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Technology Education in Elementary School: Boys' and Girls' Interests and Attitudes

Abstract

This paper reports the results of an initial study investigating gender differences in interests and attitudes by pupils, aged 8-12 years, to school technology teaching in Sweden. The types of learning activities and content topics in technology teaching preferred by girls and boys were studied, as well as the differences regarding self-confidence in technology. The pupils' attitudes to technological professions were also investigated. The study was conducted in ten schools. A total of 256 pupils completed a questionnaire that was administrated during their school technology sessions. The analysis of the answers showed that a vast majority of both boys and girls experienced school technology as very positive. No gender differences in preferences for different types of content and activities were detected. The pupils' judgement of their own capability in the field of technology showed that both boys and girls considered themselves to be very competent. The boys felt, however, somewhat more certain about their competence compared with the girls. Gender differences were found in views of possible future occupations, but the pupils' views of future occupations in technology showed no significant gender differences.

Introduction

The fact that technology is strongly associated with masculinity can be seen in the male dominance that exists in engineering. In Sweden, during the academic year 2007/2008, the proportion of female students at the Master of Science in Engineering Programme was 25%, and in other higher education technical programmes it was 23% (SCB, 2009). By comparison, 85% of the students in health care and social work programmes were women. The proportion of women in the Master of Science in Engineering Programme has slowly declined over the past decade.

This raises the question of how much interest in technology there is among girls at the elementary school level. This article presents a study focusing on young girls' and boys' (aged 8-12 years) experiences of school technology teaching in Sweden. The pupils' perceptions of their own ability in terms of technology and their statements about possible future occupation will also be reported.

Background

As a starting point of this study, the division between male and female is understood as one of the strongest categorizations in our society, and our perceptions of what aspects of human life and society count as female and male vary over time and according to place and culture (Berner, 2003;

Connell, 2003). Gender is not static; it changes continuously and all of us are involved in this creative process, often without being aware of it. According to Harding (1986), gender is created in a process that takes place simultaneously at three different levels; structural gender, individual gender, and symbolic gender. Structural gender is concerned with organisation and division of labour by gender; individual gender focuses on the socially constructed individual identity; and symbolic gender is about the perceptions that our institutions express.

Male and female are often perceived to represent a dichotomy, i.e. what is regarded as masculine is the opposite of what is seen as feminine, and these opposites even exclude each other, such as active/passive or logical/illogical (Faulkner, 2001). Technical competence is a fundamental part of the cultural construction of certain masculinity, while women are associated with technical incompetence. Similarly, the relationship to technology and machines is an important part of men's cultural and social identity, while this could even be counteractive to the construction of feminine identity (Mellström, 2003).

Technology was introduced as a compulsory subject in the Swedish school system as a result of the 1980 curriculum for the nine-year compulsory school. Before designing our current curriculum for the compulsory education system, the preschool and the after-school centre, the Curriculum Committee (Läroplanskommittén) was given directives to pay attention to the issue of how different interests can be taken advantage of and promoted as early as possible in the education system. In connection with this, girls' interest in science and technology was specifically mentioned as an area the directives say that the school system has failed to address and develop (Directive 1991: 117, p.8).

The government bill that was introduced in 1992 (Prop. 1992/93: 220) points out that today's complex technological society demands that citizens have knowledge and understanding of technology, both as preparation for an active participation in society and as preparation for professional life. School technology teaching has a very important role in stimulating pupils', especially girls', interest in science and technology.

In the current syllabus of technology subjects for Swedish compulsory schools, the gender dimensions are presented in the account of the aim of the subject and its role in education, as follows:

> The attitudes of girls and boys to technology differ somewhat – as do traditional views on the role of girls as opposed to boys in technological contexts. One aim is that everyone is given the opportunity to consciously acquire all-round knowledge in the subject. (National Agency for Education, 2001)

A study on how girls and boys regarded science and technology in lower secondary school (Staberg, 1992), based on interviews and classroom observations, showed that the girls searched for contextual knowledge and had a more theoretical approach in their studies, compared with the more playful attitude of the boys. The girls criticised the lack of connection with reality, and sought understanding and cooperation. The science and technology subjects were seen as masculine by both sexes, and girls' interest in technology declined slowly but clearly from Grade 7 to Grade 9 (aged 13 to 15 years old).

