Forest-themed learning games as a context for learning via collaborative designing of crafts

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This case study describes the types of learning games produced and the learning experiences of students who engaged in a project implementing the principles of learning by collaborative designing via forest-themed contextualization of crafts. The ultimate aim of this report is to describe how the project succeeded in changing the traditional instructional strategies used in craft education. This unique project was part of a craft course delivered as a component of primary school teacher education in the University of Eastern Finland. The students' task was to design and produce a textile-based and forest-themed learning game for primary school children. The outputs of the study were the learning games produced (36 in number) and student portfolios (215 pages). The games were illustrated and the written data analyzed using the inductive content approach and a hermeneutic viewpoint as the methodological basis. The results show that the design task guided learning in a multidisciplinary manner and increased the number of tools students could use to learn crafts and produce the games. Collaboration and working in teams changed the learning process from teacher- and subject-centered to process-based. Forest-themed learning games may serve as a framework for collaborative designing; the approach offers a rich and non-traditional context for learning of crafts by university students. In terms of craft education, the approach highlights the importance of collaboration, the use of process-based crafts, and the possibilities afforded to shift the focus to more participatory activities to learn generic skills.

Keywords: collaborative designing, crafts, craft education, learning by designing, learning game

Introduction

Finnish schools and teacher education were the focus of international attention in the 2000s because of high scores on international evaluations (e.g., Pisa). However, the Finnish educational system has been criticized; the system is claimed to be teacher- and subject-centered and not to address student interest and the need for participatory activities (Pirttiniemi, 2000; Arvaja, 2005). Also, craft education has been criticized from both tradition-based (Ihatsu, 2002) and individualistic learning perspectives (Garber, 2002). Skill-based craft teaching has emphasized that functional objects are the end-products of the craft process (Karppinen, 2008). However, Garber (2002) argues that practical applications of craft are redundant; the tools and artefacts required in everyday life are readily available. Thus, a modern perspective toward the teaching of crafts may be that such teaching improves generic skills (Garber, 2002; Pöllänen, 2009). As society has developed, the meaning of craft has undergone social and cultural changes, and the challenges faced in the craft education of primary school children and their teachers have increased in number.

The learning objectives of the entire basic education system are under challenge (Binkley, Erstad, Herman, Raizen, Ripley & Rumble, 2010). It seems to be generally agreed that if we are to adequately and pro-actively meet the challenges encountered over the past decades, education will have to play a key role (Buchberger, Campos, Kallos & Stephenson, 2000; Perkins, 2009). The nature of skills needed in the twenty-first century has changed. Binkley et al. (2010) remind us that we must respect the demands of society, namely that schools should turn out people who are prepared to learn new things and collaborate to solve problems. Collins, Joseph, and Bielaczyc (2004) suggest that education should concentrate on instruction that produces students who can create ideas, share them in the

community, design products, and, in the end, publish their work to a wider audience. These demands encourage teacher educators to experiment with new ways to educate students, so that they acquire experience in the building of new instructional strategies (Reigeluth, 1999).

Many constructivistic instructional approaches (e.g. Resnick, 2002), for example problem-based learning (Hmelo-Silver, 2004), authentic learning (Lombardi & Oblinger, 2007), and learning by designing (Harel & Papert, 1991), seek to address the challenges with which learning and teaching are confronted. These approaches are largely based on co-operation, employ real-life contexts, and seek to develop multidisciplinary and learning tasks and projects that demand inquiry. They emphasize learning that is contextualized (van Oers, 1998). According to Rule (2006), real-world problems and inquiry-based activities enable learners to practice their skills regularly. Relevance of and choice within a learning task, along with discussion within a community of learners, empowers students to increase their knowledge and skills. Such instructional strategies are inherently incompatible with the traditional concept of the curriculum unit and the idea that disciplines are discrete, and also challenge knowledge-based and teacher-centered instructional strategies. The learning environment will become multidisciplinary, focusing on the learning of skills and knowledge needed for the future (Laurilland, 2002; Lombardi & Oblinger, 2007). Lombardi and Oblinger (2007) and Claxton (2008) argue, however, that educators have historically concentrated principally on the cognitive learning domain; other domains, including the affective, psychomotor, and conative domains, have been perceived as less valuable or have been totally ignored. The conative domain, in particular, which determines whether a student has the necessary will, desire, commitment, mental energy, and self-determination to actually perform, has been totally neglected. Sawyer (2004) claims that traditional teaching has focused on delivery of lower-order skills to learners.

