (Strategy Oulu, 2000) and the University of Helsinki (Strategy, 2002). It is of special interest in the present context that in addition to the above more general university strategies, there have been official and semi-official national ICT strategies as well as university-level ICT strategies. There have been so far four official national strategies of information society or national ICT strategies, and before these one national educational ICT development project in Finland. The recommendations of the TOP Project (TOP, 1986; 1989) in the eighties can be seen as the first, although unofficial or semi-official national ICT strategy. A summary of these strategies is presented in Table 1 above (cf. e.g., Meisalo, 2007; 2009; OECD, 2009, 132-133).

Table 1. The objectives and implementation approaches of the national ICT strategies in Finland.

Year	Strategy	Objectives	Implementation approaches
1986, 1989	Computer in Education TOP, 1986; 1989	-Students as active workers of the information society: -IT as a school subject -basic IT skills for all -advanced IT skills for IT teachers	-Funding the production of software suitable for computer-assisted learning -Large in-service programme for all teachers at school -Training of IT teachers
1995	Education, Training and Research in the Information Society	-Students active in information processing -ICT as an intercurricular subject -Promote the use of ICT in learning	-Funding the production of Web pages and Web-based learning environments -Funding of an in-service programme for all teachers at schools
2000	The Second Strategy for Education Training and Research in the Information Society (SETRIS, 2000)	-Students active in information processing and in use of communication technology -ICT as a part of an intercurricular subject "Human Being and Technology" -Promote the pedagogical use of ICT, emphasising ODL solutions; Teachers to have not only technical but also pedagogical ICT competences. -All teachers on all levels should have at least moderate ICT competence, 50% good ICT and ODL competence, and 15% excellent	-Funding virtual schools and designing of new learning environments that relate to future operational environments -Funding of ICT infrastructure of schools and libraries -Funding of an in-service programme for all teachers at schools and universities
2004	Information Society Programme for Education and Research 2004-2006 (OPM, 2004)	It should be taken care in TE that students get necessary knowledge and skills in utilising ICT, knowledge on digital learning materials and services, as well as on teaching, and school – home interaction.	Recommendation to universities and polytechnics
2006	Information Society Programme 2007-2015	Teachers should have outstanding information society skills, and ICT should be a part of multiform teaching at all levels of education.	Close integration of the use of ICT in teaching with basic and further education of teachers. Encouraging institutions to implement new, innovative learning styles and methods.

Each University was supposed to formulate strategies of their own in harmony with the national strategies, and even though they are not necessarily updated recently, they do have continuously obvious effects on planning of curricula. An example of these strategies is the Information Technology Strategy developed at UH (Strategy, 1996) right after the publication of the first official national strategy in 1995. The latest development in this field is that the teacher training schools attached to universities have co-operated nationally in formulating their own strategies (Strategy, 2009).

Ministry of Education has financed teacher educators' in-service training courses or staff development projects supporting ICT use in TE from the mid 90s until the end of year 2007. These in-service courses and projects have aimed to developing teacher educators' ICT-competence and they have been designed based on the ICT strategies in each Finnish university. As an example of this type of staff development project, one at UH is shortly described below (in more detail Lavonen, Lattu, Juuti, & Meisalo, 2006).

A project at UH is an example of a university level ICT strategy development project for TE. An ICT strategy and an implementation plan for TE were created in a co-operative process during the two academic years 2000-2001 and 2001-2002 at the Faculty of Behavioural Sciences in UH. Visions and expectations of staff members and students were registered by questionnaires and by making notes during co-operative sessions in which the strategy was created. Thereafter, an implementation document, where the staff development programme and plans of how to develop ICT infrastructure and to integrate ICT in TE, was created. A large programme for staff ICT skills development was implemented and a new infrastructure (a new domain and websites etc.) was developed. Altogether 53 one or two credit point in-service courses were organised on the use of basic ICT tools and learning management tools, web publishing, and ODL solutions. As many as 505 staff members participated in these ICT courses. On the basis of staff self-evaluation data, staff ICT skills developed substantially and ICT use in TE grew more versatile.

On the basis of the data collected during the staff development project, a list of properties needed for a successful staff development project was created. The main facilitator for development of ICT skills was the co-operative local ICT strategy planning and implementation process where staff became aware of the possibilities of ICT use as a part of teaching and learning and how ICT use and ODL solutions can make teaching and learning in TE more versatile. Secondly, the development of an ICT infrastructure, especially web publishing and the use of ODL solutions, decreased constraints in versatile ICT use.

Thirdly, organising multiform and versatile courses, which were co-operative, reflective and contextual, helped staff members to improve their ICT competence. The courses demonstrated how ICT and ODL solutions can be used in TE and staff members could easily try and evaluate different ICT uses. Consequently, there are some basic conditions that should be realised before staff members use ICT in TE: They should have an ability to control ICT use in teaching and learning, and ICT use should maximise the effectiveness for achievement of higher level goals of TE and not cause disturbances to achieving other higher order goals.

After the systematic staff development project described above, several ICT courses have been organised for staff members annually. These courses have been partly financed with the resources allocated by ME specifically for this purpose. It is not clear how this type of courses could be financed in future. Moreover, there have been available ICT-courses offered by the Educational Centre for ICT at UH. These courses are generally offered to all staff members of the university without any special orientation to TE.

The final comment on the effects of steering through strategies is that there seems to be too little co-ordination and harmony among different types of national and local level strategies. When there are too many, too different, and too often changing strategies, their implementation in the formulation of goals or in teaching practice is very difficult. Perhaps the most important effects of different evaluation processes

can be accredited to the self-evaluation phase. However, there have been so many and frequent efforts to implement new strategies and recommendations of evaluations of various types with little connection with these strategies that all staff are totally exhausted and reluctant for further effort. Furthermore, there have been indications that the adopted top-down approach to strategy implementation may be problematic (Lavonen, Lattu, Juuti, & Meisalo, 2006).

In addition to implementation of the ICT strategies through seminars, training and tutorials organised for teacher educators, the academic curriculum is an important tool for strategy implementation focussing on the development of skills of student teachers. For example, at the Department of Teacher Education at UH, goals for learning the use of ICT in education are described in the aims of TE courses and teaching practice.

In the primary school TE programme, there is an ICT driving licence course and test aiming to introduce basic ICT tools and university ICT services, like databases and library services. In addition, there is a media education course aiming to introduce different types of ICT use in school education. More specific competences to use ICT, for example, in analysis of research data are learned within courses designed for research methodology. Moreover, there are goals for ICT use in teaching and learning within the aims for teaching practice.

Student teachers in the subject teacher education programme learn to use basic ICT tools at their home departments. The goals for learning pedagogical use of ICT are described among the aims for specific pedagogical courses. For example, in the course "*Theoretical, psychological, and didactical basis related to teaching and learning particular subject"* subject student teachers should learn to use versatile teaching methods and ICT in the teaching of their subject. During their teaching practice, student teachers should learn to use as a support the theories of education, pedagogy and learning while analysing and developing their own pedagogical approaches in teaching the subjects.

The tripartite co-operation in Finnish teacher education

In the Finnish system of subject teacher education there are three partners who participate in the programme and make important contributions. The subject departments at various faculties have focussed traditionally on educating future researchers (or artists) and little on future needs of those students studying for teaching careers. However, this situation has been and is changing as the importance of TE is now quite generally recognized. This is at least partly due to the societal role of the universities being in focus in discussions on budgetary needs of universities and the major impact of teachers in forming the new generations, the future of the whole society. (Lavonen, Krzywacki-Vainio, Aksela, Krokfors, Oikkonen, & Saarikko, 2007)

Some subject departments have had chairs with the responsibility to supervise TE at the department. The crucial role of subject departments is in ascertaining the high level of content area knowledge for subject teachers, highlighted by the writing the Master's thesis at the department of the majoring subject. The thesis facilitates the future teacher's access to research-oriented work, and emphasises the understanding of the creation process of new scientific knowledge in their field of teaching and learning. Most important is the goal of preparing future teachers to autonomously understand and utilize new achievements of scientific research. One of the interests of subject departments is in recruiting new talented students. The departments maintain, therefore, contacts with schools and urge student teachers to meet with youth, even in their free time (e.g., at shopping malls) demonstrating interesting science phenomena. The interaction with pupils not only at school but also at their leisure time also provides student teachers valuable experience in working with young people. We may note an important role of subject departments had in the implementation of the very successful LUMA Project (LUMA, 2006) on advancing mathematics and science education in Finland in organising Master-level courses for

unqualified substitute teachers working at schools. In primary teacher education, at least in Helsinki, professors of subject area take responsibility for quality control of specialization courses in their subject.

The second partner in TE is the Department of Teacher Education at the Faculty of Education (or equivalent). These institutions are responsible for organising and developing Master's level primary school TE programme and the pedagogical studies of a subject TE programme. In these institutions, there are professors of general education, educational psychology, etc., but also several specialised in educational problems of certain subject areas. Their focus has been on introducing students in research on teaching and learning and on how to implement research outcomes in teachers' daily work. They have had over years an important role in the development of research in these areas.

Pedagogical content knowledge has been one of the crucial issues in training of subject teachers, but the shift from *syllabus* type of thinking (emphasising organisation of contents) to *curriculum*-oriented ideas has put more importance on the goals of education on student level and on the teaching-studying-learning process. Among other things, the pedagogical studies in TE introduce the student teachers an idea of *a teacher as a co-operative professional* who is able to develop oneself while in work. This kind of professional is able to argument for the decisions that s/he makes regarding his/her own teaching.

The third partner in TE is the teacher training school. Teacher training schools were transferred into the university structure in 1974. This system of Normal Schools (practice schools) attached administratively to universities has many unique features as almost all other schools in Finland are run and financed by local authorities. The Normal Schools are state schools and their teachers have a different status than teachers in other schools. They have a dual role: on one hand to teach their pupils and on the other, to supervise and mentor student teachers. Many mentor teachers are active in research and development work and/or are members of teams producing learning materials for schools. They have good contacts with different university departments offering visits and study opportunities even for school students. Altogether, these schools want to offer a multi-faceted environment for teaching practice extending even outside the schools. They have close contacts with different educational establishments, civic associations and organizations. In addition to study in classroom, their students also visit different places of employment (with a possibility of internships), as well as museums and theatres. Learning by researching is supposed to be a natural way of approaching an issue, often with co-operative supervision by university professors and other experts. Herewith, the student teachers can put into practice their knowledge of theory as well as their experience and skill in doing research. Being able to guide others to learn is one of the central aims of the practical training. The above features are described as goals of teacher training schools, but there is frequent critique based on the demand of having at least a substantial part of the teaching practice in more typical schools. Actually, parallel to the Normal Schools there have been so-called field schools with an important contribution to the capacity and volume of TE in the times of high demand of qualified teachers. There has been a three-year project financed by ME to study their contributions in the field of TE. The ongoing reform of the Finnish university system will most probably have an effect on the status of Normal Schools, but by the time of writing this text there is little information on which way the development will proceed.