Lindahl (2003) followed a group of 80 pupils from the age of 12 (Grade 5) until the age of 16 (Grade 9), and investigated their attitudes towards and interest in science and technology over time. Data was collected using observations, interviews and questionnaires. The results indicated that initial experience with chemistry, physics and technology in Grade 7 made the girls uninterested in learning more, but also showed that they were not so good in these subjects. Over the

years, their interest remained at a very low level, but they felt slightly more competent. The boys also expressed lack of interest in technology, but were slightly more positive than the girls. Lindahl also investigated pupils' interest in other subjects. She noticed that interest in learning more in the social sciences and biology increased over the years for both girls and boys, as did their feeling of success.

In The Relevance of Science Education Project (ROSE), students' views about science and technology in education and in society are investigated. This was a large-scale international comparative study, involving 40 countries with over 40,000 students, about 15 years old (Schreiner & Sjøberg, 2004). Data were obtained by means of a questionnaire. The students were requested to indicate their interest in learning different science and technology topics, their experience with and views on school science and technology, and their views and attitudes to science and technology in society. Results from the ROSE project indicated that young people in all countries had rather positive attitudes to science and technology in society. The girls seemed, however, to be much more ambivalent than the boys and the differences were most dramatic in the richest North-European countries. The higher the level of development in a country, the lower the interest the students expressed in learning topics related to science and technology. Girls seemed to dislike school science and technology to a larger extent than the boys, and the gender differences were greater in more developed countries. While very few girls in most developed countries would like to get a job in technology, the boys were more positive, taking a somewhat neutral position towards the issue.

Weber and Custer (2005) have studied what content and types of activities in technology are most appreciated by female and male students aged 11-19 years old. The study consisted of two surveys involving a total of 348 middle school students and 311 students in high school technology education. The researchers found fewer differences between male and female students' scores for technology content than regarding the type of activity that was offered. The girls appreciated more design-oriented activities, while boys preferred activities that involved utilizing. The young girls in the study appreciated technology to a greater extent than the older girls.

Regarding pupils' judgement of their own competence, Staberg (1992) showed that girls in Grade 7-9 estimated their own abilities in science and technology as lower than what did boys. This finding is confirmed by other studies (Tallberg Broman, 2002). According to a survey carried out by the Association of Swedish Engineering Industries, with a sample of 354 respondents, this type of uncertainty about own abilities also tends to exist among female teachers in technology (Teknikföretagen, 2005).

Further, Skogh (2001) explored how girls aged 7-12 years old related to the technology they encounter in the home and school. Twenty-six girls from two schools were followed throughout their first five school years. Regular technical education was offered in only one of the schools. Data was collected by interviews, observations and questionnaires. Skogh found that girls' technological self-confidence was related to the extent to which they had positive experiences of the technical tasks they had to face, and to whether or not they had a firmly rooted definition of technology, i.e. a clear idea of what technology "is". Skogh believes that technology education is an effective way, through technical experience, to give more girls the possibility of shaping a "technical identity."

In a two-year research project, girls' participation in technology education in four school districts in Connecticut was studied (Silverman & Pritchard, 1996). Data were collected by classroom observations, focus group interviews, and surveys. The study reported that despite the fact that girls of 11 to 14 years of age appreciated technology education and had good confidence in their own technical ability; they did not voluntarily choose courses in technology and could not see themselves in a technical profession. Only a few girls were willing to challenge stereotypes about nontraditional careers for women.

