

OECD/CERI ICT Programme

A Case Study of ICT and School Improvement
at

Oulu Teacher Training Upper Level
Comprehensive School, Finland

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1 Overview of the present

Brief description of the school

This study was conducted in Oulu Teacher Training Upper Level Comprehensive School, which is located in the suburb of the city of Oulu. The school is a teacher training school and it is administratively a part of the Faculty of Education of the University of Oulu. Finnish teacher training schools, like Oulu Teacher Training Upper Level Comprehensive School, play a central role in the training of prospective teachers. Due to their history the teacher training schools are also called "normal schools", as in the past their primary duty was considered to be setting the norm, or giving the model, for good teaching. As the teacher training schools are administratively part of the faculties of education, matters concerning open vacancies like ICT-teachers, are handled by the administrative organs of the universities. In all other respects these schools enjoy total independence. Their operations are governed by the relevant legislation of the teacher training schools and regulations issued directly by the Ministry of Education. Source of income of Oulu Teacher Training School is the University of Oulu, which is funded by the Finnish government.

Besides the training of prospective teachers, teaching experiments and educational research has a big role in everyday activities of the school. The school supports and complement research activities of the faculty of education, which influence to the teaching and the projects of the school. For example, in Oulu Teacher Training Upper Level Comprehensive School there have been implemented two innovative projects, which integrated ICT to the different learning contexts. The projects are *Distance education and telematics* project and *Inquiry-based computer supported collaborative learning (CSCL)* project. The latter was conducted in collaboration with the researchers of the faculty of education.

At the secondary level of Oulu Teacher Training School there are 261 students, of which 21 are immigrants. The percentage of immigrants is 8%, which is higher than elsewhere in Oulu (mean 1%). The mean size of a class is about 18 students and the school building is 18 years old (built in 1983). The staff (n=69) consists of teachers and other employees working in education. 43 of them hold a full time job as a teacher, 2 as a special teacher, 2 as a study adviser, 1 as a social welfare officer, 2 as a technical administrator and the rest as secretaries, attendants and kitchen and cleaning staff. In this school each lesson lasts 75 minutes.

In the curriculum of the school it is said that knowledge in the various fields of the arts and sciences, together with educational and didactic theory and know-how, are applied in practice. According to additional data like *ICT and network strategy paper* this particular school also aims to act as a local development center for learning concerning also pedagogical practices with ICT. The common aim of the Oulu Teacher Training school is to provide the students with ability to face on-going social changes. There is a generally agreed opinion that this is one of the most important purpose of the school and the school should have a sustained effort towards it through different innovations among education and ICT. Interviewed parents also agreed that one important goal in schooling is to ensure the students basic skills to use ICT.

The use of technology

The Oulu Teacher Training Upper Level Comprehensive School is equipped with 4 computer classes and a school library in which students are able to use six www-connected computers individually beyond the class time. For students there are also several older computers for e-mailing and chatting during the breaks in the corridors and halls and about 10 PC's for teachers in teachers' lounge. There is also a telematics classroom with videoconferencing equipments. The school has a 10 Mb/s internet-connection. The total number of www-useable computers is 124 and other computers 26. 64 of the computer processors are Pentium 200 MHz or less. There are also 15 Mac-computers and the rest of the processors are faster Pentiums than 200MHz. The school has also a digital camera, printers and scanners. All together, there are about two students per computer.

There are two persons working as a technical administrator in the school, which is rare in Finnish comprehensive school. They don't teach in any particular lessons or subjects but instead they help teachers and students when there are technical problems with the computers. The administrators take care of the computers including servers and software in lower and upper comprehensive schools and in the secondary level in Oulu Teaching Training School.

The head administrator estimated that he assists the teachers privately about seven hours per week with technical questions that teachers face with ICT.

