Craft and design education and research in Finland

Pirita Seitamaa-Hakkarainen, Sini Riikonen and Varpu Mehto

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Introduction

Recently, maker pedagogy has sparked interest from various stakeholders in K-12 education because of its close association with science, technology, engineering, arts, and math (STEAM) education (Bevan et al., 2014). Both knowledge creation learning and maker pedagogy address new demands for teaching 21st-century competences and the renewal of pedagogical practices. Competences such as critical thinking, creativity, multi-literacy, learning to learn, and collaboration and communication require new pedagogical practices to be cultivated during education. Such activities are based on nonlinear pedagogy, where required knowledge and solutions cannot be determined beforehand (i.e., open-ended and authentic tasks) but emerge interactively through repeated personal and collaborative efforts. Nonlinear pedagogy involves a shift from individual learning to collaborative activity and multiple methods of knowing, often extending school subject boundaries.

Parallel to such trends, the Finnish national core curriculum for basic education (FNBE) provides new opportunities for maker-centered learning to conduct multidisciplinary school projects that aim to support 21st century competences. In the following sections, we will briefly introduce the theoretical background of maker-centered learning and open up the recent situation of craft education in Finland and the Finnish national core curriculum of craft education.

Maker-centered learning and Finnish national curriculum for craft education

Recently, the emergence of digital fabrication technologies has given rise to the maker movement and maker pedagogy (Schad & Jones, 2020). Maker-centered learning is based on the idea of Papert's constructionism, and the term "maker-centered learning" has been developed to define learning processes where the aim is to foster creativity through intensive artifact-mediated making processes within a shared interactive space (Clapp et al., 2016). In many countries, maker-centered learning, also called STEAM, has emerged as an after-school or out-of-school makerspace that enables material exploration and knowledge sharing, including the possibility to attain new digital skills and make innovations. In maker-centered learning, the main aim is to support complex problem solving (Bevan et al., 2014), and it combines traditional and digital tools and technologies as mediums. However, in Finland, as well as in other Scandinavian countries, craft education (previously textile and technical craft) has been an obligatory school subject since 1866 (Pöllänen, 2009; Syrjäläinen & Seitamaa-Hakkarainen, 2014) and has signified the educational importance of learning by making for many centuries. Despite differences in historical and educational roots, the recent maker-centered learning and craft education share similar foundations (i.e., active hands-on working with artifacts designed to engage learners in co-creative processes under teacher or facilitator guidance). Both emphasize the importance of engaging pupils in the holistic design and making processes from ideation to iterative testing and construction as well as reflective evaluation (Seitamaa-Hakkarainen & Hakkarainen, 2017). Students are introduced to traditional and digital fabrication technologies, such as 3D CAD and 3D printing, electronics, robotics, programming software, and wearable computing with various sensors (e-textiles) by which they may create multifaceted and complex artifacts (Blikstein & Worsley, 2016). Investigations have revealed that participation in maker learning enhances students' creativity and imagination, design thinking, and learning in STEAM subject areas (Clapp et al., 2016; Petrich et al., 2013). When embedded in meaningful and authentic contexts that spark curiosity and creative expression, maker projects are likely to be equally motivating for girls and boys, low- and high-achieving students (Buchholz et al., 2014; Kafai et al., 2014; Martin et al., 2018), and those who have challenges adapting in traditional educational settings (Sormunen et al., 2020). Few studies have focused on epistemic practices, the design-based development of maker-centered learning settings, and teachers' practices of orchestrating nonlinear and creative processes (Riikonen et al., 2020a; Viilo et al., 2018).

Changes in Subject Matters

In Finland, craft education is compulsory from grades 1 to 7 and is a voluntary subject in grades 8 and 9, when comprehensive schools end. Craft lessons vary from 2 to 3 hours a week, depending on the grade level. A craft teacher usually takes care of craft education lessons from grades 5 to 9, whereas class teachers teach at the primary level (grades 1 to 4). Craft education has a steady position in the national basic core curriculum, and recently, two previously separated content areas were combined as multi-material crafts consisting of textile and technical contents (Kokko et al., 2020). The recent renewal of the craft curriculum has caused confusion related to how to organize the "new" subject that brings together both practices of textile and technical crafts, as well as the concepts of multi-materiality and technology education, which have been seen as challenging (Kokko et al., 2020). Furthermore, educating qualified craft teachers has a history almost as long as that of craft education itself. In 1970, all teacher trainings were moved to universities; since then, qualified craft teachers hold a master's degree in education and can continue to doctoral studies. Since having a long history in craft education, all schools have their own special classrooms and spaces to do textile or technical techniques and various specific tools and digital instruments to work with.