Mammes (2004) shows, however, that both young girls' and boys' interest in technology is affected in a positive way by technology education. Four classes in the third year of elementary education were chosen for the study. Two of them were exposed to an intervention programme and the remaining two served as control groups. First, differences between the level of interest shown by boys and girls in technology were determined by a survey, and after exposure to technology education, a second survey took place. The results also showed that experiencing teaching of technology in elementary school can compensate for gender differences in interest in technology. Previous research (Roger & Duffield, 2000; Silverman & Pritchard, 1996) also indicated that teachers' awareness of and willingness to change their own gender stereotyped attitudes, expectations and actions is essential to change the girls' and boys' traditional approach to science and technology. The content of topics and way of working in technology and science education should also be relevant to the girls' experiences, interests and preferences.

It is difficult to extract a coherent view from earlier research about attitudes towards and interests in technology and technology education, as the question is very complex. Attitudes and interests may be influenced by many different things in school, as well as by social and cultural factors. Previous research about pupils' interest in technology education also often includes science. This fact complicates the drawing of clear conclusions about technology education specifically. However, the gender differences concerning how older pupils approach technology and technology education, which have been indicated in previous studies, have inspired me to investigate younger pupils' attitudes to technology and technology education.

The purpose of this article is to describe how girls and boys in elementary school are experiencing technology education in which they have participated in connection with the study. What content and types of activities in technology education do they appreciate? Do the pupils have confidence in their own ability in terms of technology? Can they imagine having a technical job, as an adult? How do the answers of the girls and boys differ?

Research design

The study was carried out in conjunction with technology lessons implemented by teacher trainees in technology during the teaching practice section of their teacher training programme. The data collection was conducted by ten technology teacher trainees who were engaged in teaching practice of two and three weeks in ten different Swedish schools. The participating schools were located in different types of residential areas in terms of economic, social and ethnic structure. Gender balance among the teacher trainees was unequal, but was representative of the prospective teachers in elementary school; 90% were women.

A total of 256 pupils in Grade 2-6 in elementary school (aged 8-12 years old) independently responded to a questionnaire about technology and teaching of technology. The proportion of girls and boys participating in the study was equal (129 girls/127 boys). The number of pupils per grade is shown in Table 1.

The extent of the pupils' previous experiences of technology in school varied. Some pupils had been offered some technology education, some pupils had undergone technological activities which had not been called technology, while others had not experienced any teaching of technology at all.

The content of the lessons varied to some extent, but common to all classes, except one, was that the pupils were working practically in some way with the following activities: design of vehicles (2 schools), mechanical models (2), structures using simple materials (2), their own inventions (1), other types of models (1), and taking apart and examining clocks and watches (1). The teacher trainees also indicated that they spent time during the lessons discussing technology and its

Table 1. The distribution of the number of pupils by grade, and gender balance.

Grade	Girls	Boys	Total
2	36	26	62
3	42	40	82
4	39	41	80
5	0	0	0
6	12	20	32
Total	129	127	256

influence on the environment (1 school), history of technology (1), the concept of technology (2), technical systems - communications, and water and sewage (2), and making study visits focusing on technology in the local environment (2). The number of technology lessons also varied between schools, but all pupils in the study had undergone technology teaching corresponding with the current syllabus of the technology subject.

After the technology lessons the pupils were surveyed and asked about what lesson content they had appreciated/not appreciated, what they perceived as difficult, and the confidence they felt regarding their own technical ability. The survey was conducted by the teacher trainees reading from a manuscript that I had made, after which the pupils wrote their responses to the questions themselves. The questions were formulated as six open questions (see Appendix) in order to facilitate access to a richer source of material than would be the case using multiple choice questions. The questions were deliberately simply formulated in order to get initial data for this first study. The teacher trainees made notes on the content and structure of their technology lessons, and enclosed these with the data collection.