Based on ICT practices survey and interviews it can be stated that in this school teachers use computers almost daily in their work but not together with students during lessons. The most common activities are text processing, drawing, e-mailing and information searching in Internet. 68% of the teachers send weekly more than six e-mails and uses actively different mail lists and newsgroups in order to collaborate with other teachers. Even 72% of the teachers reported that they use computers several times a week also at home for preparing lessons. There is an assumption that teachers of teacher training schools are more skilled ICT users than average subject matter teachers in Finland.

ICT in education

In Oulu Teacher Training Upper Level Comprehensive School all the 7th grade students have some basic education about ICT, but in the 8th and 9th grades ICT is a voluntary subject. Thus, there is a great variation in using computers, but on an average, it could be estimated that the students use computers once in a week during the lessons. The integration of ICT with other subjects depends on the teacher and the subject. It seems that the teachers' skills and possibilities to use different softwares don't vary very much but there is a greater variation in actually using them in teaching. 50% (n=8) of the teachers who answered the ICT practices survey questionnaire reported that they use computers in education several times per month. The rest of them use it few times in a year.

In education the most common activities with students were text processing and Internet based activities like information searching. The least used Internet activities were creating web-pages and chatting and mailing to newsgroups. Playing the games in the lessons were also quite rare. The third of the teachers estimated that they have sometimes organized computer mediated collaborative learning situations. Interviewed students told that sometimes in the last minutes of the lessons they are allowed to surf and chat freely in Internet in the computer labs.

Generally, it seems to be quite common and appreciated to use computers in education, but there were also some opposite experiences and opinions about it. One interviewed teacher told that she uses ICT very rarely in education. She argued that the schedules of the computer classrooms are sometimes inflexible, so the arrangement of the ICT supported learning demands a lot of organization. She also thought that the materials of her own subject matter (foreign languages) are still quite unsatisfactory. As an example she stated that when she uses computers in education the students usually play cd-roms, which are played trough quite soon. She evaluated that the time that has been used for playing could have been used more effectively for studying. She figured that for the academic program of the school ICT plays only a small role in her subject matter.

Different student groups as users of ICT

It is difficult to say the exact percentage of students who have a computer at home, but it can be estimated that 70% of the students do have computer at home. Many teachers avoided learning tasks that could be completed with a computer at home in order to diminish social inequality. Instead, in the school teachers aim to offer all students equal possibilities to study with computers. One teacher commented, that she hopes the world is going to be smaller via media tools like computers, and her students have equal possibilities to learn about it more.

It seems that Oulu Teacher Training School can offer the students equal possibilities to better their academic performance with ICT. However, teachers estimated that there are some groups of students which may not benefit of these ICT-possibilities. All interviewed teachers pointed out that in the lessons where ICT is used the students with social or learning problems have usually same difficulties in studying than they have in the other lessons. From the point of view of this sub-population of the students, ICT was not seen as an answer to diminishing the gap between the students with different background. Instead, the students with better academic skills were reported to be able to use their skills more effectively because studying with ICT usually bases more on individual activities than traditional teacher-led activities. Two teachers thought that maybe the collaborative learning situations could offer new possibilities to support low-achieving students. As an example they mentioned that when learning processes are shared in a common environment it is possible to follow the problem solving processes of the high-achieving students, which could help the low-achievers.

In the interviews the equality between genders was mentioned as one aim of the education. Usually boys are more interested in technical subjects and applications and use computers in their leisure. Both the teachers and the parents mentioned that the school should more consciously try to motivate girls to gain their ICT skills. However, according to observational data the boys who were already skilled with ICT were the most common users of the computers in the corridors. In the classrooms there were minor differences in ICT activities between boys and girls, but the observational data showed that the voluntary users of ICT were mainly boys. According to principal, besides the gender equality the school also aims to assure basic ICT skills for all students including students in special education and immigrant students. The data did not show how ICT is integrated into special education.