There are many challenges in taking advantage of all the positive features of the above described system. Recruiting competent personnel and talented students is a must for successful functioning of research-based TE. There has been much effort towards these goals and the outcomes have grown gradually rather good in both respects. In Finland, TE programmes attract students of highest ability groups, which is different from many other OECD countries. Also competent staff on high academic standards has been easier to recruit when the integration of TE into the traditional research-oriented university culture has proceeded.

There have been efforts over long periods of time to apply creative approaches in TE at all levels. Demand for creativity has been obvious in areas like arts, music or literature, but creative problem solving has been a key issue, say, in mathematics and science education. Here even contacts with researchers and innovators in industry and business have been utilised. Altogether, the chairholders are key persons in networking both locally with several subject departments and nationally with teachers' organisations or scientific associations, and even globally in their research contacts. Many staff members have been active in teams producing teaching/learning materials for teacher education and for schools. European co-operation within e.g., Socrates and other programmes has also been important for the staff. Quite many of them have also influenced the designing of the national core curricula for schools in the subject area of their specialty.

Co-operation of all the partners is important and many universities have founded councils of co-operation in TE. These councils have been active in formulating strategies for TE, and organising seminars to bring together all partners in TE; their work has proved to be most valuable. It has also been possible to establish resource centres for TE and school contacts at different faculties like the LUMA Centre at the Faculty of Mathematics and Sciences (co-operating with the Department of Teacher Education, Faculty of Behavioural Sciences) and the AINO Centre at the Faculty of Humanities, both at the University of Helsinki, but recognising relevant needs on national level. Similar activities are emerging at least at the Aalto University, University of Oulu, and University of Eastern Finland.

The study system in teacher education

Master-level teacher qualification as a basis for orientation to research and development

The first degree to be studied at university level is *kandidaatti/kandidat* (Bachelor, BA/BSc), which became compulsory in the Bologna process as the first formal step towards academic qualification. The second, higher degree is *maisteri/magister* (Master, MA/MSc) and is presently the basis for teacher qualification in general education. The *lisensiaatti/licentiat* (Licentiate) degree is usually considered as the first (non-compulsory) post-graduate degree while the doctorate (*tohtori/doktor*) is a very formal and internationally highly esteemed degree. Since the MA/MSc degree is the basis of qualification, postgraduate studies are not beyond the reach of practicing teachers. The work to renew once more the system of TE, this time along the guidelines of the Bologna process, was started very efficiently with a national steering group (Jakku-Sihvonen & Niemi, 2006a). The new system has been implemented since 2005 and the transition period has now ended.

Bachelor degree is divided in studies in intermediate and minor level subjects: there is no major subject level, but a thesis on the intermediate level is included (see e.g., Jakku-Sihvonen & Niemi, 2007). This degree is the common first degree while the Master's degree including the major part of pedagogical studies qualifies for teacher profession. A Master's degree usually includes studies in one major and two minor subjects. Studies in the major subject are further divided into intermediate subject studies and advanced studies. The core of advanced studies is comprised of the Master's thesis project, which alone gives about 40 credits.

Primary school teachers (grades 1-6) major in educational sciences and take the multi-subject didactical course of intermediate level (60 credits). These studies qualify for teaching all subjects at primary level. One of the "minor subjects" in subject TE programmes covers pedagogical studies for 60 credits (intermediate level). These pedagogical studies are divided in three roughly equal parts: courses in general pedagogy, subject didactics, and teaching practice. In the Finnish system teachers who take the Master's degree including these pedagogical studies get full formal competence for teaching in secondary schools those subjects included in their degree studies with more than 60 credits. There are no further examinations or other accrediting authorities in the qualifying process, but local authorities and schools

recruiting teachers may have their own preferences regarding the combination of subjects and/or practical experience.

A rather recent idea that has an effect on TE is the political goal of having a more unified (comprehensive school) TE harmonising class teacher education and subject teacher education. This has become feasible as both types of teachers take a Master's degree. There are obviously many practical problems in pursuing this goal, but it has already been put in practice by primary school student teachers who may study a minor subject such as mathematics or English for 60 credits and thus qualify to teach the subject concerned in lower secondary schools. It is also possible for student teachers in subject teacher education to study the multi-subject didactical courses of 60 credits designed for primary teacher education. However, courses of this type have seldom been opened due to problems in financing them. It seems that the access may be gradually growing more open, though depending on political decisions and the availability of necessary funds. Another unification, which has happened already, is the opening of the vocational education sector to teachers qualified in general education and vice versa.

There have been frequent evaluations of TE over recent years in different contexts. The Committee on the Development of Teacher Training (1989) was assigned to analyse the need for reforms in TE and soon afterwards, teacher education was subjected to further scrutiny by a national and international evaluation process in the context of evaluation of Faculties of Humanities, Mathematics and Sciences, and Education (OPM, 1994). Another evaluation process covering all faculties active in TE was arranged in 1999 (Jussila & Saari, 1999). Soon thereafter the national programme for developing TE was published (OPM, 2001). At the University of Helsinki there were, moreover, further evaluation processes by international groups of experts (Lahtinen, 2003; Kaivola, Kärpijoki, & Saarikko, 2004; Niemi & Jakku-Sihvonen, 2006).The next step was the Bologna Process, which has been implemented quite successfully in Finland (see e.g., Jakku-Sihvonen & Niemi, 2006a). We may note, that the above evaluations have put little emphasis on the progress of ICT use in TE. However, there has been a national working group analysing challenges of ICT in Finnish education under the auspices of the Finnish Parliament and SITRA, the Finnish Innovation Fund (Sinko & Lehtinen, 1999). Their recommendations have helped in promoting ICT use even in TE.

Curricula and their implementation in teacher education

We are entering a big and rapid change towards an even more independent system of higher education. All Finnish universities have been state universities being autonomous as to their teaching and research, but their finances depending on the State Budget. These financial ties are being loosened and the status of the university staff as state officers is being discontinued. It will be seen how much these and other current changes will affect curricular development. As mentioned before, even now no detailed "curriculum of subject teacher education" covering all universities in Finland can be presented. Their large variance in pedagogical studies is illustrated e.g., by Jakku-Sihvonen, Tissari, and Uusiautti (2008). The general features of the curriculum have been described e.g., by Niemi and Jakku-Sihvonen (2006) and Jakku-Sihvonen and Niemi (2006b). The curricula are usually revised every second year and they are published on the web pages of the faculties. Secondly, TE is diversified in that subject departments design their own curricula and the respective faculties make decisions on these. Special profiling of courses given to student teachers has become more common in recent years. This profiling has increased the possibility of getting the themes of Master's thesis projects closer to the problems of subject teachers' work.

In primary TE much emphasis has been put on the development of the graduate research seminar as well as the interaction of teaching practice and data acquisition for the master's thesis project. Furthermore, the recently emphasized possibilities for combining classroom teacher and subject teacher competences has become attractive as it opens new professional flexibility and sometimes even higher salary for graduating teachers. Much emphasis in secondary TE has been focussed on subject didactics at Departments of TE.

This does not necessarily mean that the share of subject didactics in credit points has increased, but student teachers are more motivated to study general education courses when these courses are tailored to account for topics relevant to the specific subject area and the age level of their future pupils. Since subject teachers teach all children in several age groups and particularly due to the principle of inclusive education implemented in the comprehensive school, there has been a growing need for courses in educational psychology and special needs education tailored for student teachers. Problems of multicultural education need more emphasis in TE, too, since there are increasing numbers of immigrant students in the Finnish school system. Here teaching of official domestic languages (Finnish and Swedish) to immigrants of all ages is also crucial.

During recent years, much effort has been expended to promote the interaction and co-operation of different departments and faculties involved in TE. Furthermore, co-operation with institutions outside universities has grown in importance. It may be said that the emphasis on goal-setting has gradually changed from teaching different content areas to educating top-quality teachers. Professional growth is a long process. It is important that student teachers receive orientation to their future work even during their first study years. This has been especially challenging for subject teacher studies at the subject departments. This should not mean only some school contacts during the first study years but also, among others, balancing critical scientific thinking and creativity in the goals of teacher studies. There is a significant motivational factor for student teachers in seeing the relevance of their studies to their future profession. Similarly, the curriculum covering pedagogical studies in subject TE has been processed at the Departments of Teacher Education and at the Faculties of Education. It has been important to harmonise the approaches and terminology in courses of general education and subject didactics. Offering experiences of team work during studies has been considered important in both primary and secondary TE as teachers can be seen as members of multi-professional teams when they work in schools.

The challenge of having to satisfy the demands of the whole extent of student teachers' future career has brought up the need of applying futurological research in the planning of TE and even including methods of futurological research in the TE curriculum. The relevant time span in teacher career is at least thirty years, possibly fifty years or even more in the future. These challenges have been accentuated in the rapid development of ICT use in schools. Already in the 80's, this has led even to researching values as well as moral and ethical aspects in TE (e.g., Niemi, 1988). Such an interest has continued to focus on current critical issues in different disciplines, especially on problems of computer science and computer applications in schools (see Tirri, 2000; Meisalo, Sutinen, & Tarhio, 2003, 194-216), but also nanoscience and gene technology being lately perhaps the most problematic areas. Careless copying in the Internet seems to be a serious problem globally. Professional ethics have become an important focus area for teachers' organisations as well as study and research ethics at universities.

The general objective of a teacher as *a researcher and developer of his/her own work* has a long tradition and was originally described as a 'pedagogically-thinking teacher' in Finland. This is considered to be a definitely more powerful approach than that of *reflective teacher*, since personal experiences only are less valid and reliable than research outcomes as the basis of pedagogical decision making. There is a strong tradition of research on teacher thinking in Finland (e.g., Kansanen, 1991; 2002). Ideas of Problem-Based Learning (PBL) have been under intensive discussion and several models of implementation have been suggested and tested. However, it has also become most evident that principles of ultimate constructivism cannot be successfully applied in subject areas with well-developed theoretical structures like mathematics or physics. ME has emphasised the development and implementation of the strategy of the information society in TE and this has influenced even the curricula. It is interesting to note that at some stage the formal goal of having at least one third of the TE courses in virtual form was suggested, but now the goal-setting even here focuses more on the skills and motivation of student teachers. There has been a solid research (and development) effort covering a wide field of computer applications from using e-mail in modern language education (Tella, 1991) to developing computer-assisted piano lessons for

student teachers (Oksanen, 2003) and different applications of microcomputer-assisted school science laboratories (Lavonen, 1996) as well as interactions in Web-based communities of student teachers (Meisalo, Lavonen, & Juuti, 2006). Further important projects have been recently described in an OECD (2009) publication from the viewpoint of researchers at the University of Jyväskylä.

Continuing Professional Development of Teachers in Finland

In-service Education

In-service training is considered to be training to update the knowledge and skills of teachers who are already working in schools, during the course of employment. This 'brushing up' of professional skills covers all kinds of effort towards teacher professional development delivered within the school sector, but also often by external training providers. The definition of in-service education covers all activities intended to update teachers' skills and knowledge. In Finland there is little on the level of laws about professional development of teachers. The focus is on in-service education, which is considered to be the responsibility of employers, it means municipalities as local school authorities. However, the National Board of Education (NBE) co-ordinates national in-service programmes. It is important that, as we can see in Table 1 above as an example of these efforts, all listed ICT strategies included some kind of in-service training effort for teachers.

