Changes in learning process caused by the implementation of ICT in education in Estonian in-service and pre-service teachers perceptions

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Abstract: The current paper reports on a qualitative study examining in-service and pre-service teachers perceptions about changes in the learning process caused by the involvement of ICT (Information and Communication Technology) in Estonian schools. Based on five in-service and five pre-service teachers' interviews, findings indicate some positive, some negative and some in-between (considered by teachers as positive from one side and as negative from the other side) changes in the student's and teacher's roles in the learning process and teaching process. Interviews were recorded and transcribed. Content analysis was used as the data analysis method. The paper discusses estimated changes by both groups in the Estonian educational system. A comparison of in-service and pre-service teachers' opinions has been provided.

Key words: implementation of ICT; teachers; qualitative study

1. Introduction

Since 1987 when the first school computerization program was implemented in Estonia (*The Estonian Tiger Leap into the 21st Century*, 1999, p. 11), the information society period can be said to have started in Estonian school system. Wide usage of the computers in education in US started almost more than ten years earlier in the 1970s (Alessi & Trollip, 2001, p. 4). Currently there are computer classes in each school in Estonia and every educational institution has an approach to ICT study tools and several packages of educational software have been created in addition to the provision of hardware. Most teachers have been educated to use both of those. Therefore there have been fast developments related to ICT usage in Estonian educational system during last two decades. According to the fourth development plan of ICT in education "learning tiger", currently every school in Estonia should be able to create a computer based learning environment and use it in an active way for learning and teaching.

Hargreaves (1998) stresses that there is a certain group of teachers being resistant to change. Huberman (1992) points that some teachers are deeply cynical about changes in learning and instruction. That change demands changes in teacher understandings and beliefs as well. Also Dwyer, et al (1991, p. 52) argue that teachers' instructional change could only proceed with a corresponding change in beliefs about instruction and learning. Has that change taken place in Estonian teachers' perceptions today?

2. Previous researches

Several authors have pointed out that due to implementation of ICT, roles and teaching-learning strategies are

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changing (e.g. Kolderie, 1990; Norum, et al., 1999; Fayiz, et al., 2006). Kolderie (1990) mentioned the ICT influence in education many years ago, and stated that new technology implied a major change in the role of the teacher in school. Lam and Lawrence (2002, p. 296) have declared "the teacher is no longer the 'star attraction' in the room" and students find more interesting resources by themselves. The computer is like the third party in the learning and it leads to changes in both the roles of the teachers and the students (Lam & Lawrence, 2002).

Teaching and learning strategies are changing because technology fosters the use of more student-centered learning strategies (Norum, et al., 1999; WANG, 2002; Lam & Lawrence, 2002; LU, et al., 2007). Student-centered learning environments are designed to provide students with opportunities to take a more active role in their learning. These environments allow students to examine complex problems using a wide variety of resources, develop their own strategies for addressing these problems in a collaborative manner (LU, et al., 2007). ICT has many possibilities to offer such kind of learning environment.

Ravitz, et al (1999) discuss the role of technology in the learning process and state that modern technology is reorienting learning more to the direction of constructivism. Today's learners are constructing their knowledge themselves on the basis of pieces of knowledge available in the Internet and therefore it can be considered as a student-centered approach (Ravitz, et al., 1999, p. 17). Lam and Lawrence (2002) indicate that in student-centered classrooms, usage of computers changed teachers' roles mostly to facilitators, coaches, and guides on the sidelines. Learners get more autonomy and control over their own learning (Lam & Lawrence, 2002). Scrimshaw (2002) has declared that teacher's and students' roles depend on how the computers are used. For example, using drill and practice programs, learner is just a receiver, but using simulations, he or she becomes an explorer.

