Informatics in Education, 2006, Vol. 5, No. 2, 167–182



# Finnish Teachers and Pupils as Users of ICT

Päivi ATJONEN
*Department of Education, University of Joensuu*
*P.O.Box 111, FIN-80101 Joensuu, Finland*
*e-mail: paivi.atjonen@joensuu.fi*

Received: April 2006

**Abstract.** The main task of this follow-up study was to describe teachers' expectations, experiences and possible changes in the pedagogical use of ICT. As a part of an ICT development project, three sets of data were gathered from a region in Eastern Finland, by means of questionnaire. A total of 156 teachers of primary and early secondary education returned the questionnaire in 1999, 155 teachers in 2001, and 81 in 2004. The results indicate that teachers have increased their use of various ICT applications (especially data processors, web-browsers, e-mails, and CD-ROMs) both in their private lives and in pedagogical practice. Based on their own self-assessment, the teachers' ICT abilities have improved during the project period. Co-operative activities by means of ICT also increased between colleagues. Although teachers saw ICT as helpful for pupils' learning, some sceptical attitudes emerged as well.

**Key words:** information and communication technology, pedagogical use of ICT, teaching and learning, basic education.

## 1. Introduction

Various rapid technological innovations have opened up huge numbers of opportunities for pedagogical uses of information and communication technology (ICT) during the past decade. National and international investigations and their meta-analyses have supported the optimistic view that many difficulties in teaching and learning can be erased or relieved by means of ICT. The history of CAI programs (computer-assisted instruction) was promising, but the Internet, CD-ROMs, functionally versatile workstations with fast processors and information networks in particular, including digital platforms for web-based learning, launched a new era for educators.

Information networks have improved living conditions and opportunities to earn a living for several vocational groups, from farmers to secretaries, from handicraft designers to high-tech businessmen. Distance learning has spread in a way which seems realistic in relation to its extended applications. Various forms of e-Learning are becoming more popular at all levels of education, from day-care centres and secondary schools to universities.

Scrimshaw (2002) has summarised the reasons for the pedagogical use of ICT (Table 1).

Despite the promising opportunities of e-Learning, m-Learning or u-Learning (electronic, mobile, ubiquitous), the problems should also be kept in mind. The advantages

Table 1

Purposes for which ICT is being introduced to schools (Scrimshaw, 2002, p. 9)

| Direct support to learning | Indirect support to learning | Achieving community purposes |
|---|---|---|
| • More efficient learning | • Teacher development | • Promoting greater social equality |
| • Promoting active learning | • Encouraging educators to publish their own resources | • Providing a suitably skilled labour force |
| • Promoting independent learning | • Improved administration and management | |
| • Developing group works skills | • Improved assessment services | |
| • Developing citizenship skills | • Improved employment opportunities | |
| • Developing communication skills | | |
| • Developing ICT skills | | |

of computers, open learning environments, digital materials or networking are sometimes overstressed. Teachers' IT skills are not always the best possible. The promotion of greater social equality in relation to relatively expensive digital technology may be more of a dream than a reality because of different financial priorities in different local municipalities. Robertson (2002), for example, has shed critical light on these aspects from the British viewpoint.

In this article I will elaborate on the strengths and weaknesses of ICT by discussing a case-study from the Kainuu region in Finland (see Fig. 1) and compare it to national and international (especially European) data, as well. Finland is known as a highly technical country due to a good technical infrastructure, successful basic and higher education and its internationally recognised high-tech companies, like Nokia (mobile phones). Although the basics for the pedagogical use of ICT is good, needs for improvement are also necessary in Finland.

### 1.1. *Perspectives of Teachers in Relation to the Pedagogical Use of ICT*

Teachers are the obvious key persons to bring the versatile digital world to schools and pupils. Their IT attitudes and skills have been eagerly investigated and it has been found that teachers have mainly positive attitudes towards and beliefs about ICT's power to enhance teaching-learning processes and to improve pupils' learning (Dal, 2004; Hernes *et al.*, 2005, p. 285; Hylén, 2003, p. 12; Williams *et al.*, 2000, pp. 308–312.) Sceptical scenarios and negative experiences have also been reported: for example, Watson (2001) refers to the British surveys of 1989 and 1997, in which only 10% of teachers said that ICT had an impact on teaching and learning. He also points to the fact that this figure was 20% in Finland according to Sinko and Lehtinen (1999) and asks why one must wait so long for significant results.

One reason for the slow progress lies in the technical and pedagogical skills of teachers, which should be improved by their initial and in-service education. Without proper

basic computers skills, peripherals and network tools and without a clear vision of their pedagogical use, nothing important will occur in the classrooms. New ICT requirements are challenging, especially for the experienced teachers but there is remarkable variation in IT skills between teachers for all age groups, school subjects and educational levels. Finland has, among many other countries, invested notable sums of money in order to establish and update teachers' skills and knowledge. The results are quite good but they could be better.

Being able to teach through ICT is not an inborn ability, it must and can be learned. Promising experiences are obtained from peer-teaching and peer-tutoring instead of externally organised training sessions (McCarney, 2004). As is the common way, teachers usually start using computers for their private affairs and the planning of teaching and gradually they gain enough courage to use computers in the classrooms with pupils. Among the most popular applications, word processors, web-browsers and CD-ROMs, sometimes spreadsheets, graphics and databases are also mentioned.

On the other hand, teachers' expertise in pedagogy should be appreciated by offering more technical support than nowadays seems to be the case in many countries. The use of computers can be psychologically explained as a combination of attitudes and skills. Trust in computers (technical stability), computer confidence and computers' perceived general value and status value are important factors for attitudes. If the attitudes are positive, teachers may want to improve their skills, if they trust themselves and their learning; if not, they may refuse to use computers in the classrooms, especially when technical support is not easily available (Bradley and Russell, 1997; Kian-Sam and Chee-Kiat, 2002).