It may be noted, indeed, that while pre-service TE of teachers for general education has been assigned to universities, they have a minor role only in in-service education. The general approach has been that the NBE yearly puts a number of in-service courses on tender and university staff and educational enterprises may give an offer to run these. A positive case of interaction of national authorities responsible for curricular reform in schools (NBE) and teacher educators was in the context of reform of 2003, when Physics and Chemistry were brought with subject status on grades 5 and 6 in the Comprehensive School having been earlier integrated to general science with little emphasis. It meant that primary school teachers who previously had marginal training only in these subject areas were supposed to start teaching these areas. In this situation, there was a call for major effort in in-service education of teachers working on this school level. While already in the period when the curricular reform was designed, the science education experts at the university department of teacher education were well informed on the renewal process being strongly in favour of it, they had a major challenge in renewing the curricula of pre-service education of primary school teachers. Finnish industrial organisations had supported the curriculum reform and the Information Office of Finnish Industry found it important to support production of materials for in-service training (DLRs at www.tat.fi/Aineistot/Verkko-oppimateriaalit). NBE has the overall responsibility for organising in-service education, but also City of Helsinki had a massive task of training essentially all primary school teachers to cope with this renewal and was willing to co-operate. All these parties joined forces and created Web materials in co-operation with experts at HU for teachers on grades 5 and 6 and these materials were widely used both in pre-service and in-service courses. Both teachers' and students' materials produced in the framework of the ASTEL Project emerging from this co-operation are available over the Internet (in Finnish and major part also in Swedish) at the Web pages www2.edu.fi/astel/index.php of NBE.

Further education

Further education of teachers gives new qualifications and higher competence levels. It is often considered to be of the type of postgraduate education and is usually organized at universities, research-based TE can be seen to benefit greatly from the system of further education. There has also been available some resources for doctoral schools in this area. Implementation of modern technologies both in the daily work of teachers and in the research projects has been among the goals of doctoral schools following the official goals of the information society. Their research is supposed to focus on the development of

teaching practise, new learning materials, etc. Postgraduate studies are assigned to the partner universities; the doctoral school organises seminars mainly on relevant research methods. There is also interaction over the Internet on the problems of research projects in the meantime. An important feature of these schools has been their international co-operation offering doctorands contacts across borders as well as broader views on the key issues in their research area. The doctoral school makes it possible for school teachers who get a position as full-time researchers to finish their doctorate in three to five years. However, it is not uncommon that the major part of doctoral work is done while working full time as a teacher and only the final stages of the thesis project are accomplished using a scholarship. Many teachers studying in postgraduate schools have a long teaching experience. They have high competence in applying their research outcomes in school practice both themselves and through being active in in-service training. These doctoral students are not young and there are demands that the median age of doctorands should be lower in the future.

Implementation of the OECD/CERI study in Finland

Selection of the target groups

In Finland, initial teacher education for primary and secondary school is presently at eight universities of which it was decided to choose University of Helsinki (UH), Department of Teacher Education and University of Eastern Finland (UEF), Department of Applied Education, Joensuu, for this study. Also the teacher training schools associated with the respective Faculties co-operated participated in the study. A specialist group with experts from ME/NBE (Jari Koivisto), Ministry of Traffic and Communications (Sanna Vahtivuori-Hänninen), IT Dept of University Administration of UH (Matti Lattu) as well as the representatives of the Departments of TE were consulted for the planning of the study. University of Helsinki is situated at Helsinki metropolitan area and while all Finnish institutions active in TE can be considered to be quality providers, at this multidisciplinary university the number of possible subject specialisations is larger than at other universities. Joensuu is a smaller town in eastern Finland and there has been a major effort to develop ICT uses in education and related research. There is a short description of the selected Departments below.

The target group of this study represents over 40% of all student teachers in Finland. This percentage value has been estimated using the intake figures to teacher education (OPM, 2007, pp. 22-23) and is rather high due to the large number of student teachers enrolled in subject teacher education programmes at University of Helsinki. It was not possible to extend this study to all institutions active in TE in Finland due to the limited resources allocated for this project.

University of Helsinki

General description

University of Helsinki is a traditional research-oriented university (founded 1640) with 11 faculties (Theology, Law, Medicine, Arts, Science, Pharmacy, Biosciences, Behavioural Sciences, Social Sciences, Agriculture and Forestry, and Veterinary Medicine). It is a member of the League of European Research Universities (LERU) and has been the best Finnish university on international ranking lists. The present Department of Teacher Education was established in 1974 following a thorough reform of the system of general education from late sixties. (The Department was for some years called Department of Applied Sciences of Education, but adopted again its original name from 1st January, 2010.) Tasks of the University include research, teaching and interaction with society. UH is bi-lingual (Finnish and Swedish), teaching also many courses in English. However, according to the national TE policy primary TE and pedagogical courses in secondary TE for Swedish-language schools have been assigned to Åbo Akademi University. Actively enrolled at UH are 35,300 degree students, as well as 47,000 continuing education and Open

University students. The University has 7,900 employees, 3,900 of whom are researchers and teachers. UH operates on four campuses in Helsinki and in 19 other localities in Finland. It aims to establish its position among the leading multidisciplinary research universities in Europe. The organisational structure of the University has been renewed by the end of 2009 to be more efficient and to cope with the new legislation covering higher education in Finland as well as the financial challenges of the current tight economical situation.

Central administration and ICT

UH has an IT Department, which makes it easier for staff and students to work in the university by offering high quality ICT services. The services of the department support the execution of the basic tasks of the University. The IT services in campuses are provided by Campus Service Centres of University Administration. They coordinate IT activities, standardize the technical solutions and take care of the local maintenance of the information network. They also provide IT classrooms and service points as well as local support by local teams. The Helpdesk service receives from both staff and students all requests for help and support. The Educational Centre for ICT offers support for the teaching personnel in the pedagogical use of tools and services for e-learning. Library staff provides free advice and guidance to customers, helping them find the information they need. Departments and faculties use ICT services extensively for administrative purposes so that e.g., all registers are on-line. Locally produced learning materials are expected to be available for student teachers on the web pages of the Departments.

Activities at faculty and departmental level

One of the strengths of UH is subject teacher education with a rather large volume by national standards, 622 students entering the secondary school TE programme yearly (OPM, 2007, 23). Furthermore, there are 120 students entering correspondingly the primary school TE programme at the Department of TE (OPM, 2007, 22). The evaluation report of subject TE (Kaivola & al., 2004) describes in more detail these joint activities of several departments at six faculties at the University as well as co-operation with Sibelius Academy (music teachers), University of Art and Design (visual arts teachers), and Theatre Academy (training in the pedagogy of dance and theatre arts). Subject teacher studies at UH can be performed in 27 different disciplines. There are two teacher training schools attached to the University and a varying number of field schools for teaching practice of student teachers.

There has been a definite upgrading of staff competence at departments active in TE during the last years. UH has requested that all permanent staff must have a doctorate in their field of teaching to promote the idea of research-based teaching. There have also been several younger staff members enrolled in doctoral studies, most of them having at least some connection to ICT use and TE. There has also been a specific focus on ICT skills of staff members at the Faculty. A specific working group of the Faculty of Education in the mid nineties analysed the status and future needs in ICT skills in the field of education (Meisalo & Lavonen, 1995). Furthermore, already the implementation of the first national ICT strategies were planned carefully with co-operative approach and their impact was followed in detail (Lattu, Lavonen, Juuti, & Meisalo, 2004; Meisalo & al., 2006). At several university departments there has been a tradition of research on educational uses of ICT. In the following we are able to mention only few examples of related research and development effort at UH.

We list here some recent EU-funded projects where Science-related teacher educators at UH have been active and which relate with ICT use in TE. The following examples are EU-funded projects where this group has been active:

- The GRID project to create a network for the exchange of best practice in the field of Science teaching in Europe.

- Effective Use of ICT in Science Education (EU-ISE) http://www.fizyka.umk.pl/~pdf/EU_ISE/
- The European Teachers Professional Development for Science Teaching in a Web-based Environment (EuSTD-web, http://cms.ua.pt/eustd-web/)
- MaterialsScience: University-school partnerships for the design and implementation of research-based ICT-enhanced modules on Material Properties http://lsg.ucy.ac.cy/MaterialsScience/
- The Effective Use of Computer Aided Teaching and Learning Materials in Science Teaching - a teacher training course with a European perspective CAT (http://cat.upatras.gr/)

Another example of a group with related interests at the same Department is the *Media Education Centre*. The general aim of this Centre is to conduct research and developmental work on media education. In addition, it aims e.g., at organising media education courses in initial as well as in in-service TE co-ordinating and taking part in national and international projects connected with media education. Furthermore, it contributes to international consultancy operations and disseminates information and knowledge with respect to rapidly evolving media education systems. To sum, the Centre specialises in different kinds of activities connected with media education, such as MICT (modern ICT), ODL, CMHCS (computer-mediated human communications systems) and even the Virtual School concept and virtual learning environments. The international projects where the Centre is active include:

- Project *Gender Awareness in Media Education* http://www.project-game.eu/partners.php
- Project *Characteristics of Volition in Media Literacy* http://www.helsinki.fi/sokla/media/volition.html
- Project Interactive Tracing and Graphical Annotation in Pen-based E-Learning http://www.helsinki.fi/sokla/media/itrace.html

Further examples would be projects related to concept mapping by Mauri Åhlberg at Department of Teacher Education and Ismo Koponen at Department of Physics. Neither should we forget the research and development work on learning materials for TE. Examples of materials related to ICT use in TE include research-based materials by Hakkarainen, Lonka, & Lipponen (2004) and Meisalo et al. (2003), which are closely related to creative uses of ICT in TE. Anyway, we emphasize that the above list is by no means to be considered as a full documentation of all related research-oriented projects, but only as some ad hoc examples.

At UH there are also the resource centres AINO and LUMA mentioned before. We describe here the latter in more detail: The nationally active LUMA Centre focuses on continuous teacher education. The activities bring together different subjects, institutions and educational levels from primary education to higher education. This also provides a breeding ground for interdisciplinary co-operation. Continuous teacher training is the core activity of the centre. The activities of the centre are planned, drafted and implemented by a working group made up of twenty expert members and a coordinator acting as the leader of the group. Most of them are teacher training professionals. They are responsible for the visibility of their own discipline in the activities of the centre. The centre also provides Internet materials for schools and for professional development of teachers in Finnish Swedish and English (e.g., www.myscience.fi).

Resource centres have been set up in subject departments in order to support their activities. BIOPOP supports biology teaching on the Viikki campus. The researchers of subject didactics at the Department of Teacher Education are responsible for researching and developing Science teaching. Several resource centres exist on the Kumpula campus: GEOPISTE (geography), KEMMA (chemistry), KONDENSAATTORI (physics) and SUMMAMUTIKKA (mathematics).

Student teachers occupy the roles of both actors and learners in the activities of the centre. The forms the activities take vary according to the subject. The activities are either integrated into degree studies and research in TE, or student teachers take part in them in conjunction with their studies and acquire valuable work experience at the same time. The contact persons for the resource centres are usually student teachers about to finish their studies or postgraduate students in subject departments. Student teachers are actively involved in organising different kinds of events. For example, dozens of them have volunteered as group leaders for children and families in the annual science fair.

