Are girls equal in technology education?

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Introduction

Finnish technology education dates back to 1866 when craft education was accepted to be one of the compulsory subjects in the school curriculum. Uno Cygnaeus, founder of Finnish general education, considered "technological" contents an important part of craft education. Cygnaeus emphasized dexterity, design and aesthetics but also consideration, innovation and creativity. (Kantola 1997, p. 18)

There have been many pedagogical and administrative changes in general education since Cygnaeus' times, but one remarkable change took place in the beginning of the1970's when the parallel school system (folk school and gymnasium) was abolished and the comprehensive school was introduced in the country. A significant reform was introduced in teacher education in 1979. Since then all comprehensive school (grades 1 to 9) teachers, both class teachers and subject teachers, have been trained up to master's level.

In this article, we will discuss the changes in Finnish technology education since 1970 from the point of view of changes in curriculum, particularly from the gender point of view, but also considering pedagogy, teacher education, society, and the concept of learning.

Technology education and craft education

Handicraft teaching and technology teaching have seldom been compared in research literature. Comparisons are mainly made between technology, science and mathematics. The reason for this is obviously that, for instance, in England and the United States handicraft education has developed into technology education. According to Alamäki (1999, p. 37), technology education has evolved from craft education in many countries. He also argues that, due to technology education still being in the evolution process, many approaches from crafting to applied science are being used in technology. Järvinen (2004a p. 45 and 2004 b p. 8) claims that technology education cannot be monopolized by either craft or science education because it involves mathematics, science, arts, handicrafts and genuine innovative problem solving.

Kantola (1997) and Parikka (1998) define technology as an umbrella concept for handicraft education. Anttila (1993), Peltonen (1988) and Suojanen (1993), on the contrary, regard handicraft education as an umbrella concept for technology education. Alamäki (1999, p. 14), then, explains that 'käsityö' (craft or handicraft) is the official name and overall term for a subject group that consists of the school subjects 'tekninen työ' (technical work) and 'tekstiilityö' (textile work). "Käsityö in the Finnish educational context has no direct English equivalent but implies a combination of crafts, design and technology education." (ibid. 1999, p. 173.) He also notes that

”the contents and processes of the Finnish ‘tekninen työ’ correspond to the international view of technology education”. He goes on by saying that in many Finnish publications (e.g. Alamäki 1998a; 1998b; 1999; Alamäki & Suomala 1998; Kankare 1997) the English equivalent of the term ‘tekninen työ’ is technology education. (ibid. 1999, p. 14.) By merely changing the title of the subject there is no change in learning. What matters is the contents of teaching. Therefore, the objectives and contents of craft education have to be discussed and altered towards technology education.

Experts in craft education and technology education, whether Finnish or foreign, agree on particularly one view. Both groups see that an essential part of learning is the creative planning and production process (Anttila 1993, Hill & Lutherd 1999, Eggleston 1994, Lindfors 1992, Peltonen 1988, Suojanen 1993, Yli-Piipari 1991). Kojonkoski-Rännäli (1998, p. 368) distinguishes, mainly following Bunge (1985, p. 220), the handicraft production activity and the technological production activity. According to her, hands-on methods are used in handicraft, whereas in technology, methods of modern technology are used.

In this article thinking and use of the brain is considered to lead all work done by hand. Technology is seen as “logos” of “techné”, where technology is not restricted to modern technology, but is seen from a wide perspective - from traditional to modern.

The 1970 Framework Curriculum and the 1970 Curriculum

Girls and boys should not be separated during craft lessons (Peruskoulun opetussuunnitelmakomitean mietintö I, 1970 p. 49, Peruskoulun opetussuunnitelmakomitean mietintö II, 1970p. 338)

In 1970, the Ministry of Education published two memoranda to guide teachers in transferring from the old parallel school system to the comprehensive school system. The 1970 Framework curriculum (Peruskoulun opetussuunnitelmakomitean mietintö I, 1970) gave the rationale and philosophy, aims and objectives, information needed to implement and develop the curriculum, different methods, information about learning materials, information about differentiation, evaluation, extra mural activities, counselling, organizing the work and co-operation between the school and homes for the schools.

The 1970 Curriculum stated the attainment targets and contents for different school subjects and in craft education listed grade by grade the techniques (i.e. measuring, marking, sawing etc.), materials (i.e. planks, metal rod, plastics etc.), and objectives (mainly different techniques) with some ideas for different projects. It also gave information on different working, learning and teaching methods, evaluation and integration. Craft education was divided into two sub-areas: technical craft and textile craft. The document emphasized that the division should no longer be according to one’s sex, but both girls and boys should study textile craft and technical craft. All pupils were supposed to study the same programme from grade one to three, then choose one of the two subject areas for grades four to seven. During the spring term (January – May) grade six pupils were supposed to change the subject area. (Peruskoulun opetussuunnitelmakomitean mietintö II, 1970). However, boys mainly went for technical craft classes and girls for textile craft classes. Girls were more open-minded in their choices than boys were.