Simpson and Payne's (2002, pp. 35–36) assessment of the most influential factors in the pedagogical use of ICT from a teacher's viewpoint is apparent in the following summary:

- the knowledge of the teacher on what technology was available, what it was capable of, and how it might be used within the classroom;
- the location of the technology within the school;
- the decision taking processes which determine the allocation of resources and the distribution of ICT in schools;
- the confidence and expertise which the teacher has in using the ICT available;
- the teacher's knowledge of and responses to the skills and expectations of the pupils;
- the subject and typical established teaching practices of the individual teacher.

### 1.2. *Perspectives of Pupils in Relation to the Pedagogical Use of ICT*

As indicated in the Table 1 from Scrimshaw, a lot of hope has been placed upon the enhancement of pupils' learning in ICT discussions: more efficient, active and autonomous learning is expected to occur thanks to ICT. Many research results offer evidence for these hopes, but the individual effect of ICT is difficult to prove because of the variety of individual and contextual factors that influence learning (Markauskaite, 2003).

Advocates for the pedagogical use of ICT have spoken of the open environment, stressed the management and assessment of multitude information, and found new opportunities to emphasise pupils' active roles in teaching-learning processes (Jonassen *et al.*, 2002). The use of the Internet, intranets and emails enable new contacts across the classes, schools and nations, not to mention the benefits of word processors and the most common peripherals (printer, dvd/cd drives, data projector, digital camera, video-conference tools) for learning processes and results.

Lately, researchers around the world have been very keen on collaborative web-based learning. According to constructivist learning conceptions, distributed cognition and development of expertise are applied and web-based learning is also appreciated in the context of basic education. Simultaneously, many teachers are worried about pupils' net-addiction and loneliness, due to communication purely by means of technology (Blanchard and Marshal, 2005; Charlton, 2002; Fisher and Mandl, 2005; Jonassen *et al.*, 2002).

According to many Finnish and international surveys and investigations, pupils are still motivated to learn with computers and they would like computers to be used more at schools than currently happens. The latest international PISA (Program for International Student Assessment; 41 countries involved) results show that pupils' access to computers at home or at school has improved but huge variation exists between countries (OECD 2005, 22). On the one hand, pupils learn their advanced IT skills through their leisure time, through hobbies and together with friends. On the other hand, not all adolescents have a computer at home with which to learn. If the schools and teachers are not interested in providing their pupils with at least basic ICT skills, schools' opportunities to increase educational equality in this respect will be neglected.

Distance learning or blended learning is perhaps not a common solution for the youngsters but it should be considered and developed seriously in sparsely populated areas where the availability and quality of traditional institution-based education is threatened due to, for example, strong out-migration (Oliver and Trigwell, 2005; Ludlow *et al.*, 2002). At least some courses could be experimented with in the upper grades of comprehensive school (age group of 12–16 years). Many countries have successfully established virtual schools for the general upper secondary school (age group of 16–19) including in Finland (part of my empirical data emanates from a school that belongs to this kind of a network).

In summary, from both the teachers' and the pupils' perspectives, it can be said that ICT innovations are not easy to successfully implement, even though many advantages of the newer technology are apparent. Both mental and physical obstacles have emerged when local or national educational authorities or researchers have tried to promote ICT at schools. On the other hand, significant improvements are also evident when key elements from the developmental efforts match together. I will now focus on one of the many efforts in order to show, by means of empirical data, how a group of Finnish comprehensive school teachers succeeded in their pedagogical work with ICT.

### 1.3. *Research Tasks*

The Finnish Ministry of Education has launched three broad national programmes for the development of ICT in education since 1995 (see the latest: Opetusministeriö, 2004). The National Board of Education prepared and implemented many development plans to put the broader strategies into practice. Notable investments in hardware, software and the in-service education of teachers have been carried out based on these strategies. Dozens of development projects organised by different agencies, researchers and consultants have been in progress to encourage schools, teachers and pupils to use ICT. Among these many projects was the Kainuu project, established in 1999, which this article discusses.

The main task of this follow-up study was to describe the teachers' expectations, experiences and possible changes in their pedagogical use of ICT. The key areas of experiences and changes were the teachers' 1) private and pedagogical use of ICT, 2) assessments of their pupils' interests in using ICT, 3) teaching-learning methods in ICT and 4) opinions on aspects of ICT in the curriculum. In this article, I will address the first two areas.

## 2. Methods

The Kainuu project was launched in the middle of 1999, with the participation of four municipalities in the Kainuu region (Hyrynsalmi, Paltamo, Puolanka and Ristijärvi; see Fig. 1) and a neighbouring municipality, Pudasjärvi, which were responsible for its costs in conjunction with the Finnish National Board of Education.

The Kainuu region is situated in Eastern Finland. It suffers from severe out-migration, and therefore dozens of small schools have been closed during the project's active years. Sustainable solutions to guarantee quality education for the remaining pupils are needed. The five participating municipalities had a total of 23 605 inhabitants at the beginning of 1999 (range 1 798–10 044) and 22 059 at the end of 2004 (range 1659–9561). The municipalities are sparsely populated, with a mean population density of 2.7 persons per square kilometre (range 1.7–5; mean for Finland 17 inhabitants/km$^2$).

The Kainuu project aimed at increasing the use of ICT in its different forms and ways, especially in the primary and early secondary education (pupils aged from 7 to 16). This required in-service education for teachers, to improve their technical and pedagogical ICT skills. Networking across the municipalities by means of emails, video conferencing and electronic discussion tools was encouraged. The project was based on a 'differentiated step-by-step strategy', i.e., teachers were not forced to participate and their activities were not strictly controlled.