University of Eastern Finland

General description

University of Joensuu is from the beginning of 2010 a part of the University of Eastern Finland (UEF), but it had already previously been a multidisciplinary research university, which celebrated its 40th anniversary in 2009. The university has grown in Joensuu around a Teacher Training College, and the Faculty of Education. One of its strengths is TE with a rather large volume by national standards, 140 students (80 in Joensuu and 60 in Savonlinna) entering the primary school teacher education programme yearly and 202 the secondary school teacher education programme (OPM, 2007, 22-23).

The University of Joensuu and the University of Kuopio merged to constitute UEF, which began its operations on 1st January, 2010. UEF seeks to be an internationally recognized research and teaching university, which is among the top three most significant universities in Finland and among the leading 200 universities in the world. Due to its high standard in teaching and competitive research, UEF is striving to be a prominent player in the Finnish and international innovation systems. The merger of the two strong universities into UEF was a response to the recent changes in the global research and innovation environment. The goal is to create a sufficiently large and operational unit, which is efficient in research, education, and societal impact. The operational integration of the campuses will lay the foundations for a strong and competitive, research-based competence cluster in eastern Finland.

UEF comprises four faculties: the Philosophical Faculty, the Faculty of Science and Forestry, the Faculty of Health Sciences, and the Faculty of Social Sciences and Business. The University of Eastern Finland has its main campuses in Joensuu and Kuopio, and there is also a satellite campus in Savonlinna. The new university has over 14 000 students and some 3 000 members of staff.

The university has five areas of expertise: natural sciences and new technologies; teacher training, education and culture; borders, European border areas and Russia; health sciences, molecular medicine and welfare research; and environmental research and renewable natural resources. *One of the new emerging fields of the University of Eastern Finland is educational and development technology.*

Teacher education, research, and ICT

The School of Applied Education and Teacher Education of the Philosophical Faculty at UEF in Joensuu has more than 20-year tradition on teaching, development, and research on computer supported learning and pedagogy of ICT, which is included in all the degree programmes in faculty. The co-ordinating research group is called Research and Development Centre in Information Technology in Education (TOTY) led by Prof. Patrick Dillon and Dr. Mikko Vesisenaho. The group has intensive collaboration with e.g., University of Nottingham (UK). Several younger staff members are enrolled in related doctoral studies. There has also been important development using design-based research approach on introducing modern learning environments in science teaching (especially biological sciences).

The latest research and development projects of the TOTY are e.g., Multidimensional Learning Environments, Net Generation, Responses to ICT, Personal Learning Environments, Continuing Teacher Training, and E-Learning and Pedagogy of ICT in General.

- *The Multidimensional Learning Environments Project* focuses on the flexible use of ICT in education. The ICT can be seen as an element which can rich the learning environment in contact and distance teaching. The main output is the use of ubiquitous technology which can project support everyone even in rural and technologically inadequate environments. The approach includes also the nearby communities and companies. (Vesisenaho, 2009)
- *The Net Generation* theme focuses mainly on secondary level students and student teachers as people of the net generation. The aim is to describe these students and their ways of using ICT. The further aim is to find ways how schools and teachers could take advantage of students' skills when designing learning environments. (Valtonen, Kukkonen, Dillon, & Väisänen, 2009)
- One branch of the *Responses to ICT* is in combining ecological theory of learning and contextualization in learning ICT with student teachers. (Vesisenaho & Dillon, 2009)
- *The Personal learning environments project* has the linkages to development of teacher's pedagogical skills on polytechnic level. One part of the development is the development of combined technological solutions for educational purposes.
- Development and implementation of *Continuing Teacher Training in Integrating ICT* has been carried out for more than 10 years with the support of NBE.
- *E-learning and Pedagogy of ICT in General* focuses mainly on teachers' ways to use online learning environments for supporting learning. This area is based on teachers' conceptions of learning and technological pedagogical content knowledge (Valtonen, Kukkonen, & Wulff, 2006).

In addition, the Department of Computer Science and Statistics has a strong focus on Educational technology research. The Educational Technology Research Group (http://cs.joensuu.fi/edtech) is led by Prof. Erkki Sutinen and has a significant expertise in design methodologies of e-learning. The group is internationally recognized for its unique and pioneering work in e.g., ethnocomputing and ICT for Development. The concrete research themes of the group include e.g.,

- *ICT for development (ICT4D)*: the group is actively developing activating and relevant educational systems and materials for developing countries in ICT.
- *Design methods for educational technology*: the group is researching the use of agile and participatory design methods for educational technology.
- *Visualization tools for learning programming*. The tools developed by the group include, for instance, *Jeliot* and *Woven Stories*.
- The unit has several years experience on *designing, implementing and running an online study programme ViSCoS*. In *ViSCoS*, digital learning content and various learning systems have been developed to support the learning of University level basic and intermediate studies in Computer Science.
- *Technologies for children (Kids Club)* including games, robotics and tangible technologies in learning.

International Multidisciplinary PhD Studies in Educational Technology (IMPDET) (http://www.impdet.org/) is a joint PhD program between computer science and education with online

courses, intensive face-to-face workshops and summer schools, an international pool of supervisors and carefully planned study counselling and mentoring environment.

Data acquisition

The general framework for implementing national IITT studies is presented at http://www.oecd.org/document/38/0,3343,en_2649_35845581_42418790_1_1_1_1,00.html . It is important that there are several data acquisition methods in use to allow triangulation. Our approach differs in some respects from the recommendations in the general OECD plan due to local circumstances. A description of researcher visit in this context is presented in the Appendix to give an idea of the practicalities of data acquisition in this project.

Questionnaires

There were four different questionnaires in use, one for student teachers, second for teacher educators third for mentor teachers. The fourth questionnaire was for universities (teacher training institutions). All questionnaires were translated from the English original to Finnish in iterative processes of several rounds checking some details from the Swedish version to ensure correct interpretations. Some terms in the Finnish version differed from the original due to different national usage. For example the terms 'teacher education' and 'teacher educator' were used systematically instead of 'teacher training' and 'teacher trainer', since the latter terms had been interpreted as overly old fashioned. The questionnaires in the final version were made accessible to the participants of the study over the Internet by putting them on the OECD mainframe computer in Paris. The fifth questionnaire for young teachers was not distributed in Finland.

The rationale behind the questionnaires was the common situation in OECD countries. According to the literature review (Enochsson & Rizza, 2009), teacher trainers do not prepare student teachers enough in the field of ICT use in education. There is lack of equipment, confidence, support, incentives, and the knowledge of how to work with ICT in a pedagogical way. The questionnaires have questions about these factors and also to what extent teacher trainers use certain kinds of technology in their teaching and what kind of help could enable them to increase the use of ICT in their teaching. There are also questions about the importance they attach to ICT in teaching. The questionnaires were looking answers to the questions:

- To what extent and in what ways is technology used in institutions of teacher education in OECD countries?
- In what ways are student teachers prepared to integrate technology in teaching in institutions of teacher education in OECD countries?
- If student teachers are not satisfactorily prepared, what are the main obstacles according to the stakeholders?

We saw in advance that it would be difficult to persuade the institutions and persons in the sample to be active as we had experiences from similar Web questionnaires. The members of the target groups wonder what they gain by participating. How they could allocate time for responding? The problems resulted in a low activity rate as we can see later.

In the first round, requests to fill in the forms in the Internet were sent in April 2009 by e-mail to 118 students enrolled in Helsinki and 111 in Joensuu. These students were taken by systematic sampling from those participating in the final teaching practice period. Similarly by early May selected 16 teacher educators working at both Departments and 16 mentor teachers at associated teacher training schools in Helsinki and 18 in Joensuu were asked to fill in the respective forms. A reminder was sent to all those who

had not responded by mid May. Persons responsible for TE programmes at the Departments filled in the respective forms assisted by several staff members during this first round.

It is regrettable that few persons only in the target groups filled in the questionnaires initially. During the interviews several reasons for the low activity were given, but giving reasons did not solve the problem. It is a detail that perhaps for teacher educators and mentor teachers the remainder was sent too soon after the original request to participate and some commented that it might have been useful to send more than one reminder. Several of those who participated in the study indicated that they participated more for reasons like 'I am a good girl/boy' or 'I am such a conscientious person' and only one message was received that the person was glad to participate because she considered herself to be an expert in this field.

Due to the above problems it was found advisable to reopen the survey in November, 2009 for a new group of student teachers and a larger number of teacher educators and mentor teachers. Requests to fill in the forms in the Internet were sent in November by e-mail to 270 student teachers enrolled in Helsinki and 136 in Joensuu. These were student teachers who did not participate in the study in the first round, the selected student teachers were all those participating in the next to final teaching practice period this academic year. It was also decided to call all teacher educators working at both Departments and all mentor teachers at associated teacher training schools to fill in the respective forms. There were 31 staff members and 89 mentor teachers in Joensuu. It is more difficult to tell exactly the size of these target groups in Helsinki, while the mailing list included persons who were not in the target group and they were asked not to respond. Similarly, those who had already responded in the first round were asked to ignore the e-mail. A reminder was sent to all 23rd or 24th November, again with the request to ignore the e-mail, if they had already responded. The response rate of teacher educators and mentor teachers can be considered to be satisfactory after the second round.

Interviews

The groups of the ICT experts responsible for the development of ICT use for teacher education were interviewed 19th May in Joensuu and 25th May in Helsinki using an interview guide prepared by OECD staff for the OECD/CERI study (see http://www.oecd.org/dataoecd/3/2/42419175.pdf). Both groups consisted of best available local experts in the field and they were committed to work as hard as needed to find adequate responses. In the same context the university questionnaire data (their responses to the Web questionnaire) were discussed. There seemed to be a very good teamwork in the groups being interviewed and the interviewed persons had obviously a quite wide spectrum of different competence and experience profiles. Both of these interviews took about one hour, they were video-recorded, and the recordings were analysed using a variant of the Critical Incident Method.

Furthermore, representative groups of teacher educators, mentor teachers, and student teachers were also interviewed (convenience sampling) using the respective interview guides. The interviews were recorded on video and subjected to a qualitative analysis of interesting aspects. Some information on the themes discussed during the interview sessions could be later confirmed or added on the basis of informal discussions with the interviewed persons. At UEF, Joensuu campus, interviews of student teachers were organised during a researcher visit April 20th and staff/mentor interviews May 18th, 2009. At UH most interviews could be organised only somewhat later by the end of May and in early June. This timing caused major difficulties especially when trying to persuade students to participate in the study. However, altogether 20 sessions were recorded the average time being about 45 to 50 minutes for group interviews and 30 to 40 minutes for individual ones.

Teacher educators and mentor teachers

In Joensuu, two groups of teacher educators (2+3 persons) were interviewed, one in the morning and the other in the afternoon of May 18th, 2009. In between there were interviews of mentor teachers. They were from two schools, one group of three mentors from a secondary school and another of two mentors from a primary school. All these were group interviews showing commitment to expressing honestly their feelings and facts about ICT use in teacher education.