2 Overview of the past

According to principal, the perspective of the Oulu Teacher Training School to ICT has been quite technology driven, but it has been changing towards more integrated model. Nowadays the aim is to use ICT as a supportive tool for learning. In addition to traditional ICT teaching like software programming courses, there has been many projects in the last few years which have aimed to integrate ICT and learning into different subjects like history and biology (for more see <http://norssi oulu.fi/projektit.html>). For example, in the international Socrates project Internet has been used as a communicating tool to contact international cooperation students (see <http://norssi oulu.fi/projektit/urbino/index.htm>). Also the news of the school have been reported in html-format since 1997. Both the students and the teachers report projects and latest

news in the web pages of the school.

Based on teachers interviews it was possible to highlight two projects which were mentioned in all interviews as innovative or progressive. Both of these projects aimed to find out new innovative ways to support teaching and learning with ICT. The other similarities were that the first propositions of the projects came outside of the school like Ministry of Education and the Faculty of Education. Anyhow, it looks like these pedagogically innovative projects were needed in the school and had been under teachers' consideration earlier. In the following sections these two projects and their effectiveness are described more accurately. The innovation of the school is defined here in terms of conventional schooling processes and outcomes. ICT is not defined here as an innovation, it's role is just to realize the innovation.

Distance learning and integrated use of ICT

One project which supported the innovation of the integrated ICT-using was *Telematics teaching* in Oulu Teacher Training School. In 1994 the Finnish Ministry of Education inquired whether the teachers' training schools would be interested in investigating the possibilities to establish telematic distance education clusters around their own locations. In this project telematics was defined as a real time distance learning between two or more participants or participating groups. It utilizes the latest data and tele technologies like data networks. The aim is that the geographical location of the participants is not significant in learning. The purpose of this project was that the participating school should have the facilities to make telematics an established method of teaching. Three training schools including Oulu decided to join the project, which was to last for two years.

In the first years, three teachers were responsible for carrying out this project in Oulu Teacher Training School. The school rented a PictureTel Live PCS 100 desktop equipment and started first telematic experiments with the Continuing Education Centre and the Faculty of education. At the beginning of 1995 the costs of forming telematic connections thorough multipoint video bridges were unreasonably high. Similarly, inspite of the fact that the digital ISDN telelines offered a chance to transfer live video in addition to sound and graphics, the bridges were quite unreliable.

In September 1995 the planning and construction of a telematic classroom begun and its aim was to have a room for a distance education and video conferencing. In one classroom the videoconferencing equipment and network software programmes were installed in a 100MHz Pentium computer with 16 Mb RAM. Nowadays, fourteen students at a time can attend telematic lessons in the classroom. The desks are equipped with fixed microphones, one per two students. The microphones are connected into the soundcard through a sound mixer. Though the sound system has an echo eliminating feature built in it, a few acoustic boards were fixed on the walls and the ceiling.

In March 1995 a telematics project on the English language was carried out between a class in Oulu Teacher Training School and a class in the school of Pyhäjoki. These two classes had two teachers, who were present at each site and thus could share experiences and exchange

opinions. Telematic lessons covered the various aspects of language teaching. The inquiry made among the students revealed the interesting fact that although live video conveyed little information, it was considered an important part of telematics, especially in forming social contacts. The student feedback was mostly positive. In the autumn 1995 the telematic cooperation was continued in mathematics. Also the Introduction on Studies and Science course, planned by a group of teachers from Oulu Teacher Training School, was launched. The telematic part of it was carried out in January 1996. Based on good experiences the school participated in the EU-project *T3* (Telematics for Teacher Training) in 1996-1998, which was coordinated by the university of Exeter in Great Britain. *POVILUS* project started in 2000. Its goal is to integrate telematics and www-based environment with learning. Ten cities from northern part of Finland participated in this distance learning project.

