PRIMARY SCHOOL TEACHER STUDENTS' PERCEPTIONS OF TECHNOLOGY

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Abstract

Technology education in the Finnish comprehensive school is an integrated subject, "Technology and the Individual" being one of the cross-curricula themes. It is accepted that students' conceptions are related to their teachers' conceptions. From the viewpoint of primary technology education and the development of primary teacher education, it is important to know teacher students' perceptions of technology and technology education. This study focuses on how primary teacher students think about technology. Results showed that teacher students understand technology from quite a limited perspective, thinking that technology in their everyday life is mostly based on domestic appliances, computers and mobiles. Although the teacher students' perceptions of technology were limited, their overall experiences towards it were positive. After the cross-curricula course, they viewed technology more broadly, understanding e.g. the history of technology, technological responsibility and its impact at the individual, social and global level. Emphasis was placed on the teacher students' abilities to apply technology and use it with their pupils in their future teaching profession. Despite limitations, the study provides insight into teacher students' perceptions of technology and it also contributes for further understanding in the area of cross-curricula themes.
Key words: *technology education, perceptions, primary education, teacher education.*

Introduction

Technology has been defined in a number of ways over the past decades and the traditional view of technological knowledge as an application of scientific knowledge has been critized (see e.g. McCormick, 2004; McRobbie, Ginns and Stein, 2000). There is a broad consensus that technology encompasses much more than simply objects. In broader definitions, technology has been seen to have several dimensions. According to McRobbie et al. (2000), technology has a human as well as a social dimension; it is a process, it is situated, and technology leads to the development of products, or artefact. Also Rowell (2004) acknowledges the social-cultural character of technology as a human endeavour. McCormick (2004) discusses the content of technological knowledge. Technological knowledge includes procedural knowledge, for example design, problem solving, planning, systems analysis, modelling, and metacognition, but it may contain conceptual knowledge in a different way as science education. A crucial factor in the design and construction of artefacts in a technological project is knowledge of materials and their relevant properties (McRobbie et al., 2000). Pavlova (2005) has discussed the influence of social change

on technology education. She suggests that in technology education classrooms, students should be involved in democratic debates on the future outlines of technological development, the development of their social and ecological sensitivities, and discussion on the role of designed objects in the life of contemporary society. Thus the multifaceted view of technology should be taken into account in education.

In previous research, it has been found for example that primary school teachers tend to perceive technology as being linked with computers and highly technical advanced machinery, and many do not realize that technology is already a part of their instruction. When studying pupils' experiences, Svensson and Ingerman (2009) found that children have qualitatively different ways of understanding technological systems. These were, 1) focusing on the use of particular objects, 2) over-focussing on the function of the objects, 3) seeing them as a part of a process, 4) seeing them as system components and 5) understanding objects as being embedded in systems. Pupils' also have been found to have negative associations towards industry and despite being reminded about its importance (Cullingford, 2004). However, in the broad view of technology, industry is part of it.

Students' conceptions about technology have been studied less. Recently, Mawson (2010) studied 5-10 year olds' conceptions of technology. According to De Miranda (2004), the absence of research on learning and instruction in technology education could be attributed to a lack of theoretical grounding in the field. He compares technology education with the contemporary view of science education, and these two fields could be seen to be coherent.

In the Finnish national core curriculum (2004), technology education is integrated into different disciplines, thus affecting every teacher. Primary school teachers in particular, have to think how technology education can be incorporated in their instruction. Teachers' perceptions of a subject may affect how they teaching it. For example, there is interaction between the influence of primary teachers' perceptions of information and communication technology and their pedagogy (Loveless, 2003). It is essential for the teacher to be knowledgeable in order to stimulate a positive attitude towards technology in the pupils (Rohaan, Taconis and Jochems, 2010). Rohaan et al. (2010) identified aspects of technology-specific teacher knowledge which are likely to play a role in this process.