The data were gathered by means of questionnaires because of the size of the target group. The questionnaire consisted of the following parts of which B, E and F, in particular, are the focus of this article:

A. Background information (e.g., municipality, sex, teaching experience, type and size of school, subjects taught, ICT facilities at the school, nature of the school curriculum)


Fig. 1. Kainuu region in Finland.

B. Previous personal experiences in using ICT (e.g., applications used in private life and at school, use of telematics, distance or online learning, need for in-service education, estimate of present ICT skills)
C. Previous experiences in curriculum design (school-based, generally, or in relation to technology)
D. Previous experiences in teaching methods (in general or in relation to technology)
E. Ideas for using ICT for teachers' networking or for pupils activities as a part of the forthcoming project (open questions)
F. Attitudes towards ICT in teaching and learning (20 items, Likert scale: 5 = I agree... 1 = I disagree)
G. Concluding remarks (e.g., general attitude towards the project, extra opinions)

Three sets of data were gathered: first in October 1999 (expectations), second in January 2001 (experiences of the first 1.5 years) and third in October 2004 (final assessment of the 4 years). The first two inquiries took place during two large in-service education days, during which the teachers filled-in the questionnaire. A total of 156 teachers (72%) returned the questionnaire in 1999 and 155 teachers (74%) returned it in 2001. The third inquiry was implemented by means of a postal survey about 10 months after the project was closed, and only 81 (48%) teachers returned the questionnaire, which threatens the reliability of the results.

No exact comparisons (person by person) between the three data sets were attempted because the project functioned on a voluntary basis, and it was not possible to exactly

estimate the total number of active teachers, moderate actors or onlookers. The three respondent groups were almost identical in terms of their background information (sex, age, teaching experience, school type and size).

The research data discussed here refers to a heterogeneous teacher group which tried to follow Finnish ICT strategies at their own pace and in their own terms. Although they received some extra support from the project, they tried to improve the use of ICT mainly by means of normal resources. They are ”ordinary Finnish teachers” although they live and work in a different geographical area compared to, for example, the Helsinki capital area. The data includes teachers not only from rural areas but also from big schools (= more than 200 pupils) situated in densely populated areas. It includes both IT beginners and experts but the majority of the respondents is somewhere between beginners and experts, as is typically the case in Finland and in many OECD countries.

The results from the Kainuu region are compared to some national (e.g., Huovinen, 1998; Ilomäki, 2002; Ilomäki and Rahikainen, 2001; Nordic countries, 2006; Sinko and Lehtinen, 1999) and international (e.g., Dal, 2004; Hernes *et al.*, 2005; Higgins, 2005; Hylén, 2003; Jedeskog, 2000; Kankaanranta *et al.*, 2000; OECD, 2005; Simpson and Payne, 2002; Williams *et al.*, 2000) data, in order to shed light on the broader context of this case-study.

## 3. Results

About two thirds of the Kainuu teachers were women, and half of the teachers were working either at the pre-primary or at the primary school level (grades 0–6). One third or fourth of the respondents had an M.Ed. or M.Phil. Degree and the mean length of their teaching experience was 18 years. Only slight but not significant variations between different sets of data were noticed in these descriptive figures. The teachers were typical of those of the Kainuu region and Eastern Finland in general (Rönnberg, 2000).

### 3.1. *Teachers as Users of the ICT at Schools*

The Kainuu teachers reported that they had increased their use of ICT both in the planning of teaching and in its use in the classrooms. 24% of the second inquiry and 46% of the third inquiry reported expanded use. About half of the respondents said that they used ICT in the classrooms, which is very similar to Norwegian (Hernes *et al.*, 2005) and Islandic (Dal, 2004) teachers. In Eurobarometer Flash, the biggest number of ICT-related lessons was reported from Great-Britain (Hylén, 2003, pp. 10–11). In the PISA data, 36% of Finnish schools reported that they used computers at schools at least a few times per week, however the average of OECD countries was 43% (Kupari and Välijärvi, 2005, p. 174).

The most familiar applications were data processors, the Internet, subject-based computer programs (incl. CD-ROMs) and email; 43–70% of Kainuu teachers announced that they were personally familiar with these applications. The percentages increased 10–15 units during the project’s four active years. The results of all inquiries indicated that the

men were more familiar with all kinds of applications than the women, and that the teachers at the primary school level were the most active in using ICT in the classroom.

In relation to telematics, the teachers mainly used email and the Internet to look after their private affairs (58% said 'often'), to maintain contacts with colleagues (49%) and to prepare their lessons (34%). Networks for information acquisition from experts, electronic publishing and pupils' distance assignments were mentioned quite often. Some gradual increase in the above-described aspects can be observed from 1999 to 2001 and 2004. One fifth of the teachers used online courses as a part of their teaching and learning in 1999, but the share for 2004 was 38%, which is a significant increase. The women were also less experienced in these respects.

The findings about the use of various applications were quite similar to those reported in other Finnish surveys and investigations, although the ability or activity level of Kainuu was slightly below average (Huovinen, 1998; Ilomäki, 2002; Koivisto *et al.*, 1999; Sinko and Lehtinen, 1999). The main trends of the results also resemble the findings reported by Dal (2004; Islandic teachers), Heikkilä (2005; vocational teachers of Europe), Hernes *et al.* (2005; Norwegian teachers), Williams *et al.* (2000; Scottish teachers), Simpson and Payne (2002; Scottish teachers), and Kankaanranta *et al.* (2000; the SITES-survey on 26 countries).

As far as teachers' ICT skills are concerned, 58% of respondents saw themselves as beginners but only 2% saw themselves as experts at the beginning of the project in 1999, but some improvement is evident since then (Fig. 2).

