Identifying Past and Current Trends in Technology Education in Finland

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Technology education makes a unique contribution to the development of all young people by providing them a wide range of knowledge and skills. It has a role in shaping future debates and discourses by developing students' technological literacy and by raising awareness of various dimensions of technology. In order to understand technology education in Finnish basic education, it is necessary to consider it within the subject of craft, particularly the domain of technical craft activities. However, the role of technology education has been and still is undefined in Finland. Thus, we need strategic planning and research in order to develop the necessary procedures and operations to achieve improvements in the future. In order to do that, the aim of this research was to identify past and current trends in technology education in Finland. This was done by observing the development of technology education in Finland's national curricula during years 1970–2014. More in detail, a qualitative, theory-driven content analysis was performed for the National Core Curriculum for Basic Education 2004 and 2014. In this analysis a theoretical framework 'A model for defining technology education (Parikka & Rasinen, 1993) was utilized. Based on the comparative analysis of technology education in these curricula, it seemed to be well represented in the National Core Curriculum for Basic Education 2004: craft curriculum. However, in the National Core Curriculum for Basic Education 2014 technology education was more evidently represent in science curriculum.

Keywords: technology education; craft; national core curriculum; curriculum analysis; trends

Introduction

Technology education has potential to develop students' skills in many ways by raising their awareness of the various dimensions of technology by enhancing the creativity and innovativeness of young people (Niiranen, 2016). The nature of technology education provides students with a systematic approach to solving problems and a context in which students can test their own knowledge and apply it to practical problems. Commonly, technology education, engineering design or design and technology education emphasize learning by doing and learning while designing. The hands-on nature of technology educational activities helps students to conceptualize scientific and technological knowledge and bring it into real world uses (Ritz & Fan, 2015). It is widely agreed that one of the most important aims for education is to foster individuals' creative thinking in areas such as problem solving, design and invention (Barak & Albert, 2017). It has also been pointed out that, based on recent recognition, a variety of cognitive skills can be developed and nurtured by applying them to a practical context (Williams, 2009). However, technology education is a complex domain with several interrelationships between discourses surrounding technology and the social, economic, political, cultural, religious and philosophical perspectives (Dakers, 2018, p. 6). In fact, the precise identity or definition of technology education is still unclear, and there are many varying orientations towards teaching it in schools worldwide (de Vries, 2018; Williams, 2009).

According to Dakers, Dow and McNamee (2009, 382) in its modern sense, technology as a concept derives from the Indo-European root *tek* which means 'to fit together the woodwork of a woven house' and this derivation has translated over time into the Greek term *techne,* which 'came to refer to the knowledge or skill of the *tekton,* one who produces something from wood' (Porkorny 1967 cited in Roochnik 1996, p. 19). The term *techne* is typically translated as 'art', 'craft', 'skill', 'expertise', 'technical knowledge' and even 'science' (Roochnik, 1996). In the nineteenth century, technology was situated in the realms of engineering, and these concepts still seem to share aspects that relate to human action: ethics, sustainability, criticality and design (Dakers, Dow & McNamee 2009, p. 384).

In order to understand technology education in the Finnish basic education, it is necessary to consider it within the subject of craft, particularly the domain of technical craft activities. Technology education is not an independent subject in basic education; rather, technological topics are decentralized and taught through various subjects (NCCBE 2014). However, craft education, especially technical craft, can be seen as supporting technology education due to the fact that as early as 1866, Uno Cygnaeus described 'technological' content as an important aspect of craft education (Rasinen, Ikonen & Rissanen, 2006). In a study of technology education implementation in Finnish basic education, 90 percent of students in ninth grade (N=1181) regarded manual skills and technology as interrelated (Järvinen & Rasinen, 2015).

As the role of technology education has been and still is undefined in Finland, we need strategic planning and research in order to develop the necessary procedures and operations to achieve improvements in the future. In order to do that, the aim of this research was to identify past and current trends in technology education in Finland. This was done by observing the development of technology education in Finland's national curricula during years 1970–2014.

Development of Craft and Technology education after polishing the parallel school system in 1970

In the Finnish general education schools, there has never been a school subject called "technique" or "technology". When observing the five curricula from the past 50 years one finds the concepts of technique or technology mainly under craft subject, particularly in "technical work" contents.