The major aim of contemporary technology curricula for primary schools is to equip students with the understanding and skills which will enable them to participate effectively in productive and innovative activity, in a world that is becoming increasingly technological. This means that students need to develop a comprehensive understanding of technology that encompasses all of its dimensions. In order to achieve this aim, it is expected that teachers should be able to plan and implement learning experiences that would promote students to engage in the understanding of technology.

According to the Finnish National core curriculum (2004), the objective of integrating instruction is to guide pupils towards examining phenomena from perspectives relating to different fields of knowledge, thereby elaborating themes and emphasizing general educational goals. Integration is described in cross-curricular themes which represent emphases most central to educational and teaching work. Cross-curricular themes are to be present in core and optional subjects, in joint events such as assemblies, and are to be manifest in the school's operational culture. One of the cross-curricular themes is "Technology and the Individual". This theme helps the pupil both to understand the individual's relationship to technology, and to see the importance of technology in our daily lives. Basic education has to offer a fundamental knowledge of technology, its development and its impact, guiding the pupils towards sensible choices, and leading them to consider the ethical, moral and equality issues associated with technology. Instruction must advance understanding of the operating principles of tools, equipment and machines, and teach the pupils how to use them.

The pupil will come to understand technology, its evolution, and its impact on different spheres of life, different sectors of society and the environment; learning to use technology responsibly, learning to use information technology equipment, programs and data networks for various purposes, and learning to take a stand on technological choices evaluating the impact of today's technology-related decisions on the future.

The core content is technology in everyday life, society, and local industrial life; the development of technology and the factors affecting that development in different cultures, in various spheres of life, and in different eras; the development, modelling, and assessment of technological ideas; the life-cycle of

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products; information technology and the use of data networks; technology-related issues of ethics, morality, well-being, and equality; technology and future society. Concluding, we can point out that the view of technology in the Finnish core curriculum is very broad corresponding to the definitions discussed above. In the literature cross-curricula themes are also called thematic or interdisciplinary instruction.

The aim of this study was

- to investigate primary school teacher students' perceptions of technology in cross-curricular theme studies
- to identify how thinking about technology changes while studying of the cross-cultural theme.

Methodology of Research

Primary school teacher students participating in the study were primary school teacher students in their first and second year of education. In our primary school teacher education, students become familiar with cross-curricular themes through group work, each group having its own particular cross-curricular theme. These studies last two years, six lessons in the first year and eight in the second. The teaching approach is collaborative at every stage. The first year students search for information on their theme and then write a theoretical report. During the second year, they plan intervention for its use in school and then pilot it. The groups come together, each presenting its ideas on their own theme in question. The students in this study participated in the "Technology and the Individual"-group.

The methodology of this study is qualitative. The data consists of mind maps, writings and students' reports before and after the course of "Technology and the Individual". During the two years, teacher students wrote small narratives and drew mind maps on the issue of technology. The data varied according to the group, the size of which varied from eight to seventeen teacher students, depending on the case. Due to the fact that some of the teacher students changed the group and others accelerated their studies, the number of teacher students participating is not the same at the beginning as at the end of the course. (see Table 1.)

Table 1. Description of the participants.

Group	Starting Year	Number of teacher students	Data	Final Year	Number of teacher students	Data
1	2005	16	writings mind maps	2007	8	Writings reports
2	2006	16	writings mind maps	2008	11	Writings reports
3	2007	15	mind maps	2009	17	mind maps reports
Total		47			36	

Both the writings and mind maps were analyzed by using content and discourse analysis. The hermeneutic cycle was used to check the quality of the interpretive inquiry. Because mind maps during the two first cases gave better information on the teacher student's perceptions of technology, when the third group started in 2007 we only used mind maps instead of writing. Only the third case data also included mind maps constructed after the course.

Data analysis was conducted qualitatively due to the small number of participants and the aims of the study. The data has been categorised to suit this present study, but some ideas from previous studies have been also utilised (see e.g. Briggs, 1982). The SOLO taxonomy is used to describe the complexity of the mind maps. According to Briggs (1982), the Structure of the Observed Learning Outcome (SOLO) taxonomy is divided into five major levels: 1) pre-structural, 2) uni-structural, 3) multi-structural, 4) relational and 5) extended abstract. In this study, we used only four major levels to describe the complexity of the mind maps, the pre-structural and uni-structural levels being combined (see Table 2). The classification criteria are shown in Table 2.