It is difficult to say, unambiguously, whether the changes in the self-assessed abilities are significant or not, but compared to some research reviews of ICT progress and

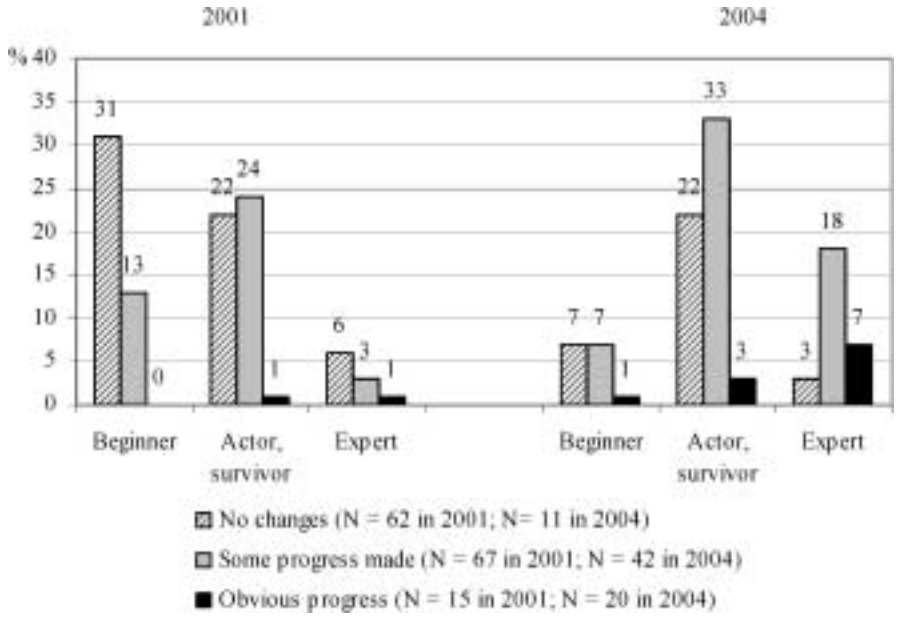


Fig. 2. Teachers' self-assessment of their ICT skills (percentage distribution).

its general slowness (Jedeskog, 2000; McCarney, 2004; Mioduser *et al.*, 2003; Watson, 2001; Reynolds *et al.*, 2003; Robertson, 2003), the result can be regarded as moderate.

All around the world teachers complain about a general lack of in-service education and technical and pedagogical support, as was also the case in my follow-up data. In practice, it is difficult to reduce gender and intergenerational differences. Trust in computers and computer anxiety influence decisions to use ICT in classrooms, and women in particular hesitate over the technical trustworthiness of computers and networks. (Tuomivaara, 2000, pp. 219–222.) In these circumstances, separate computer courses can even increase these teachers' anxiety. (see also Nordic countries, 2006, pp. 87–90.)

ICT tools open up various new ways to connect professionals. According to the latest Scandinavian survey, teachers ($N = 1166$) from Finland, Sweden, Norway and Denmark reported frequent daily contacts with colleagues by means of ICT (Nordic countries, 2006, pp. 70–71). Among many important objectives, the Kainuu project aimed also at increasing the teachers' collaboration within and between the municipalities by means of electronic tools (emails, video conferencing, groupware). The teachers wrote about their various expectations of this area in 1999. Not all of them came true but the main categories of their expectations were present in the experiences reported in 2001 and 2004 (Table 2).

One can conclude from Table 2 that some interesting differences exist between the years and that the ways of using ICT were quite conventional. On the other hand, it should be kept in mind that the number of ICT beginners among the respondents was high and expectations must be quite modest because of the adopted step-by-step strategy.

Table 2

ICT activities with colleagues (number of mentions, $f = 102$)

| **Activities with colleagues** | | **Year 2001** | **Year 2004** | **Total 2001+ 2004** | |
|---|---|---|---|---|---|
| | | ***f*** | ***f*** | ***f*** | ***%*** |
| Use of email | | 22 | 06 | 28 | 27.5 |
| ▪ *In general* | *(7+2)* | | | | |
| ▪ *Creating contacts* | *(13+3)* | | | | |
| ▪ *Exchange of materials* | *(2+1)* | | | | |
| Planning meetings, negotiations | | 19 | 08 | 27 | 26.5 |
| ▪ *In general* | *(10+2)* | | | | |
| ▪ *Video conferences* | *(9+3)* | | | | |
| ▪ *In-service education sessions* | *(0+3)* | | | | |
| Cooperation of different kinds between teachers | | 14 | 07 | 21 | 20.6 |
| Use of Internet and networks | | 11 | 03 | 14 | 13.7 |
| Distance counselling | | 00 | 03 | 03 | 2.9 |
| Other activities | | 08 | 01 | 09 | 8.8 |
| **Total** | | **74** | **28** | **102** | **100** |

*Subcategories and their frequencies* (*years* $2001 + 2004$) *in italics*

Similar findings can be found from several Finnish and European surveys and investigations. However, among the participants there are also advanced users who work fluently and almost daily with mobile or interactive technologies (e.g., laptops, video conference software, handheld devices, interactive whiteboards), digital platforms and various peripherals (e.g., document camera, e-Music equipment).

As was mentioned in the Introduction, general attitudes towards computers and their pedagogical use are reported as positive in many international evaluations (Dal, 2004; Hernes *et al.*, 2005, 285; Hylén, 2003, 12; Williams *et al.*, 2000, pp. 308–312). For example, 77% of Scandinavian teachers assessed that ICT had had moderate or great positive impact on pupil performance and on the teaching-learning processes (Nordic countries, 2006, p. 58). Finnish or Kainuu teachers are no exception from these figures, even though the correlation between attitudes and practical experience is not linear: teachers may have positive attitudes before real teaching experiences. Potential bad experiences of teaching may change temporarily their thoughts in a negative direction. Yet, when familiarity with the technology increases, attitudes once again become more positive.