In August 2012, an expert group established by the Finnish Ministry of Education began work on a proposal to develop a 2020 national core curriculum. The national objectives for basic education seek to order subject areas into six multidisciplinary groups. Visual art and craft, music education, and drama are grouped in a single multidisciplinary group termed "Art and Craft", but the distinct subject areas are preserved. Teaching can be organized traditionally, but teaching can also be integrated or thematized (FNBE, 2013). Thus, one way in which to strengthen the relevance of crafts is to develop instructional strategies that consider the educational challenges posed. The value of craft education may lie in development of authentic learning contexts and the possibility that meaningful projects may be formed by creating, designing, and making (Pöllänen, 2009; Seitamaa-Hakkarainen, 2010). However, Loi and Dillon (2006) argue that, if a system is to be changed, it is usually necessary to deliberately intervene to bring about such change. Thus, in the project under discussion, the contextualization explained to students served as an example of craft education. The present project is just one example of modern teacher education in the University of Eastern Finland; we implemented the principle that learning should be achieved by collaborative designing and contextualizing within a common theme. The aim of the present study is to describe how such a project can succeed in breaking down traditional craft instructional strategies. To attain the aim, we describe learning games that students constructed, and their experiences.

Learning by collaborative designing

Learning by designing (Harel & Papert, 1991) is a product of constructionist theory which emphasizes the value of learning garnered by participation in some form of creation and designing, while interacting with others. The theory suggests that new ideas are most likely to evolve when learners are actively engaged in the building of some sort of external artefact (programs, machines, or games) on which they can later reflect and share experiences. The approach builds on constructivist theories that assert that knowledge is not simply transmitted from teacher to student, but is rather actively

constructed in the mind of the learner. However, learning by designing also emphasizes construction of external artefacts, social interaction, and co-operation. Thus, the constructionist perspective is based on the idea that construction processes are more valuable when learners produce artefacts via co-operation, sharing aspects of their understanding and their thoughts. Ackermann (1996) maintains that knowledge building is most successful when things that are tangible and sharable are made. When students are asked to design something for the use of others, learning becomes a path toward achievement of wider intellectual and social goals.

As mentioned above, learning by designing values both learning and the outcomes thereof; these include the artefacts produced. However, information-processing and construction of meaning by a learner is core to the process (Kafai, 1996). The essence of learning by designing lies in construction of meaning. Learners are expected to create objects or artefacts representing a learning outcome that they find meaningful; Kolodner (2006) claims that this facilitates deep learning; the design process creates a rich context in which learning may occur. The design challenge provides the basis for learning of necessary content, and engaging with the challenge affords a natural and meaningful venue for the use of both new information and existing skills. In practice, this means that a learner, as a part of a team, has to identify a particular goal, examine his or her prior experiences, and investigate the means and actions available in the context of his or her own motives, goals, and means of accomplishing the task and process. Process involves the cognitive, affective, psychomotor, and conative domains of learning (Lombardi & Oblinger, 2007; Claxton, 2008). Learning by designing is one example of a model of authentic instruction that usually features collaborative problem-solving. This means, in practice, that students have to work together to overcome a mutual challenge; ideas must be contributed and exchanged, and the knowledge or resources needed to achieve the goal must be acquired (Binkley et al. 2010). Lehrer, Ericsson and Connel (1995) have shown that learning by collaborative designing elicits the kinds of skills necessary to effectively define problems and, next, to break these problems into sub-problems; to control and organize projects to create new knowledge; to search for necessary information; and to report on, evaluate, and reconstruct results.

Kolodner (2002) remarks that the perceived need to make a design work requires an ability to retrieve information, to identify incomplete and poor conceptions, and to debug applications to attain solutions. An iterative (i.e., spiral and cyclic) design process affords opportunities to apply and test new solutions. At the very least, the collaborative nature of design provides opportunities for co-operation and teamwork, and requires communication of ideas and results. Learners varying in conceptual preference or background may contribute constructive suggestions. The context of design forces learners to think like experts (Kafai, 1996; Kolodner, 2002). Such learning also develops creative and innovative capacities (Lee & Breitenberg, 2010).

Engeström (1992) has observed that interaction between a subject and his/her community follows explicit and implicit social rules, and that community members continuously negotiate the division of labour. Thus, when learners are asked to design something for the use of others, their learning is important for achievement of greater intellectual and social goals. Community knowledge is mobilized to support learning among all members. In such a learning situation, the context in which learning occurs is crucial, as are the social contexts that learners bring to their learning environment (Kafai, 1995). Engeström (1992) emphasizes that the nature of collaboration depends on whether or not learners share the same objective. Co-operation is a collaborative process by which learners focus on a shared problem, seek to reach consensus on possible solutions, and finally try to find a mutually acceptable way of solving the problem. Sharing of an objective, organization of collaborative efforts, and development of a joint activity programme, are examples of reflective communication; this is the highest form of collaboration. Collaboration to produce artefacts, using (for example) tools, materials, sketches, various technologies, and prototypes, help to distribute cognitive achievements among team

members (Hutchins, 1995). Contrastingly, if learners execute individual tasks in the absence of a common target, the various action plans will be instituted in the absence of agreed guidelines; the wholeness of the task and the need to embrace the work of others are ignored (Engeström, 1992). Kvan (2000) and Lahti (2008) remind us that a design task must include a definition of the design group, identify the required outcomes, ensure that collaboration is recognized as important, and clarify group member interdependencies. Only then might a collaborative design project be successful.