The 1970 Framework Curriculum and the 1970 Curriculum

In 1970, Ministry of Education published two memorandums to guide the teachers in transferring from the old parallel school system to the comprehensive school system. The 1970 Curriculum stated the objectives and contents for different school subjects. Craft education was divided into two sub-areas: technical and textile craft. The document emphasized that the division should not be any more according to one's sex and both girls and boys should study textile craft and technical craft. Technology as a concept is not to be found in the 1970 Curriculum. In turn, concept of technique is to be found under "technical craft".

Note, since the 1970 Curriculum document there has not been a national curriculum in Finland. The documents afterwards have been framework curricula, and the municipalities and schools have planned their own curricula following the national core curriculum.

The Framework Curriculum for Comprehensive Schools 1985

For the first time the concept "technology" can be found (but not defined) in 1985 Framework Curriculum for Comprehensive Schools. 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). The general objectives are to develop pupils' problem solving and planning skills.

The Framework Curriculum for Comprehensive Schools 1994

Technology is clearly stated out in the general objectives of the 1994 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 adaptations and to be able to exert an influence on the direction of technical development. Furthermore, it states that students without any 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 that technology has on the interaction between man and nature, to be able to make use of the possibilities it offers and to understand the consequences. (Peruskoulun opetussuunnitelman perusteet 1994, pp. 11–12.) However, the document does not give any operational instructions how to study technology. Under craft the technological objective is that pupils will acquire unprompted knowledge of the traditional and modern technological materials, tools and techniques that can be applied in daily life, further studies, jobs, and hobbies (ibid. pp. 105–106). This is the first document since 1970 where cross-curriculum subject areas are introduced.

Research design

The aim of this study was to identify the development of technology education in Finland. To do so, an analysis by observing the development of technology education in Finland's national curricula during years 1970-2014 was performed. A qualitative, theory-driven content analysis was determined to be the best method for describing the meanings of qualitative material in a systematic way due to the use of pre-determined analytical criteria. When performing the analysis of national core curricula 2004 and 2014, a theoretical framework 'A model for defining technology education' (Parikka & Rasinen, 1993, see Figure 1) was utilized in the analysis. Particularly, we have observed how the concept and the word 'technology' is present in these curricula.

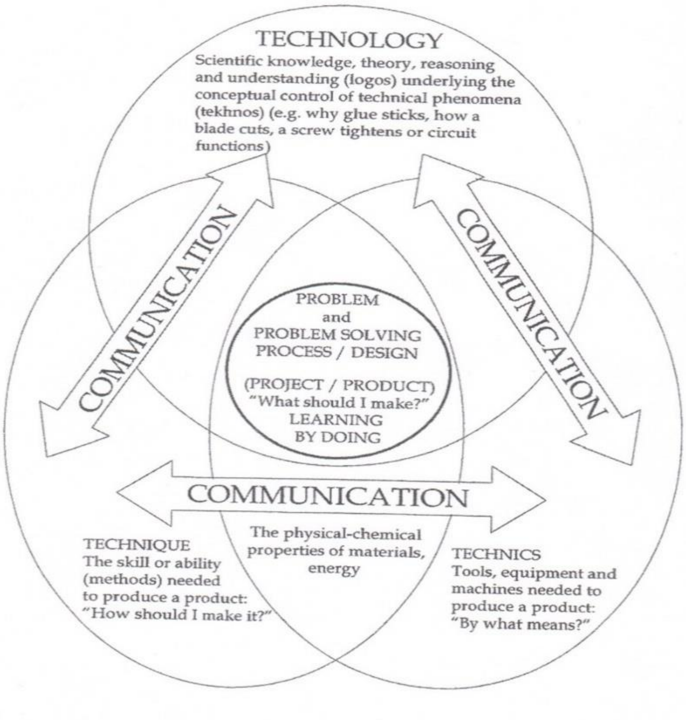

Figure 1. A model for defining technology education (Parikka & Rasinen, 1993)

Findings of the National Core Curriculum for Basic Education (NCCBE) 2004 and 2014

During the past 15 years the concept of technology has been mainly mentioned in the context of crafts and science. Therefore, in the following we will observe the objectives and contents of science and crafts in more detail. Aside of this comparison, we will observe the suggested possibilities for co-operation, integration, cross-curricular themes and transversal competence. In relation to technology education, it is referred in a broad sense in 2004, however, in 2014 NCCBE technology is mainly understood as ICT.

In the tables 1 and 2, there are direct references to technology education from the 2004 and 2014 NCCBE:s, with some notions (in italics) made by the authors and highlighted description in relation to technology (in bold).

