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Development of Students' Attitudes towards Technology Education between Years 1993-2022 in Finnish Comprehensive School

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Abstract

Technology is affecting our lives more and more. It has consequences to every human being, and we find ourselves faced with both positive and negative aspects of technology. Certainly, this has an effect on our attitudes towards technology. In this study, we tried to find out if there have been any changes in attitudes towards technology among Finnish school children during the last 30 years. The attitudes measured in 1993 were compared with the results from 2012 and 2022. The number of test participants was 267 in the first measurement, 317 in the second and 284 in the last measurement. The age of the student respondents was 11–13 years. The measurements were done with exactly the same Likert scale attitude questionnaire in all three measurements. Some positive changes were found in attitudes towards technology in girls test group. Unfortunately, boys' development between years 2012-2022 is alarming and should be of great concern. The development in attitudes can be explained by the changes in technology education curriculum. From a broader point of view, the development in attitudes can be due to the changes in society as a whole.

Introduction

The Finnish educationalist Gygnaeus (1810-1888) founded public schools in Finland in 1866. At this time, Gygnaeus also introduced craft as a pedagogically based compulsory subject, in an attempt to improve general education in Finland. In 1866, educational Sloyd (known as craft and technology education today) became a compulsory subject in Finland. Gygnaeus drew a sharp distinction between handicraft and manual arts as part of the general curriculum and handicraft as part of a technical or specialised education. Furthermore, Gygnaeus insisted that handicrafts should be taught by regular teachers, rather than specialised craftsmen (Kananoja, 1989).

Industrialisation in Finland occurred between the years 1920–1960. At the same time, the national curriculum began to focus on industrial skills, as such skills were required in society (Kananoja, 1989); little emphasis was placed on the development of students' personalities and the enjoyment of craftwork. However, the policy of fulfilling the needs of an industrialised society did not last long. In the Committee Report (1970), it was claimed that craft education was outdated. The Committee Report also emphasised the importance of gender equality for the first time: it was considered that craft education could develop the important skills needed for everyday life in both sexes. At this time, the name of the subject was changed from craft education to technical craft and textile

craft, and it was recommended that the number of lessons taught should be considerably decreased.

Technology Education was first introduced in the Framework Curriculum Guidelines (NBE, 1985), yet its impact on the subject of craft was insignificant. Handicraft skills were still considered of great importance; however, electronics and engineering were incorporated into the subject. The authorities wanted to develop technology education, but, in practice, this was difficult. They also wanted to preserve the link to the heritage of Finnish craft and support student equality.

Based on the needs of changing society and working life the, the importance of developing students' technical literacy was emphasised in Framework Curriculum Guidelines 1994. A manmade environment was discussed from different aspects. For example, mechanical, thermal, and electrical engines were introduced. Moreover, energy resources, production and transfer of energy or electricity, as well as raw materials, manufacturing, and construction of artefacts in industry were considered important (NBE, 1994). A couple of researchers noticed the importance of technology and a vision of current trends in Finnish technology education was introduced as seen in Figure 1.

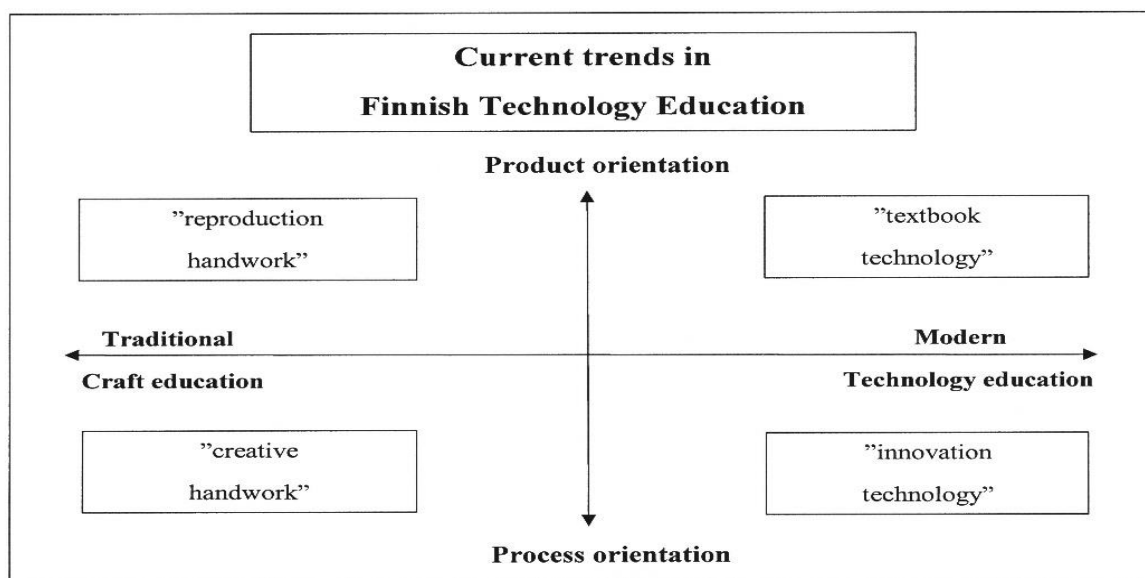


Figure 1. Current Orientation in Finnish Technology Education (Autio, 1997)

In early 2000's, a serious discussion took place between the authorities and the representatives of the craft industry, concerning the importance of technology education as an active part of general education in Finland. Moreover, several development projects concerning technology education were started (Lavonen, Meisalo, Autio, & Lindh, 1998; Parikka, 1998). Unfortunately, these assertions were not considered in the Framework Curriculum Guidelines of 2004 (NBE, 2004), with technology merely mentioned in the craft curriculum. Nevertheless, in practical level curriculum introduced a specific cross-curricular theme - The Human Being and Technology.

The 2004 curriculum emphasised the meaning of technology from the point of view of everyday life, society, industry, and environment, as well as human dependency on technology. The students should be familiar with

new technology and know how it is developed and what kind of influence it has. Working with different tools and machines develops students' technological skills. Moreover, studying technology develops student's technological knowledge and helps students to discuss and think about ethical, moral and value issues related to technology. There was a high compatibility with the goals mentioned in our new curriculum and the nature of literacy in technology described in the publication, *Standards for Technological Literacy: Content for the Study of Technology* (Dugger & Gilberti, 2000). However, in practical level, a separate technology education subject was not established and the curriculum guidelines in technology education stated that technology should be taught in all subjects as an integrated subject.

The last Framework Curriculum Guidelines 2014 (NBE, 2014) specified that in grades 1–9 technical craft and textile craft should be taught to both boys and girls throughout their entire compulsory schooling. In addition, the name for the subject was to be Handicraft and in practical level, it was expected to be many changes, as there are no separate subjects - just one multi material craft for both sexes. It means that there will be minor emphasis on technology - art and design will be emphasized over technology education. Instead, the development of students' personalities, the growth of self-esteem and gender issues will be more important throughout the whole curriculum. There was expected to be many problems, as competence in different craft areas requires very different knowledge and skills; technological reasoning is based on very different scientific elements.

What is more, during last year's there have been radical changes in craft teacher education. Based on gender equality there are no separate programs for technical craft teachers and textile craft teachers. The craft teachers have to master different contents and techniques in both technical and textile area. Unfortunately, the amount of ECTS credits is still the same as earlier although the students should master two different expertise areas. According to Kokko, Kouhia and Kangas (2020) confusion has occurred both in terms of the organization of the "new" subject that brings together the practices of textile and technical crafts, and the means and methods of craft education. Especially the new concept, multi-materiality, as well as the concept technology education, have been regarded problematic. Moreover, the changes and reduction in the distribution of the lesson hours have made the situation even more problematic.

Methods

The aim of this study was to measure students' attitudes towards technology and find out whether there were any differences between the measurements in 1993, 2012, and 2022. The number of test participants was 267 in the first measurement, 317 in the second, and 282 in the third measurement. The age of the student respondents was 11–13 years. Approximately same number of boys and girls as well as 11- and 13-year-old students took part in the study. In all samples (1993, 2012, and 2022), the schools were approximately the same. Those schools were originally selected to ensure that schools with different curriculums as well as rural and city schools were represented.