In learning by designing, the design task should be open-ended, unstructured, and authentic in nature, because constraints will be set by the learner (Kafai, 1995). The problem must be undefined (to some extent); the problem cannot be solved immediately, and thus requires sustained investigation. Lombardi and Oblinger (2007) point out that the conduct of authentic activities affords opportunities to examine design tasks from a variety of theoretical and practical perspectives, using various resources to distinguish relevant from irrelevant information. Success in this kind of task is not achievable in the absence of collaboration with other learners and experts. Authentic activities enable learners to make choices and to reflect upon the learning process, as well as on their skills and abilities. Experimentation and exploration (concrete actions) facilitate analysis and synthesis of the process and product (Kafai, 1996).

In Finland, design is an essential feature of craft education in primary and secondary schools and in teacher education. Acquisition of valued skills via the design and making of crafts has traditionally been achieved independently (Garber, 2002). Social interaction has been confined to discussion and comparison involving teachers and peers; this is not true collaboration (Lahti, 2008). To attain successful collaboration (Seitamaa-Hakkarainen, Lahti, Muukkonen & Hakkarainen, 2001), and to acquire the skills needed in the twenty-first century (e.g., Collins, Joseph and Bielaczyc, 2004), the theoretical framework of the project described in the present study was based on the concept of collaborative learning by designing. Students were asked to design and produce a textile-based forest-themed learning game for primary school children.

Research question, context, data collection, and analysis

Research question

This case study describes the types of learning games produced and the learning experiences of students who engaged in a project implementing the principles of learning by collaborative designing via forest-themed contextualization of crafts. The ultimate aim of the work was to describe how such a project might break down the traditional view of instructional strategies in craft education.

Context and participants

The study took place in the context of teacher education in the University of Eastern Finland; in particular, the craft course offered to students in primary school teacher education. The course ran twice in the autumns of 2009 and 2010. Participants were students in their first year of training in primary school teacher education. In total, 120 students participated. Craft experience varied, but was usually minimal; some participants had studied craft in secondary school and others in grade three of primary school.

The project was embedded into a craft education course (a 2-credit course; 21 contact lessons; 33 hours of independent work); the course was compulsory during the first term. Other courses addressed subjects of the primary school curriculum of Finland, including mathematics, physics, chemistry, biology, geography, history, the mother tongue, religion, sports, visual arts, and music; basic courses in the educational sciences were also offered. The objectives of the craft education course were acquisition of familiarity with the craft process and related aspects of product design, and learning the

basics of textiles, skills, and pedagogy. The idea was that students would be able to plan, implement, and evaluate craft education in primary schools using the concept of integrative learning. To attain those objectives, the student task was to design and produce a textile-based and forest-themed learning game for primary school children.

The course began by creation of a design task; student input was valued. The teacher imposed an open-ended learning task; this was to design and produce a textile-based and forest-themed learning game for primary school students (in grades 1–6). The focus on forest in the context of learning was derived from the perceived need to develop a multi-disciplinary real-world task (Finland is rich in forest) that would motivate students in teacher education and in schools to practice skills that will be needed in the future (Buchberger,

Campos, Kallos & Stephenson, 2000; Perkins, 2009). The task was supposed to be multi-disciplinary in nature, thus encouraging students to co-operate in the construction of new relationships that shared knowledge and skills (Kafai, 1996; 2006). In summary, a design task was indeed given to the students, but the instructions were deliberately rather vague. The keywords were forest, learning game, primary school, and crafts; students were encouraged to do what they wished with these words. However, the end-product was defined to be a forest-themed learning game, but none of the grade level of application, form, or content, was defined. The task did not contain any constraints about the materials, tools, or techniques to be used. Nor were exact procedures or guidelines given. Some kind of thematization was considered to be an essential scaffold for the learning process, because the course featured very few contact lessons and the prior skills and knowledge of the students were minimal.

Students commencing in 2009 (60 in number) and 2010 (60) were both asked to work in teams of 3–5 students. There were 36 independent teams in total. Each team had to design their own learning game, while co-operating intensively with each other. In addition, students were encouraged to exploit the knowledge of existing experts both inside the university (e.g., experts in forest science, educational sciences, and psychology) and outside the university.

The design challenge and learning process required students to practice the basic craft techniques needed for their game both individually and co-operatively. When students began to gain expertise in the required skills and practices, they also began to model for and coach their peers in the ways in which they were practicing teaching; the course teacher assisted with this process. To get students to this level, different instructional methods were used. These were traditional lecturing and demonstration, for example, and also co-operative learning and cognitive apprenticeship. The design challenge and learning process were intended to simulate the structure and representations that future teachers should apply.

In summary, the craft course featured both social and physical interaction. The course was guided by the principle of socio-constructionism; this is both a constructivist learning theory and a theory of instruction. Constructivism means that pedagogical strategies were based on learner commitment, active playing of a role, and construction (see Ruokamo, Tuovinen, Tella, Vahtivuori & Tissari, 2002).