### 3.2. *Teachers' Reports on Pupils' ICT Usage*

The results of PISA 2003 indicated that the percentage of pupils using a computer at least a few times each week were the highest in Hungary, Great Britain and Denmark, as far as use at school is concerned, and in Canada, Island and Sweden for use at home. Finland represented an average level but had made clear progress from 2000 to 2003. (OECD, 2005, 20.) The amount of use, the ease of access to the Internet, or the number of computers are perhaps not the best indicators because according to the PISA results, moderate use of computers is related to good school success (Kupari and Välijärvi, 2003, p. 179). Pupils still seem to be interested in computers, although Finnish – like, for example, Danish, Hungarian or Japanese – pupils were not so keen on technology than some other countries' (e.g., Canada, Germany, Iceland) pupils. The main trends are similar to those reported in the latest survey on Scandinavian teachers (Nordic countries, 2006).

Because of scant research resources, I did not gather information from Kainuu's pupils directly but I asked the teachers to assess pupils' views and interests indirectly. The following results are based on data reported by teachers.

In October 1999 the teachers of Kainuu expected that the exchange of emails, various joint projects between schools (both within and between municipalities) and distance learning by means of video conferencing might be possible and interesting. The 2001 and 2004 results (Table 3) revealed that many of the above-mentioned activities came true in practice: the Internet was used as an information source, emails were exchanged for different purposes, experience was gained in video conferencing and distance learning, and pupils' reports and writings were published electronically. The proportion of different activities varied from 2001 to 2004, from the most conventional to newer activities.

When the respondents were asked to freely describe their various positive experiences on the pedagogical use of ICT, 14% of the utterances ($f = 116$) focused on the pupils' motivation and interest. They were also pleased with technical advances, i.e., new equip-

Table 3

ICT activities with pupils (number of mentions, $f = 180$)

| **Activities with pupils** | | **Year 2001** | **Year 2004** | **Total 2001+ 2004** | |
|---|---|---|---|---|---|
| | | ***f*** | ***f*** | ***f*** | ***%*** |
| Search for information in the Internet | | 35 | 06 | 41 | 22.8 |
| CAI programs, CD-ROMs | | 25 | 05 | 30 | 16.7 |
| ▪ *In general* | *(15+3)* | | | | |
| ▪ *Programs for special education* | *(7+0)* | | | | |
| ▪ *PowerPoint* | *(3+2)* | | | | |
| Use of email | | 21 | 09 | 30 | 16.7 |
| ▪ *In general* | *(10+4)* | | | | |
| ▪ *National and international contacts* | *(6+2)* | | | | |
| ▪ *Sending and receiving pupils' assignments* | *(5+3)* | | | | |
| Video conferencing | | 14 | 03 | 17 | 9.4 |
| Writing reports and producing other assignments | | 07 | 09 | 16 | 8.9 |
| Electronic class newsletter | | 02 | 07 | 09 | 5.0 |
| Web-based courses | | 00 | 08 | 08 | 4.4 |
| Use of digital camera | | 04 | 02 | 06 | 3.3 |
| Other activities | | 14 | 09 | 23 | 12.8 |
| ▪ *Distance learning* | *(3+0)* | | | | |
| ▪ *Editing home pages* | *(2+1)* | | | | |
| ▪ *Project on local geography* | *(2+1)* | | | | |
| ▪ *Acquaintance with a virtual science museum* | *(2+0)* | | | | |
| ▪ *Various other experiences* | *(6+7)* | | | | |
| **Total** | | **123** | **58** | **180** | **100** |

*Subcategories and their frequencies* (*years* $2001 + 2004$) *in italics*

ment and software for the use of pupils and teachers had been bought (19%) due to the project.

From the pupils' viewpoint, quite a few teachers complained that there are not enough work stations and that fast broadband access to the Internet is missing. Similar worries can also be read from other national and international reports. Depending on various teachers' pedagogical perspectives, quality of net connections and peripherals and physical placement of computers at school, technical infrastructure can be a real obstacle to advanced pedagogical use of ICT or it may be used as an excuse (Kiesi, 2005; Nordic countries, 2006, pp. 82–84; OECD, 2005, p. 29; Opetushallitus, 2005, p. 35; Reynolds *et al.*, 2003, p. 154; Smeets and Mooij, 2001, pp. 408–409; Williams *et al.*, 2000, p. 313.).

As a summary of pupils' perspectives (reported by their teachers), Fig. 3 draws attention to certain attitudinal items (5-point scale, $1 =$ I agree $\ldots$ $5 =$ I disagree):

The questionnaire contained 20 items but Fig. 3 only refers to those seven items directly concerned with the pupils' perspectives on the advantages or disadvantages of

PL1. ICT is a good tool for the independent search for information.

PL2. ICT is at its best when substantial and amounts of information are being processed.

PL3. Computers are good tools in promoting social learning.

PL4. CD-ROMs and websites inveigle pupils too easily onto the wrong tracks in their learning.

PL5. ICT increases pupils' interest in learning and teaching.

PL6. ICT is suitable for the development of pupils' cognitive abilities.

PL7. Working with computers easily leads to mechanical learning.