The research on students' attitudes toward technology has a long history. PATT (Pupils Attitudes Towards Technology) is the first instrument specifically made for this purpose. This instrument was first conducted in the

Netherlands and since 1984 researchers have been using it in several different formats and several different instruments have been made for measuring an attitude in the field of technology (Garmiere & Pearson, 2006).

According to Ankiewicz, van Rensburg and Myburgh (2001) attitude is a broad concept with several different definitions and interpretations. The most common definition for attitudes is “Attitudes are psychological tendencies that are expressed by evaluating a particular entity with some degree of favor” (Eagle & Chaiken, 1993). According to de Klerk Wolters (1989) the attitude towards technology is “a certain feeling with reference to technology, based on a certain concept of technology, and that carries with it an intention to behavior in favor of or against technology”. Dyrenfurth (1990) and Layton (1994) state that technology is determined and guided by human emotions, motivation, values, and personal qualities. Furthermore, they are using the concept ‘technological will’ - students’ will to take part in lessons and technological decisions.

To evaluate students’ attitudes towards craft and technology, a questionnaire was devised, consisting of 14 statements. For each Likert-type item, there were five options, from ‘Strongly Disagree’ (= 1) to ‘Strongly Agree’ (= 5). The questionnaire also featured some questions about students’ backgrounds, in addition to questions that attempted to gauge students’ motivation and success, in terms of craft and technology education classes. The questionnaire was based on the PATT standards (Pupils Attitudes Towards Technology), which were designed and validated by Raat and de Vries (1986) and van der Velde (1992). The original instrument, which consisted of 78 items, turned out to be too complicated and time consuming for 11- to 13-year-old students.

In this kind of research, which is aimed at relatively large group of students, the test instrument should be easy to use and suitable for large-scale research. Likert scales are by far the most used in attitude measurements. We can assume that this is mostly due to practical reasons. The Likert scales can easily be constructed and depending on the nature and structure of the test, they usually offer an acceptable reliability and validity. As self-report instruments, they are quite simple to use, and they are not time consuming. Hence, for this study, a shorter version of attitude questionnaire was developed. Based on the PATT (Pupils Attitudes Towards Technology) studies, six factors associated with technical attitudes were found: interest in technology, consequences of technology, difficulty of technology, role pattern, technological career, and technology as school subject. These factors were used to establish the final questionnaire with fourteen Likert scale statements.

The instrument used in this research seemed to be congruous with previous and later developed PATT instruments. From this point of view, the internal consistency of the questionnaire was relevant. Although attitudes are not to be measured with paper and pencil tests, according to the researcher’s observations, the test worked quite well - it was easy to use and not time consuming. In addition, the students could fully concentrate on answering all the items. Reliability of the questionnaire was 0.853.

The main goal of this study was to find out if fundamental changes in attitudes towards technology can be seen during the last 30 years. Furthermore, we tried to find out which elements in those attitudes were the most positive and negative. The main intention of the research was not to compare boys and girls; however, the comparison resulted in some new and interesting data. The research questions were:

1. Are there differences in students' attitudes towards technology in Finland between the years 1993 and 2022?
2. Is there a difference between boys and girls in attitudes towards technology?
3. Which elements in the attitudes were valued the most positive and the most negative?

Results

To measure the affective area – “technological will”, a questionnaire consisting of 14 statements was devised. For each Likert-type item, there were five options, from ‘Strongly Disagree’ (= 1) to ‘Strongly Agree’ (= 5). The average values for each statement are presented in the Table 1.

Table 1. Average Values for Each Statement in Students' Attitudes towards Craft and Technology

Statement number	1993		2012		2022		p-value	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
1. I am interested in technology and the phenomena related to it	2.80	3.98	3.17	4.21	3.24	4.02	0.00*	0.84
2. I spend a lot of time with technology-related hobbies	1.72	3.01	2.62	3.01	2.4	2.86	0.00*	0.29
3. Newspapers, magazines, and articles from the field of technology are interesting for me	2.07	3.06	2.35	2.90	2.14	2.81	0.78	0.08
4. Understanding technology-related phenomena will be beneficial in the future	2.92	3.79	3.25	3.86	3.39	3.79	0.00*	0.99
5. Understanding technology-related phenomena requires a special talent	2.93	3.35	3.26	3.53	3.14	3.15	0.11	0.12
6. Both boys and girls may understand technology-related phenomena	4.56	4.06	4.55	4.36	4.7	4.67	0.46	0.00*
7. Mankind has rather benefited than sustained damage from the development of technology	3.59	3.81	3.87	4.21	3.9	4.11	0.05	0.06
8. In the future I would like to choose a specialty, or a profession related to technology	1.95	3.09	2.30	3.23	2.22	3.00	0.08	0.62
9. My parents have a lot of technology-related hobbies	2.32	2.70	2.94	3.01	2.71	2.98	0.01	0.06
10. The atmosphere in the Technology Education / craft lessons is pleasant and inspiring	3.03	3.78	3.50	4.28	3.89	3.86	0.00*	0.65
11. Technology Education /craft lessons contribute to the development of my manual skills	3.58	4.27	3.69	4.25	3.95	3.90	0.01	0.01
12. Technology Education / craft lessons develop my logical thinking	2.98	3.49	3.42	3.84	3.35	3.60	0.01	0.56
13. I have been successful in Technology Education / craft lessons	2.89	3.48	3.35	3.91	3.70	3.70	0.00*	0.11
14. Technology Education / craft lessons will be beneficial for me in the future	3.00	3.85	3.14	3.88	3.28	3.38	0.08	0.00*
All 14 items	2.89	3.54	3.24	3.74	3.29	3.56	0.01	0.88

I am interested in technology and the phenomena related to it

The highest correlation (0.76, $p < 0.001^{***}$) to the average of all other statements was found in statement: I am interested in technology and the phenomena related to it. In the factor analysis, this statement explained 57.7 % of the total variance. Very significant statistical difference was found in 11-year-old girls test group as the result was 2,53 in year 1993, 3,43 in year 2012 and 3,64 in 2022. Unfortunately, in 13-year-old girls test group the development was diminished, as the result was 3,00 in year 1993, 2,97 in year 2012 and 2,95 in 2022. Among 11 and 13-year-old boys just small changes was found between years 1993-2022, as 11-year-old boys had 4,01 in year 1993, 4,34 in year 2012 and 4,15 in 2022. In 13-year-old boys test group the small development was diminished, as the result was 3,95 in year 1993, 4,07 in year 2012 and 3,88 in 2022. The average values for statement 1: I am interested in technology and the phenomena related to it are presented in Figure 2.

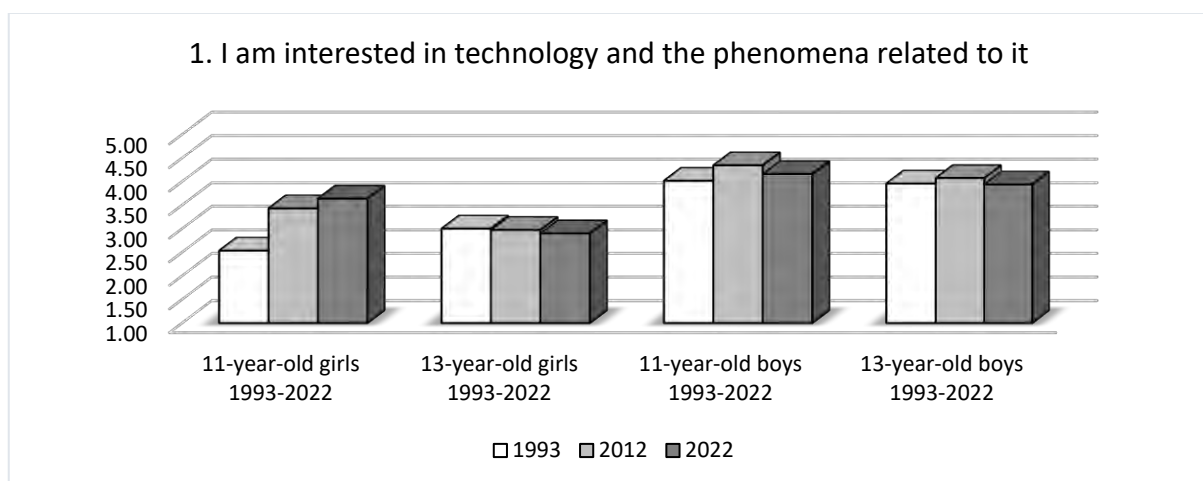


Figure 2. The Average Values in Statement 1

I spend a lot of time in technology related hobbies

Relatively low values were found in statement: Spends a lot of time in technology related hobbies. Very significant statistical difference was found in 11-year-old girls test group as the result was 1,84 in year 1993, 2,72 in year 2012 and 2,46 in 2022. Same direction was found in 13-year-old girls test group, as the result was 1,62 in year 1993, 2,53 in year 2012 and 2,37 in 2022. Among 11 and 13-year-old boys the direction was opposite and just small changes were found between years 1993-2022, as 11-year-old boys had 3,16 in year 1993, 3,07 in year 2012 and 2,91 in 2022. In 13-year-old boys test group the result was 2,90 in year 1993, 2,96 in year 2012 and 2,80 in 2022.

