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# Learning by Doing and Creating Things with Hands: Supporting Students in Craft and Technology Education

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**Abstract**
Learning by doing and creating things with hands have always been key elements in Finnish craft and technology education. Tacit knowledge (i.e., understanding how various materials behave and knowing how to manipulate them) is knowledge that can be gained only through individual and concrete experiences. Finland's new National Core Curriculum for Basic Education 2014 (NCCBE 2014), which came into effect in August 2016, emphasizes pupils' ownership of ideas and learning through meaningful and concrete experiences. The hands-on nature of the subject provides pupils with the possibilities to both conceptualize scientific and technological knowledge as well as multiple strategies to put that knowledge into practical uses. In Finland, there is no independent subject called technology education. Rather, technology education is decentralized and taught through various subjects. Craft, however, is a subject that supports technology education because it is a practical subject with hands-on activities. In craft, pupils actively practise experimentation, investigation, invention, problem solving and designing skills. The NCCBE 2014 represents a major change in craft. It now becomes a multi-material, integrated subject involving technical and textile craft for all pupils during compulsory lessons in grades one to seven. This paper will explore and discuss how learning by doing and creating things with hands will be fundamental aspects of an evolving craft and technology education. A qualitative, theory-oriented content analysis was first performed to examine the extent of the learning by doing approach in craft and technology education in the NCCBE 2014 document. Meaningful sentences or themes and manifest content were chosen as the analysis units. Second, a case study method was utilized to examine the learning by doing approach in craft and technology education taught by the Teacher Education Department at the University of Jyväskylä to determine its alignment with the NCCBE 2014.

**Keywords:** learning by doing; curriculum; technology education; craft

## Introduction

Almost 30 years ago Brown, Collins and Duguid (1989, p. 32) raised a concern that activities at schools too often create a separation between knowing and doing. They claim that knowledge is treated as 'an integral, self-sufficient substance, theoretically independent of the situations in which it is learned and used' (Brown, Collins, & Duguid, p. 32). This might still be the case as PISA (Programme for International Student Assessment) studies show that students may have good knowledge of school subjects and disciplines, but seem to have problems in applying their knowledge in practice. This disconnect indicates the need for a greater emphasis on soft skills, i.e., problem solving, creativity, collaboration and critical thinking, which have become more relevant in today's society.

Technology education has been developed to help people deal with technology. It can provide pupils active engagement and participation, meaningful experiences and possibilities for hands-on working (Järvinen & Rasinen, 2015; Martin, 2012). It has been suggested that problem-based technological activities can help people engage with both tool-related hands-on and discursive practices of technology (Wilkinson & Bencze, 2011). Williams (2009, p. 248) points out that based on recent recognition, a variety of cognitive skills can be developed and nurtured through application to a practical context.

In order to understand technology education in Finnish basic education, it is necessary to consider it within the subject of craft, especially technical craft. In Finland, technology education is not an independent subject in basic education; rather, the education is decentralized and taught through various subjects (NCCBE, 2014). However, craft education, especially technical craft, supports technology education. Craft is a practical subject that involves hands-on activities, where students actively practise experimentation, investigation, invention, problem solving and designing skills. In technical and textile craft education workshops, pupils work with various materials and techniques when creating their projects. Finland's former National Core Curriculum for Basic Education 2004 introduced seven cross-curricular themes in Finnish education, one of which was 'Human beings and technology', which addresses technology education. Much of the technological content of the theme was studied during technical craft lessons and they shared some same specific aims (Järvinen & Rasinen, 2015). In a study of technology education implementation in Finnish basic education, 90 percent of pupils in ninth grade (n=1181) regarded manual skills and technology as interrelated (Järvinen & Rasinen, 2015). Finland's new National Core Curriculum for Basic Education 2014 (hereinafter NCCBE 2014) describes seven transversal competence areas, one of which is 'Taking care of oneself and managing daily life'. This competence area addresses students' need to receive basic information about technology, its advancement and its impacts on various areas of life and the students' environment. In instruction, the versatility of technology is examined, and pupils are guided to understand its operating principles. Pupils are also guided in the responsible use of technology, and are invited to consider ethical questions related to it.

## Learning by doing in technology education

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 or learning while designing. During activities, designers are involved with continual reflection, brainstorming and prototyping, learning by iteration and from feedback and failure, by noticing and troubleshooting, in a dialogue with ideas, material and people (Adams, Turns, & Atman, 2003; Crismond & Adams, 2012). It can be concluded that learning by doing enhances students' understanding and engagement (Kelley & Knowles, 2016). Next, learning by doing and pragmatism in relation to technology education is discussed.