In Helsinki also two groups of teacher educators (2+3 persons) were interviewed, the date was June 4th, 2009. There was a wide range of specialties of the staff members from mathematics and sciences to humanities and educational sciences. Furthermore, there were two groups of three mentor teachers each, both from a secondary school training subject teachers (May 27th). At another teacher training school there were two groups of two mentors, one group from primary level and the other from secondary school level (May 25th).

Student teachers

Student teacher interviews were organised at UEF in Joensuu during a researcher visit April 20th, 2009. Three groups of 2-4 student teachers were interviewed using an interview guide prepared by OECD and the coverage of subject areas in these groups was as intended. The first group consisted of two student teachers in the subject teacher education programme, one of them was enrolled in the Foreign language TE programme and the other in the Science TE (Biological sciences) programme. The second group of two student teachers in primary school TE programme was heterogeneous while one of them was getting a double competence also as a subject teacher in social sciences. The third group was of four student teachers enrolled in the subject teacher education programme, one majoring in Mother Tongue (Finnish), two in Mathematics, and the fourth in Geography.

At UH most interviews could be organised only somewhat later by the end of May and in early June. This caused major difficulties especially when trying to persuade student teachers to participate in the study. It appeared that most of them had some summer job over university holidays and they were just dropping in shortly at the campus. So an interview of a group of 3-4 student teachers (mathematics and sciences) was organised, but then we had to be satisfied with individual interviews of four student teachers (one enrolled in the primary school, three in the secondary school TE programme) due to the late timing by the end of semester (May 27th –June 2nd). Furthermore, we found out that there was a large variance in the background and in the study paths of the interviewed students so that one could belong only marginally in the target group in one way or another.

Results

Due to the low numbers of student, mentor, and teacher educator participation in the first round of the questionnaire study no analysis of the data was considered advisable on that basis only. All the analysis of the questionnaire data below is based on combined data of first and second rounds. No advanced statistical analysis was considered advisable even on the basis of combined data due to problems in the sampling procedure. However, some descriptive graphics are included in Chapter *Questionnaire Data*. There were few comments only as reactions to open-ended questions. These did not give significant new information. This outcome has been common experience as to similar Web questionnaires.

Interview data

Student teachers

It appeared that the majority of students had clearly positive attitude to ICT use, but there was also a variance in the opinions. All interviewed student teachers in Joensuu were satisfied with their acquisition of ICT skills. However, the ICT courses in different years and in different training programmes and even

for different subject majors varied quite a lot especially at UH. Courses for attaining basic ICT skills had been recommended for student teachers, but they were not always compulsory. One student teacher commented: "It is so, that it [ICT training] has esteem but it is not a must." Some students who had school teaching experience over several years (returning to MEd studies after a lower degree obtained a few years earlier) reported that there has been a huge positive development in ICT use in TE during these years. Such a student who had taken the ICT course some years earlier could be quite frustrated: "I was quite anxious and felt that teachers overestimated my skills." On the other hand, student teachers were according to their responses generally well motivated to use modern equipment and innovative teaching methods, and they reported help being available when needed. They found it positive that the teacher training schools had been renovated recently and there were the newest equipment available offering new and interesting technologies to be implemented in teaching practice. Peer support was seen very important when encountering technical problems, but peer groups were also seen as valuable forums for discussing pedagogical aspects of ICT use. Student teachers generally felt confident of getting help by mentor teachers when needed, but even "there was such a feeling that pupils come and help the (student) teacher".

There was, indeed, a general positive opinion of the possibilities to use modern technologies when in teacher education, e.g., "Teacher educators and mentor teachers do their best and if you have an idea and ask if you can do some experiments, it will be allowed." However, some student teachers saw a problem in the reality of practice teaching being far more conservative than orally expressed intentions of mentor teachers and teacher educators. Even if student teachers felt that modern equipment and an Internet connection of high quality were generally easily available for all, some practical problems in the accessibility of computer labs to student teachers (locked doors) could be identified and rectified immediately by agreeing on contact persons who would be present practically all time. A generally expressed problem was lack of time to concentrate in learning something new as the student teachers felt being always overloaded with work. Some students who had practical teaching experience in lower secondary schools over some years reported that there has been a huge positive development in ICT use in teacher education during a few years. For instance: "It was a surprise that the lessons were so that there came the slides, and then it was asked that when these [slides] will be available in the Net, this had become in those two and half years!"

The problematic examples discussed by student teachers included information search over the Internet (problematic due to the dangers of misusing unreliable information and plagiarism). As especially positive examples were mentioned the availability of MBL equipment for Science experiments as well as many simulations based on Applets. Even the use of concept mapping with the aid of Freeware available over the Internet (CMapTools) received positive comments. There were some wishes regarding the availability of interactive whiteboards in teacher training schools (where these were installed during the period of implementation of this survey), but also one student teacher commented that "perhaps the most negative example of misuse of modern technologies in teaching I saw was associated with the use of a Smartboard".

Teacher educators

The interviews disclosed high motivation of teacher educators to use ICT in their teaching and showing student teachers how to use modern technologies, even if they expressed being overloaded with routine work all the time. Altogether, the interviews indicated a most serious effort to promote ICT use in TE. The interviewed teacher educators did not report major problems in their ICT skills or those of student teachers: "[We can say that] at least in this house [at Department of Teacher Education] ICT skills have been excellently taken care of; during the courses there has been no need to tackle any problems." "There is much that is in everyday use [for student teachers]." But also that "Student teachers have the knowhow already from the comprehensive school, there is no need to actually teach them, they learn at home, in their hobbies, etc." And another comment: "They [students and student teachers] *are* in the Internet, they *do not go* there." The common attitude was quite critical if they were presented the goal of maximising ICT use in

teacher education. They accepted that there are many benefits in using learning platforms for independence on time and site, etc. However, “it is not so sure if there is more learning”. They saw that modern technology offers valuable tools, but “one has to have a look if this [ICT use] is a clever approach”. Altogether, teacher educators were reluctant to evaluate how ICT in general is integrated in teacher education: “I think that it depends more on the individual teacher than is systematic how ICT use is integrated in TE.”

All teacher educators were quite modest when evaluating their own contributions in creative research-and-development work so that they had to be persuaded to give examples of the ICT use they had developed. Research orientation was not always obvious, but research-based design was apparently often used for creating new learning materials. There was a clearly indicated need for more time and resources for serious research. Both departments were active in research programmes focussing on educational ICT uses as is required by the idea of research-based teacher education. Research activities as described under the descriptions of the institutions were rather weakly communicated during the interviews.

Many staff members were very active, indeed, and they had creative ideas for ICT use in their classes. Some of them readily presented examples of the teaching materials they had developed for Internet use. Ideas were of a wide range and often showed quite original thinking, even if some could be said to be on a rather modest level of creativity. Even here collegial support was seen very important when encountering technical problems, but peer groups were also seen as valuable forums for discussing pedagogical aspects of ICT use similarly like by student teachers. Peer groups even at subject departments were seen as valuable forums for discussing different aspects of ICT use. Wishes for all kinds of co-operation of staff members at all involved institutions including mentor – teacher educator contacts were expressed. Altogether, a major problem seemed to be the need for more co-operation and teamwork, especially across subject area boundaries or over bureaucratic borderlines. Administrative use of ICT was seen more crucial by teacher educators than in the other groups of interviewees. Their workload caused by implementation of different strategies, related to ICT use or to more general goals, and being subjected to frequent evaluations of so many aspects of their work was felt as a true problem. Some staff members expressed their views that the approach in implementing the ICT strategy of the University could be less of top-down nature. This can be interpreted as a wish for more open interaction with central administration of the University and especially with their IT Department.

Mentor teachers

The interviewed mentor teachers were obviously highly motivated to use ICT in their teaching in school and in supervising, as well as to guide student teachers to use modern technologies. They showed this motivation even if they felt (like teacher educators) being overloaded with routine work all the time. The teacher training schools at both Faculties had had their premises renovated recently and they had been able to get a largely new set of ICT equipment for use in their learning environments. Even if modern equipment and a wideband Internet connection were generally easily available for all at the teacher training schools, it was also obvious that more new equipment like interactive whiteboards were in the process of being installed shortly before the case study period or during it, and few mentor teachers (practically no student teachers) were familiar with their technical or pedagogical use to proper extent. The mentor teachers pointed out that they needed time to learn necessary technical and pedagogical skills. (About using new software:”It was possible to succeed with the help of the software provider, but it took much time, indeed!”)

Anyway, by the time the interviews took place the mentor teachers were looking forward to more easy access to classrooms equipped with interactive whiteboards and to computer laboratory classrooms where each student/pupil could have access to a personal computer. Another example although not so impressive one of gradual change in technology quoted as positive development was that overhead projectors were

being replaced by document cameras. Mentor teachers indicated that they found promptly technical help when needed, either by their peers or by technical ICT experts of their school.

The mentor teachers saw that they had to have a facilitator role in promoting ICT integration in teaching practice. They suggested that the best approach was small-group discussions where they could tell student teachers about their own goals on ICT use and support each student teacher in forming her/his own personal goals. "What is most needed is encouragement." In the scaffolding process they felt that meeting face-to-face with student teachers is of primary importance while virtual communication channels have a supporting role.

Many mentor teachers were quite active users of different types of ICT and they had creative ideas for ICT use in their classes. The first rather obvious comment on the benefits of ICT was the power of process writing. A mentor teacher (Mother Tongue) said that "The writing process is so different with the aid of a computer" and another (Mathematics and Physics teacher) continued that "The same in Physics when writing reports." Teaching materials can often be found in the Internet, e.g., "All pictures we take nowadays from the Internet." or "There [in the Internet] one can find all kinds of materials for Physics: pictures, video-clips, information on planets," Apparently all lesson plans of student teachers were submitted in digital form and they were commented by e-mail, more seldom using a learning platform. Some mentor teachers were following regularly Internet sources for finding digital learning materials, e.g., teachers' programmes of BBC, and also helping student teachers to utilize them. One of mentor teachers commented that "One should be able to give positive experiences [on ICT use in teaching] to them." Mentor teachers had in general confidence on ICT skills of student teachers, but there was some worry on equality: "Students [student teachers] have been in unequal positions regarding if they have had a computer [Internet access] at home or not."

All interviewed mentors were quite modest when evaluating their own contributions so that they had to be persuaded to give examples of the ICT use they had developed. However, the submitted examples covered a wide range of original ideas, even if the implementation showed sometimes a rather modest level of technical expertise. They also quoted several interesting applications designed by student teachers. These included the creation of a three-dimensional video-clip presentation for learning spatial vision (using red/green spectacles), video-recording and analysing creative lessons during teaching practice, and collecting a library of Applets for science lessons or using multiple original sources in the Internet for foreign language teaching. On the other hand, some mentor teachers complained that most often student teachers mechanically prepare PowerPoint presentations with little if any originality.

Ethical and moral aspects of ICT use were also discussed spontaneously in general terms. "I do not like to control [Internet access of students/pupils]." This [responsible behaviour when using ICT] should be integrated in the whole curriculum." Anyway, while no major problems in this respect were indicated in the discussions, all mentor teachers seemed to be alerted.