Among girls, the most significant development in the whole questionnaire was found in this statement between years 1993-2012. This may be due to the fact that especially girls are interested in technological everyday solutions (e.g., mobile phones, tablets) that were not in everyday use 30 years ago. Unfortunately, the direction was opposite between years 2012-2022 and neither boys nor girls did not report more technologically related hobbies than 10 years before. The average values for statement 1: I spend a lot of time in technology related hobbies are presented in Figure 3.

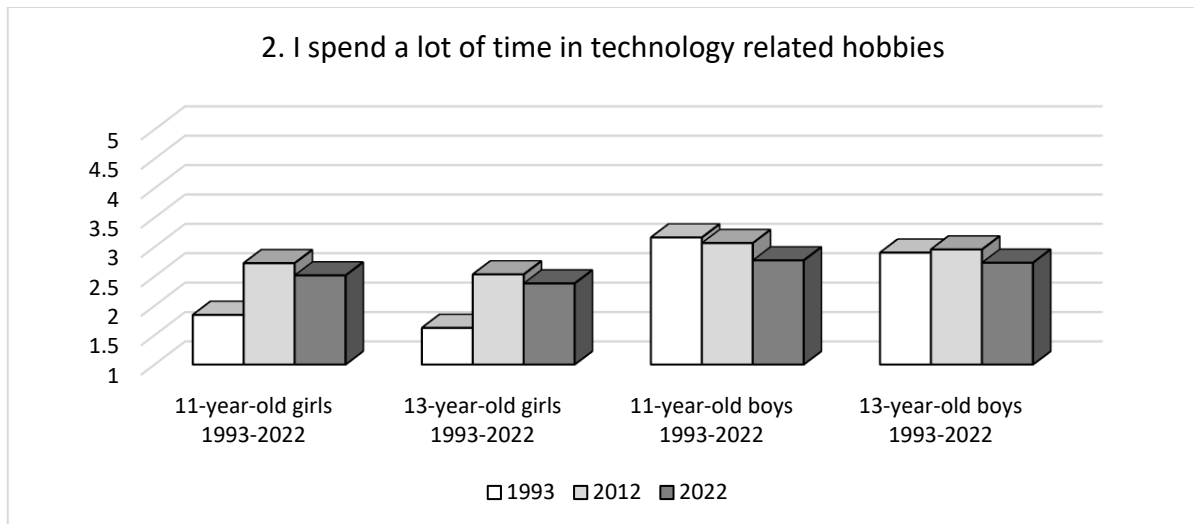


Figure 3. The Average Values in Statement 2

Newspapers, magazines, and articles from the field of technology are interesting for me

Another statement with low values was found in statement 3: Newspapers, magazines, and articles from the field of technology are interesting for me. However, very significant positive statistical difference was found in 11-year-old girls test group between years 1993-2022 as the result was 2,00 in year 1993, 2,34 in year 2012 and 2,52 in 2022. Unfortunately, in 13-year-old girls test group opposite direction was found between years 2012 and 2022, as the result was 2,11 in year 1993, 2,34 in year 2012 and 1,89 in 2022. Among 11 and 13-year-old boys smaller changes were found, but the direction was mostly negative, as 11-year-old boys had 3,11 in year 1993, 2,84 in year 2012 and 2,97 in 2022. In 13-year-old boys test group the result was 3.02 in year 1993, 2.94 in year 2012 and 2.63 in 2022. The average values for statement 3: Newspapers, magazines and articles from the field of technology are interesting for me are presented in Figure 4.

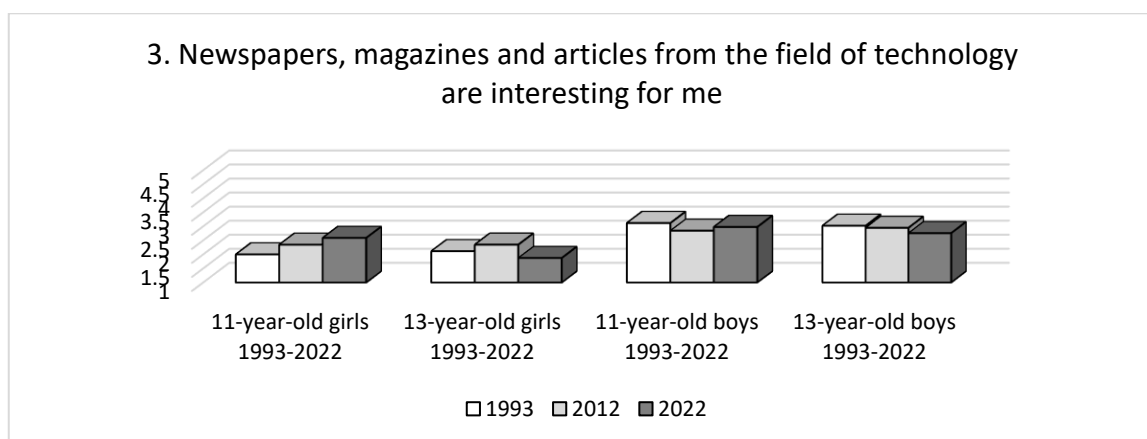


Figure 4. The Average Values in Statement 3

Understanding technology related phenomena will be beneficial in the future

Significant positive statistical difference was found in 11-year-old girls test group as the result was 2,91 in year

1993, 3,45 in year 2012 and 3,43 in 2022. Unfortunately, in 13-year-old girls test group the development was diminished, as the result was 2,93 in year 1993, 3,09 in year 2012 and 3,16 in 2022. Among 11 and 13-year-old boys just small changes was found between years 1993-2022, as 11-year-old boys had 3,88 in year 1993, 3,96 in year 2012 and 3,72 in 2022. In 13-year-old group, the result was 3.72 in year 1993, 3.75 in year 2012 and 3.87 in 2022. The average values for statement 4: Understanding technology related phenomena will be beneficial in the future are presented in Figure 5.

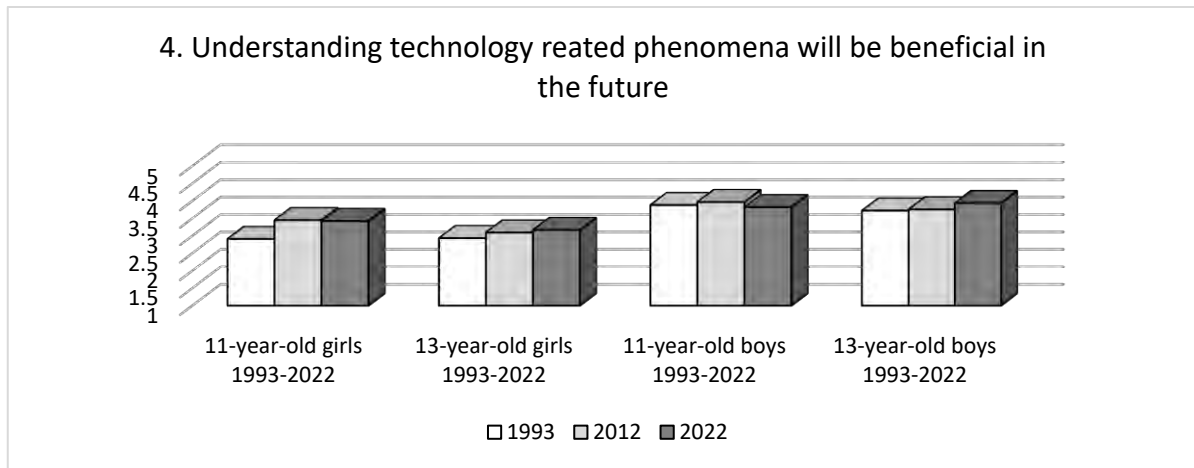


Figure 5. The Average Values for Statement 4

Understanding technology-related phenomena requires a special talent

Relatively small changes were found in 11-year-old girls test group as the result was 3,33 in year 1993, 3,53 in year 2012 and 3,22 in 2022. Opposite direction was found in 13-year-old girls test group, as the result was 2,63 in year 1993, 3,04 in year 2012 and 3,11 in 2022. Among 11 and 13-year-old boys just small changes were found between years 1993-2022, as 11-year-old boys had 3,61 in year 1993, 3,61 in year 2012 and 3,22 in 2022. In 13-year-old boys test group, the result was 3.16 in year 1993, 3.45 in year 2012 and 3.08 in 2022. The average values for statement 5: Understanding technology-related phenomena requires a special talent are presented in Figure 6.