CHANG (2002) is arguing between student-centered and teacher-centered approaches in Computer-Assisted Instruction (CAI). He states that teacher-centered approach has also several positive sides in CAI: "It may be inferred that a teacher-centered approach can help students 'see and sift through' a large amount information and data. It also helps them to understand debris-flow hazards, and hence, can assist students in actively constructing their own meaningful learning and to apply these learning outcomes to new problems" (CHANG, 2002, p. 285).

All authors mentioned that changes provide high-level requirements to human resources (teachers) in schools. It would seem that teacher-training units in universities don't pay enough attention to the ICT developments in the educational system. Students following a teacher education curricula have only a very limited number of courses to gain computer-based teaching/learning skills (Valcke, 2007). Eriksen (2004) considers that skills and competencies, which the tomorrow's teachers need, should be based on a professional-oriented focus and modern teaching methods. These skills and competences should be related to knowledge, social and cultural identity and ICT. WANG (2002) has stressed that it is essential that teacher educators guide and direct teachers to challenge, confront, and reconstruct their beliefs and perceptions about teaching and learning in the information age. Bell and Biott (1999) asserted that co-learning between the in-service and pre-service teachers would be effective way to transpose new competences to the in-service teachers.

Therefore, the implementation of ICT has brought forth several changes in the roles and teaching-learning process. Yet teacher training has not closely accompanied these changes. This may cause a situation where teachers do not see these changes in their real school life, or do not accept these changes. The additional problem for Estonian school system is that many teachers in schools have trained during the Soviet time, when students' activity and flexible thinking was punished and the teaching was entirely teacher-centered. Several researchers show that teachers tend to teach the way that they were taught (e.g. Ball, 1990; Becker, 1991). The aim of the current study was to investigate how Estonian in-service and pre-service teachers perceive the changes caused by

rapidly raising usage of computers in school education.

3. Method

Participants were selected from two different groups: (1) in-service teachers and (2) pre-service teachers in Estonia. Five people were selected from both groups. The aim of the study was to clarify how in-service and pre-service teachers perceive changes in learning process caused by the involvement of ICT in schools. Changes in the role of teachers, in the role of students, in learning and in teaching were studied.

In-service teachers were selected for the study on the basis of:

(1) Regional belonging (north, south, west, east parts of the country and the biggest island);

(2) Subject of teaching (mathematics, science, humanity, physical education and elementary school teacher);

(3) Gender (1 male and 4 female according to the proportion of the male teachers in the Estonian school-system);

(4) Category of teacher in Estonian school system (teacher-beginner, teacher, senior teacher, teacher methodologist and teacher awarded as the Teacher of the year).

Four of the in-service teachers had obtained teacher education during the Soviet time and had teacher experiences from that period as well (continuity of service 14-35 years) and only one in-service teacher had obtained teacher education qualifications since the period of the Estonian independence. Age of the in-service teachers ranged between 23-58.

Pre-service teachers were selected having regarded to:

(1) Subject of teaching (teachers of mathematics, science, humanity, physical culture and elementary school teacher);

(2) Gender (1 male and 4 female);

(3) Teacher experience (one without any experience before the teacher practice, one without any experience after the observing practice, one without any experience after the main practice, one having some experiences before the teacher education and one at the same time working and studying as a pre-service teacher).

All pre-service teachers were students of the University of Tartu during the study, but they came to the university from different parts of the country. The schooling in comprehensive schools of three pre-service teachers was after independence while two pre-service teachers had also experiences from the Soviet time. Age of the pre-service teachers ranged between 20-24.

Data was gathered using semi-structured interviews. Open questions in the interview were formulated generally and by the use of these questions the changes in the role of teachers, in the role of students, in learning and in teaching were clarified. Participants could describe and explain their personal thoughts and experiences with the help of open questions as deeply as they wanted. One interview took approximately 45 minutes.

Interviews were recorded and transcribed. Content analysis was used as the data analysis method. The aim of the analysis was to find out, how the particular group of people describes changes and which attitudes this group relates to that particular change. When teachers exhibit more positive attitudes toward ICT related issues, then they have more behavioral intentions to use it (Liaw, et al., 2007).