The socio-constructive element of the course was based on the idea that people learn effectively when they make things that are tangible and sharable (Ackermann, 1996). Students worked in co-operation with each another and experts, and thus benefited from the knowledge and skills of others. Both the process of creation and the learning games produced were shared. Jonassen (1995) states that this form of learning is personally meaningful and supports development of creative solutions to problems that simulate real-world scenarios.

Data and analysis

The data analyzed in this descriptive case study consists of the learning games produced (36 in number) and student portfolios (215 pages) in which they described their project experiences.

The games were described in outline and photographed in detail. They were illustrated as seen; they were "the things in their appearing" (Finlay, 2009). This means that the principal task was a general description of game content and characteristics; no subjective sensations or personal understandings were sought (Anttila, 2006). Photographs were used as reminders; it was easier to work when researchers did not have to handle artefacts during analysis. This reduced the level of mistakes and problems associated with subjective interpretation, because researchers did not have to rely on memory.

After completion of this first phase, student portfolios were analyzed using the inductive content method and a hermeneutic approach. Such analysis has been found to be valuable when no previous study has dealt with the phenomenon in question (Elo & Kyngäs, 2008). Portfolio data were read as a whole, in an effort to define an appropriate unit of analysis. In line with the hermeneutic principle, no predetermined set of criteria was established (Klein & Myers, 1999). Categories and a coding scheme were derived inductively from the data. Identified themes were expressed in a single relevant word, phrase, sentence, or paragraph. The principal differentiating factor was the expression of an idea (Minichiello, Aroni, Timewell & Alexander, 1990). Thereafter, the task was to identify central themes emerging from the data. For this reason, thematically similar themes were re-integrated to derive a coherent explanation of student experiences. This was done to fully understand the theoretical properties of the category and to draw conclusions from coded data (Zang & Wildemuth, 2009). The final phase of analysis was to describe how this type of project succeeds in breaking down traditional instructional approaches to the teaching of craft. To attain this aim, the context, the descriptions of student experiences, and the learning games produced, were made as rich and dense as possible (Denzin, 1989).

One way to validate qualitative studies is to address the issues of trustworthiness and honesty (Lincoln & Guba, 1985; Bryman, 2001). To enhance the rigour of the present study, the following criteria of trustworthiness were considered: credibility, confirmability, dependability, and transferability. Credibility was assessed via identification of thematic categories, by clearly describing the analysis criteria, and by checking interpretations. The literature and the findings of other researchers may strengthen the confirmability of the present study. The case study approach focuses strongly on validity, which was assured by the involvement of two researchers who worked independently. Thus, during analysis, dependability and confirmability were ensured via peer examination. Researchers discovered uniformity when both had analyzed and compared the data. Transferability is assured; the data were rich and the descriptions detailed.

Critics of the case study method believe that study of a small number of cases affords no grounds for establishment of reliability or generality; others feel that intense exposure to the case biases the findings (Yin, 1994). These restrictions will be countered by presenting detailed and intensive information on the information obtained in a real-life context. Despite the fact that the results of this case study may not be generalizable to all situations and contexts, the information may be useful when interpreting certain scenarios. Mayring (2007) argues that, in most cases, the targeted conclusions of a qualitative study may be more general than the results themselves suggest. One advantage of the case study approach is that it is possible to provide detailed descriptions of specific and unique cases to help develop the information needed for further research. A case study, used as a research strategy, may highlight real-life context and project uniqueness, as is true in the present instance.

While case studies often include specific information on the context and the subjects, ethical questions must always be considered. It is essential to pose such questions to ensure that the conclusions are valid and that the methodology used is beyond reproach. In the present study, the ethical guidelines of Christians (2000) we used; the course began with preparation of the design task in a manner that involved the students. The task constituted the entire course; students did not have extra work to do while constructing the learning games; and the process and results are reported accurately with attention to privacy and confidentiality. Student privacy was maintained in the quotations selected to illustrate interpretations. No quotation or learning game contains any information that is embarrassing or harmful.

Results

The learning games

The learning games were outcomes of a collaborative design project implemented during a craft course in primary school teacher education. As is usual in a learning-related context, an element of common theme and the broad nature of the design task were outlined (Seitamaa-Hakkarainen, 2000; Lahti 2008). The task was to design and produce textile-based and forest-themed learning games suitable for primary school children. The key terms textile crafts, forest, and primary school set the design context.

Although the task was quite open in nature, all games produced were textile-based board games. The games had many similar properties, but were quite different. The following features characterized the games:

- Game design; the idea, exploitation of the forest theme, the target group
- Game construction; instructions, rules, components
- Craft content; techniques, materials, and suitability
- Product design; aesthetic and technical characteristics

The students exploited the features of existing popular games in *game design*, but, at best, these were used in innovative ways. Often, a question-and-answer format was chosen. Some games involved memory or functional tasks (Figure 1). Only a small number of games were based purely on chance. In addition to contributing to craft education, all games were developed with reference to the primary school curriculum and incorporated ideas from biology, geography, nature studies and ecology, history, orienteering, the mother tongue, foreign languages, and various other activities. All games sought to be instructive.