Peer groups were seen as valuable forums for discussing pedagogical aspects of ICT use like by student teachers. Again, a major problem seemed to be the lack of co-operation and teamwork, especially across subject area boundaries or over bureaucratic borderlines. A younger mentor teacher suggested to use discussion forums in the Intranet having had positive experiences of this during his student teacher period at the Department. This has been in routine use for student teachers only, but could have important potential also for teacher educators and mentor teachers.

Questionnaire data

Here teacher educators and student teachers questionnaire data are presented and analysed. Two other questionnaire data results are available in the OECD publication. There were altogether 149 teacher

educators and 178 student teachers who answered the questionnaires. Background information of the respondents is presented in Table 2.

Table 2. Background information on teacher trainers and student teachers.

	Female	Male	Altogether	Age, mean
Teacher trainers	92	57	149	48,0
Student teachers	60	36	178	27,1

The teacher trainers had been working as a teacher trainer in average 14 years and they were teaching the following subjects:

- Educational science 64
- Mathematics 18
- National language 24
- Foreign language 9
- Social studies 14
- Science 24
- ICT 6
- Other 25

Student teachers were mainly studying in subject teacher education programme and they were studying during their studies the following subjects:

- Mathematics 42
- National language 16
- Foreign language 28
- Social studies: History 10, Religion 9, Philosophy 4, Psychology 8
- Science: Biology 9, Physics 18, Chemistry 22, Geography 14

Teacher educators were asked to do self evaluation of their expertise in ICT use. Altogether, 69% of the teacher educators felt that they are fairly or very comfortable in using ICT at their home. On the other hand, 77% of the teacher educators felt that they were fairly or very comfortable using technology in their classroom.

The teacher educators and student teachers were asked to evaluate the technological and pedagogical support in the institute. Altogether 71% of the teacher educators thought that the institute has a policy to foster and sustain ICT-based innovations in teaching and 58% of them had personally been engaged in a project aimed at using ICT in new and innovative ways. In the open responses there were several descriptions of projects teacher educators have participated. Some of the projects were financed by their own university (ICT unit, faculty or department), some by the Ministry of Education or National Board of Education. There were also several EU-financed projects and projects with research funding. Altogether, 96% of the teacher educators thought that there is technological support available for them and 77% of

them thought that there is also support available for pedagogical use of ICT. Correspondingly, 80% of the student teachers thought that there are technological support and 30% of them though that there is pedagogical support available for them at their institution. Altogether, 63% of the teacher educators and 61% of the student teachers thought that the quality of the technological support is good or very good. About 60% of the respondents in both groups who thought that there is pedagogical support available thought that this support is good or very good.

The teacher educators were asked in the questionnaire to evaluate what kinds of technological equipment are available in the classrooms they are teaching. The student teachers were asked to evaluate what kinds of technical equipment are accessible for them as student teachers at the institution. The results are presented in Figure 1.

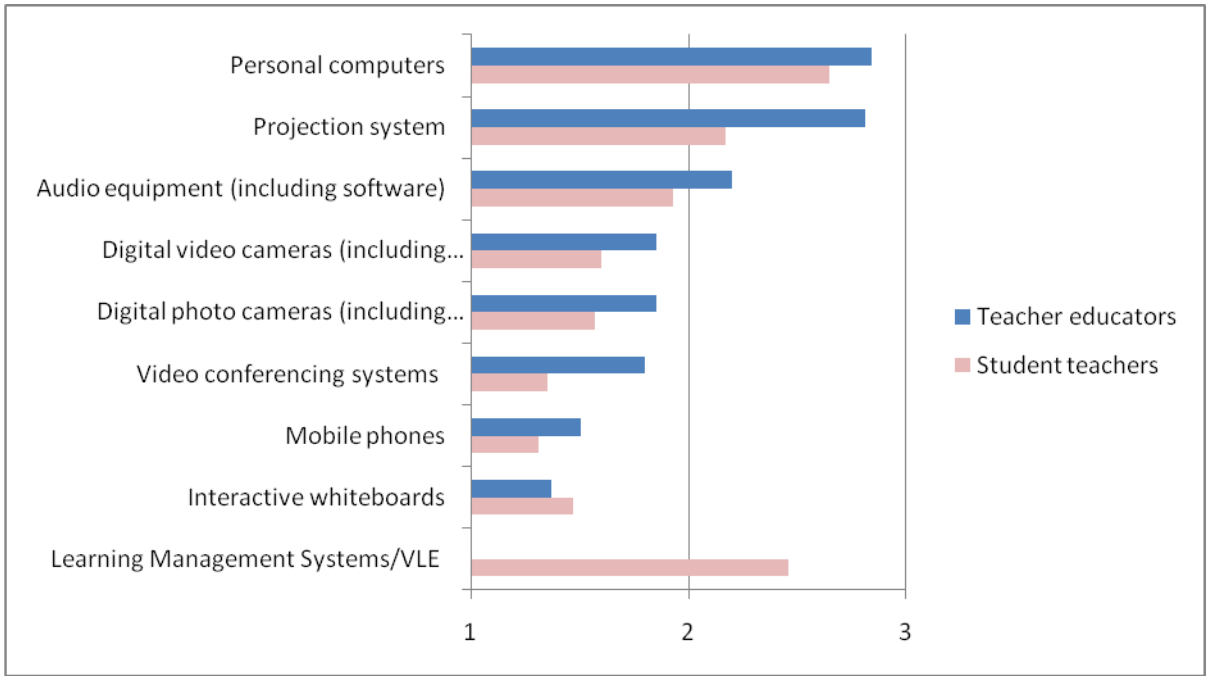

Figure 1. Comparison of teacher educators' and student teachers' evaluations through mean bars:

Teacher educator: What kind of technological equipment is available in the classrooms you use? N = 119 …136, Scale: 1 = In no class-room … 3 = In all classrooms. Observe missing data for the last item.

Student teacher: What kind of technical equipment is accessible for you as a student teacher at the institution? N = 103 …106, Scale: 1 = Not accessible … 3 = Free access

We see that personal computers are accessible as well to teacher educators and student teachers. Student teachers do not feel projection systems to be equally accessible, we interpret that there might be a problem of communication, similarly also with video conferencing systems. These data indicate that there is almost no accessibility to mobile phones. This must be interpreted that while practically everybody has a personal mobile phone, this reaction means that there are seldom if ever school-owned ones available (or in need). Interactive whiteboards were in the process of being installed in practice schools and in the demonstration laboratories of the departments during the time of the survey in spring 2009, so that the situation had been very different already in the beginning of the next academic year.

The student teachers were also asked to evaluate what technological devices they had used in the courses they had taken. In average they had used personal computers, projection systems and learning management systems during less than half of the courses. They were typically never using other equipment.

The teacher educators were asked in the questionnaire to evaluate to what extent they thought the use of technology in different areas of education is important for a student teacher to acquire. Respectively the student teachers were asked to evaluate to what extent they feel confident to integrate technology in education in different areas. The results are presented in Figure 2. *Missing data* are due to the teacher educator questionnaire having more items than the student teacher one.

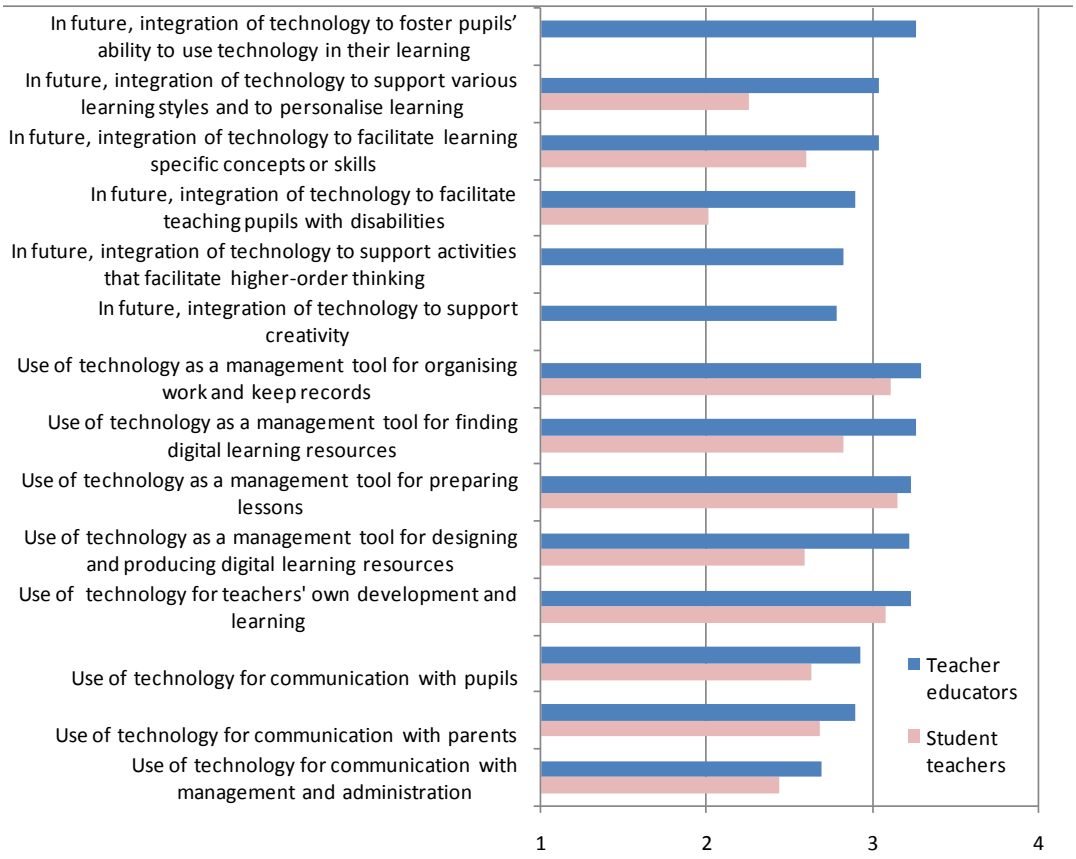

Figure 2. Comparison of teacher educators' and student teachers' evaluations through mean bars:

Teacher educators: To what extent do you think the use of technology described below is important for a student teacher to acquire? N = 129 …133, Scale: 1 = Not important at all, 2 = Little important, 3 = Quite important, 4 = Very important

Student teachers: To what extent do you (a student teacher) feel confident to integrate technology in the following areas? N = 88, Scale: 1 = Not confident at all, 2 = Somewhat confident, 3 = Confident, 4 = Very confident. Observe missing data for three items.

Here the differences in the evaluation of teacher educators and student teachers of the importance of supporting different learning styles and in helping with students with disabilities is somewhat astonishing. To some extent even the evaluation of importance of ICT in preparing learning resources being much lower by student teachers was not expected. Perhaps it could be speculated that student teachers have not learned about the power of ICT tools in these respects. The same could be speculated about contacts with pupils, parents, and administration for both teacher educators and student teachers. We have to observe that the wording of the items was somewhat different for teacher educators and student teachers so that statistical testing of the significance of the differences was not advisable and the differences have to be interpreted cautiously. However, it can be noted that all student teachers' evaluations are lower than teacher educators'.

The teacher educators were asked in the questionnaire to evaluate how much they teach the use of the technological devices to student teachers. Respectively the student teachers were asked to evaluate how

often they have used technological devices in the courses they have taken. The results are presented in the Figure 3.