Technology as a concept is not to be found in the 1970 Curriculum. In turn, the concept of technique is to be found under the title “technical craft”. One of the general objectives in technical

craft studies was to become acquainted with technical domains. The pupils' own designprocess was regarded as important and the contents of, for instance, machinery and electronics can be seen to be of a technological nature. The 1970 Curriculum and Framework Curriculum documents is a very radical, educationally professional, ambitious and future oriented.

The Framework Curriculum for Comprehensive Schools 1985

Both sexes should study technical work and textile work (Peruskoulun opetussuunnitelman perusteet, 1985 p. 206)

Since the 1970 Curriculum document there has not been a national curriculum in Finland. The documents since then have been framework curricula, and the municipalities and schools have planned their own curricula following the national framework. The reasons for this are decentralization of the educational management, reform in teacher education, and need to plan the curriculum to fit the local circumstances. In the 1980's the inspection system was also abolished. Inspectors' posts at national and regional level were changed to instructors' and supervisors' posts. Their role was not to check if the teachers had done their job, but to assist and help teachers in planning, developing, and organizing in-service education for teachers. Schools and municipalities were guided to develop their own curriculum following the national framework curriculum. Teachers were highly educated and they were considered to be able to develop their own curricula.

In 1985, after 15 years experience of the comprehensive school- system, a Framework Curriculum for Comprehensive Schools (Peruskoulun opetussuunnitelman perusteet 1985) was published by the National Board of Education. The document introduced six general objectives, one of which is gender equality. Enhancing equality at school means offering the same possibilities for both boys and girls (ibid. 1985, p. 13). There are references to the discussions in parliament about promoting gender equality. According to the law, the schools should promote equality between sexes. The National Board of Education leaves it to the municipalities to decide how to organize craft education. However, from grade one to grade three all pupils should study both textile work and technical work, from grade four to six part of the studies are common to all pupils but part is either technical or textile work. At grade seven technical work and textile work are common subjects to all pupils. However, if the municipalities want they can, on top of the common studies, differentiate teaching into technical or textile work. (ibid. pp. 206 – 207).

For the first time also the concept of technology was introduced - but not defined. However, the concept is to be found only under "Craft, technical work and textile work". Technology is the starting point of technical abilities, planning, and implementing (ibid. p. 206). During technical work lessons pupils should also learn to manage technology (ibid. p. 208).

In the curriculum the sector on craft, technical work and textile work introduces first the general objectives and gives information on how teaching should be organized. After this, the objectives of technical work and textile work are introduced together with contents grade by grade. The contents are mainly different techniques (i.e. cutting, sawing, soldering etc.). There is also information on how to differentiate the curriculum in different municipalities, how to evaluate, and what the opportunities for integration are. Although the general objectives are to develop problem solving and planning skills, the specific objectives are a mere list of different techniques (ibid. pp. 208 – 213). The approach in the curriculum can be characterized as behaviouristic. It has been written from teachers' point of view rather than from pupils' point of view. Such expressions as "pupils will be taught to turn wood" and similar are used (ibid. pp. 208 – 213).

In practice, many schools continued to differentiate pupils after grade three in either textile or technical work groups. The groups were in most cases formed according to sex. Pupils were probably offered a chance for a short change of three to six weeks to study the other subject area of craft.

The Framework Curriculum for Comprehensive Schools 1994

"Craft, technical work and textile work form an entity at primary and junior secondary level which is meant for all pupils regardless of sex." (Peruskoulun opetussuunnitelman perusteet 1994, p. 104)

For the first time in the history of the curriculum development of Finnish general education schools, technology is clearly mentioned in the general objectives of the curriculum. For the comprehensive school the national guidelines state that the technical development of society makes it necessary for all citizens to have a new kind of readiness to use technical applications and to be able to exert an influence on the direction of technical development. Furthermore, it states that students without regard to sex must have the chance to acquaint themselves with technology and to learn to understand and avail themselves of technology. What is particularly important is to take a critical look at the effects technology has on the interaction between humanity and nature, to be able to make use of the possibilities it offers and to understand their consequences. (Peruskoulun opetussuunnitelman perusteet 1994, pp. 11 - 12.) However, the document does not give any operational instructions on how to study technology.