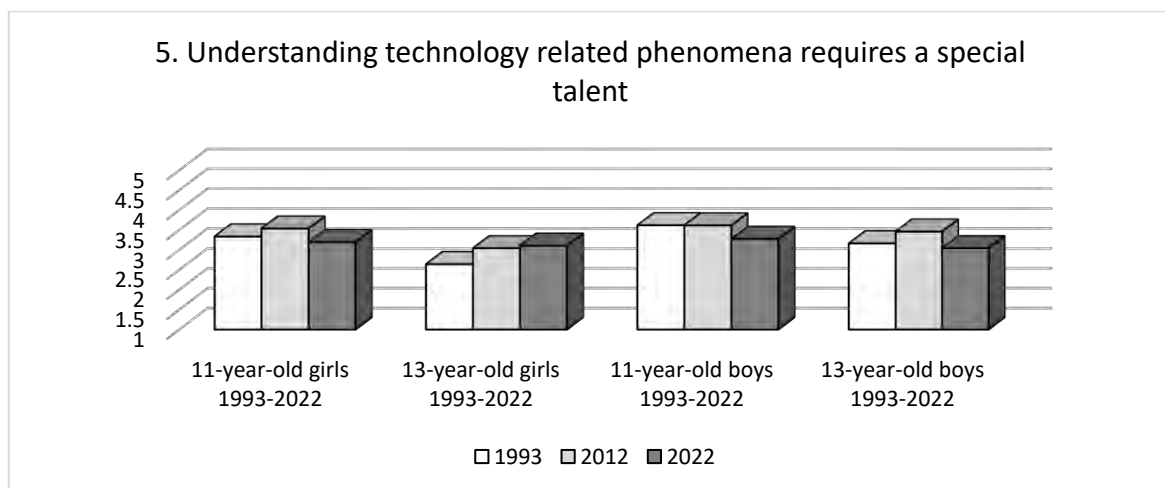


Figure 6. The Average Values for Statement 5

Both boys and girls may understand technology-related phenomena

The highest average values in the whole questionnaire were found in statement 6: Both boys and girls may understand technology related phenomena. This is a clear sign that gender issues are important in Finnish craft and technology education, and both boys and girls are aware of them.

Among 11-year-old girls test group the result was 4.44 in year 1993, 4.57 in year 2012 and 4.68 in 2022. In 13-year-old girls test group, the result was 4.64 in year 1993, 4.53 in year 2012 and 4.7 in 2022. Among 11 and 13-year-old boys the values were lower, but direction was positive during years 1993-2022, as 11-year-old boys had 4,04 in year 1993, 4,31 in year 2012 and 4,62 in 2022. In 13-year-old the result was 4.06 in year 1993, 4.40 in year 2012 and 4,73 in 2022.

A self-critical remark has to be made in this statement. If there is a possibility that gender stereotypes have been discussed in several other issues and the researcher ask about differences between boys and girls, the respondents may be already programmed into a certain answer. The average values for statement 6: Both boys and girls may understand technology-related phenomena are presented in Figure 7.

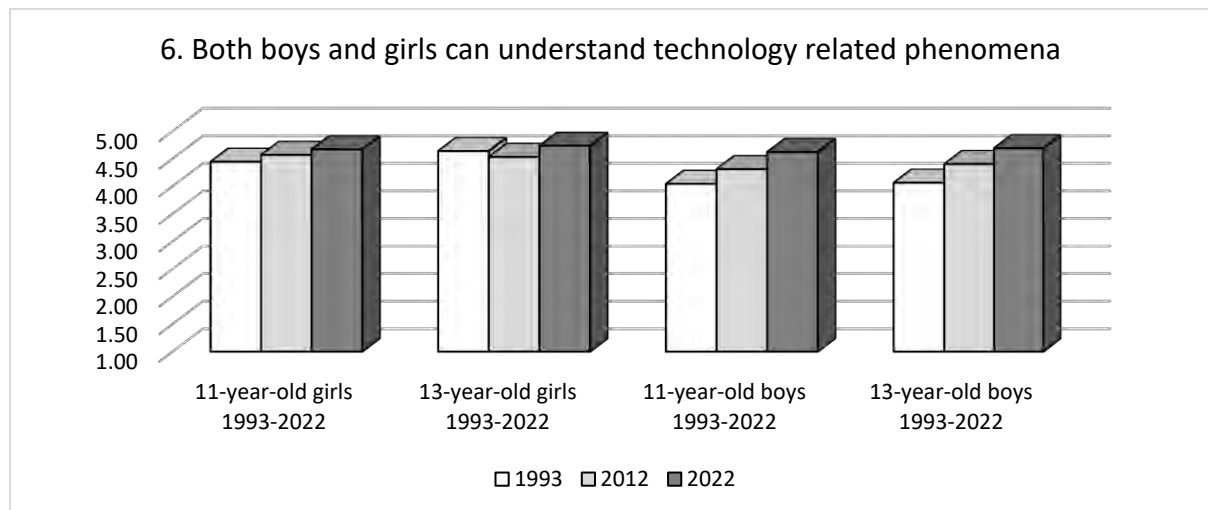


Figure 7. The Average Values for Statement 6

Mankind has rather benefited than sustained damage from the development of technology

Among all test groups some positive changes were found during years 1993-2022, as the result was in 11-year-old girls test group 3,40 in year 1993, 3,84 in year 2012 and 3,90 in 2022. Same direction but smaller change was found in 13-year-old girls test group, as the result was 3,73 in year 1993, 3,89 in year 2012 and 3,94 in 2022. Among 11 and 13-year-old boys positive changes were found between years 1993-2012, but not anymore 2012-2022, as 11-year-old boys had 3,83 in year 1993, 4,26 in year 2012 and 4,06 in 2022. In 13-year-old boys test group, the result was 3.78 in year 1993, 4.14 in year 2012 and 4.17 in 2022.

The average values for statement 7: Mankind has rather benefited than sustained damage from the development of technology is presented in Figure 8.

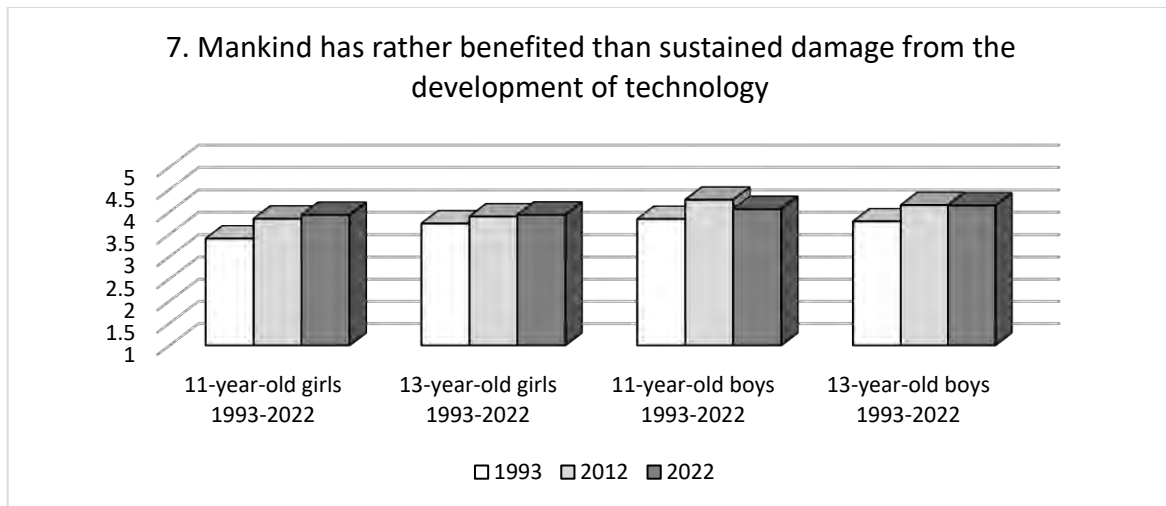


Figure 8. The Average Values for Statement 7

In the future I would like to choose a specialty, or a profession related to technology