Analysis was inductive. Attention was paid to the linguistic expressions not to the persons. The unit of the analysis was independent sentences, which were coded into manageable content categories of changes using emergent coding, where categories were established following some preliminary examination of the data. These

categories were direct quotations to retain semantic context of the expressions. Nevertheless instances of overlapping between the categories of changes were eliminated during the analysis. Categorization was carried out by two independent researchers. Kappa-coefficient as classification agreement was 0.86. These categories of changes were linked to the categories of personal evaluations, which were given by the participant to the particular change. According to these evaluations, three categories describing attitudes related to the different changes became evident: (1) Positive changes; (2) Changes considered both, as positive and negative; (3) Negative changes.

Similarities and differences of categories of changes were investigated between the groups and between the categories of evaluations. The tables presenting whether there was a stronger presence of positive or negative changes illustrated relational concept analysis.

4. Findings

The smallest number of changes caused by involvement of ICT in education was perceived by both groups in the student's role (Table 1). Both groups mentioned as positive change that students are more involved in the educational process. They can discuss about their goals and choose materials for achieving these goals. Pre-service teachers perceived as positive change that students are no longer so much knowledge obtainers, but become more experimenters. With the help of computers, they can do experiments and discover knowledge by themselves. This result is according to Pratts' (1999) results of changes in students' roles with the effective use of IT. In-service teachers mentioned as positive changes that students become more independent learners and it is easier to take into account that every student has his/her individuality. Students can choose the pace and path in learning. They can choose materials, which correspond to their learning style, level and special needs. The same changes in students' roles were seen by Lam and Lawrence (2002).

Table 1 Perceived changes in the role of students caused by the involvement of ICT in Estonian schools

	In-service teachers	Pre-service teachers	Both groups
Positive changes	(1) Becomes a more independent learner; (2) Student gain individuality	Becomes more of a experimenter	More involved in the educational process
Both, as positive and negative changes			
Negative changes		Anonymity of student is increased	(1) Becomes a teacher as well; (2) Becomes more passive

An interesting result was that both groups saw the disappearance of clear roles of the student as a learner and knowledge obtainer and becoming a teacher as well as a negative one. Pre-service teachers remembered the cases when they laughed at a teacher if he/she said something wrong concerning about computers, or had done something in a rather inefficient way, or had used learning materials, which were too glary. In-service teachers recalled how badly they felt themselves if they could not do anything as well and as quickly as students, how they were ashamed of their foolishness etc. Lam and Lawrence (2002) have stated that the loss of teacher's expertise could be terrifying for teachers and they are afraid to look foolish in front of their students. Both groups mentioned, as negative changes, that students become more passive. They just get materials for their papers and homework from the Internet, or from the materials given electronically by the teacher without understanding, and in some cases, even without reading these materials. Students do not want to take notes or read long text. Instead, they want that notes are prepared by the teacher; that they get handouts and in the class they can just sit and listen,

that there are no long text, and instead of that teacher has prepared short conclusions from the text, etc. This result was unforeseen, because most of the studies have found that, in the learning process with computers, students play a more active role (e.g. Lam & Lawrence, 2002; WANG, 2002). Pre-service teachers saw that anonymity of students increases as a negative change as well. Teachers cannot identify papers, tests and the other writing documents by handwriting. Therefore students can use the anonymity in an unethical way, for example, submit documents under another name, or a write test instead of their classmate.

An unexpected result was that pre-service teachers perceived more negative changes in the teacher's role than in-service teachers did (Table 2). Pre-service teachers mentioned that teachers change from concrete and familiar persons to indeterminate supervisors, sometimes even not seen by the students, which weakens personal contacts and relationships between teachers and students. It is harder to communicate with an unknown person. Pre-service teachers said that teachers are less authoritative as well. Decreasing authority was related to the teacher's poor computer-skills and that the teacher is no longer the only source of information. Teachers have lost their power, because they cannot be the only knowledgeable and skillful persons in the classroom. Sometimes they need help from the students, or they should ask help from the educational technologist. It changes teachers to more helpless in the opinion of the pre-service students.