Table 1. Comparison of technology education perspectives in NCCBE 2004.

Holistic approach	**Science**	**Crafts**
In the NCCBE 2004 technology is understood in a broad sense. It can be seen for instance in the cross curricular theme namely Human Being and Technology (official translation Technology and the individual): "The instruction must advance **understanding of the operating principles of tools, equipment and machines, and teach the pupils how to use them."**	**Environmental and science studies** grades 1–4: no mentions about technology **Physics and chemistry** grades 5–6: no mentions about technology **Physics**, grades 7–9: The instruction gives the pupil the ability to discuss and write about questions and phenomena within **the realm of physics and technology**, using appropriate concepts, and helps the pupil to understand the **importance of physics and technology** in everyday life, the living environment, and society. <u>Objectives:</u> The pupils will **learn to use appropriate concepts, quantities and units in describing physical phenomena and technological questions.** *Out of nine objectives one refers to technology "use appropriate concepts…" No deeper technological know-how is achieved.*	The instructional task in crafts are to guide the pupil in systematic, sustained, independent work, and to develop creativity, problem solving skills, an understanding of **everyday technological phenomena**, and aesthetic, technical, and psychomotor skills. The instruction is implemented through projects and subject areas corresponding to the pupils' stage of development, and uses **experimentation, investigation, and invention**. <u>Objectives,</u> grades 1–4: *in total 11 objectives, out of which one is:* The pupils will **• gain an introduction to the technology of day-to-day life** Core contents: *in total 6 one is:* • phenomena in nature and the built environment that are close to the pupil, and the **technological applications** of those phenomena <u>Objectives,</u> Grades 5–9 *In core contents there are references to integration (compare STEM, STEAM)* *• connection between applications and problems that appear in crafts, on the one hand, and, on the other scholastic subjects such as visual arts, the natural sciences and mathematics* Contents of technical work: • **operation principles of various devices, structures, and technological concepts and systems, and applications of those concepts and systems** (*one of the eight core contents*). *These contents are similar to Technology and the individual – cross curricular theme objective.*

Table 2. Comparison of technology education perspectives in NCCBE 2014. Transversal knowledge (T), contents (C) and objectives of instruction (O).

Holistic approach	**Science**	**Crafts**
Aiming for transversal competence Taking care of oneself and managing daily life (T3): The pupils need basic **information about technology and its advancement** and its impacts on various areas of life and their environment. They also need **advice in sensible technological choices**. In instruction, the **versatility of technology is examined**, and pupils are guided **to understand its operating principles** and cost formation. The pupils are also guided **in using technology responsibly** and invited to consider ethical questions related to it. Multiliteracy (T4): The pupils must have opportunities to practice their skills both in traditional learning environments and in digital environments **that exploit technology** and media in different ways.	**Environmental studies** <u>Objectives of the instruction,</u> grades 1–2: O9 To guide the pupil to familiarize himself or herself with a diverse range of **everyday technology and to inspire the pupils to experiment, invent, build, and innovate together** with other pupils. Contents, C4 Exploring and experimenting: The chosen contents include **problem-solving** and research assignments concerning nature, **built environment, everyday phenomena, technology**, humans, and human activities. <u>Objectives of the instruction,</u> grades 3–6: O7 to guide the pupils to understand the use, significance, and operating principles of **technological applications in daily life** and to inspire pupils to experiment, invent, and be creative together. O17 to guide the pupil in exploring, describing, and explaining physical phenomena in daily life, nature, and **technology** and constructing and understanding of the law of conservation of energy **Physics,** Grades 7–9 The task of the subject of physics is to support the development of the pupils scientific thinking and worldview. The instruction of physics helps the pupils understand the significance of physics and **technology in daily life**, the living environment, and the society. The pupils' ability to discuss topics and phenomena of physics and **technology** is enhanced in teaching and learning. The instruction conveys an image of the significance of physics in building a sustainable future: physics is needed in developing **new technological solutions** and securing the well-being of humans and environment. <u>Objectives of the instruction:</u> O8 to guide the pupil to **understand the operating principles and significance of technological applications and to inspire the pupil to participate in forming ideas for simple technological solutions and designing, developing, applying them** in cooperation with others.	Crafts is a subject in which multiple materials are used, and its activities are based on craft expression, design, and **technology**. Making crafts is an **exploratory, inventive, and experimental activity** in which different visual, material, and **technical solutions** as well as production methods are used creatively. In crafts, the pupils learn to **understand, evaluate, and develop different technological applications** and to apply the knowledge and skills learned in school in their daily lives. <u>Objectives of the instruction,</u> grades 1–2: O1 to encourage the pupil to become interested in crafts and curious about inventing and experimenting with crafts. *No mentions about technology.* <u>Objectives of the instruction</u> grades 3–6: O6 to guide the pupil to use information and communication technology for designing and producing crafts and for documenting the crafts process. *Reference is made only to ICT. Only in the contents there are references to technology (and there, mainly to high-tech contents).* Grades, 7–9: The teaching and learning of crafts strengthens and deepens **innovation and problem-solving skills** that emerge from the pupils' own experiences as well as their knowledge and skills related to craft expression and making and designing crafts. The learning of crafts is based on observation and exploration of the built environment and the multi-material world and application of knowledge. <u>Objectives of the instruction:</u> O4 to guide the pupil to use the concepts, signs, and symbols of crafts fluently as well as to strengthen his or her visual, material, and **technological expression** *(? what might this mean?)*. O6 to guide the pupil to use the possibilities of information and **communication technology** in designing, producing, and documenting the craft process as well as in producing and sharing communal information. O7 to guide the pupil to **understand** the meaning of crafts, manual skills, and **technological development** in his or her own life, the society, entrepreneurship, and working life.