One statement with low values especially among girls’ tests groups was: In the future I would like to choose a specialty, or a profession related to technology. Among 11-year-old girls test group the result was 2.00 in year 1993, 2.39 in year 2012 and 2.39 in 2022. Same direction was found in 13-year-old girls test group, as the result was 1,92 in year 1993, 2,22 in year 2012 and 2,11 in 2022. Among 11 and 13-year-old boys just small changes were found between years 1993-2022, as 11-year-old boys’ result was 3,01 in year 1993, 3,29 in year 2012 and 3,11 in 2022. In 13-year-old boys test group, the result was 3.15 in year 1993, 3.18 in year 2012 and 2,88 in 2022.

Although girls’ attitudes have changed in a positive direction, it seems that the probability of even considering these engineering-related occupations as appropriate is much lower for females than for males and only few girls are willing to challenge stereotypes about non-traditional careers for women (Eccles, 2007; Autio, 2013). The average values for statement: In the future would like to choose a speciality or a profession related to technology are presented in Figure 9.

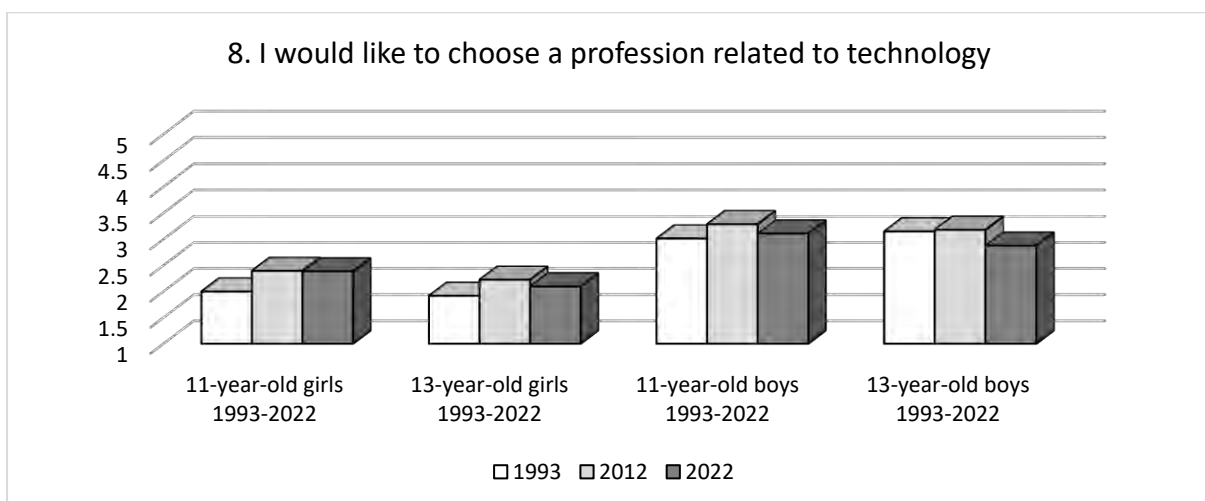


Figure 9. The Average Values for Statement 8

My parents have a lot of technology-related hobbies

Positive changes were found between years 1993-2012 in all test group, but unfortunately, the direction was not the same during 2012-2022 especially among girls. The result in 11-year-old girls test group was 2.35 in year 1993, 3.07 in year 2012 and 2.86 in 2022. Same direction was found in 13-year-old girls test group, as the result was 2,29 in year 1993, 2,84 in year 2012 and 2,62 in 2022. Among 11- year-old boys, the value was a bit higher 2.53 in year 1993, 3.03 in year 2012 and 3.12 in 2022. In 13-year-old boys test group changes were smaller, as the result was 2.82 in year 1993, 2.98 in year 2012 and 2.82 in 2022.

If parents have more technology-related hobbies, it is obvious that there are more examples from parents and role models in general. Furthermore, if parents and teachers are more aware of technological phenomena, they can tell students what they are good at or not good at with more information on which to base such conclusions (Eccles, 2009). The average values for statement 9: My parents have a lot of technology-related hobbies are presented in Figure 10.

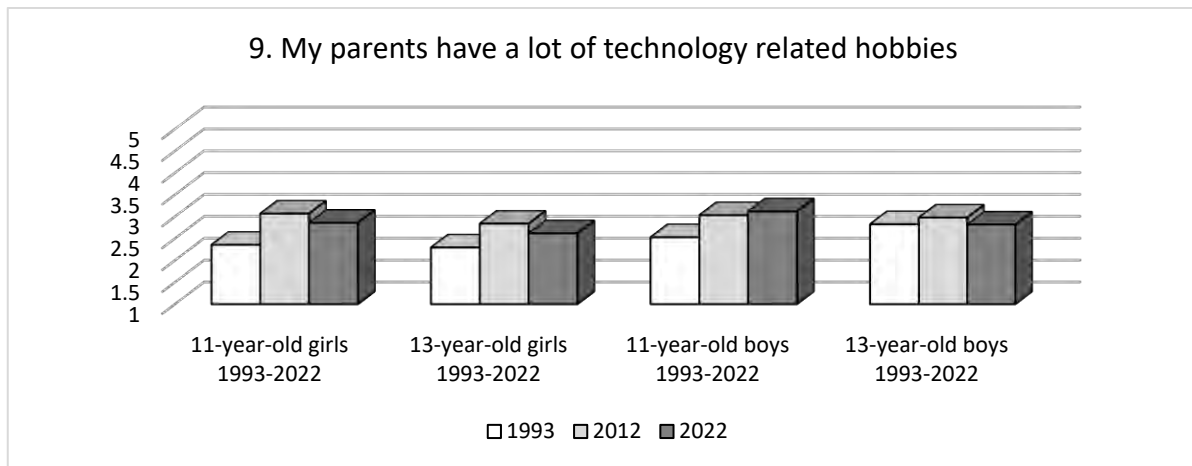


Figure 10. The Average Values for Statement 9

The atmosphere in the Technology Education / craft lessons is pleasant and inspiring

Very significant positive statistical difference was found in both 11- and 13-year-old girls test group as the result for younger girls was 2,93 in year 1993, 3,53 in year 2012 and 3,86 in 2022. Same direction was found in 13-year-old girls test group, as the result was 3,10 in year 1993, 3,46 in year 2012 and 3,97 in 2022. Among 11- and 13-year-old boys, the direction was positive during 1993-2012, but unfortunately, the positive change diminished between 2012-2022. 11-year-old boys result was 3.82 in year 1993, 4.27 in year 2012 and 3.83 in 2022. Among 13-year-old, the result was 3.74 in year 1993, 4.27 in year 2012 and 3.90 in 2022.

It is not surprising that both boys and girls are attracted to craft and technology education because they enjoy working with their hands and like the independence and chance for creativity provided by these classes (Silverman & Pritchard, 1996). In this case, boys’ development between years 2012-2022 is alarming and should be of great concern. The average values for statement 10: The atmosphere in the Technology Education / craft lessons are

pleasant and inspiring are presented in Figure 11.