Under chemistry, the concept technology is mentioned once: "pupils should be able to acquire such a terminology that they are able to discuss questions concerning nature, environment, and technology" (ibid. p. 86). Under craft, the technological objective is that pupils will acquire knowledge of the traditional and modern technological materials on their own, knowledge of tools and techniques that can be applied in daily life, further studies, jobs, and hobbies (ibid. p. 105 - 106). Despite the stated objective at the end of 1990's woodwork was mainly taught during technical work lessons in the Finnish primary schools. Electricity and electronics tasks, plastic work, and service and repair were taught to a certain extent. Lack of financial resources and ideas were regarded as the most significant obstacles to the development of technology education. (Alamäki 1999, p.136). In informal discussions between teachers and teacher educators, technical work education in schools has been said to mainly include copying and reproducing processes, such as the copying of wooden and metal items, not modern, design-oriented processes. (ibid. p.39) According to Kankare (1997, pp. 156 – 157 and pp.176 – 177) woodwork was mainly emphasized by the Finnish technical craft teachers, although most teachers did not want to divide the contents according to materials, but considered the subject area in an holistic manner. Also Sanders (2001, p. 50) has found in the USA that most technology education teachers still stick to traditional general technology education and woodwork courses.

Although "craft, technical work and textile work form an entity at primary and junior secondary level which is meant for all pupils regardless of sex" (Peruskoulun opetussuunnitelman perusteet 1994, p. 104) in addition to having partly common craft education for both boys and girls, the document allowed the schools to emphasize one of the two craft domains. This meant in practice that most schools continued dividing pupils into either textile work or technical work after grade three.

This is the first document since 1970 where cross-curriculum subject areas are introduced. The1970 and 1985 curricula mention holistic teaching and integration but there are no clear cross-curricular titles.

Framework curriculum for comprehensive education 2004

The human being and technology – a new cross-curricular theme

For the first time in the history of Finnish general education curriculum planning the 2004 framework curriculum introduces a cross-curricular theme:

- *the human being and technology*.

The other six are:

- development of personal identity
- culture identity and internationality,
- communication and media skills,
- committed citizenship and entrepreneurship
- responsibility for the environment, well-being and sustainable future
- safety and traffic behavior (ibid. pp.36 – 41).

Under the title ” the human being and technology” the meaning of technology in our everyday lives and dependency of human beings on modern technology should be studied. This theme will offer basic know-how of technology, the development of technology and the effects of technology, guide pupils to make reasonable choices and guides them to consider the ethic, moral and equality questions related to technology. Teaching should also improve the ability to understand how different devices, equipment, and machines work and how to use them.

The aims are as follows:

A pupil will learn

- to understand technology, the development of technology and its impacts on different fields of life, different sectors in society, and on the environment
- to use technology in a responsible and critical manner
- to use information technology equipment, programs and networks for different purposes
- to state one’s opinion concerning technological choices, and to consider the effects of today’s decisions about technology on the future

The core contents

- technology in everyday life, in society and in local trade and industry
- the development of technology and factors affecting the development in different cultures and different fields of life during different eras
- the development, modeling, and assessing of technological ideas and the life-span of a product
- the use of information and communication technology and information networks
- the ethical, moral, well-being, and equality concerns related to technology
- future society and technology

(ibid. p 40 - 41).

"Teaching will be conducted following the same contents for all pupils including contents from technical work and textile work." (grades 1 -4) (Perusopetuksen opetussuunnitelman perusteet 2004, p. 240)

"Teaching comprises contents of technical work and textile work for all pupils together, on top of this pupils can be given a chance to emphasize in their craft studies either technical work or textile work according to their interests and aptitudes." (grades 5 – 9)(ibid. p. 242)

In the framework curriculum, references to technological studies can be found only under science (particularly physics) and to a considerable extent under craft (particularly technical work). The subject groups in other subjects have not considered the cross-curricular theme " the human being and technology" in their text. However, the instructions from the National Board of Education are that the schools have to clearly indicate in their curricula how these cross-curricula themes are included in different school subjects and they have to be seen in the activities of the schools (ibid. p. 36). The framework curriculum does not give instructions how this should be done, this is left for the schools to decide and think about. By studying 50 Finnish municipal curricula (this will cover an average of 400 schools) one notes that often " the human being and technology"-cross-curricular theme is understood to be information and communication technology. This indicates that the theme has not been understood in its' broad sense, but in a very narrow manner.