Figure 1. Different disciplines and school subjects have been applied in the learning games. Photo Sinikka Pöllänen.

The forest theme was ubiquitous. Most games dealt with real-life questions involving the seasons, or animals and plants; games featured the lives of ants, birds, or mice; and plants or mushrooms. One game considered the historical dimensions of forestry, one forest conservation, and another public rights of access. Only a few games were based wholly on imaginary stories. However, imaginative elements (popular stories or narratives) underlay real-life questions (Figure 2). Thus, most students had integrated facts, fiction, new information, and earlier experiences, in their games. They readily embraced the design task. The layout of games varied, and most games integrated layout and narrative. The games featured many play elements to make gaming meaningful. The games indicated that information-processing and construction of meaning had been the core to the process in the game design process (see Kafai, 1996; Kolodner, 2006).

Figure 2. Imaginative elements backgrounding real-life questions in learning games. Photo: Sinikka Pöllänen.

In most instances, games were designed to be played by upper primary school children; only two games were targeted at early grades or pre-primary children. Students had clearly explored the suitability of their game for the chosen age group; the games were (appropriately) both instructive and fun; and they incorporated different school subjects of the target group.

Students integrated knowledge obtained in various courses when exploring *game construction*. The instructions, the rules, and the questions used in the games were, for the most part, carefully prepared from the following perspectives: the stage of development of players; integration with other school subjects; and appropriateness of the level of difficulty of text. The games consisted of a board, rules, instructions, and game components, which typically resembled the pawns of chess. These pawns took the form of, for example, animals or berries (Figure 3).

Figure 3. The story of a game can be seen in the details: Berries as pawns. Photo: Leena Vartiainen.

In terms of craft content, the games showed that students had learned and applied the basic craft skills, techniques, and knowledge necessary to allow a primary school teacher to apply the games. At the very least, students used the basic materials and techniques regularly employed in Finnish primary school craft education. Students applied these techniques in their basic form, but also in more challenging three-dimensional constructions or on game boards (Figure 4). A few groups also used more difficult techniques (e.g., embroidery) or applications (e.g., felting on a canvas rug, paper-dyeing). However, these techniques and applications are best suited to the upper classes of primary school. In addition, metal and natural or recycled materials were used. Despite the fact that the course was of very short duration, students learned and applied the following techniques: felting, sewing by hand and with a sewing machine, crocheting, embroidery, textile-printing, sun-painting, stringing, frame-loom weaving, string-making, tassel-making, and simple beading.

Figure 4. Different techniques of art and craft used in the learning games; the "Trip to Lapland" is used as an example. Photo: Leena Vartiainen.

The data showed that product design had been a complex problem; students processed the *aesthetic and technical characteristics* of the games throughout the entire design process. Students developed their ideas as they learned the required techniques and practiced their skills. At this stage, help from other team members and the teacher had been essential. Lehrer, Ericsson and Connel (1995) have also described how collaboration helps to define problems and organize the teams' work.

The required aesthetic features of the game controlled the design process. Students familiarized themselves with basic materials, but some applications and desired aesthetic features required specific materials, for example silk or plastic to represent a shimmering lake or ice. As far as materials were concerned, most games were usable and appeared to be sustainable. However, tree branches and other materials collected in the wild are often very fragile. It was obvious that students employing such materials envisaged that pupils might visit the forest to collect materials for their craftwork. The games used various kinds of textiles (e.g., felt, rough and smooth materials). Thus the board and the game components offered opportunities for concrete touch experiences and the meaning of interrelationship between the physical body and materials.

Ackermann (1996) maintains that knowledge building is most successful when things that are tangible and sharable are made. This can be seen in the learning games: they were designed and produced with reference to the objectives of the craft education course. They revealed the level of learning of students, their skills, and their ability to plan craft education in primary schools via the concept of integrative learning. It was concluded that the design challenge had provided impetus for the learning of necessary content, in a co-operative manner, and afforded a natural venue for the use of both new information and skills.

Student experiences

The second research aim was to describe the learning experiences of the students. The rather open-ended and authentic learning task was both interesting and challenging to students. A common theme had facilitated the overcoming of initial difficulties; a common idea emerged. This kind of shared problem is noticed to be a prerequisite for collaboration (e.g. Seitamaa-Hakkarainen, 2000; Lahti 2008). However, students identified the task as a new and unprecedented form of pedagogy.

Student learning experiences were analyzed by examining the portfolios. Such analysis identified four main themes:

- Characteristics of the learning
- Meaning of the process
- Learning of crafts
- Teaching of crafts

The most evident *characteristic* of the learning was the multidisciplinary nature of the experience. According to Rule (2006), real-world problems and authentic activities usually transform the nature of learning process and help to focus on the learning of skills and knowledge needed for the future. This process could be seen in the portfolios. Students described how they used different information resources (experts, internet etc.) and gathered information from different scientific fields while they performed the learning task. They wrote that the project had increased their knowledge and skills in several areas relevant to their future careers as primary school teachers; these included project-based learning, the interplay between teaching and learning, design, collaboration and teamwork, problem-solving, self-directedness and reflection, and communication. Students also appreciated the fact that they had learned basic skills in craft education and, at the same time, how to use gaming as an instructional model. Students learnt more about student-centered learning, the basics of the primary school curriculum, and the content of various school subjects. The project theme caused students to explore forest-related issues and sustainable development despite the fact that sustainability was not mentioned as part of the learning task. Students defined the details of the task, identified problems, and planned, together, how to solve them.