Computer Supported Collaborative Learning (CSCL) projects

In the autumn 1998 the school joined an European Union financed research and development project called CL-net. The aim of the project was to explore the computer supported learning in a comprehensive school context. In Oulu Teacher Training School the CL-net projects were a part of a series of intensive case studies of a three years research project on cognitive and motivational effects of computer supported collaborative learning, which was conducted in 1998-2001. Pedagogical and theoretical background of the projects aroused from studies of the inquiry based learning and CSCL (Computer Supported Collaborative Learning). Four teachers of the school participated in CSCL-projects and integrated network-based learning environment into their teaching. The subject of the CSCL-courses were literacy, mathematics, chemistry and physics.

The project tied especially to one class which participated in inquiry-based CSCL projects in science and literature lessons. The chemistry teacher and the mother tongue and literature teacher of the class thought that the idea of inquiry-based learning fits well, for example, in the curriculum of the chemistry and literacy. The literature and chemistry classrooms were provided with six Mac computers, which were located at the back of the room. As a collaborative software students used Computer Supported Intentional Learning Environment (CSILE) in the intranet of the school (Scardamalia & Bereiter, 1996). The students had also an easy access to Internet and to the library of the school. The teachers planned the learning projects collaboratively with the researchers of the Faculty of the Education, who provided pedagogical support in planning the inquiry-based learning, but did not participate in the classroom activities.

The teachers who used CSILE expressed also pedagogical problems. In the beginning of using computers and network-based learning environments there were many technical and didactical problems. The lesson planning seemed to be difficult, everything took longer than planned and a few students did not engage themselves in the inquiry-based learning. When evaluating the students ICT skills the teachers noted that students used computers better than they expected. They also felt that the students learned to ask questions and to share information concerning their examinations. It was possible for the teacher to observe and support students' learning processes better than before.

Mainly, the teachers' first expressions of the inquiry-based CSCL was positive and the teachers continued to use network-based learning environment. Especially the literacy teacher reported that working with CSILE was a good experience. Generally he evaluated that the possibility to share students own thoughts and questions in CSILE seemed to help to understand the literacy more deeply. He also noticed that it is very difficult to make boys read books and talk about them, perhaps a computer environment would entice them to exchange ideas about what they have read. The literacy teacher continued to use network-based learning environment for at least three years as a part of the research with this particular class. In 1999 students used also in physics learnin a computer-based measurement system and www-based Knowledge Forum environment, which is the new version of CSILE. Also one teacher in mathematics integrated KF learning environment into studying in the courses of geometry, algebra and statistics with another class.

3 The Present

ICT infrastructure and academic rigor

The outcomes the study showed that ICT infrastructure of the school could be considered as well constructed. The technical resources of the school are quite satisfactory, so it should be possible to use ICT in a various ways in every day activities. The amount of the computers (two students per computer) and especially www-connected computers is bigger than on the average in Finnish upper level comprehensive schools. The administrative staff of the school takes care of both the hardware and the software of the school and assists teachers in their problems when needed. The teachers ICT practices survey showed that 61% of the teachers use ICT to network with their colleges. The critical level of conducting integrated ICT teaching in different subject domains seemed to be the question of using computer labs. Usually the classrooms with computers are booked so the integration of ICT with some subjects seems to be impossible. Also the diversity of the technological possibilities in teaching was considered to be a complex problem. As it is stated in *ICT and network strategy paper* of the school, this is one of the limitations of the general development of the school.

As a teacher training institution this school should develop educational ICT practices. There are some general goals which the school is aiming to. These goals are generated from the national standards and visions of the networked virtual schools given by Ministry of Education, but there isn't any determination how ICT should be used in particular subject domains. Anyway, based on class observations, it appears that ICT is changing the way the teachers teach. Even though the observed ICT lessons were mainly teacher centered, the students followed the teaching and worked actively with their own computers at the same time as the teacher was speaking. In the literacy lessons, where the students and the teacher worked collaboratively supporting each other in www-based learning environment, this moving towards student centered learning was notified more clearly. Generally, it seemed that active learning with ICT facilitated deeper understanding of the problems students were dealing with, but there was no systematic student centered curriculum or pedagogy.