Technology education objectives under craft education are as follows:

pupils

- familiarizes themselves with everyday technology
- familiarizes themselves with Finland's and to an appropriate extent also other nations' design, craft, and technology culture for building their own identity and their own design activities
- familiarizes themselves with the know-how connected to traditional and modern technology which can be applied in daily life, further studies, in future jobs, and hobbies
- learn to state their stand on the development of technology and the meaning of it for the well-being of human beings, society and nature (ibid. 241 – 242)

If one compares the objectives to the contents of technical work and textile work, it is obvious that by studying only one sub-area all technological objectives can not be achieved. However, most municipalities (of the 50 municipal curricula studied) have decided (against the regulations of the framework curriculum) to differentiate pupils after grade four into technical work or textile work.

The document suggests integration between different school subjects. It is based on a constructivist learning concept where the learner is active and target oriented. The objectives are stated from the learner's point of view, not as teacher's activities.

The myth of girls' and boys' jobs

There has not been much research done on gender equality in technology education in general education schools. Haynie (1999, 2003) has conducted studies in gender issues in technology education in the USA. His interest has been in if women are accepted into the technology education professions. Sanders (2001 p. 41)) noted that despite some gains in diversity, "technology education is still taught by middle-aged white men". Haynie (2003 p. 29), for his part, asks the question: Why? One can assume that if the subject is mainly taught by men, the pupils tend to think it belongs to "the masculine category" and are not willing to choose to study the subject. However, there has

been a remarkable change in the number of girls choosing technology education in the USA since industrial arts was abolished and technology education introduced. Nearly half (46,2 %) of middle-school technology students in 1999 were female (Sanders 2001, p. 43). Out of all school levels one third of students were female in 1999 while the percentage of females enrolled in industrial arts classes was 2,1 % in 1963 and 16,8 % in 1979.

The fact that girls do not choose technical studies can be explained by the myth of men's and women's jobs. During the agricultural era women took care of homes, cooking, nursing, making clothes and tended the domestic animals. Men, in turn, made sledges, furniture, hunted and worked on the fields. During the industrial era men went to work in the factories while women remained at home to take care of cooking, nursing, cleaning, washing, mending the men's clothes… We no longer live in an agricultural or industrial era, but in an information or technological era where women are no longer working at home but outside the home.

However, the myth of women's and men's jobs is still to be seen when one examines the statistics on how the different sexes are divided across different fields of study. Nowadays the number of female and male students from vocational institutions to universities in Finland is about equal, for example 52,3 % of university students in 1997 – 1998 were female students (Suomen virallinen tilasto 2003). Female students choose health oriented studies while male students choose technically oriented studies (ibid. 2003). The number of female students studying in technical and technological institutions at vocational, polytechnic and university levels in Finland is minimal compared to the number of male students studying technically oriented branches. A minor increase in enrolment of girls in technical universities has taken place in recent years, but the number of female students is still very modest. In vocational institutions, polytechnics, and universities the number of female students in technical fields in 2000 was less than 20 % (ibid. 2003).

Our school curriculum before 1970 has supported the division of duties into women's and men's work. While girls at school studied cookery and textile handicraft, boys were doing woodwork and metalwork. Since 1970 the Finnish school authority have realized that crafts curriculum did not treat the two sexes equally. Already the 1985 but particularly the 1994 Framework Curriculum (Peruskoulun opetussuunnitelman perusteet 1994) states clearly that "craft, technical work and textile work form an entity at primary and junior secondary level which is meant for all pupils regardless of sex" (p. 104). This type of thinking is supported by a memorandum of the working group on the renewal of basic education (Perusopetuksen uudistamistyöryhmän muistio 2001). This document states that "the contents of craft education for grades 5 – 7 should be mainly the same for boys and girls including elements from textile work, technical work and technology" (p. 31). Also the 2004 Framework Curriculum (Perusopetuksen opetussuunnitelman perusteet) emphasizes equal craft education for all pupils. However, the 1985, and 1994 framework curriculum expressed a possibility for an emphasis on one of the two subjects. Also, according to the 2004 framework curriculum, pupils can be given a chance in their craft studies to emphasize either technical work or textile work according to their interests and aptitudes.

More than ten years ago, a technology education experiment was launched at the University of Jyväskylä. One of the aims of this experiment was to develop the craft curriculum in the direction of technology education. The reasons behind this were the awareness of the development of craft education globally and the development of Finnish society from an agricultural via an industrial to a technological or an information society. (Rasinen 2003). According to Parikka (1998, p. 40) craft education has developed via education of techniques towards technology education. Kantola (1997, p. 181) also supports the idea of craft education developing towards technological education.