Table 2 Perceived changes in the role of teachers caused by the involvement of ICT in Estonian schools

	In-service teachers	Pre-service teachers	Both groups
Positive changes	Author of the learning materials		(1) To be a teacher is easier (2) To be a teacher is more comfortable
Both, as positive and negative changes		(1) Learner (2) Not the only source of information	
Negative changes	(1) Learner (2) Expert of computers	(1) Indeterminate supervisor, sometimes even not seen by the students (2) Less authoritative (3) Helpless	

In-service teachers complained that all community members—parents, students, school principals—are of the opinion that teacher should be an expert in computers. Such kind of expectations puts pressure on the teachers, which is negative. Teacher is becoming a learner was mentioned by both groups, but this change was differently evaluated by these two groups. In-service teachers mentioned this as negative change, because they have no time; they were not used to learn any more and elder people couldn't learn so quickly as younger ones do. Therefore they perceived this change as negative one. Pre-service teachers mentioned almost the same negative aspects, but they added that to be a learner gives teachers an opportunity to remember what is learning and how to be on the same side as a learner. They also mentioned that the life-long learning supports the following of changes in the surrounding world. Teacher do not need to be the only source of information by the involvement of ICT has noted by the pre-service students as in some cases positive and in other cases as negative. It was evaluated as positive, because students and teachers have more possibilities to obtain information and as negative because this change decreased the authority of teachers. Collins (1991) explaines that loss of teacher's authority is natural, because computers contain more information than teachers can possibly obtain.

Both groups mentioned that by the involvement of ICT, it is easier and more comfortable to be a teacher. It is easier to prepare and modify learning materials, lesson plans, check tests, to take into account students'

individuality, etc. Usage of computer drill programs frees teachers from mechanical work and saves their time. It is comfortable to choose suitable educational software, or digital learning materials from the Internet. In-service teachers indicated that the teacher has become the author of the learning materials and evaluated this change as positive. The teacher has no obligation to use materials not suitable to her/him and students, but she/he could create their own or modify those already existing.

The results of this study indicated that participants identified more changes in teacher's role than in student's role. Comparing changes in learning and teaching, participants perceived more changes in learning than in teaching. Changes in learning were more likely to be similarly perceived by both groups comparing with the other aspects (Table 3).

Table 3 Perceived changes in the learning caused by the involvement of ICT in Estonian schools

	In-service teachers	Pre-service teachers	Both groups
Positive changes	Broadens horizon new learning methods	(1) Takes less time (2) Is more active	(1) Immediate feedback improves comprehension (2) Motivated learning (3) Plenty of different learning opportunities (4) Materials are available in the Internet (5) Web-based learning
Both, as positive and negative changes	Comprehension, conjunction instead of the learning by heart	New learning skills	
Negative changes	(1) More communication through the computers (2) Less emotional (3) Social stratification	(1) Spelling and orthography problems (2) "Noise" of information obligation to submit printed papers	(1) Less human contact (2) Handwriting has became worse (3) Using copy-paste instead of own work (4) Health problems