The analysis of the responses to the questionnaire showed that pupils' statements could be grouped into different categories with each category representing a group of statements that had similar meaning. The categorization was made on the basis of responses to the questionnaire, with regard to the degree of appreciation/dissatisfaction with the technology lessons; the content of the lessons; the judgement of their own competence in terms of technology, and finally, to their plans regarding future occupations.

Results

The analysis of the responses to the questionnaire showed that the vast majority of pupils experienced the teaching of technology they just had undergone as very positive. In fact, 88% of the respondents to the survey used expressions such as "fun", "great" and "good". The gender differences were negligible.

> Fun, we learnt a lot. (Boy, Grade 4)
> It was fun. (Girl, Grade 2)

What did the pupils perceive as fun during the technology lessons? It was found that 12% of the girls answered that "everything was fun", while 16% of boys answered the same way. The most common responses given were of the type "build" and "make", such as "build a car" and "make a mechanical toy" without specifying what kind of activity they appreciated the most. Common to these responses, which were given by about 40% of the boys and girls, was that they described some type of practical work. Some examples of such responses are:

It was fun that we could build something, and that we did not just read as in ordinary science lessons. (Girl, Grade 6)
It was fun to build the car and then to test whether it worked or not. (Boy, Grade 4)

Design or aesthetic activities were not mentioned by the pupils to any great extent, and the percentage of girls and boys that brought this up was small. Similarly, things such as coming up with one's own solutions to problems and cooperation were mentioned only by a small percentage of the girls and the boys.

To invent. (Boy, Grade 3)
It was fun that we had to think a lot. (Boy, Grade 6)
To build a car together with Erik. (Girl, Grade 4)

Study visits with a focus on technology in the local environment were mentioned by 15% of girls and 11% of boys.

The museum was most fun, because there one could look at old cars and trains and things like that. (Boy, Grade 4)

To the question of what the pupils perceived as less fun during lessons, about 40% of the girls and boys responded "nothing was less fun". The activities that both girls and boys considered as less fun comprised the practical work (17% and 11% of girls and boys, respectively). These responses do not describe what specifically was less fun in this activity. However, difficulties in the functioning of the construction work were mentioned by a small percentage of both the girls and boys. Study visits in the local environment were mentioned as being less fun by a small percentage of both girls and boys.

The visit to Torkälleberget Open-Air Museum, to stand still and listen. (Girl, Grade 4)

However, concerning the pupils' responses to the question about whether any specific content or activity was seen as difficult, a bigger difference between girls' and boys' responses was identified since 28% of the girls and 46% of the boys answered that "nothing was difficult". To a relatively high degree, when pupils listed something as difficult, it fell into the category of practical work (39% and 25% of the girls and boys, respectively).

It was hard to attach the wheels and get them to roll. (Girl, Grade 4)
To open the clocks. (Boy, Grade 2)

A small percentage of the girls and boys stated that coming up with their own solutions was difficult. The difference between the girls' and boys' answers about how difficult the technology lesson was perceived to be may signal a difference between boys' and girls' judgement of their own capability in the field of technology. This fact is also confirmed in the answers to the question "Do you think you are good at technology?" (Table 2). Here, 52% of the girls said that they were good or fairly good at technology, while 64% of the boys stated the same. However, 29% of the girls and 20% of the boys believed that they were not too good, while less than 10% of girls and boys did not think they were good at technology.

From the beginning I hardly understood anything, but once I started, I was good. (Girl, Grade 6)
I don't know. We just had a few lessons. (Girl, Grade 6)
Yes indeed. (Boy, Grade 4)

Table 2. The pupils' answers to the question "Do you think you are good at technology"?

	Yes	Pretty good	Slightly	No	Other
Girls	39%	13%	29%	9%	10%
Boys	41%	23%	20%	7%	9%
Total	40%	18%	24%	8%	10%

The final question of the questionnaire was about how the pupils saw their future career plans and whether they, in this context, would be willing to work with technology. Here, 32% of the pupils responded that they could imagine themselves working with technology as an adult, while 58% answered "no" to this question. Most of the pupils did not want to work with technology, and the gender differences were relatively small in the whole group.