Effectiveness

It was generally accepted that the projects which had lasted quite a long time were important for the development of the school. Both of the effective projects were initiated by a few active teachers. Generally speaking it seemed that the interviewed teachers appreciated the use of ICT as an additional tool which could facilitate their conventional teaching methods. Because of the already heavy work load they hesitated to start using ICT in pedagogically more demanding ways literacy.

The problematic point of the innovations was diffusion. It seems that the active teachers couldn't convince all their colleagues that integrated working with ICT can be a new opportunity for positive enhancement in teaching. Some teachers, who were not participating in these projects, also felt that it was difficult to start ambitious ICT innovations without the same external support that was allowed to these projects.

All interviewed individuals agreed that projects like telematics and inquiry-based CSCL were important because they aimed to develop pedagogical practices to integrate ICT meaningfully into teaching and learning in different contexts and subject domains. For teacher, who uses ICT randomly in teaching, agreed that of the pedagogical development is important in integrating ICT with teaching. Based on over ten years of experience in ICT teaching, the technical specialist teacher also agreed this. On the other hand, he proposed, that sometimes it is more effective to concentrate on practicing technical skills. Generally, it appears that the teachers admit that ICT is effective and important, but they sometimes feel that it is problematic to use in their own teaching. When the interviewed were reflecting the past, the projects like telematics teaching and inquiry-based CSCL were seen as possible new opportunities for teaching and learning. Based on these experiences there are projections for the future in the school (see chapter 5).

Equity

As a result of technology integration, students appeared to feel more confident when they were able to study different subjects with computers. For example, when technology was integrated into literacy learning the students felt they were better prepared because they were able to use supportive tools like www-based collaborative learning environment and word processing software. The school aims at providing a opportunity to become familiar with ICT equally to all students. However teachers estimated that there could be differences between low- and high-achievers in their ability to benefit from integrated ICT learning. It is difficult to determine if the intensive use of ICT in learning has resulted in increasing differences among these groups of learners. Based on the interviewed students' self-reports, it can be assumed that studying with ICT has opened more opportunities for active learning but on the same time it demands more developed learning skills. On the other hand the use of network-based collaboration tools seemed to help low-achievers to follow more skilled students' problem solving processes..

According to the observations, the most active ICT users were usually boys. The interviewed teachers and parents mentioned the equity between genders as an important goal, which should be reached in schools by motivating girls to study technology and ICT more eagerly. The school had, however, no specific plans to diminish the gap in ICT performance between boys and girls.

4 Main hypothesis

1. the technology a strong catalyst for educational innovation and improvement or does it serve only as an additional resource for improvement?

In the beginning of the ICT was technology driven but the school is currently moving strongly towards a model in which technology serves as an innovative additional resource and in which technology changes also the learning practices. For example, the innovative projects like telematics teaching and inquiry-based computer supported collaborative learning used technology as a tool for a pedagogical change.

In the spring 2000 the Oulu Teacher Training School participated in the national project of the networked virtual schools. For the future there are many plans in which www-based learning environments are used in both distance and face-to-face contexts to support learning in different subject domains. The aim is to use technology just as an additional resource to implement the innovations.

1. the diffusion of use of ICT follow the traditional diffusion pattern or did different diffusion patterns occur?

Initial aims of the innovations (described in chapter 2) were 1) to support learning in distant educational context, and 2) to support collaborative inquiry-based learning in classroom context. The innovators and early adopters of these innovations were the few teachers who were apparently inspired by the new pedagogical possibilities the technology could offer. Also the principal of the school supported these projects, which maybe made the processes of the innovations rather effective and well known among teachers.