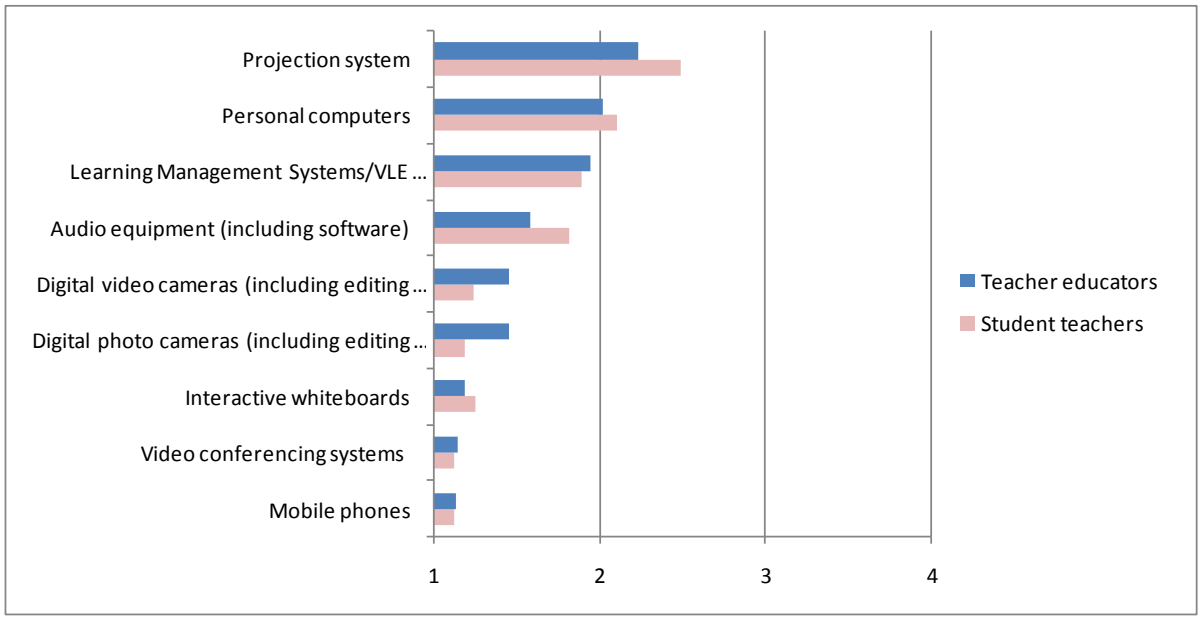

Figure 3. Comparison of teacher educators' and student teachers' evaluations through mean bars:

Teacher educator: Do you teach the use of the technological devices below to student teachers? N = 129 …132, Scale: 1 = Never … 4 = In every class

Student teacher: What technological devices have you used in the courses you have taken? N = 107 …112, Scale: 1 = Never … 4 = Almost always (The scale has been modified to fit with the teacher educator scale)

Here we do not see any major discrepancies between the evaluations of teacher educators and student teachers especially as the wording of the questions was not identical, so that even here statistical testing of the significance of the differences was not advisable and the differences have to be interpreted with caution. However, the low frequencies of the use of modern technologies in the evaluations are indications of something to be noted, it could lead to an identification of a substantial problem, indeed. We must try and find an interpretation by triangulation in the context of combined data.

The different ways suggested for help in increasing the integration of technology in TE receive positive evaluation except for 'policies using ICT across curriculum'. Indeed, such policies may appear to a single teacher educator as quite weak recommendations only. It is to be noted that task related incentives do not appear here as very attractive contrary to some expectations. Allocation of time is the most prominent problem to be solved. Reliability of equipment is more a problem than availability of high quality equipment as such, but in general there could be better access to equipment. Hands-on training seems to be evaluated higher than pedagogical training courses or technological/pedagogical support (hotlines). Altogether, all suggested approaches were evaluated as offering some help, but it seems that preferably all or many of them should be developed and not just some of them.

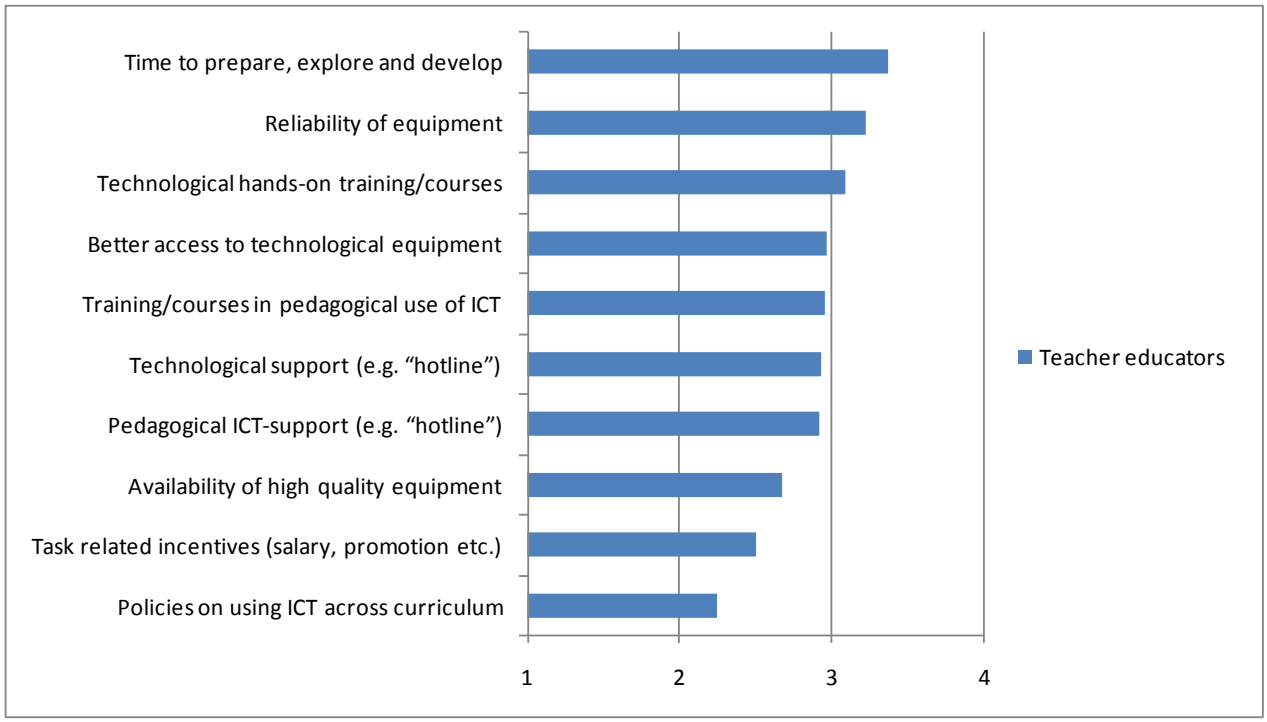

Figure 4. What importance do you attach to the following suggestions to help teacher educators increase the integration of technology in their courses?

Mean bars. N = 131 …133, Scale: 1 = No importance at all, 2 = Little importance, 3 = Quite great importance, 4 = Very great importance

General Observations.

The overall picture has to be based on multiple sources of information (triangulation principle): questionnaires, interviews, informal discussions, observations, as well as earlier research and reports. The time of organising the survey and when the researcher stayed at the teacher training institutions was very dynamic. The technical development within this area has been very rapid and both the hardware and the necessary software were changing all the time so that the staff and mentors had to brush up their knowhow continuously. Also transfer to new technical standards took apparently quite a lot of time and it was seen that even researcher staff was using much time in mechanical tasks of the type of transferring videos on VHS cassettes to digital files for the Internet. It was also reported that there are difficulties in using in parallel different 'year models' of hardware or software especially at multiuser situations like in a video workshop.

There were many contradictory opinions identified in the interviews. These appear to be due to quite varying study paths of student teachers and the large variance of interest and expertise profiles of teacher educators and mentor teachers. There are quite different cultures in relation to ICT use e.g., in different subject areas, but it cannot be said stereotypically that the relation with ICT is negative in humanities/arts and positive in mathematics/science. As a general feature we may identify a strong mission of ICT use offering a tool for reaching valuable goals and being on the other hand cautious of possible overwhelming influence of technology in pedagogical culture.

We may note that our study did not extend to so-called 'field schools' which are co-operating with university departments of teacher education, but have no formal connection to these universities. Anyway, in Finland a definitely major part of teaching practice of student teachers takes place at teacher training

schools attached to universities. Thus we may interpret that this does not distort our picture of ICT use in TE too seriously. On one hand, we may interpret that the above described wide variances in opinions reflects true experiences of the target group. On the other hand, the cogent impression of activity and creativity of teacher educators and mentor teachers as well as the majority of student teachers may be speculated to be due to these kinds of special persons being more easily available for interviews than more passive individuals. However, it appears that a more comprehensive study had been very difficult to perform with available resources.

Summary and Conclusions

From research on reform and policy implementation, it is well known that change in education is very slow and often tends to fail and this general observation seems to be especially true as to complex innovations like ICT use in teacher education. Diffusion and adoption of innovations are complex processes altogether, there is no direct transfer from strategies to practice. Thus all effort to facilitate these processes is important and our study in the context of the global OECD/CERI New Millennium Learners project strives to analyse and provide suggestions for reaching relevant goals in Finland. Alongside documentary analysis of national and local strategies our analysis strives also to provide a framework for understanding the implementation processes of these strategies. This national case study was performed the empirical phase starting in the spring term 2009 with an extension of the collection of questionnaire data during the following fall term. Our study was performed on three levels: Strategy analysis on national level, analysis of curricula, course descriptions and infrastructure on institutional level, as well as observations and interviews collecting experiences on actual learning situations on individual level. We can compare the above approach with Fullan's (2001) recommendation to analyse innovations. Firstly, the general level for discussing the educational innovations is national or strategy level. Secondly, circumstances in local level, teacher educators' competencies and ICT infrastructure at a TE institution. Thirdly, there are the properties of the innovation; in this case, the properties of 'ICT use in TE' itself, like different ways of ICT use practiced in TE, usability of ICT, easiness of ICT use. The first two levels are essentially identical with ours, but the properties of an innovation are replaced in our analysis with personal use of innovations, which is of course related to the properties of innovations.

The study began with an analysis of the development of the present system of teacher education and the efforts to implement national ICT strategies in TE. The conclusion was that there has been much success, but the promotion of ICT use in education has not been systematically in focus in various strategies. Although the teacher educators and student teachers evaluated national level teacher education strategies and ICT strategies having a minor influence only to the adoption of ICT use in education, these strategies certainly have a role. However, it is apparently not enough that the strategies have been implemented in writing the curricula and formulating the goals of different courses and teaching practice but it has to be ascertained that their influence is brought down to the level of teaching-learning processes.