Table 2. SOLO-taxonomy of teacher students' mind maps.

SOLO-taxonomy	Criteria
1.Pre-structural and unistructural mind maps	-unconnected information, lacking organisation -simple and obvious connections with concepts
2.Multistructural mind maps	-a number of connections may be made, but the meta-connections between them are missing
3.Relational level	-the significance of the parts in relation to the whole
4. Extended abstract level	-connections with concepts -generalised principles and ideas

The data was analyzed using the methods of inductive analysis, and from this we searched for themes versus the imposing of predetermined codes. The codes and categories specifically emerged from the writings and mind maps while the descriptive themes were constructed based on the core ideas that emerged from the different teacher students' writings.

Results of Research

Writings at the start of this course: What does technology mean to you?

Figure 1 shows results from the analysis of teacher students' writings at the onset of the courses in 2005 and 2006. Students view technology as being 1. everyday technology, e.g. food, everyday life, mobility, home technology, 2. technology in entertainment e.g. leisure time, music, movies, 3. technology in communication such as the mobile phone, 4. energy from the viewpoint of consumption, 5. computer-assisted studies, the Internet and searching for information.

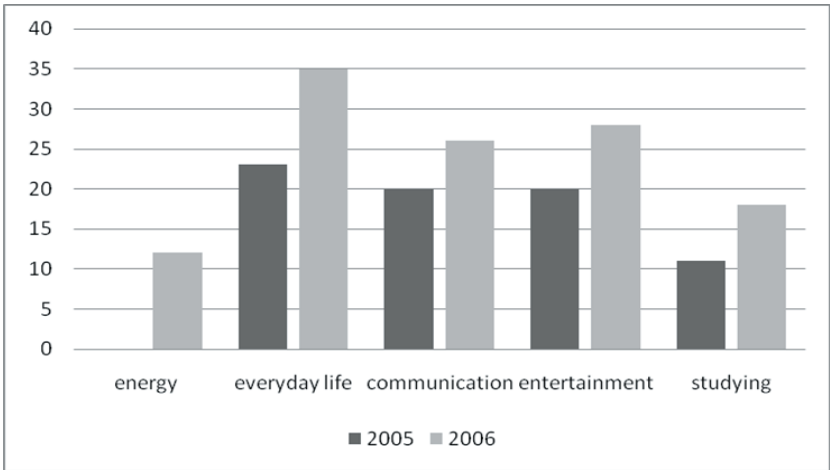

Figure 1. Teacher students' (n=32) perceptions of technology revealed in their writings at the start of courses in 2005 and 2006.

Results showed that primary school teacher students understand technology from quite a limited perspective. They think that technology in their everyday life included machines and equipment such as computers, domestic appliances and vehicles.

In many ways, technology for me means its household use e.g. the coffeemaker, the oven…

Also a few had perceptions concerning e.g. food and clothes.

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I rarely think about all the related technologies e.g. food technology.
The manufacturing of my sports shoes requires technology.

Some teacher students think that in everyday life technology includes transport and the use of the vehicles such as the airplane, car, train and bike, for instance.

Technology for me means when I sit in the train and go home…..
Cars have techniques which require technology.

Teacher students wrote also about entertainment. Most of the primary school teacher students thought that they used technology during their free-time e.g. music, movies and television.

I have to listen to music in my free-time.
I needed technology when I turned on the radio or CD player.
I watch television.

Technology is useful in communication with friends or with parents. Almost all the teacher students mentioned the mobile phone.

Thanks to my Mobile, technology is always with me. I can call my friends or my parents from anywhere.
I use my mobile everyday. It is a part of me.
Technology is important. I use Messenger or Skype to contact my friends.

Teacher students wrote also about energy. Only the teacher students participating in the 2006 wrote that technology could be electricity or a heating system. They only wrote about energy consumption, not energy production.

Our heating system includes technology.
Electricity in the home needs technology.