John Dewey (1859-1952) was unquestionably the most significant figure in the field of experiential education. He was also a leading proponent of pragmatism one example of which is learning by doing. When considering pragmatism as a concept, it can be divided into four philosophical stances that are understood to loosely define it (Roberts, 2012, p. 49). The first characteristic is about *examining things based on practical consequences*. In other words, one chooses the right course of action on the basis of the likelihood of success, or with an awareness of the consequences of one's actions (Roberts, 2012, p. 50). As it relates to technology education, learning by doing is accentuated by activities involving design and scientific inquiry. The design process in technology education, or in engineering, may be characterized as a goal-directed and iterative activity whereby the designer learns about the problem through proposing solutions and synthesizing ideas (see Purzer, Goldstein, Adams, Xie, & Nourian, 2015). The second characteristic of pragmatism is that pragmatists understand that thinking cannot be removed from the world, since *knowledge acquisition is inherently interactive (*Roberts, 2012, p. 51). This means that the interaction of thinking and action and the ways in which the two revise each other, are key factors in bringing about new awareness and learning (Roberts, 2012, p. 51).

The third tenet of pragmatist ethos is *the importance of context* (Roberts, 2012, p. 52). This means that in order to consider practical consequences interactively, one must be situated somewhere. In terms of technology education, problem solving, project-based learning and creating with the use of one's hands are evidently suitable methods for learning, and each of these pedagogical approaches is inherently contextual. A study by Fain, Wagner and Vukasinovic (2016) indicates that problem-based learning can facilitate knowledge transfer, encourage and support collaborative work and improve students' thinking and designing skills. Often when learning is grounded within a specific context, learning is authentic and relevant, and therefore representative of an experience that may be found in practice (Kelley & Knowles, 2016).

An important characteristic of technology education is a high proportion of tacit knowledge required. Tacit knowledge and skills, i.e., understanding how various materials behave and knowing how to manipulate them, can be gained only through concrete experiences. The fourth characteristic of the pragmatist ethos is *fallibilism* (Roberts, 2012, p. 52). Fallibilism, meaning that errors are seen part of the learning process, is also an inherent part of technology education.

## Methods

In embarking on this research, the general aim has been to provide information about the approach of learning by doing, and of making things with one's hands within the context of craft and technology education. The research questions were: 1) How the 'learning by doing' method is visible in NCCBE 2014 and 2) How learning by doing is implemented in craft and technology education?

A multi-method approach was utilized through the use of qualitative, theory-driven approach in the analyses. First, learning by doing was explored in craft and technology education in Finland's new National Core Curriculum for Basic Education 2014, which came into effect in August 2016. The data were analyzed using qualitative theory-oriented content analysis. In this analysis, Roberts's (2012) descriptions of four philosophical tenets for pragmatism provided guidelines for the analysis. Meaningful sentences or themes and manifest content were chosen as the analysis units.

In order to answer to the second research question and to gather more information about the role of learning by doing in craft and technology education, the focus of this study was broadened to include craft and technology education curriculum and how it is implemented in teacher education at the University of Jyväskylä. During the academic year 2016-17 a pilot curriculum of an integrated craft education (technical and textile crafts) was put into operation for the first time with one group of teacher education students, who specialized in crafts. The aim of the analysis was to explore those practical elements that refer to the concept of learning by doing. The case study method was chosen as it provides a way to explore a phenomenon in-depth and is an appropriate tool for describing and explaining processes associated with the it (Gagnon, 2010). The analysis consisted of the two craft and technology education teachers' reflections about the practical methods in implementing the curriculum during an academic year 2016-2017. This process gave a starting point for the revision of our craft and technology education curriculum that will be implemented in the Department of Teacher Education at the University of Jyväskylä between 2017 and 2020.

**Findings of the NCCBE 2014 analysis**

Based on the theory-oriented content analysis of NNCBE 2014, it can be concluded that *learning by doing* was an inherent component of craft education in various aspects. In the analysis of the objectives and key content areas of crafts in grades 1–6 (ages 7-12) findings were divided into four sub-categories based on how learning by doing was related to them:

1) **Ability to manage a complete crafts process:** pupils are guided to design and produce their own craft product independently, using a diverse range of techniques, tools, machines and equipment.

2) **Use of multiple materials:** pupils are guided to invent and experiment with crafts and to work with various materials in a suitable way; promoting pupils' manual and motor skills.