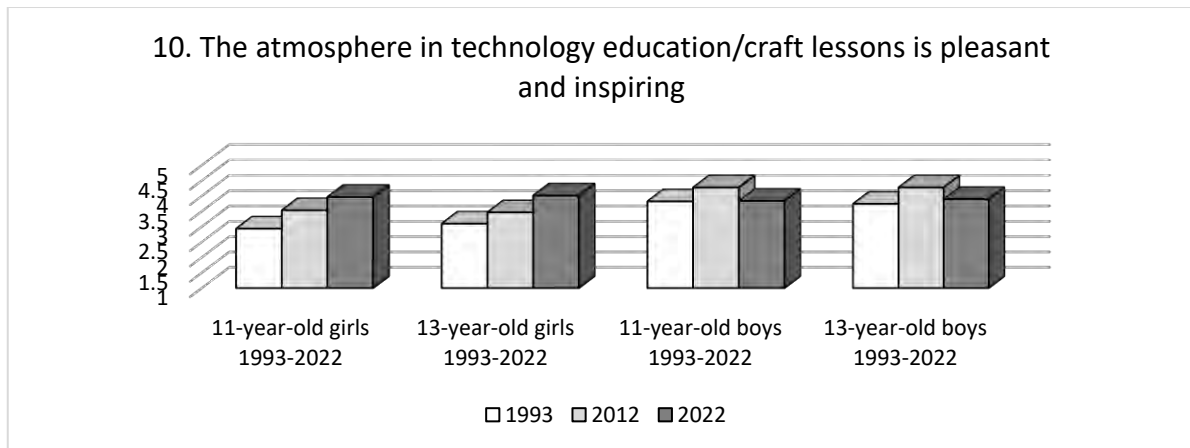


Figure 11. The Average Values for Statement 10

Technology education /craft lessons contribute to the development of my manual skills

One statement with high values was - technology education/craft lessons considerably contribute to the development of manual skills. Positive changes were found during years 1993-2022 especially in girls test groups, as the result was in 11-year-old girls test group 3,60 in year 1993, 3,81 in year 2012 and 4,07 in 2022. Same direction but smaller change was found in 13-year-old girls test group, as the result was 3,55 in year 1993, 3,60 in year 2012 and 3,91 in 2022. Unfortunately, the direction was opposite among 11- and 13-year-old boys, as 11-year-old boys had 4.42 in year 1993, 4,29 in year 2012 and 4,03 in 2022. Among 13-year-old boys test group, the result was 4.15 in year 1993, 4.21 in year 2012 and 3.77 in 2022.

The development seems to be opposite between boys and girls. Is it because girls’ give more value to the skills they have learned in technical craft and boys’ feel that they have not had much use for skills in textile craft, which they have been provided after the year 1993. The average values for statement 11: Technology education /craft lessons contribute to the development of my manual skills are presented in Figure 12.

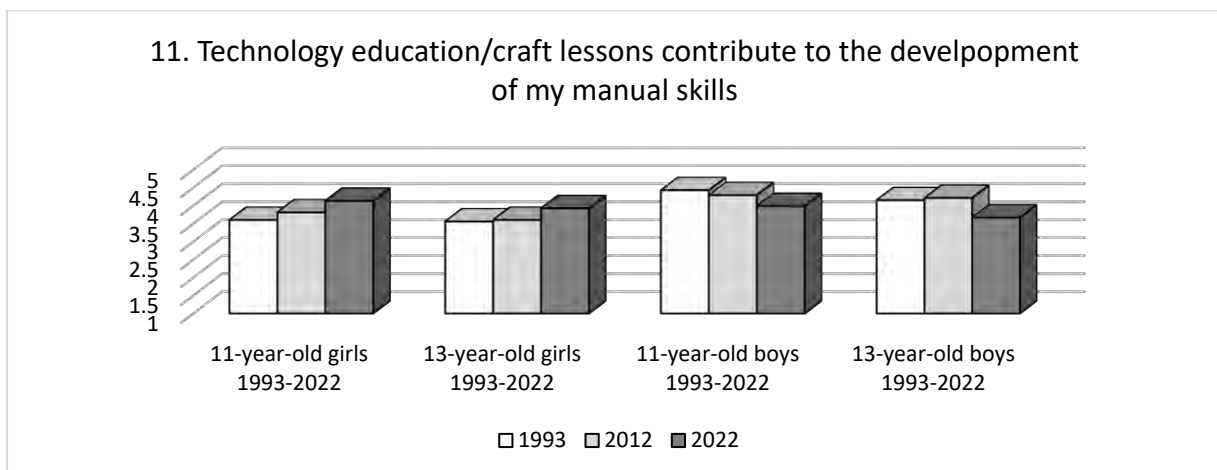


Figure 12. The Average Values in Statement 11

Technology education/craft lessons develop my logical thinking

Significant positive statistical difference was found in all test groups between years 1993-2012. Unfortunately, the positive change diminished during 2012-2022. The result for 11-year-old girls was 2.89 in year 1993, 3.59 in year 2012 and 3.39 in 2022. The results in 13-year-old girls test group were 3.05 in year 1993, 3.29 in year 2012 and 3.36 in 2022. Among 11- and 13-year-old boys the direction was positive during 1993-2012, but unfortunately the change was opposite between 2012-2022. 11-year-old boys result was 3.59 in year 1993, 3.86 in year 2012 and 3.71 in 2022. Among 13-year-old, the result was 3.41 in year 1993, 3.82 in year 2012 and 3.48 in 2022.

The average values for statement 12: Technology education/craft lessons develop my logical thinking are presented in Figure 13.

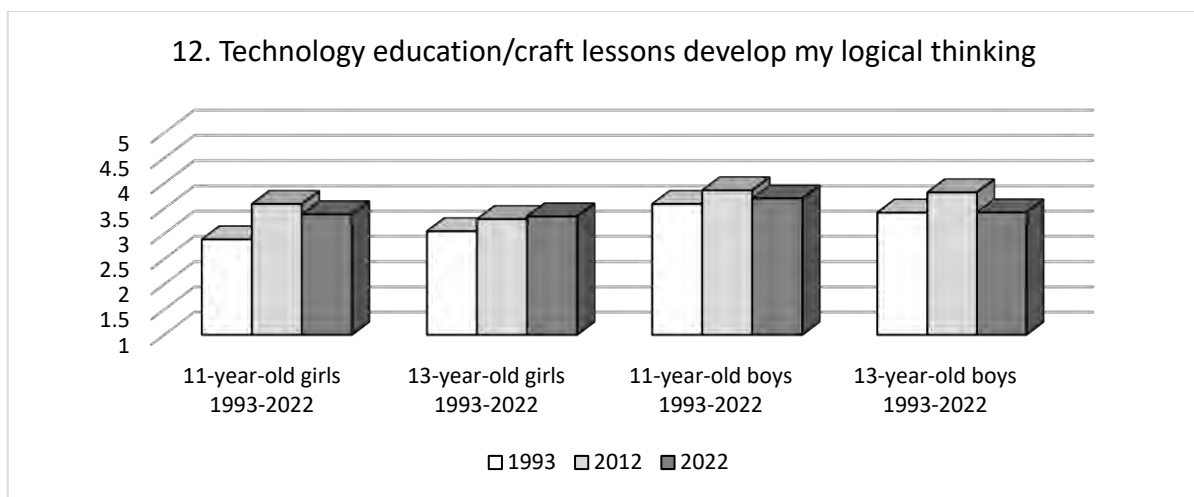


Figure 13. The Average Values for Statement 12

I have been successful in technology education/craft lessons

Very significant positive statistical difference was found in both 11- and 13-year-old girls test group as the result for younger girls was 3,07 in year 1993, 3,46 in year 2012 and 3,77 in 2022. Same direction was found in 13-year-old girls test group, as the result was 2,75 in year 1993, 3,27 in year 2012 and 3,68 in 2022. Among 11- and 13-year-old boys, the direction was positive during 1993-2012, but unfortunately, the positive change diminished between 2012-2022. The result for 11-year-old boys was 3.63 in year 1993, 3.82 in year 2012 and 3.68 in 2022. Among 13-year-old, the result was 3.36 in year 1993, 3.99 in year 2012 and 3.72 in 2022.

Cheryan, Ziegler, Montoya & Jiang (2017) argue, that even if women are successful in other fields, it does not mean that they could not be equally successful in engineering, if they feel that they belong there. Hence, more attention should be paid to girls’ subjective task value (STV) ranking for craft and technology education relative to their ranking of other subjects.

The average values for statement 13: I have been successful in technology education/craft lessons are presented

in Figure 14.