In spite of national regulations, experiences from other countries (see e.g. Rasinen 2000, pp. 43 – 83) and experiences from some schools in Finland (Autio 1997 pp. 120 - 123), and research findings (Autio 1997, pp. 235 - 240 and Rasinen 2000, p. 130) supporting the importance of offering girls equal possibilities to study technological contents, the tradition in crafts education in many schools is still that after grade three pupils have to drop one domain of general education (see e.g. Heinonen p. 76). From then on they will study only textile work or technical work. It is claimed that pupils have a choice. However, this does not seem to be a choice but an obligation to leave aside one important field of education. The choice is quite often made by teachers or parents, not by the pupils. Or, if the pupil decides, there is always social pressure when making one's choice. Because girls have traditionally taken textile work and boys technical work, it is difficult to make individual choices which deviate from the mainstream. According to Linda Gottfredson (2002), different choices are made more based on sex than interest. The dominant factor is primarily one´s sex, secondly social suitability and thirdly what is nice to do. Why force pupils to choose? We do not ask them at grade three or five if from now on they would prefer geometry to arithmetic. Nor we do teach English, music, history… separately to girls and boys.

By choosing the learning contents in both branches of craft education in such a way that they are not gender biased allows girls and boys to study a similar curriculum at all levels. This is reality, for instance, in teacher education during basic courses (4 credit units). The number of female students specializing in technology education and technical work (15 credit units) at the University of Jyväskylä is increasing annually and is 40 % this year.

Girls' versus boys' performance in mathematics and science

Another myth explaining why girls do not choose technological careers has been that they do not manage as well as boys in mathematics and science in schools. Because of this they will not be able to pass examinations at technological universities. This myth has no basis in reality. The 2002 international PISA (Programme for International Student Assessment) -studies proved that there are no gender differences in mathematics performance amongst Finnish junior secondary school students at 15 years of age (Välijärvi, Linnakylä, Kupari, Reinikainen & Arffman, 2002, p. 22, 26, 39). Finland's performance in mathematical literacy also showed high equality. The standard deviation for student scores in mathematical literacy was the smallest among the OECD countries (ibid. 2002, p. 10). Also in scientific literacy Finland showed a high level (ibid. 2002, p 12). In scientific literacy the standard deviation was the second smallest (ibid. 2002, p 13). Both in mathematical literacy and scientific literacy Finland seems to have achieved a high level of performance and low disparities (ibid. 2002, p 14). In mathematical literacy, no differences were found between Finnish boys and girls. The same applies to science. "In scientific literacy Finland displayed no significant gender differences". (ibid. p. 39.)

The 2004 PISA study (Kupari, Välijärvi, Linnakylä, Reinikainen, Brunell, Leino, Sulkunen, Törnroos, Malin & Puhakka pp. 24 – 25.) found that the gender difference was relatively small. In mathematical literacy boys gained 548 points (mean value) and girls 541 (mean value) points. The difference of 7 points is, however, statistically significant. In the 2002 study the difference was only 1 point. Also the scientific literacy of the Finnish pupils can be characterized by high performance and equality. Although the standard deviation gives an impression that equality is being realized, the score gained by the girls was significantly better than the score gained by the boys. Also in 2000 (reported in 2002) the difference of the mean values was 6 points, but then it was not statistically significant. (ibid. pp. 26 – 28)

These resluts do not support the myth of girls being less able to study in technological institutions. However, in senior secondary schools girls tend to choose fewer courses in mathematics and physics than boys do. When applying for technical universities high marks in mathematics and physics are recognized and valued by the universites. This partly explains why technical universities and technical polytechnics are male dominated.

Discussion

There have been several attempts to interest girls in technical studies. Unfortunately, the campaigns have been aimed mainly at students at the secondary school stage. It seems that it is too late to start affecting attitudes at this age. The attitudes are formed at a much earlier stage of development of the individual.

Technology has to be studied by all pupils at all levels. As long as technology is a cross-curriculum theme, different subjects should consider how it should be studied. There should be continuous consultation between different subject areas and strong co-operation and, where it is advisable, integration should be applied. Technology education is mainly to be seen under the objectives and contents of craft education. Therefore, this subject area should take main responsibility for making sure that all pupils will study technology and co-ordinate the activities at school level. Different studies (e.g. Alamäki, 1999, Kankare, 1997 and Rasinen 2000) prove that to develop the subject area learning materials and in-service education have to be improved. In future, to guarantee more efficient learning, the subject area of “technology” should be introduced.

However, even today by following the approved framework curriculum, schools can offer equal technology education to all pupils regardless of sex. The contents of the studies have to be developed in such a way that they are not gender biased. What would our globe look like if female brains were actively developing technology?

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