After six years the reform of the integrated use of ICT has inspired other teachers too to use some of the models as a part of their everyday teaching. Over half of the teachers reported that they use computers several times in a month in education. However, many teachers expressed that it is difficult to find a progressive pedagogy which could lead to deeper learning. Based on this case study it could be stated that there is a need to find more innovative ways to integrate ICT into different subject matters, especially subjects in humanities. Thus, in Oulu Teacher Training Upper Level Comprehensive School there are still late adopters and resisters who don't find ICT as an innovative tool which could be used in teaching.

1. the successful ICT implementation depended mostly on staff competence in integrating ICT into instruction and learning or have the school technological infrastructure and students' ICT competence determined outcomes more than staff competence?

The technical infrastructure of the Oulu Teacher Training School is quite good. There is a full-time administration staff which helps the teachers in their technical problems. There are also active teachers who have some responsibilities of the technical infrastructure of the school. These teachers have usually good expertise in ICT. Thus, it seems that in this school the innovative use of ICT shouldn't depend strongly on teachers' competence to use ICT, because there are quite many possibilities to have guidance and support in technical questions which teacher face in every day situations. The innovative projects described in this case were mainly pedagogical innovations. In this case, successful implementation of ICT depended upon both the technological infrastructure and the teachers' competence to integrate it. It is obvious that the researchers' pedagogical support played also an important role.

1. the gaps in academic performance between high and low poverty (more advantaged and disadvantaged) students increase or not when all students have equal access to ICT?

The interviewed teachers and parents thought that the use of ICT had not led to meaningful changes in the gaps in academic performance among sub-populations defined by achieving level, gender or socio-economic status. It is difficult to avoid or diminish the gaps in academic performance because it depends usually on a student's socio-economic background like his or her parents' own education and profession. It is difficult to estimate the possible diverse effects of ICT use on the performance of high and low poverty students.

It is, however, noticed that the use of ICT has motivated some students, especially boys. The teacher who participated in the inquiry-based CSCL projects argued that the students had clearly gained more problem solving skills and reached deeper understanding of the subject than the other students who didn't participate in this project. Thus, integrated use of ICT can better the academic performance, but it is difficult to evaluate does it really diminish, or increase, the achievement gap between different users. In this case school it is believed that if all students are offered equal possibilities to access to ICT, it could diminish gap between different students. The school aspires to ensure that every student has basic skills in using ICT when she or he leaves this school. The aim is to offer equal possibilities for all students.

1. the successful implementation of ICT lead to the same or higher academic standards in spite of the low quality of many ICT materials or does ICT use lead to lowering academic standards as students spend more time on marginally beneficial ICT materials?

The teachers reported in the ICT practices survey that the most common activities in education with computers were writing with a Word processing program and using the World Wide Web. The available data of students' performance like short stories written in literacy lessons and interviewed teachers' evaluations of the academic performance showed that these common activities with ICT could lead to higher academic standards than studying without them. In contrary of that, the use of some instructional programs and materials, like cd-roms, was felt as

activities in which students were passive learners. The teachers believed that the students' own active thinking is important in learning with ICT.

It seems that it is difficult to design beneficial ICT materials for students who are 13-16 years old. In general, in Finnish schools ICT is mainly used as a tool for text production, information search and collaboration. Teachers use very seldom ICT in delivering instruction or presenting learning material. It can be concluded that the Finnish teachers are not so dependent on the learning materials.

5 Projecting to the future

A number of factors contribute to the sustainability of the integrated ICT teaching. One of the main reasons to continue to develop the pedagogy with the help ICT is that in this school it is considered to be an useful tool in creating student-centered learning situations where students are able to communicate and practice problem solving together as a team. This is exactly what they are expected to do later on in future working contexts. Also technical skills are seen as essential skills to possess in the future.

The other reason to sustain and embed innovations within the broader teaching culture is that implementation is driven by the teachers who are active and central participants of the teachers' community (eg. one of the teachers who participated in the innovations referenced earlier was the vice principal of the school). As a teacher training school teachers they have good possibilities to share their knowledge of the benefits of the integrated use of ICT both to their colleagues and to teacher trainees. They have good possibilities also to inform teachers from the other schools, because the teacher training school is usually a learning center for in-service training of teachers. It is a place where teachers can take part in courses and update their knowledge about modern education.