Most of the primary school teacher students thought that technology belongs to teaching and learning. They gave some examples of its use in university, school lessons or at home. They referred to the Internet and its use in searching for information.

Technology supports my learning. I use the Internet when searching for information on a school task.
Technology means that I use the Internet daily when searching for information.
…an effective source of information nowadays is the Internet.
Internet and its possibilities in the teaching process.
Usage of the Internet for studying….

Mind maps at the start of this course: What does technology mean to you?

Mind maps were used each year at the start of the course and those produced in 2005 and 2006 (case 1 and 2) were quite simple. However the mind maps produced in 2007 were complicated and were extensively orientated towards technology (see Table 4.).

Table 4. Classification of the teacher students' mind maps at the start of their course.

Classification of mind maps	Case 1 at the start of 2005	Case 2 at the start of 2006	Case 3 at the start of 2007
Pre-structural/unistructural	5	3	0
Multistructural	11	9	0
Relational level	0	4	5
Extended abstract level	0	0	10
Total	16	16	15

In 2007, the teacher students' mind maps included the history of technology and industrial technology e.g. food and medical technology as well as mind maps on ethical questions and technological risks e.g. the development of weapons, pollution and the depletion of natural resources. Figure 2 is a classification at the relational level of teacher students' mind maps.

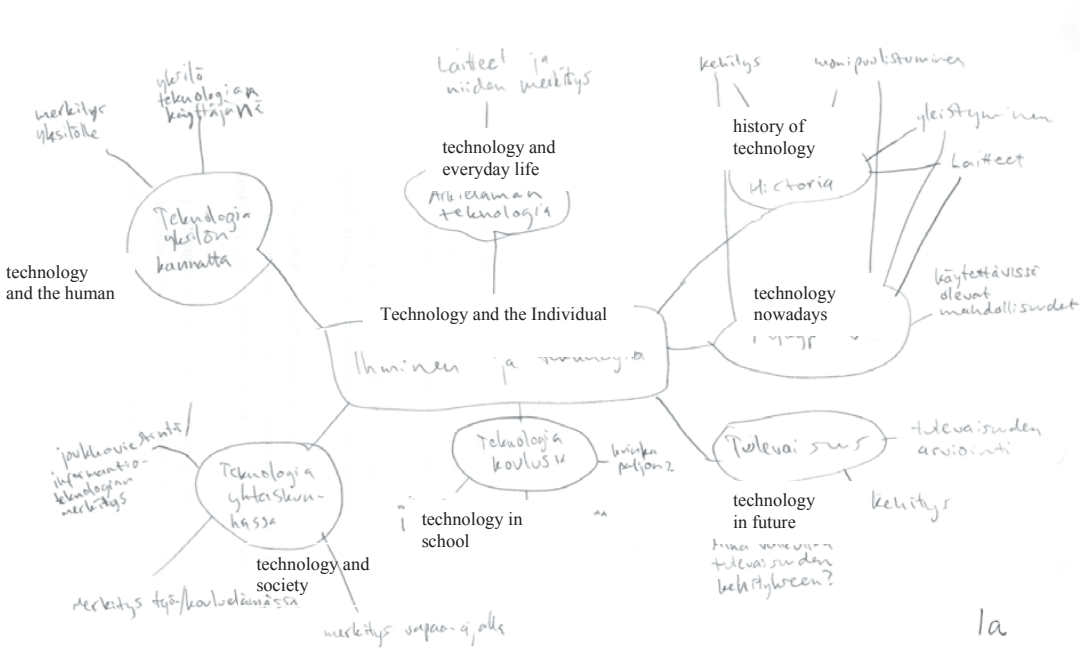

Figure 2. An example of teacher students' mind maps at the start of the course in 2007. The mind map is classified at the relational level (see Table 2).

The student wrote that technology could be understood as being both at the societal and personal level. He also used concepts concerning the history of technology, technology nowadays and the future, technology at school and our everyday life. (see Figure 2.) His mind map cannot considered to be at an extended abstract level because he did not write about the risk of technology at the local or global level.