Conclusion

As described in this article, technology education worldwide is a complex domain with several interrelationships between various discourses. In Finland, the situation and role of technology education is complicated due to a missing definition of what is technology education and how its aims should be covered in basic education. Based on the comparative analysis of technology education in national curricula, it seemed to be well represented in the National Core Curriculum for Basic Education 2004: craft curriculum. However, in the 2014 curriculum technology education was more evidently represented in science as if many objectives were transferred from 2004 craft curriculum to 2014 science curriculum. On top of this a methodological instruction "in cooperation with others" has been added to the science objectives.

Finland's current National Core Curriculum for Basic Cducation (2014) brought many changes to craft subject, and thus also to technology education, by combining two content areas of craft entities, technical and textile crafts, under one new concept of multi-material crafts. This change outlines that core objectives and contents of technical and textile craft will no longer be taught or referred to separately in grades one to seven. The new curriculum started to be in effect from the beginning of the academic year 2016 first with primary level (grades 1-6, ages 7–13), then in 2017 with secondary level grade 7 (age 13–14), grade 8 in 2018 and grade 9 in 2019 respectively. There is evidence that this change in crafts caused confusion among pupils, more specifically in their interest towards studying crafts, but also among craft teachers. This confusion is evidenced in a report of Hilmola and Kallio (2019) which reveals that during the academic year 2018–2019 there was a dramatical drop in the number of pupils choosing craft as an elective subject for the grades 8–9. The drop was 41 % with technical craft and 45 % with textile craft (Hilmola & Kallio, 2019). Concerning the 'turbulence in crafts', Kokko, Kouhia and Kangas (2020) observe the situation via the writings which crafts teachers and other stakeholders have produced in their professional magazines, curriculum blog and written statements during the years 2014–2019. Authors draw some conclusions concerning the future of technology education against its traditional connections with technical craft by making suggestions based on some textile craft teachers' views and by for instance providing a rather limited example of coding within textile craft. However, it is unclear how many teachers exactly share this opinion. Also, the authors seem to have a surprisingly narrow view on how technology education was described in the article titled 'Innovation activity in technical craft' in Technical teacher magazine in 2014 (Kokko, Kouhia & Kangas, 2020, p. 13).

If we accept that technology is 'human innovation in action' as is stated by International Technology and Engineering Educators Association (ITEEA), the learning environment provided by craft, particularly technical craft, offers good possibilities for students to work in a practical manner, accessing the domain of technological knowledge and working technologically. As craft and science are interrelated, there are many natural possibilities for co-operation and establishing the links between these subjects. However, this co-operation does not imply that we should change the inherent role of craft education i.e. designerly thinking and problem solving but foster the cross-curricular links in a context where the integrity remains respected (see Williams, 2011, p. 32). Thus, the statement "making crafts is an exploratory, inventive, and experimental activity in which different visual, material, and technical solutions as well as production methods are used creatively" (NCCBE 2014) calls for thinking and acting in an innovative manner. It will be fundamentally important to get more research on how technology education will be organized in the Finnish general education schools.

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