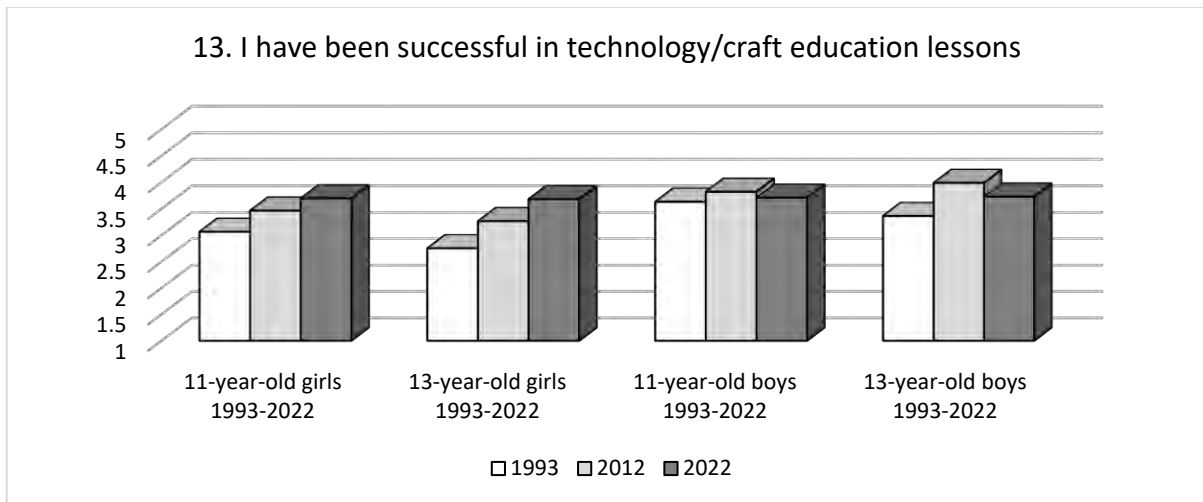


Figure 14. The Average Values for Statement 13

Technology education/craft lessons will be beneficial for me in the future

Significant positive statistical difference was found in 11-year-old girls test group as the result was 3,02 in year 1993, 3,46 in year 2012 and 3,48 in 2022. Unfortunately, in 13-year-old girls test group the development was diminished, as the result was 2,98 in year 1993, 2,89 in year 2012 and 3,16 in 2022. Among 11- and 13-year-old boys, just small changes were found between years 1993-2012, unfortunately, the direction was negative during 2012-2022. The result for 11-year-old boys was 3.89 in year 1993, 3.94 in year 2012 and 3.37 in 2022. Among 13-year-old boys, the result was 3.82 in year 1993, 3.81 in year 2012 and 3.38 in 2022. Boys’ development between years 2012 and 2022 is alarming. Is it due to changes in the curriculum or changes in society as a whole, needs more appropriate research. The average values for statement 14: Technology education/craft lessons will be beneficial for me in the future are presented in Figure 15.

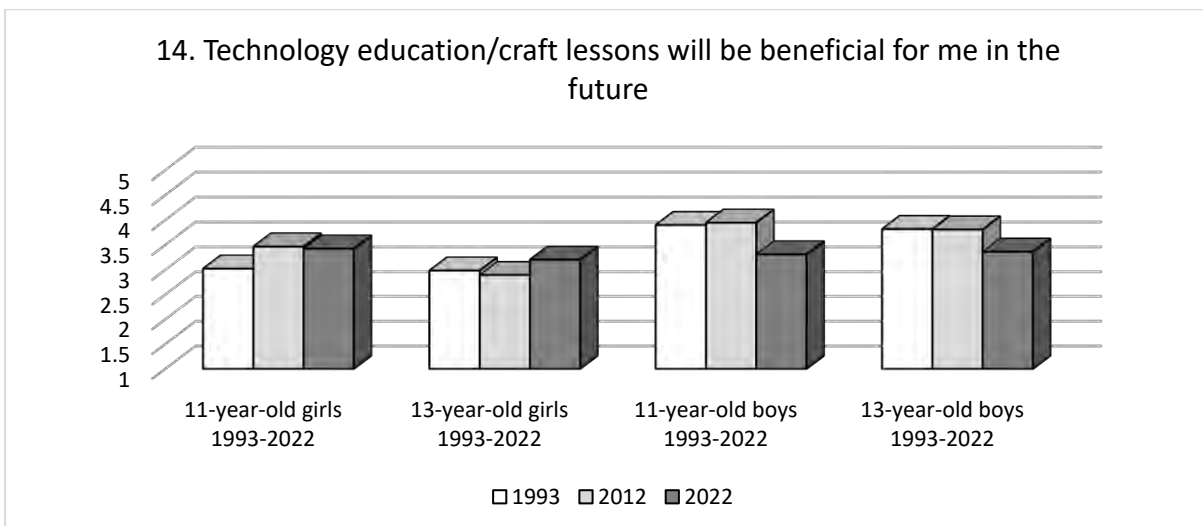


Figure 15. The Average Values for Statement 14

The last Curriculum 2014 (NBE, 2014) specified that technical craft and textile craft should be taught to both boys and girls throughout their entire compulsory schooling. Hence, in the year 2022, there were no separate subjects, just one multi material craft for both sexes. In practice there was minor emphasis on technology - art and design was emphasized over technology education.

Anyway, all boys and girls had a real experience of combined craft education, and it was expected that both boys and girls were willing to make more non-traditional choices regarding the preferred craft area. In fact, among girls there was a noticeable development towards combined craft education, as 58,7 % of girls would have chosen combined craft, 28,0 % of girls would have chosen only textile craft and 13,3 % just technical craft. Preferred craft area in the year 2022 among girls is presented in Figure 16.

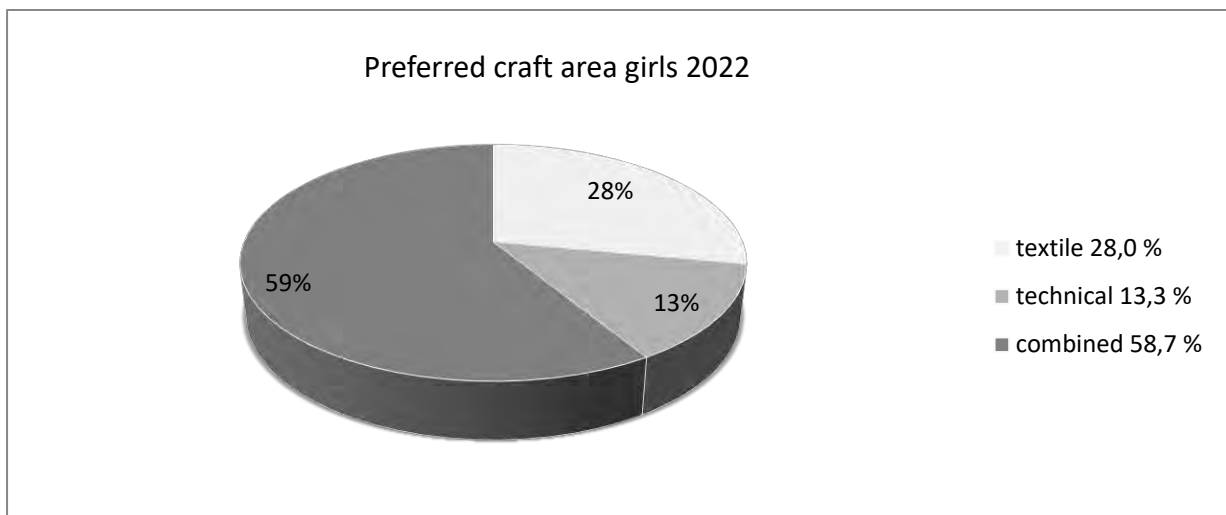


Figure 16. Preferred Craft Area among Girls in the Year 2022

Unfortunately, among boys the development was different, and the result was very close to the measurement in the year 1993, as 79,3 % of boys would still have chosen technical craft, only 3,7 % textile craft and 17,0 % combined craft. Preferred craft area in the year 2022 among boys is presented in Figure 17.