It seems that the key problem in implementing the strategies has often been that the request to introduce new technologies has not been accompanied with allocating necessary resources. For instance, the teacher training schools participating in this study received up-to-date technology they had long been waiting for, in the context of renovating the school buildings only. There had been interesting efforts to experiment with interactive whiteboards especially at UEF, but this technology was earlier seen too expensive to be implemented more widely. However, some municipalities made decisions to equip all classrooms in their schools with interactive whiteboards challenging departments of teacher education to introduce this technology more widely. This can be seen as an interesting case of bottom-up influence. By the time of this survey staff members were concerned about the consequences of the current very tight financial situation at the universities. They were afraid that the positive development of equipment as well as continuous professional development programmes may be in serious danger especially due to the

dropping off of related ear-marked funds allocated in earlier years by the Ministry of Education to TE institutions.

The questionnaires, interview guides, and data collecting forms were originally formulated by the OECD staff, but they were modified and refined on the basis of feedback from participating countries. Four different questionnaires were used in Finland, one for student teachers, second for teacher trainers, and the third for mentor teachers. The fourth questionnaire was for universities (TE institutions). Due to the low numbers of student, mentor, and teacher educator participation in the questionnaire study in the first round (spring term 2009), the second round was organized in fall 2009 with more adequate participation. However, no advanced statistical analysis could be considered advisable due to problems in sampling. The respondents could be a biased group because majority of them feel fairly comfortable using technology in their classroom and majority of them have been engaged personally in a project aimed at using ICT in new and innovative ways. However, the descriptive representation of these data complemented the interviews, observations, and other information. From these triangulation data it can be interpreted that the situation in this field is rapidly changing and any collected data will soon be obsolete.

On the basis of our combined data we could analyse the local characteristics, such as the pedagogical orientation of the staff, nature of collaboration and reflection between staff members, staff members' beliefs about the usability of educational technology, administrative leadership, technical and pedagogical support available, as well as external factors such as funding, nature of training or staff development, and the nature of development projects in ICT use.

The combined data indicate that there are no major obstacles in the use of ICT in TE. The most frequently expressed problem was lack of time to concentrate in learning something new or doing relevant research. Lack of time has been identified also in other countries as a reason for staff not being updated in the field of technology (Enochsson & Rizza, 2009, 13). In Finland this may be at least partly due to the staff structure at these departments as staff members have here more teaching hours and less time allocated for research than the average at other departments (OPM, 2007, 41). This seems to be due to the long time needed for TE to fully integrate in the structure of research universities. There are indications of serious effort to rectify this problem by a working group of ME (OPM, 2007). Anyway, we can see already presently true commitment to research of international standards in research groups at teacher training institutions. This can be seen in the descriptions of the activities of the participating departments and it was also concretely evidenced during discussions with teacher educator researchers at the participating departments. Research-based teaching as academic pedagogical approach means that teacher educators base their teaching on their active roles as researchers and on their expertise in their area of teaching. As another valuable perspective active teaching and learning in TE means that student teachers are guided and involved in (collaborative) learning processes and staff moves responsibility of learning to them. These approaches were obviously appreciated and gave many possibilities for versatile ICT use.

There was, indeed, a general positive opinion on the possibilities to use modern technologies when in teacher education. However, the actual use depended on individual initiative and there were no strict rules to be obeyed. Thus some student teachers saw a problem in the reality of practice teaching being more conservative than the orally expressed intentions of mentor teachers and teacher educators. This difference of opinions may also be due to interviewed teachers being more advanced in their ICT skills than the average and perhaps the interviewed student teachers were rather demanding in this respect as there was a convenience sampling to all of these groups. There are also indications in other countries that student teachers expect more active ICT use by mentor teachers (Enochsson & Rizza, 2009, 14). The technical development within this area has been very rapid and both the hardware and the necessary software were changing all the time so that the staff and mentors had to brush up their knowhow all the time. Also transfer to new standards took quite a lot of time and it was seen that researcher staff was using much time in rectifying problems of mixed standards of older and newer software or hardware.

There was a generally expressed need for more collegial co-operation within the staff of the departments of teacher education and at practice schools. This problem may be for some part solved by the expected development of staff structure, but a major part of it may be solved better with leadership of directors of the departments and school rectors. Services of the IT Department at the central administration were appreciated generally. However, more easy interaction was indicated to be desirable even here. Co-operative approaches in implementing the ICT strategies on departmental level could also rectify some problems (cf. Lavonen & al., 2006). There were indications of international co-operation both in European projects and in the form of visiting professors and students as well as in participation in international conferences. However, there is certainly need for more active international co-operation which would be mutually beneficial in many respects. It is also hoped that the present study would be useful in international comparisons of ICT use in teacher education even if there have been problems in the survey as to data acquisition, as described above.

Teacher educators' ICT use was primarily designing of learning sequences and in administrational duties. In the data the connection of ICT use to learning is not obvious. However, the advantages of modern equipment including positive motivational effects have appeared to decision makers more important than associated problems when e.g., interactive whiteboards have been made available. However, it seems that too little effort has often been put on teacher training in these contexts. From the point of view of a single staff member before he or she will integrate ICT to teacher education he or she has to believe that (i) ICT use can effectively support students to achieve or maintain higher-level goals ("effectiveness"); (ii) ICT use will not cause disturbances to other higher-level goals that staff members evaluate as more important than the one being maintained ("disturbances"); and (iii) staff members have the ability and resources to use ICT ("control"). Therefore, training of staff members have to be in conjunction with technical and pedagogical development of ICT use. Training and other guidance should be contextual, connected to real teaching and learning situations. Training should also support collaboration between teaching staff members as well as between teaching staff and those who are developing and giving guidance. Staff members can if left without necessary support, for example, just try to add ICT use to teacher education and guide students to do only traditional tasks with ICT while ICT use can create totally new ways of teaching and learning. For example, already Watson (2001) argued that adoption of this innovation requires whole change in teaching style, change in learning approaches, and change in access of information. For New Millennium Learners it is also important that there is proper bridging of school and life in the sense of observing youth culture with access of social media etc.

There are somewhat contradictory results on the confidence of student teachers of using ICT in classroom situations. It seems that the majority does not have any problems although they would need encouragement for more comprehensive use. On the other hand, there are some student teachers with problems in critical ICT literacy and much anxiety and even if during the survey they seemed to be those with delayed graduation, their problems need specifically focused attention. However, we are not recommending the kind of compulsory driving licence to student teachers as it is already done in UK, it would most probably strongly add to the frustration of the student teachers with anxiety. Since May 2002, all student teachers in England have been required to pass detailed tests in ICT skills to achieve teacher qualification. The tests cover a large number of core skills teachers need to fulfil their wider professional role in schools, rather than the subject knowledge required for teaching (TTA, 1999).

Teacher education in Finland is more research-oriented than in many other countries with all teachers in general education needing a Master's degree for qualification. ICT in computer-assisted research is used in collecting and handling information and data from various sources, with the emphasis on the use of ICT in supporting scientific reasoning (e.g., data analysis and search in the Internet), ODL solutions and their use in teaching and learning, such as course management systems (e.g., moodle), two-way audio/video teleconferencing, and Internet lectures. It must be noted that his kind of technology-oriented approach to analyse properties of ICT use in teacher education is not easy approach if the focus of the discussion is in

how to help student teachers to learn principles of education and to develop different skills needed in teacher profession. Therefore, discussion about ICT use and its development has to be understood as a part of the development of the whole of teacher education. Successful processes of implementation of strategies and diffusion of innovations necessitate an understanding of the fact that these are fluid, non-linear, reiterative processes in which key factors are dynamically inter-related: namely, ICT needs to be implemented on multiple fronts, both materially in terms of an ICT infrastructure and culturally in terms of generating an ethos that values ICT for classroom practice. Attending to the multidimensionality of ICT policy implementation aids the management of the change process at the local level of the school. This allows for an understanding of the ways in which teachers interpret policy and engage in implementation of ICT at the local level. Our previous analysis can be compared with these ideas from the paper by Younie (2006), which examines lessons learnt from national research and evaluation studies of ICT in schools in the UK. Overall, we emphasise that it is most important that both teacher educators and student teachers get positive experiences of ICT use and feeling of empowerment in using modern technologies in teaching. This can be achieved using multiple approaches. However, it seems that more systematic setting of goals and ascertaining that these goals are reached would be needed in further development of TE in Finland. We summarise a number of observations in the following:

Problems to be addressed for promoting ICT use in TE in Finland:

- There should be better coherence of different strategies
- implementation of strategies should start from grassroots level, not top-down
- teacher educators should have an ethos for introducing newest innovative tools in their teaching not being overly cautious for possible overdose of technological culture
- co-operation to be facilitated – newest tools for co-operation to be activated
- dynamical situation: priorities should be put for keeping abreast of the development
- staff development programmes should be more systematic allowing less possibilities for dropping off
- locally developed innovations and research outcomes should be marketed even to colleagues
- ICT use and skills as learning outcomes should be made more clearly visible and concrete in the description of goals of all courses and learning programmes
- There should be clear indication in goal descriptions when learning, motivation, or doing is in focus.
- student teachers should be shown more clearly that ICT use facilitates reaching goals
- teacher educators should use for their advantage youth culture including social media to facilitate formation of learning communities etc.
- international co-operation in developing modern approaches of ICT use in teacher education has to be maintained and strengthened

We may sum up that there is a need for university department of teacher education to design the ICT-related goals of the programmes of teacher education and related courses on a more concrete level and to create a systematic way for systematic follow-up of reaching these goals. Also ways to ascertain necessary resources for TE institutions should be identified and utilised.

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APPENDIX
RESEARCHER VISIT TO UNIVERSITY OF JOENSUU 19.-20. APRIL, 2009

The contact person agreed in advance was not available due to illness. However, practical arrangements were not problematic due to the flexibility of local staff. The programme consisted of four sessions:

1. The visitor participated in a research seminar for staff professional development. Current status of two research projects on ICT applications in primary teacher education was reported. Both referred to using the virtual learning environment *moodle* and there was a solid theoretical analysis in the background. A British professor working at the faculty on pedagogy of ICT was a significant contributor in the discussion even if local young researchers had the main role.

2. It was possible to follow two group-work sessions in a science education course for the primary school teacher education programme in Joensuu. The group-work was organised practical studies (biology) as the starting point. Optical microscope was the most often used instrument and a handbook was an important source of information while student worksheets guided the activities.

3. There was an interview session with the Head of the Department of Applied Education. It was agreed how to get the sampling of teacher educators' e-mail addresses for the questionnaire study. The headmaster of the nearby teacher training school dropped in and he promised to send the corresponding list of mentor teachers' e-mail addresses. It was agreed that the visit for interviewing staff would be organised 18.-19. May.

4. Group interviews of student teachers (cf. http://www.oecd.org/dataoecd/3/2/42419175.pdf). The first group consisted of two students in the Subject teacher education programme, one of them was enrolled in the Foreign language teacher education programme and the other in the Science education (biological sciences) programme. The second group of two student teachers in primary school teacher education programme was heterogeneous while one of them was getting a double competence also as a subject teacher in social sciences. The third group was of four subject teacher students, one majoring in Mother tongue (Finnish), two in Mathematics, and the fourth in Geography. It appeared that all student teachers were satisfied with their acquisition of ICT skills. However, the ICT courses in different training programmes and even for different subject majors varied quite a lot. The teacher training school had been renovated recently and there were the newest equipment available offering new and interesting technologies to be implemented in teaching practice.