Table 3. The pupils' answers to the question "Can you imagine working with technology when you become an adult"?

	Yes	No	Yes and no	Other
Girls	29%	61%	5%	5%
Boys	34%	55%	1%	10%
Total	32%	58%	3%	7%

However, there were differences in responses between the pupils in Grade 4-6 compared with the pupils in Grade 2-3. While 36% of the girls and 42% of the boys in Grade 2-3 wanted to work with technology in the future, only 18% of the girls and 25% of the boys in Grade 4-6 felt that way.

The pupils were also asked why they wanted/did not want to work with technology. The pupils who indicated that they did not want to work with technology were asked to justify their standpoint. An equal number of girls and boys neither gave any answer nor responded that they wanted to work with something else. The most common reasons mentioned for wanting to work with technology were related to a positive experience of the current technology lessons. The gender differences were negligible. Some of the pupils referred to other factors, such as parents and personal interests, when explaining why they wanted to work with technology. Some examples are:

> Because I like to create things. (Girl, Grade 6)
> Because my mum works at Scania and my dad works as a plumber. (Boy, Grade 4)
> I have always wanted to become an inventor, and then one works with technology. (Boy, Grade 4)

The pupils who responded that they could not imagine a future job in the technical field were asked what they wanted to do as an adult. Here, a noticeable difference between the sexes could be distinguished.

The girls' interests were largely in the area of childcare/school/medical care/animal care, since 40% of girls' answers referred to this (compared to 6% of boys' answers). For the boys, 37% of their answers referred to the area of sports, for which the corresponding proportion of girls' responses was 11%. Occupations in technology, transport and science were only mentioned by boys, corresponding to 18% of the answers by the boys. Among the professions mentioned were mechanic and work with computers, despite the fact that the pupils answered "no" to the question about whether they wanted to work with technology in adulthood. This result may indicate that the pupils did not see the connection between technology and these kind of jobs.

Table 4. The pupils' answers to the question "What do you want to do as an adult"?

	Girls' Answer frequency	Boys' Answer frequency	Total Answer frequency
Don't know	12	12	24
Work with animals	22	3	25
Child care/school	10	0	10
Medical care	9	1	10
Fashion/home furnishing /cosmetics	14	0	14
Music, theatre	6	0	6
Shop/bank/law	9	5	14
Restaurant	4	3	7
Police/fireman	3	3	6
Journalist/author	2	4	6
Sport	11	25	36
Technology/science	0	12	12

I am going to work with cars. (Boy, Grade 2)
Mechanic or construction worker. (Boy, Grade 6)

Discussion

The results indicate that girls and boys to a great and equal extent experience school technology teaching as very positive. They also value the content and activities of the technology lessons in a similar manner. The pupils' responses show no gender differences in how they appreciate the teaching of technology, its content and type of activities. These findings differ from several earlier studies such as the ROSE project (Schreiner & Sjøberg, 2004), Staberg (1992), and Lindahl (2004) that indicate gender differences in interests and attitudes to science and technology education. The difference may partly be explained by the fact that the pupils in this study were younger than the participating pupils in the studies mentioned above. Staberg (1992) followed pupils aged 13 to 15 years, Lindahl (2004) studied pupils aged 12 to 16 years old and the participating pupils in the ROSE project (Schreiner & Sjøberg, 2004) were 15 years old. Mammes (2004) showed that the interest in technology of both young girls and boys was aroused and that technology education compensated for gender differences. The content and type of activities of the technology lessons studied by Staberg (1992) and Lindahl (2004) was not reported in detail, and may have been different from the lessons in this study. The content of topics and way of working in technology education has an important role in encouraging girls' interest in technology (Silverman & Pritchard, 1996; Roger & Duffield, 2000; Weber & Custer, 2005).