The meaning of the process, thus an example of iterative learning, was clear to all students throughout the project. The students created ideas, shared them as a community, designed and made prototypes,

produced learning games, and, finally, published their work to a wider audience. The data revealed that presentation of drafts very early in the project was considered unnecessary and time-consuming. Students felt that they should get on with the work immediately without spending time on explaining what they were doing or giving feedback. The portfolios revealed that this method of craftwork was unfamiliar. However, Ackermann (1996) has noticed some kind of presentations may help knowledge building because it makes things tangible and sharable. The portfolios showed that the problems dissipated when the students noticed how they could exploit the ideas of others and, near the end of the course, they began to realize what they had achieved. This was a natural progression; students initially viewed only their product as a concrete result, because the achievements of the entire group and the nature of the learning process became clear only at the end of the project. Students recognized that collaboration was useful but also demanding. All of agreement on a common schedule, creation of ideas, design, and problem-solving in an environment of close and intensive collaboration, posed challenges. However, collaborative learning is a conspicuous feature in the sharing of knowledge and craft-related skills (see Lahti, 2008). Students wrote that their varying concepts and backgrounds allowed them to contribute constructive suggestions to the design challenge; existing skills and knowledge were successfully exploited in planning and design of the games. Piloting the games to other students and subject experts, and, finally, publishing the games, were important reflective evaluative features of the learning process. The students came to understand also the meaning of collaboration in teaching. According to Ackermann (1996) this kind of process may target learning to wider intellectual and social goals:

> There is never too much working in groups. It is a good counterweight to independent working – that happens a lot in the academic world. As a primary school teacher I must be able to co-operate with different kinds of people.
>
> The most important lesson I got, was when I realized how wonderful the things were that people had produced together. I think that the objectives of learning and traditional activities in school are also in conflict. The main aim should be to bring up citizens that are able to cooperate, but the competitive spirit is fuelled, and the winning spirit is strong.

Learning of crafts involved refining of ideas over several design cycles and acquisition of craft skills. This process involved preparation of sketches and prototypes, knowledge retrieval, articulation, presentations, and skills training as is common in learning by collaboration (see Hutchins, 1995; Kafai, 1996; Kolodner, 2002). Game design required discussion and clarification of goals, possibilities, resources, problems, sub-problems, constraints, and actions. In addition to coming together in meetings, students worked independently, and used their own resources, tools, and technologies (e.g., Facebook, blogs, mobile) to interact and share acquired data, problems, and solutions. The portfolios showed the students commitment and their goals, means, and efforts to solve the learning task. Collaboration and participation helped to call for help as well as to see things that worked. Students had experienced the project demanding but meaningful.

Students made common decisions on game constraints and craft-related issues (the required techniques, materials, tools, skills, and knowledge). Game creation introduced students to the craft of game design and to the many skills involved in crafting. Collaboration with the teacher and with other students with different skills and backgrounds supported student developmental processes and the ability to attain new levels of competency in design and production. Students became engaged as stakeholders in a complex set of activities that required active participation. Thus, the more the students were involved in solving the learning problem, the more they were learning. For example, those students who already had good basic craft skills realized that there was nonetheless something new for them in the project; they wrote that they saw how crafts could be meaningfully contextualized and that the learning of craft techniques or production of a finished product was not the only important

thing to learn. Sharing of expertise, and collaboration, motivated students who were already skilled, and lowered the engagement threshold of beginners who were nervous about their weak skills. The knowledge and shared expertise of the community were mobilized to support learning of all members. Experimentation and exploration (concrete actions) helped in the analysis and synthesis of both process and product in a way Kafai (1996) have pointed out. This was evident in both the articulation and presentation sessions, and in the portfolios.

> The forest-theme was an exciting topic for a learning game. Especially implemented through crafts. At first it was difficult to design a game from these starting points, but the idea concretized when we began to do it with our hands.
>
> Making the game, as a product, did not in itself teach me new and revolutionary techniques, but I think it was an important exercise in process-based working. Self-evaluation makes it possible to develop each other's actions.

The portfolios revealed that students began to compare their learning to their own school experiences. In the present project, they were learning crafts as a group, and the design task was thematized but unstructured. Students controlled the ideas, the design, the preparation and assessment of the artefact, and the production process. In contrast, their experiences of learning crafts at school had involved use of ready-made designs that constrained the aesthetic or technical qualities of the artefact (for example, they had copied models) or had sought technical solutions (involving the use of instructions). The portfolios indicate that the new way of learning crafts had elicited useful reflections:

> This kind of work was different compared to my previous studies in crafts at school. It was nice to work freely, the only constraints being the theme. Working in groups was also a new thing in crafts. I do not even remember that themes had ever been used.
>
> I was in elementary school in a science and math focused class, where we made excursions to the forest. Now, I wonder why we did not take account of those trips at all in arts and crafts.