Finland renews national basic core curriculums for education (FNBE, 2014) every ten years, and the latest one was published in 2016 and gradually took full use in 2019 (Kokko et al., 2020). The national core curriculum is a set of regulations issued by the National Board of Education, and each municipality constructs its own local curriculum. In municipalities, the teachers are actively involved to participate in local curriculum planning, and schools and teachers have an important role in designing the local curriculum for steering and implementing the educational goals. The national curriculum consists of the general guidelines that need to be considered in each school subject. One and perhaps the most important thing in FNBE (2014) is that it strongly emphasizes progressive inquiry (i.e., knowledge-creating learning) and the integration of different school subjects. FNBE (2014) recognizes seven transversal competences in the general level of national core curriculum: thinking and learning to learn (T1); cultural competence, interaction, and self-expression (T2); taking care of oneself and managing daily life (T3); multiliteracy (T4); ICT competences (T5); working life competence and entrepreneurship (T6); and participation, involvement, and construction of a sustainable future (T7). These transversal competences and higher-level learning goals need to be defined in each school subject and grade level. Furthermore, the general idea of an interdisciplinary or thematic project is based on these transversal competencies; hence, every year, schools should organize 20% of lessons as thematic projects. These learning modules are also called "phenomenon-based studies". In these learning modules, teachers and students are involved in designing study projects that integrate several school subject domains around broad themes, such as humans and technology or human and well-being. Further, emphasizing STEAM and especially engineering practices that are strongly related to maker-centered learning has been increasingly explored. That is the reason why craft education is considered an important subject in multidisciplinary learning projects.

Innovation and Collaboration

Craft education capitalizes on innovative and experimental activities of design and technology that play a central role in the training of basic inventive skills and competences, which are critical for cultivating 21st century competences. Accordingly, various visual, material, and technical solutions and production methods are used innovatively (FNBE, 2014, p. 462). The new national craft curriculum highlights multi-materiality and holistic craft processes instead of end products (FNBE, 2014, 462). The craft process is seen to consist of various phases: production of ideas, design, experimentation, production and application, and digital documentation and assessment. Designing and making have both conceptual and material aspects and support collaborative learning when students are solving authentic design problems. Design and craft activities develop the ability to enhance and transform ideas through visualization; it involves testing the practicality of multiple solutions through sketching and making prototypes. Working relies on sharing expertise in teams representing diverse knowledge and competences. As multi-materiality is emphasized, students work with various materials and techniques: the craft education is not restricted to some special traditional craft techniques or materials; rather, it emphasizes the development of versatile working capabilities. While collaboratively developing new innovations, students' teams handle versatile and sophisticated epistemic issues, ranging from making tangible objects to inquiring about scientific STEAM phenomena. Thus, in our maker-centered projects, we use the concept of co-inventions, indicating collaborative design, craft, and engineering practices involved in students' artifact designing processes.

Growing mind co-invention projects and related research

At University of Helsinki, we conduct research in the field of craft and design education on a regular basis. To illustrate one example, we will explain how the Growing Mind project was organized in the following paragraphs. We can usually rely on a large network of schools and teachers who want to develop their teaching skills related to digital technology. Our very important partner for scaling up maker-centered learning and co-teaching is the Innokas Network, which nationally coordinates and guides teachers, school administrators, and other stakeholders. The Innokas Network organizes events and professional development programs and provides consultation for teachers. This way, we are able to deliver best practices in schools and get teachers to develop these practices together with us. Before starting the school project, the teachers participated in our workshops and discussed what kind of thematic project they would like to conduct. We have emphasized the iterative nature of the making projects, so we provided different models of processes, such as invention process, design thinking process, and learning by collaborative designing. We have also provided external support for technologies to be used in the class, and we have provided substitute teachers so that teachers can participate in our workshops. We also make available experts to visit in the schools if the teachers want to utilize that kind of possibilities. Furthermore, we have provided a preliminary project planning structure where teachers clarify the different phases of the project—at least roughly so that each phase should be somehow planned but not in the particular order. This is the way to make sure that different school subjects are included (e.g., science content). It is a flexible tool, and it is modified during the project many times (Table 1).

Table 1. Structure of the school project phases

Orientation	Skill building on technology; user-centered approach; design process
Design challenge	Open design and invention challenge (recognized everyday problems, sustainable future, specific users)
Ideation	Producing design ideas and analyzing design constraints
Peer-review	Presenting ideas and obtaining feedback from peers, teachers, and experts
Knowledge seeking	Knowledge seeking from museums, internet, and joint field studies
Co-design	Testing design ideas and creating mock-ups and prototypes
Fabrication	Constructing models and products
Exhibition	Introducing and publishing inventions and reporting knowledge creation processes

The project usually starts with an orientation phase, which is also called skill building. In this phase, students learn the novel technology in numerous workshops, where they learn use e-textiles, microprocessors, or other various technologies that are new to them. They learn to combine different sensors or mechanical parts, such as wheels, to a processor. In this phase, we also ask professional designers or inventors to visit at school and have a short design workshop with students to familiarize them with design processes. We encourage teachers to organize visits to local museums and other kinds of visits, such as in elderly homes or kindergartens, especially if the project emphasizes the user-centered design. We organize presentations or exhibitions for parents; in some projects, parents come to school and bring their own expertise to the project. At the end of the project, we have a co-invention fare at the university; all schools and students come to the university to present their co-inventions to academic audiences and teacher students. Thus, we are able to promote the idea of maker pedagogy to a wider audience.

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