Let discuss about the positive changes in learning perceived by in-service and pre-service teachers. In-service teachers mentioned that using computers broadens ones horizon–students know even more than is obligatory and have knowledge from different aspects. They said that students could use new learning methods as well, for example to learn via Internet in a common project with peers from different countries. Pre-service teachers pointed out that learning takes less time and is more active. Alessi and Trollip (2001, p. 5) declare that computer-assisted learning reduces time spent for learning. Both groups said that computer-based immediate feedback improves comprehension, learning became motivated and due to ICT capabilities plenty of different learning opportunities are possible. Immediate feedback assures that mistakes made by students do not become fixed and hence the students learn more. Students like to use computers and therefore the learning is more motivational for them. ICT offers different possibilities to present information: besides the text and static graphics, present animations, sound and videos; there are different kinds of educational software, which make possible different learning situations; computers could be used as communication tools as well. Therefore the number of possible learning opportunities has grown. Both groups mentioned, as a positive change, that materials are available in the Internet and it is possible to learn to use web-based learning as well. Due to such changes, learning materials are available free of charge, there are no problems to access the learning materials and learn even at home, when sick, for example. The same benefit was mentioned by Alessi and Trollip (2001, p. 5).

Some changes in learning were perceived as negative as well. Both groups mentioned that there are less human contacts in learning. In-service teachers told that they are afraid of the loss of emotions in learning and a

loss of real contact between the teacher and student and therefore increasingly more communication through the computers is negative—it decreases real communication between humans. Printed papers and homework raise a problem with handwriting and using copy-paste methods, instead of creating their own work. For students and even teachers handwriting has become worse and it is quite unreadable in many cases. One reason for these complaints could be the fact that in Soviet time handwriting was very important in Estonian schools, it was even separately assessed. Pre-service teachers spoke about the spelling and orthography problems as well, students cannot write without mistakes. Unlimited computer usage and ergonomical misusage causing health problems was brought out by almost every participant and was the most mentioned expression. One reason for this statement could be that there are many articles in the Estonian press pointing out that the health of youngsters has become worse. Pre-service teachers mentioned "noise" of information. This expression means that there is too much information in the Internet and seeking the right piece is not always easy; you get many links and have to look at all of these for seeking the most proper one. Disorientation has been mentioned as one of the most detrimental factor by several researchers (e.g. Barab, et al., 1999; McDonald & Stevenson, 1999). Obligation to submit printed papers has changed the learning negatively by the thoughts of the pre-service teachers. In such a format, teachers do not mark mistakes on the papers and do not write comments. Therefore students get less information about their work and they should understand by themselves what was wrong and what was right. In-service teachers worried about the social stratification. Learners having computers and Internet connections at home have better conditions and they have more learning possibilities. Even registration for different courses can be done through the Internet and whoever has Internet connection can do it faster.

Some aspects mentioned by in-service and pre-service teachers were evaluated both, as positive and negative changes. In-service teachers said that learning now contains comprehension and conjunction, instead of the learning by heart. This is seen as positive, because it decreases learning by heart without understanding, but it requires more intellectual skills and not all students are able to do this. Almost the same thought, but in a different formulation, was made by pre-service teachers. This group mentioned that implementation of ICT demands new learning skills, which could be good, but if still the students do not obtain these skills, learning could be hard for some of them.

Table 4 Perceived changes in the teaching caused by the involvement of ICT in Estonian schools

	In-service teachers	Pre-service teachers	Both groups
Positive changes	(1) Mechanical teaching could be performed by the computer (2) More linked with the real life (3) Takes into account individuality of learners (4) More flexible (5) Distribution and using of the learning materials composed by the other teachers		(1) Accessing information is quicker and more convenient (2) Visualization (3) Teaching-learning materials are created using ICT (4) Modifying teaching and teaching-learning materials (5) Plenty of teaching opportunities (6) New teaching methods
Both, as positive and negative changes		Distribution and using of the learning materials composed by other teachers	
Negative changes	(1) Needs extra work and creates teacher overload (2) Less emotional		

Teaching was the only area where pre-service teachers did not mentioned any entirely negative changes and

teachers noticed less negative changes than in learning (Table 4). Some changes pointed out in teaching were similar to the changes in learning. For example, both groups indicated that there are plenty of different learning opportunities, and they spoke that there are plenty of teaching opportunities as well. Almost the same was identified in the study carried out with 973 in-service teachers in Russia. More than quarter of teachers stressed that the adoption of up-to-date information technologies in the teaching and learning process creates new teaching and learning opportunities (Sobkin & Evstigneeva, 2004, p. 76). Teaching is more wide-ranging than in the times when only one textbook was available. In-service teachers worried about the loss of emotions in the learning and they pointed out, as a negative change that teaching has changed to be less emotional. An interesting result was that in learning only in-service teachers mentioned new learning methods as a positive change, but in teaching new teaching methods as positive change was mentioned by both groups.