The portfolios showed that students articulated their understanding of concepts in terms of the concrete artefacts produced and the principal features of the game, and next transferred these concepts to similar artefacts or situations, and, finally, to the principles of *teaching craft* at school and modifying craft education to be more project- or process-based and communal. The forest theme encouraged students to consider the possibility that some school subjects might be integrated. Integrated education, which is the bringing together of several subjects in a single educational process, has traditionally been minimal. When commencing studies, students become focused on their own learning rather than considering how fragmented such learning might be. However, most students considered that analysis of the pupil perspective on craft education, designing, and even gaming, to be instructionally valuable. The learning of crafts within collaborative teams had featured many teaching rehearsals with student colleagues; valuable new skills had been learnt. Overall, the portfolios contained multidimensional reflections on teaching:

> With this kind of theme, very different kinds of techniques and topics may be combined into a whole entity.
>
> I noticed that crafts can also be used in different applications than toys, bags etc., which the pupils do not usually even need to use. This kind of crafted game can get a lot of use, especially if the game remains at school for the use of other students.
>
> Making the game was important for my own profession in the future. I had to think about my own teaching: for example, what kind of game would be suitable for a certain age group, how the game could be educational but fun at the same time, how a game can be a part of teaching and common learning, how it could be developed and applied etc.

> I do not know whether I am right, but based on my feelings, I would say that school education often forgets to make learning meaningful in such a way that it would have personal significance to the learner. It is the same if someone else tries to tell what kind of taste is the taste of a banana, how it feels in your mouth, etc. An experience does not arise unless you can taste the fruit itself. We cannot create experiences on behalf of another person; you have to experience the thing yourself and define your own relationship to it.

Conclusion

Despite the fact that the Finnish education system has received international acclaim, the teacher- and subject-centered aspects of the system have been criticized (Pirttiniemi, 2000; Arvaja, 2005). Craft education has also been considered to be tradition-based (Ihatsu, 2002) and individualistic (Garber, 2002); skills acquisition and production of end-products have been over-emphasized (Karppinen, 2008). More generic skills are required (Garber, 2002; Pöllänen, 2009; Binkley et al., 2010). Loi and Dillon (2006) suggest that deliberate interventions may be needed if a system is to be changed. As an example, this unique course in craft education taught in the University of Eastern Finland imposed creation of a textile-based and forest-themed learning game as a task, and used collaborative design as an instructional strategy.

The task was to design and produce a textile-based and forest-themed learning game for use in primary school. Thus, the students had to solve a shared problem; the task was open-ended, unstructured, and authentic. However, contextualization allowed students to define their own learning objectives, and use skills and knowledge gained from constructive interaction between experts and each other. The results provided evidence that creation of the games required an understanding of how craft could be applied to game design and the pedagogical aspects of gaming, and required development of many different skills in design and production. The activities placed students into an active learning mode that required them to design, plan, reflect, evaluate, and modify skills, knowledge, and attitudes (see Kafai, 1996; Kolodner, 2002). To solve the learning task and to support their activities, students required different types of skills, multidisciplinary knowledge, and the ability to process information and to co-operate. The open-ended authentic learning task posed problems that could not be solved simply by reference to a single school subject or discipline. Students had to critically examine the task from a variety of theoretical and practical perspectives, in the manner favoured by Lombardi and Oblinger (2007). Thus, the learning process not only produced visible and tangible products, and craft-related skills, as outcomes, but also developed the skills required in future (see Collins, Joseph, & Bielaczyc, 2004; Binkley et al., 2010). The process involved the cognitive, affective, psychomotor and conative domains of learning (see Lombardi & Oblinger 2007).

The common design task engaged students to work toward a common goal. Despite the fact that tangible external artefacts were made, these were not individual works and the process was not guided by a teacher. The roles of both students and teachers were not traditional. The entire learning process was pursued via social interaction and by sharing of understanding and thoughts. Solving the task required active student participation, reflective communication, and construction of meaning, which, according to Engeström (1992), represents the highest form of collaboration. The meaning of collaboration and the nature of common articulations became obvious to students, as was clear in the portfolios.

The results show that development of forest-themed learning games in the context of collaborative design afforded a rich and non-traditional craft learning experience to the students. The task guided learning in a multidisciplinary sense and widened the tools used by students for learning crafts. Collaboration and teamwork meant that teacher- and subject-centered approaches were replaced with

process-based learning. Such a strategy stimulated student interest in the use of participatory activities. Figure 5 summarizes the learning process and the outcomes of the study.