In this study, there was variation in the content, type of activities and the number of lessons that the pupils experienced, which makes it difficult to come to any general conclusions about the responses to questions dealing with pupils' attitudes to the content and type of activities. However, the pupils mentioned that the practical work was the most fun and also the most difficult activity in school technology teaching. This may reflect the fact that the technological subjects and their associated practical activities obviously are not taught in elementary school to a great extent, a point which has also been reported in a previous study (Teknikföretagen, 2005).

The results of the study can be understood in the three different levels at which gender is created according to Harding (1986). Structural gender, where occupations are divided up along traditional lines by gender, was reconstructed in the answers that the pupils gave in terms of the occupations they envisaged doing in the future. Professions that are traditionally perceived as masculine were not attractive to most girls because they do not strengthen the female identity, and the opposite conditions applied to boys in relation to traditionally female occupations. The individual gender is constructed simultaneously in this process. The pupils' responses also showed how the traditional male and female professions seem to have a contradictory relationship to each other; they are seen as representing a dichotomy (Faulkner, 2001). The pupils' perceptions of men's and women's careers were very strongly divided in the traditional manner. It is interesting to consider symbolic gender in this context. In this, the values and perceptions of technology that are instilled in young pupils at school are essential issues. Here, the female teacher trainees may have affected the answers in a more non-traditional direction, as long as they themselves displayed confidence in technology. An important aspect of the issue of gender equality concerns the potential and ability of students to manage and take over their own identity process. The solution to this problem involves developing both self-confidence and the ability to manage one's own process of learning.

Reflections on methodology

As a data collection method, and because of the type of simple questions used, the questionnaire had significant limitations in obtaining enough information about pupils' thoughts about teaching, hence additional interviews will be necessary for further investigations. The results indicate that the girls in the study seem to have lower self-esteem, compared with the boys, in the field of technology. This result is consistent with data from surveys of technology in the UK (Faulkner, 2001). Looking at it from another perspective, the differences between boys' and girls' judgements of their own technological capability may also indicate that the girls judge their own competence in a more realistic way.

The fact that the pupils evaluated the technology lessons implemented by the teacher trainees in the class, and also that the students led the common reading of the questions, may have influenced how the pupils answered the questions. The personal relationship between students and pupils may have influenced the pupils' responses in a more positive direction. The pupils may also have been exposed to some stress when they wrote their answers because the questions were read out separately and the class had to wait in between each one. The fact that even the 8-year-old pupils wrote their own answers could indicate a limitation in their answer method, as they had yet not fully mastered the skill of writing. These factors may have resulted in very brief answers from at least some pupils; a fact that causes difficulties in the analysis of responses. The questionnaire's "open" questions aimed, as I previously mentioned, to increase the possibility of obtaining richer empirical material. However, a consequence was that the categorisation of replies was more difficult to carry out. After repeated perusals and attempts at categorisation, I have nevertheless kept the categories set out here. My own role as a lecturer in the teacher trainees' teacher education programme may have influenced the results of the study, since these results are also the product of my own teaching.

Conclusion

Despite the methodological limitations described above, some conclusions may be drawn from the results of the study. They indicate that although there is a great variation in the amount and nature of technology teaching the Swedish pupils investigated have experienced, a vast majority of both girls and boys perceived school technology in positive ways. Furher, they experience themselves as being competent in technology, boys to a somewhat higher degree than girls. The main gender

difference was found in how pupils look upon possible future occupations, where their responses show highly stereotype gender patterns. This remains a challenge with regards to both technology teaching and recruitment strategies.

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Appendix

Questionnaire

Grade: _____

Girl ☐ Boy ☐

1. What did you think about the technology lesson/lessons?

2. What was fun?

3. What was less fun?

4. Was anything difficult? If so, what?

5. Do you think you are good at technology?

6. Can you imagine having a technology-centred career when you become an adult?

Yes ☐ Why?

No ☐ Why not?

If you answered no; what kind of work do you want to do as an adult?