The other positive changes perceived by both groups were connected to the preparation of the lessons and designing teaching-learning materials. Both groups spoke that there is much information in the Internet and therefore access to the information needed for teaching is quicker and more convenient. There are many pictures, animations and videos in the Internet. Therefore it is easier to use visualization in teaching, which is more comprehensible for students. Almost all teaching-learning materials are created using ICT, which is convenient and timesaving. It enables modifying teaching and teaching-learning materials easily as well. Alessi and Trollip (2001, p. 5) praised the Internet as a cheap and easy distributor of materials. In-service teachers mentioned that mechanical teaching (practice and drilling basic skills) could be performed by the computer and not by the human teacher. Scrimshaw (1999) has claimed that by the implementation of ICT, teachers should teach more learning process, but not the product. The Internet is a continuously renewing database. It enables the use of up-to-date information and real online data, which links teaching more with the real life. Bransford, et al (1999) stated that learning which is connected to real world is not a new idea, but ICT is a powerful tool to provide learning in a real-world context. Teaching takes into account individuality of learners and is more flexible in the opinion of in-service teachers. ICT provides teachers possibility to use different educational software for different students. As preparing learning materials are easier and quicker now, teacher could use learning materials on different levels and compose different presentations of information in the same class. Teachers could choose the teaching method, which is most suitable for their goals and teaching style.

Distribution and usage of learning materials composed by other teachers was mentioned by the both groups, but was differently evaluated. In-service teachers described only the positive side to this change, but pre-service teachers mentioned a negative side as well. Distribution and usage of learning materials, composed by other teachers, saves teacher’s time and provides ideas was mentioned by the both groups as a positive side. As a negative aspect, pre-service teachers said that not all teachers are able to select the most correct and effective learning materials and therefore, sometimes, teaching with poor quality materials hinders learning. In-service teachers mentioned that ICT involvement in teaching needs extra work and therefore creates teacher overload.

5. Conclusion

Participants of this study mentioned several changes as caused by the implementation of ICT in education, but those could be caused by principal changes in the society. Maybe because these changes occurred almost in the same time. The participants named more changes in the learning and teaching process comparing changes in the roles of teacher and student. Maybe changes in roles are more difficult to perceive than changes in processes.

Some participants of our study even mentioned that teacher is still teacher and student is still student and there are no changes at all. The smallest number of expressions was related to changes in the role of student. Results of this study indicated that changes in teacher's role were perceived mostly negatively. This result was valid for both groups. Almost every participant talked, in different way, about the loss of the authority of the teacher. Even pre-service teachers, whose schooling time was wholly during independence, mentioned this. An interesting result was that pre-service teachers evaluated more changes in teacher and students roles as negative. At the same time in-service teachers did not mention any entirely negative change in teaching. Changes in teaching were mostly positively seen by in-service teachers as well.

There were some contradictions as well. For example participated teachers told that a learner becomes more passive, but learning is more active. They evaluated both as positive and negative change demand of new learning skills, but as positive new teaching skills.

To avoid negative aspects and strengthen positive ones and to make clear which changes are caused by the implementation of the ICT, it is recommended that courses of initial teacher training and in-service training should pay more attention to the usage of computers in everyday classes. Special attention should be paid to computer literacy for in-service teachers. The participants in the study paid little attention to learning outcomes. It can be one more challenge for training for both groups.

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