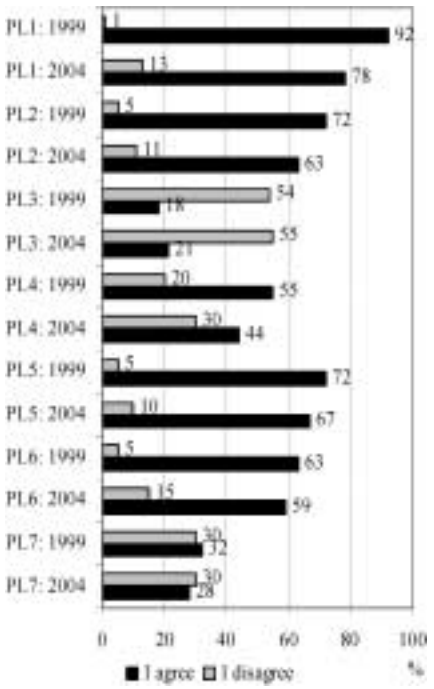


Fig. 3. Teachers' opinions of pupils' learning (PL) with ICT (percentage distributions, $N_{\mathrm{FI99}} = 156$ and $N_{\mathrm{TI04}} = 81$).

computer-mediated learning frequently mentioned in the literature. ICT was seen as a relevant tool for gathering various kinds of information, although the number of teachers who agreed with this decreased from 92% (year 1999) to 89% (2001) to 78% (2004). The effects of computers on pupils' motivation and activation were more apparent at the beginning of the project than at the end (Mean$= 3.90 \rightarrow 3.93 \rightarrow 3.75$). An opportunity to control a lot of information was appreciated, but some decline was also evident here ($3.93 \rightarrow 3.84 \rightarrow 3.70$). Many teachers were afraid that the huge amount of digital information available (especially from the Internet and CD-ROMs) can obscure the objectives of learning ($3.47 \rightarrow 3.41 \rightarrow 3.19$). Some of them did not entirely believe that social learning or social skills could be promoted by means of ICT ($2.45 \rightarrow 2.33 \rightarrow 2.51$).

## 4. Discussion

The main findings of this follow-up study indicate that in relation to ICT teachers may make important progress in the course of time and with some external support. Their private and public pedagogical use of ICT – self-assessed IT abilities included – increased, and communication between colleagues found new electronic channels. The teachers gave their pupils new opportunities to work with digital tools, seeing them as useful in improving learning results and in the enhancement of motivation.

However, these changes were not dramatic or fast. Existing pedagogical routines should be appreciated and new tools must be initiated based on these existing teaching-learning processes. The flaws of this kind of incremental development strategy are well-known, but evidence not only from the Kainuu data but also from international experiences show that revolutions are perhaps not the best ways to change teachers and schools (Mioduser *et al.*, 2003; Tubin *et al.*, 2003).

The expanded use of ICT at schools belongs to those educational innovations where the results have occurred slowly, also in international contexts (Markauskaite, 2003). Some teachers presumably feel helpless amidst the flow of information and expectations, especially when they do not have enough knowledge, education and experience. Negative attitudes come to the surface when proper information is missing and initial experiments in the classrooms are postponed. Sometimes it may be a relief to plead a lack of computers or software.

Many researchers think that incorrect arguments have been used in the efforts to promote ICT at schools. Robertson (2003, pp. 326–328) and Watson (2001, p. 215) explain that too much is discussed about the advancement of economic growth by means of ICT, and teachers do not like it when pupils are subordinated to business values. Reynolds *et al.* (2003, pp. 151–153) are suspicious of the rhetorical optimism about how ICT may solve all learning problems and erase various deficiencies for the whole of society.

Jedeskog (2000) criticises the rational-instrumental development strategy where schools' micro-political atmosphere and structure are ignored and externally supervised projects are implemented. Mioduser *et al.* (2003, 30) and Tubin *et al.* (2003) remind us that ICT is a complicated and multi-levelled group of tools and it takes quite a long time to learn to use them. Innovations at the individual level require different strategies to those innovations that are disseminated at the organisational level. Ramsay (2001) suggests, based on his ICT project in a big school (700 pupils), that schools should give solid answers to the following three questions, which may look self-evident but are ultimately not so simple:

- Why does the school believe it should teach and learn with ICT?
- What student learning with ICT is proposed to occur?
- How can the processes and practices of teaching and learning with ICT be put into place?

Systematic work has been conducted for years to develop Finland into an information society. What is meant by an information society is dependent on the speaker and the viewpoint adopted, but in all cases citizens are expected to adopt and master new technical skills, the aim being that all or almost all of them should acquire digital literacy. It is still worth remembering that besides narrow interpretations (= that citizens should be able to use technical equipment), broader thinking is needed also on the qualitative changes in living conditions that may arise from an information society. Those include changes in working cultures and know-how, which will require many structural changes in various work tasks.

As far as the sociological aspects of ICT are concerned (e-Democracy), computers for enriching teaching and learning processes are as important to pupils and teachers

living in developing areas as anywhere else. The aims and objectives of the use of ICT that are written into the national guidelines for local curricula are equally binding all over the country. Summarising the experiences received from the Kainuu project, it can be said that distance education and online learning in their different forms are essential, functional and potential tools for teachers and pupils. They can expand the ordinary curriculum, they can give pupils new experiences and skills and they may sometimes even successfully replace a lack of local educational services.

If schools in sparsely populated areas are equipped with proper information technology and the cooperative use of such equipment by people living nearby is well planned and carried out, the advantages of the expensive investments can be enjoyed by a broader sector of the population. Schools can once again become modern development centres or workshops which serve all age groups in the neighbouring society, from children to elderly people. Sometimes the versatile use of a school's digital infrastructure might even prevent the closure of a small school. I have reason to believe that these are not only visions that fit Kainuu or Finland, but that similar challenges lie ahead for teachers, head teachers, local educational authorities and national politicians all around the world.

## References

Blanchard, J., and J. Marshall (Eds.) (2005). *Web-Based Learning in K-12 Classrooms: Opportunities and Challenges*. Haworth press, New York.

Bradley, G., and G. Russell (1997). Computer experience, school support and computer anxieties. *Educational Psychology*, **17**(39), 267–285.