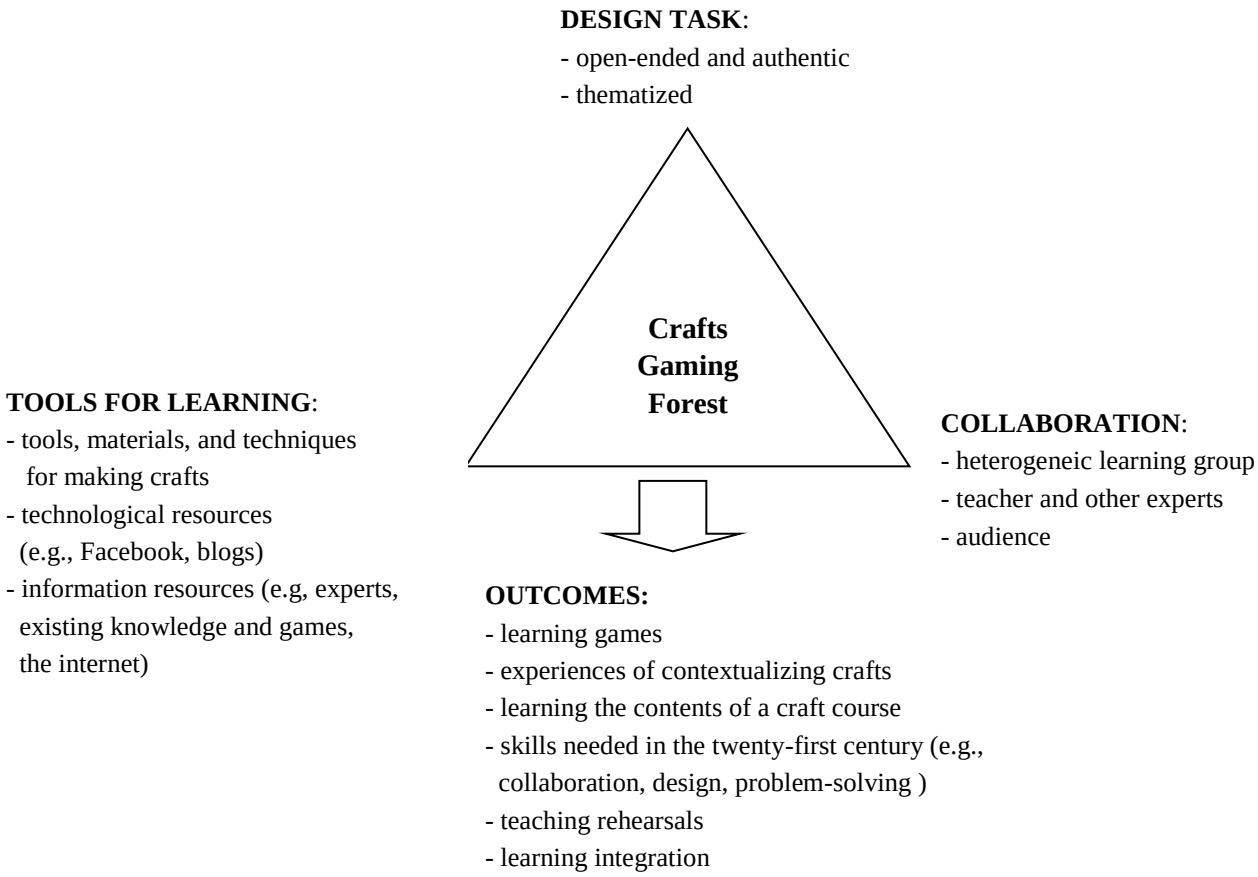

Figure 5. Elements of the collaborative design project and project outcomes.

It may be concluded that the project was an example of an instructional model that may break down the traditional concept of differentiated school subjects and courses, and eschews knowledge-based and teacher-centered instructional strategies (see Laurilland, 2002; Lombardi & Oblinger, 2007). In terms of craft education, the project highlights the success and importance of collaboration and process-based crafting, and raises the possibility that the focus can be shifted to participatory activities and acquisition of generic skills (see Ihatsu, 2002; Garber, 2002; Pöllänen, 2009). Craft education may make use of authentic learning contexts and the possibility that meaningful projects may be formed by creating, designing, and making (Seitamaa-Hakkarainen, 2010). It may be concluded that the real-world problems and inquiry-based activities that Rule (2006) have called for, may enable students to practise their skills widely also in craft education.

In the project under discussion, the contextualization serves as an example of thematized craft education. The context and the impetus for the work lie in features of the Finnish educational system, but the contextualization may be applied to craft education more generally, when craft materials and processes are part of an educational program.

This case study on learning game development, with analysis of student experiences, may form the basis of further research. Despite the fact that only one experiment is reported, it is clearly worthwhile to study student co-operation through the lenses of division of labour and intensity of effort, to develop learning by design as an instructional strategy for universities that teach novice handcrafters

how to become primary school teachers. Collaborative designing and skill acquisition form a useful pedagogical scaffold. Future research will also consider the experiences of teachers who step outside the arena of traditional impartation of craft-related expertise.

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