What are the teacher students' experiences of technology?

Teacher students' perceptions of technology are classified as being either positive or negative. perceptions. Most of teacher students had positive experiences of technology at start of the course most (see Table 3).

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Table 3. Teacher students' descriptions of their own experiences of technology.

Descriptions	Writings at the start of 2005	Writings at the start of 2006	Mind maps at the start of 2007	Total
Positive experience	31	28	4	60
Easy	1	0	1	2
Essential	14	10	2	26
Useful	10	11	1	22
Important	6	7	1	14
Negative experience	6	10		16
Unpleasant	3	3	0	6
Harmful	2	6	0	8
Distracting	1	1	0	2

In this study, we are only reporting technological experiences showed by students at the start of the course. In 2007, on the whole the mind maps contained few experiences concerning technology. The teacher students generally shared positive experiences of technology such as:

We are used to technology, I do not even think about it.
Computers can do almost everything.
...we have adapted to our technology.
Technology is very important in my life.
I use the computer every day, it's an important part of my life.

Negative perceptions towards technology were related to personal experiences or the negative influence of technology in society e.g. pollution or unemployment. Negative perceptions were apparent in descriptions in which teacher students felt the need for more technological literacy.

I do not like computers.
I'm not a technical prodigy. Through school, I have improved a little.
I would like to learn to improve my computer skills.
I am afraid that technology is everywhere; we cannot protect ourselves against it.

Reports: What did the teacher students learn?

After the course teacher students wrote that they got some ideas for their professions, reporting that they were able to plan learning experiences. They linked technology with computers and wrote about the many dimensions of technology; the history of technology, definitions of technology and technology relating to building and industry. After the course, teacher students wrote in their reports that they had:

...understanding about integrating technology into teaching and learning at the primary school level
...finding innovative methods for fostering the effective use of technology in teaching and learning
...being able to use technology for specific areas as well as personal productivity
...integrating technology into future teaching practice
Technology skills in education and learning are important.
Technological integration methods for teaching…
The problems of technology in education are connected with resources and the competence of the teacher.

Students wrote and used concepts such as responsibility, globalization, the impact on politics, inquiry based learning, conservation and education for sustainable development.

Conclusions and Discussion

The results of this study showed that although teacher students' perceptions about technology were quite limited at the start of the course, which supports the findings of Jarvis and Rennie (1996) and Jones (1997), they had obviously broadened them during the cross-curricula studies. The findings indicated that the teacher students understand technology via machines and engines, but most of them lack at the start of the course perceptions concerning e.g. the development of technology or its risks and benefits. Most of the sample population studied were aware of the individual side of technology (see McRobbie et al., 2000). It is suggested that these findings reflect the traditional disciplinary approach in the primary school curricula for dealing with the subject of technology.

According to the results, it became obvious that teacher students' abilities to make mind maps were varied and this was a problem as mind maps were used with the different groups of teacher students. The third case of data only included mind maps constructed before and after the course. Most of the mind maps from 2005/2006 were quite simple, but the mind maps from 2007 were complicated and were widely orientated towards technology. We are not aware of the reason for this noticeable difference between the mind maps from different years. However, the results of this study indicated that while learning took place, the extent of this learning varied. At the end of the course among other things, teacher students were well orientated towards responsibility.

This study shows evidence that the primary school teacher students' perceptions of technology broadened and deepened and the human perspective was taken more into account (see McRobbie, 2000). In particular, they started to think about the history of technology, technology and society and its impacts on the individual, at the social and global level as well as gaining a lot of useful technological knowledge during the course. At the end of their studies, the whole group shared many different perspectives. From this it can be concluded that these studies helped the students to understand technology in a broader way.

Despite limitations, the study provides insight into teacher students' perceptions of technology, also contributing to further understanding in the area of cross-curricula themes. How can we integrate technology issues into the curriculum? The Science-technology-society (STS) – approach could also be useful in teaching the cross-curricula theme "Technology and the Individual" at all levels and in any content area of school subjects. Although technological issues cover many different subject areas they may also take place in non-formal areas of education.

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