Charlton, J. (2002). A factor-analytic investigation of computer 'addiction' and engagement. *British Journal of Psychology*, **93**(3), 329–344.

Dal, M. (2004). How do teachers use information and communication technology in distributed and distance learning in Icelandic high schools? Paper presented at the NERA Congress in Oslo, 10–12 of March.

Fischer, F., and H. Mandl (2005). Knowledge convergence in computer-supported collaborative learning. The role of external representation tools. *The Journal of the Learning Sciences*, **14**(3), 405–441.

Heikkilä, E. (2005). Trends in European ICT-supported learning. *Lifelong Learning in Europe*, **IX**(4), 8–11.

Hernes, F., M. Hestman and E. Haaland (2005). *Knowledge and Competence in ICT among Teachers in Norway*. Norwegian university of science and technology. `http://www.ifip.or.at/con2000/iceut2000/iceut09-04.pdf`, 283–288 (assessed 21 March 2006).

Higgins, S. (2005). *Does ICT Improve Learning and Teaching in Schools? A Professional User Review of UK Research Undertaken for the British Educational Research Association*. Newcastle University. `http://www.bera.ac.uk/publications/pdfs/ICT%20PUR%20MB%20r-f-p%201Aug03.pdf` (assessed 22 February 2006)

Huovinen, L. (Ed.) (1998). Tieto- ja viestintätekniikka opetuksessa ja oppimisessa. Osaraportti 3. Peruskoulujen, lukioiden, ammatillisten oppilaitosten ja varhaiskasvatuksen nykytilanne ja tulevaisuudennäkymät (in English, Information and communication technology in teaching and learning. Part 3. The present situation and views about the future for comprehensive schools, general upper secondary schools, vocational education and early childhood education. Opetushallitus, Helsinki.

Hylén, J. (2003). ICT in the School. An International Comparison from a Swedish Perspective. `http://www.kollegiet.com/documents/pdf/KK_rapport_IT_eng.pdf` (assessed 21 February 2006)

Ilomäki, L. (Ed.) (2002). Tietotekniikka koulun arjessa. Loppuraportti Helsingin kaupungin opetustoimen tietotekniikkaprojektista 1996–2000 (in English, Information Technology during a School Workday. Final report on the project on information technology in the city of Helsinki, from 1996 to 2000. Helsingin kaupungin opetusviraston julkaisusarja A2.

Ilomäki, L., and M. Rahikainen (2001). Opettajat, oppilaat ja tietotekniikka: Erilaiset käyttökulttuurit. Helsingin kaupungin tietotekniikkaprojektin tuloksia (in English, Teachers, pupils and ICT: different cultures of use. Results on the project of information technology in the educational sector of Helsinki City. *Kasvatus*, **32**(1), 24–35.

Jedeskog, G. (2000). *Teachers and Computers. Teachers' Computer Usage and the Relationship between Computers and the Role of the Teacher, as Described in the International Research*. `http://www.diva-portal.org/diva/getDocument?urn_nbn_se_uu_diva-1198-1_fulltext.pdf` (assessed 22 February 2006)

Jonassen, D., J. Howland, J. Moore and R. Marra (2002). *Learning to Solve Problems with Technology. A Constructivist Perspective*. 2nd ed. Prentice Hall, London.

Kankaanranta, M., E. Puhakka and P. Linnakylä (2000). Tietotekniikka koulussa. Kansainvälisen arvioinnin tuloksia (in English, Information technology at schools. Results from international assessment. The IEA second information technology in education study SITES. Koulutuksen tutkimuslaitos, Jyväskylä.

Kian-Sam, H., and K. Chee-Kiat (2002). Computer anxiety and attitudes toward computers among rural secondary school teachers. *Journal of Research on Technology in Education*, **35**(1), 27–47.

Kiesi, E. (2005). Tieto- ja viestintätekniikan vakiinnuttaminen opetukseen. Esitelmä 3. virtuaalikoulupäivillä (in English, Establishing information and communication technology in teaching. Paper presented at the 3rd Virtual School Days. Helsinki. `http://www.edu.fi/virtuaalikoulu/paivat2005/materiaalit/Europaea/Ella%20Kiesi.ppt` (assessed 23 March 2006)

Koivisto, J., L. Huovinen and L. Vainio (1999). Opettajat oppimisympäristöjen rakentajina – tieto- ja viestintätekninen näkökulma tulevaisuuteen (in English, Teachers as constructors of learning environments – a future perspective on information and communication technology. Opetushallitus. Opettajien perus- ja täydennyskoulutuksen ennakointihankkeen (OPEPRO) selvitys 5.

Kupari, P., and J. Välijärvi (Eds.) (2005). Osaaminen kestävällä pohjalla. PISA 2003 Suomessa (in English, A solid basis for know-how. PISA 2003 in Finland. Gummerus, Jyväskylä.

Ludlow, B., J. Foshay, S. Brannan, M. Duff and K. Dennison (2002). Updating knowledge and skills of practioners in rural areas: A web-based model. *Rural Special Education Quarterly*, **21**(2), 33–44.

Markauskaite, L. (2003) Critical review of research findings on information technology in education. *Informatics in Education*, **2**(1), 65–78.

McCarney, J. (2004). Effective models of staff development in ICT. *European Journal of Teacher Education*, **27**(1), 61–72.

Mioduser, D., R. Nachmias, D. Tubin and A. Forkosh-Baruch (2003). Analysis schema for the study of domains and levels of pedagogical innovation in schools using ICT. *Education and Information Technologies*, **8**(1), 23–36.