3) **Development of skills:** pupils are guided to design and produce, practice their spatial awareness, sense of touch, creativity, experimentation, persistence and responsible work.

4) **Learning by doing supported by working methods and environments:** pupils are guided towards learning by doing, experiential learning, use of drama and stories, as well as the multidisciplinary nature of environmental studies.

Based on the learning by doing theory by Roberts's (2012), the category of *examining things based on practical consequences* was also observed in the NCCBE 2014. Textual descriptions such as:

- making crafts is an exploratory, inventive, and experimental activity
- guiding pupils in choosing between different techniques, tools, machines, and equipment and in using them in their work
- observing and analyzing objects as well as built and natural environments to produce new ideas
- examining the structures and the use of energy in materials
- studying the properties of materials and the operating principles of the most common machines and tools needed in craft
- on the basis of the experimentation, developing the product or piece further
- selecting and using tools and equipment that are suitable for the work
- selecting and combining crafts materials and techniques and working with them

In NCCBE 2014, there were also some descriptions about the *knowledge acquisition is inherently interactive* component of Roberts's (2012) learning by doing theory. Textual descriptions such as:

- designing and producing a crafts product or piece independently or together with others
- shared activities are emphasized in the teaching and learning of crafts
- pupils' surroundings, the local cultural heritage, and the cultural diversity of the community
- guiding the pupil to assess, appreciate and examine interactively his or her own crafts process and the processes of others as a whole

- pupils' own solutions as well as constructing and applying knowledge creatively both independently and together with others is supported

**Findings of the case study at the University of Jyväskylä**

When considering the pragmatist ethos of *the importance of context* (Roberts 2012, p. 52), it was obvious that craft and technology education depends heavily upon context, since most activities take place in a specific workshop. Thus, one of the main requirements in most craft and technology education courses is that students use various tools, machines and materials based on their needs when they create something themselves. A previous analysis of NCCBE 2014 showed that craft education has a strong emphasis on enabling a 'complete crafts process', which means that the learner will go through every phase of a design process. As it relates to the theory of learning by doing, this process involves *examining things based on practical consequences* (Roberts, 2012, p. 50) at every stage. During their studies in craft and technology education, students were first encouraged to investigate their surroundings and to identify 'problems' that they could solve by creating something by themselves. They then started to investigate existing solutions to similar problems and to develop their own ideas based on their observations. The next step was to decide on a solution and build a prototype for it. In this stage, students were encouraged to test the properties of different kinds of materials. Then students built the artefact, using all of the applicable tools, techniques and materials. This phase included many kinds of experiments, and many errors were made. This demonstrates another characteristic of the pragmatist ethos, *fallibilism* (Roberts, 2012, p. 52); this was an inherent part of the learning process. The final step was to reflect on the whole process by completing a self-evaluation.

The pragmatist element of *knowledge acquisition is inherently interactive* (Roberts, 2012, p. 51) can be found in almost all stages of the process within craft and technology education activities at the university. In the first stages, students work in small groups, presenting their ideas and discussing possible improvements. Based on these discussions, students rectified their models and then used suitable materials to build prototypes. The cooperative learning method was used also when students studied how to work with various wood and metal working machines. Also, during the process of working on their projects, students regularly got together to evaluate each other's work. Finally, at the last phase of the process the element of interaction was a component in peer-evaluation.

**Conclusion**

Today's society places a high demand on individuals to understand technology, as the technologies that govern our lives are very complex (Dakers, 2011). There is no doubt that skills such as problem solving, creativity, collaboration and critical thinking are crucial for children's' future, including the demands of a working life. As evidenced in the NCCBE 2014 analysis, there are explicit connections between the NCCBE 2014 and Roberts's (2012) theory of learning by doing. The existence of these connections was further supported by the findings of the case study at the University of Jyväskylä. It is obvious that craft and technology education emphasize learning by doing and learning while designing. Thus, it can be concluded that it has the potential to develop students' skills in many ways by providing pupils opportunities to work in a practical way, accessing the domain of technological knowledge and working technologically.

Studies have revealed that interest and self-efficacy with respect to technology arise early in childhood (Endepohls-Ulpe et al., 2012). Craft and technology education has the potential to foster students' self-efficacy by providing them with necessary skills and technological literacy. These are skills they will need to understand and utilize in order to become empowered citizens of tomorrow (Compton, 2011). If we recognize that learning by doing is a fundamental part of developing understanding and tacit knowledge that can support future ventures, it is important to gain more information on the ways it may manifest in primary education.

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