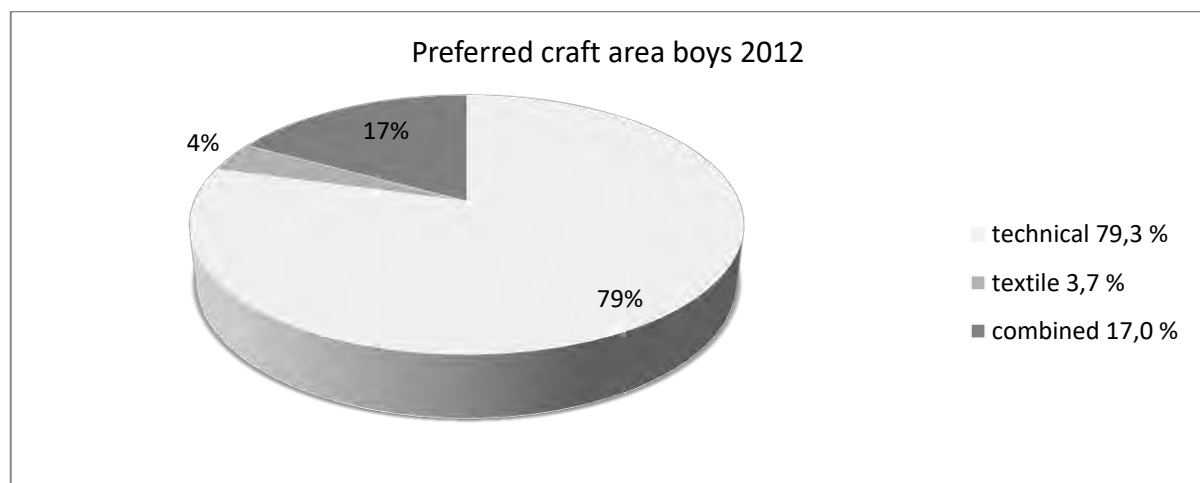


Figure 17. Preferred Craft Area among Boys in the Year 2022

From this result it can be concluded that in combined craft education technical craft provides much more interesting and valuable contents for girls than textile craft provides for boys. What is more, girls seem to feel the atmosphere more pleasant and inspiring, as can be concluded from the direction of results in statement: the atmosphere in the technology education / craft lessons is pleasant and inspiring. As well as the direction in statement: technology education/craft lessons will be beneficial for me in the future.

Discussion

The critical side from the conception stage of this study was - how are attitudes towards technology to be defined and how can it be measured in a way that would be simple, easy to use with large groups, and still be reliable and valid enough to be generalized to other student populations? Moreover, the technological world in general is quite different in 2022 than it used be 30 years ago. To achieve a relevant comparison, the measurements were made with exactly the same test instruments in 1993, 2012, and 2022. Because the test instruments were not updated during the last 30 years, there has been some criticism.

In the future, the questionnaire needs to be improved and the content needs to be updated with modern contents. In addition, some criticism could be raised because the selection of the schools was made already in 1993 and the sample was discretionary rather than incidental. However, the difference between schools in Finland is very small, as reported in the 2012 PISA results (Kupari et al., 2013).

The most promising result was that Finnish students' attitudes towards technology were definitely more positive in 2012 than in 1993. The average response in our Likert-style (1–5) questionnaire to all 14 items was 2.89 in 1993 and 3.24 in 2012 for Finnish girls. The development in girls' attitudes was statistically significant ($p < 0.01$). Another positive sign was found among boys' attitudes between years 1993 and 2012, as the result was 3.54 in 1993 and 3.74 in the year 2012. Unfortunately, the development was not as positive between years 2012 and 2022; the average response was 3.24 / 3.29 among girls and 3.74 / 3.56 among boys.

It can be concluded that the positive development between years 1993-2012 was because of changes in the technological environment in general and not only because changes in the curriculum. There are plenty of different technological solutions (e.g., mobile phones, games consoles, tablets, interestingly themed construction kits) available for all children nowadays that did not exist 30 years ago. This will be a challenge for the curriculum development in the future. How can technology education benefit from the fact that especially girls are interested in technological everyday solutions rather than technological details, as reported in several other studies (Autio et al., 2019; Cakir et al., 2019; Eccles, 2009; Mitts, 2008; Ozturk, 2023; Weber & Custer, 2005; Wender, 2004).

Nevertheless, from an intraindividual perspective, boys and girls have different patterns in how they prioritize math and science in relation to other subjects, which indeed exhibit the power of person-centered approaches. Even if boys and girls have started to place similar values on math and science, the two gender groups still vary in how they rank math and science in relation to other school subjects. Hence, more attention should be paid to girls' Subjective task value (STV) ranking for math and science relative to their ranking of other subjects, if the

problem of the gender imbalance in the physical science fields is to be remedied (Klein, Richardson, Grayson, Fox, Kramarea, Pollard & Dwyer, 2007).

The difference between boys' and girls' attitudes was not surprising because similar results have been reported during recent years in several studies (Autio, 1997; Autio, 2013; Grant & Harding, 1987; Streumer, 1988; Gilbert & Galvert, 2003; Chang, Yeung & Cheng, 2009). Now a days, the difference between boys and girls has been accepted and more attention has been paid to the underrepresentation of girls and women in science, technology, engineering, and mathematics (Burke & Mattis, 2007; Ceci, Williams, & Barnett, 2009; Ceci & Williams, 2011; Cheryan et al., 2017; Stoet & Geary, 2018). Although the difference between boys and girls in attitudes was smaller in 2022 than 1993, statistically very significant ($p < 0.001$) difference was found between boys and girls during years 1993-2022.

However, the main problem in Finland is that even though there should be more technology-related content that our children should be familiar with, the amount of craft lessons is still the same as 30 years ago. The reduction of technology education lessons is seen especially in the results among boys' test groups. The issue about underachieving boys is not a new phenomenon, although it is not usually connected to technology education. However, educators and administrators are beginning to accept the dominant oversimplified account of girls outperforming boys and express concern that the balance has now tipped in girls' favour and opportunities are being denied to boys (Titus, 2004).

Somewhat paradoxically, Estonian technology education curriculum is right now more or less the same as Finland used to have in 1993. Interestingly, this curriculum seems to be more effective when comparing Finnish and Estonian results in students' technological abilities. Moreover, even though Finland is still quite successful in Pisa studies a serious decline has been noticed in several areas and Estonia has passed Finland in several areas. In natural sciences, Finnish result was 563 in 2006 and 531 in the year 2016. In Estonia the direction was opposite as the result was 531 in 2006 and 534 in the year 2016. (Leino et. al, 2019).

Conclusions

The Finnish curriculum has put large emphasis on gender equity since 1970. Hence, it is confusing that Finnish girls seemed to be aware of the gender equity and they highly agree that both boys and girls may understand engineering-related phenomena. However, only a few girls are willing to challenge stereotypes about non-traditional careers for women. Therefore, instead of to encouraging more girls to study science and technology it is also necessary to help girls to better understand what engineering and development of technology are about. However, this is not primarily a question of giving young people information but rather a question of creating a wider disciplinary self-understanding. This requires a cultural change and critical contemplation of values as suggested by Ulriksen, Møller Madsen, and Holmegaard (2010).

Engineering has several subdisciplines that attract women more than others. Design and human technology are central aspects in any field of engineering. Thus, these areas should be considered consistently throughout the

field instead of using them to create “female-friendly” subdisciplines, which easily become devalued as softer or “imaginary” engineering (Naukkarinen & Bairoh, 2020).

According to Mammes (2004), attitudes towards technology can be significantly improved by developing special courses just for girls. “Because technology education has traditionally been such a male-oriented subject, teachers need to be aware of the differing interests of girls and consider ways of making the environment and the subject attractive to them “(Silverman & Pritchard, 1996). Furthermore, some researchers believe that “in school situations where only females are present, the gender-related segment becomes relatively inactive, and interests could develop independently. So, if girls’ interests should be turned to technology (against the gender stereotype), gender separate teaching is advisable” (Wender, 2004). In addition, several preconditions are recommended such as support from female role models and an atmosphere that encourages confidence and inclusion of technical problems in everyday situations that have a relationship with people (Häussler & Hoffmann, 1998). For example, teaching math, chemistry, and physics using more biologically based metaphors and a more real-world problem-oriented approach have been shown to increase female students’ interest in physics (Klein et al., 2007).

During last 30 years, hundreds of different development projects have been made in all over the world and in Finland gender equity in technology education has been one main theme since 1970. The results of this research show some positive signs in girls’ attitudes towards technology. However, the results in boys test groups should be of great concern. It can be concluded that an ideal solution in Finnish technology education has not been found. The problem of the inequality in the field of technology seems to be far more complicated than we used to think. It is not just technology education that is responsible for solving such a complex problem but society as a whole.

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