Nordic countries (2006). *E-Learning Nordic 2006. Impact of ICT on Education*. `http://www.edu.fi/julkaisut/eLearning_Nordic_English.pdf` (assessed 8 May 2006)

OECD (2005). *Are Students Ready for a Technology-Rich World? What PISA Studies tell us*. `http://www.pisa.oecd.org/dataoecd/28/4/35995145.pdf` (assessed 22 February 2006)

Oliver, M., and K. Trigwell (2005). Can 'Blended learning' be redeemed? *E-learning*, **2**(1), 17–26.

Opetushallitus (2005). Perusopetuksen tieto- ja viestintätekniikan opetuskäytön sekä oppilaiden tieto- ja viestintätekniikan perustaitojen kehittämissuunnitelma (in English, Development plan for the teaching of information and communication technology and for the basic ICT skills of pupils. Opetushallituksen monisteita 7.

Opetusministeriö (2004). *Information Society Programme for Education, Training and Research 2004–2006*. `http://www.minedu.fi/julkaisut/koulutus/2004/opm14/opm14.pdf` (assessed 31 March 2006)

Ramsay, G. (2001). *Teaching and Learning with Information and Communication Technology: Success through a whole School Approach*. Paper presented at the computing conference, Chicago, 25th to 27th of July. `http://confreg.uoregon.edu/necc2001/program/research_pdf/Ramsay.pdf` (assessed 29 March 2006)

Reynolds, D., D. Treharne and H. Tripp (2003). ICT – the hopes and the reality. *British Journal of Educational Technology*, **34**(2), 151–167.

Robertson, J. (2002). The ambiguous embrace: twenty years of IT (ICT) in UK primary schools. *British Journal of Educational Technology*, **33**(4), 403–409.

Robertson, J. (2003). Stepping out of the box: rethinking the failure of ICT to transform schools. *Journal of*

*Educational Change*, **4**, 323–344.
Rönnberg, U. (2000). Perusopetuksen ja lukiokoulutuksen opettajat uuden vuosituhannen alkaessa (in English, Teachers in basic education and general upper secondary education on the verge of the new millennium. Opetushallitus. OPEPRO-selvitys 13.
Scrimshaw, P. (2002). *The NOW Report: Futures in Practice. European Schoolnet*. `http://www.eun.org/insight-pdf/now_report.pdf` (assessed 23 March 2006)
Simpson, M., and F. Payne (2002). *The Introduction of ICT into Scottish Primary and Secondary School. A Cross-Cultural Exploration*. University of Edinburg. `http://www.education.ed.ac.uk/es/ms/pdfs/seed_emile_02fin.pdf` (assessed 22 February 2006)
Sinko, M., and E. Lehtinen (1999). *Challenges of ICT in Finnish Education*. `http://www.sitra.fi/Julkaisut/sitra227.pdf` (assessed in 23 February 2006)
Smeets, E., and T. Mooij (2001). Pupil-centred learning, ICT and teacher behaviour: Observations in educational practice. *British Journal of Educational Technology*, **32**(4), 403–417.
Tubin, D., D. Mioduser, R. Nachmias and A. Forkosh-Baruch (2003). Domains and levels of pedagogical innovation in schools using ICT: Ten innovative schools in Israel. *Education and Information Technologies*, **8**(2), 127–145.
Tuomivaara, S. (2000). Oppimisluottamuksen, tietotekniikkaan liittyvien uskomusten ja asenteiden yhteys tietotekniikan käyttöön nuorilla (in English, Links between learning confidence, beliefs concerning and attitudes towards information technology and young people's use of information technology. *Kasvatus*, **31**(3), 217–236.
Watson, D. (2001). Pedagogy before technology: Re-thinking the relationship between ICT and teaching. *Education and Information Technologies*, **6**(3), 251–266.
Williams, D., L. Coles, K. Wilson, A. Richardson and J. Tuson (2000). Teachers and ICT: Current use and future trends. *British Journal of Educational Technology*, **31**(4), 307–320.

**P. Atjonen** first worked at the University of Oulu (Kajaani Department of Teacher Education) and now works as professor of education at the University of Joensuu. She is also a docent of pedagogy at the University of Helsinki, a member of the Finnish Education Evaluation Council and the chair of the Editorial Board of Kasvatus (a peer-reviewed Finnish journal on educational sciences). She has published more than 150 books, scientific reports and articles on curriculum development, teachers' pedagogical thinking, pedagogical ethics, and information and communication technology.

## Suomijos mokytojai ir mokiniai – informacinių ir komunikacinių technologijų naudotojai

Päivi ATJONEN

Pagrindinis šio tęstinio tyrimo uždavinys – aprašyti mokytojų lūkesčius, patirtis ir galimus pokyčius, susijusius su pedagoginiu informacinių ir komunikacinių technologijų (IKT) pedagoginiu pritaikomumu. Vykdant IKT plėtros projektą buvo surinktos trys duomenų apie rytų Suomijos regioną grupės. Duomenys rinkti atliekant apklausas. 1999 metais atliktų apklausų anketas grąžino iš viso 156 vidurinių ir pradinių mokyklų mokytojai, 2001 metais – 155, o 2004 metais – 81. Apklausų rezultatai atskleidė, jog mokytojai ėmė naudotis platesniu IKT priemonių spektru (ypač tekstų rengyklėmis, žiniatinklio naršyklėmis, el. pašto ir kompaktinių diskų programomis) tiek ir atlikdami savo pedagoginį darbą, tiek ir kasdieniniame gyvenime. Pačių mokytojų vertinimu, jų įgūdžiai, susiję su IKT, pagerėjo per projekto vykdymo laiką. Padidėjo bendradarbiavimo su kolegomis dalis, kai tam pasitelkiamos informacinės ir komunikacinės technologijos. Nors daugelio mokytojų nuomone IKT padeda mokiniams mokytis, tačiau radosi ir keletas skeptiškų požiūrių.