There are many plans for the future in this case school based on good experiences of distance learning and network-based collaborative learning. For example, the school has participated in the project, which aims to build a common networked learning environment between Finnish teacher training schools. The project is a sub-project of the Finnish virtual university and the virtual network of the faculties of education (see <http://www.virtuaaliyliopisto.fi/english/index.html>). The goal is to build a network of the teacher training schools in Finland and to create a www-based virtual learning environment for all teachers and teacher students.

Appendixes

Appendix A: Methodology

The data collection was carried out by means of:

- with key personnel

(includes 4 teachers, the technical specialist teacher, the administrator, the secretary of the school, two parents and five students)

- of classroom and outside of classroom

(includes ICT lessons, Finnish subject matter lessons, two observations of the breaks)

- of school documents

(includes project papers, ICT and network strategy paper, students texts and other products like www-pages)

- practices survey

The first contact for this case study with the Oulu Teacher Training School was made, in the form on site visit, on December 2000. The actual data collection took place between January and February 2001, totaling several school days of one researcher. For verification and especially receiving details of minor amendments the collected data was evaluated by the Finnish case study researchers. To receive some verifications of the interviewed subjects e-mailing was also used.

Appendix B: Teachers' responses to the ICT survey

Table 1: The teachers' self-reports regarding different ICT practices (N=18).

How comfortable are you with using a computer to do each of the following?	Very comfortable	Comfortable	Somewhat comfortable	Not at all comfortable
write a paper	13	5	-	-
search for information on the WWW	8	4	5	1
create and maintain web pages	1	3	2	12
use a data base	3	5	5	5

develop a data base	3	1	-	
send and receive e-mail	13	4	1	-
write a program	3	1	-	14
draw a picture or diagram	5	5	4	4
present information (e.g., use PowerPoint or equivalent)	5	5	5	3

Table 2: The teachers' self-reports regarding different computer-related skills in their teaching (N=18).

How important is each of the following computer-related skills for your teaching?	Very important	Important	So-so	Not important at all
write a paper with a word processor	12	4	1	1
search for information on the WWW	3	10	2	3
create web pages	2	-	4	12
use a data base	2	4	6	6
develop a data base	1	1	5	11
send and receive e-mail	5	7	2	3
write a program	1	-	3	14
draw a picture or diagram with a graphing / drawing application	4	-	10	4
present information (e.g., use PowerPoint or equivalent)	2	3	8	5

Table 3: The teachers' self-reports of the ICT activities in education (N=18).

On average, how often do your students do the following for the work you assign?	Several times a week	Several times each month	A few times in a year	Never
use the World Wide Web	2	2	11	3
create web pages	-	-	3	15
send or receive e-mail	1	1	8	8
use a word processing program	3	5	9	1
use a computer to play games	-	1	4	13
use a spreadsheet	-	3	3	12
use a graphics program	-	3	4	11
join in an on-line forum or chat room	-	-	5	13
use a presentation program (e.g., PowerPoint)	-	1	4	12
use an instructional program (including simulations)	-	6	6	6
other computer uses	1	3	6	7

Appendix C: Informative WWW-sites

WWW-site of Oulu Teacher Training School <http://norssi oulu.fi/english/>
 Telematics project sites <http://norssi oulu.fi/~pkemppai/telemat/frontpag.html>
 Other projects reported on the Web <http://norssi oulu.fi/projektit.html>
 (mostly in Finnish)

Students' products on the WWW

Students' homepages <http://norssi oulu.fi/english/yakotis.html>
 Report of the *Lake* project <http://norssi oulu.fi/~pkemppai/rantaprojekti/thursd.htm>
 The fotograf presentation of the school <http://norssi oulu.fi/kuvat/esitys/>
 (pictures change every four seconds)