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Design Thinking and Collaborative Learning

Pensamiento de diseño y aprendizaje colaborativo

ABSTRACT
This paper presents design thinking as an alternative approach to conduct research on collaborative learning with technology. The underlying premise of the paper is the need to adopt human-centered design principles in research and design of computer-supported collaborative tools. Two research results are described in order to discuss the possibilities and challenges of applying design methods for designing and researching collaborative knowledge building tools. The paper begins by defining collaborative learning with new technologies as a wicked problem that can be approached by adopting a design mindset. Design thinking and particularly research-based design relies on a shared, social construction of understanding with the people who will later use the tools. The key phases in research-based design (contextual inquiry, participatory design, product design and software as hypothesis) are described and exemplified through the presentation of two research results. The two prototypes presented are the fourth version of the Future Learning Environment (Fle4), a software tool for collaborative knowledge building and Square1, a set of hardware and software for self-organized learning environments. Both cases contribute to the discussion about the role of artifacts as research outcomes. Through these cases, we claim that design thinking is a meaningful approach in CSCL research.

RESUMEN
El artículo presenta el pensamiento de diseño como un enfoque alternativo para realizar investigaciones sobre aprendizaje colaborativo con tecnología. Se describen dos resultados de investigación a fin de debatir las posibilidades y los retos de aplicar métodos de diseño para diseñar e investigar herramientas de construcción de conocimiento colaborativo. El texto comienza definiendo el aprendizaje colaborativo con nuevas tecnologías como un problema complejo que puede afrontarse mejor mediante la adopción de una actitud de diseñador. Se presenta el Diseño Basado en la Investigación (DBI) como un ejemplo de pensamiento de diseño basado en la construcción social del conocimiento con las personas que más adelante utilizarán las herramientas. Se describen las fases clave que caracterizan el método DBI (investigación contextual, diseño participativo, diseño de producto y software como hipótesis) y defiende la necesidad de adoptar un enfoque de diseño centrado en las personas. Los dos prototipos presentados son la cuarta versión de Future Learning Environment (Fle4), un software para la construcción de conocimiento colaborativo, y Square1, un conjunto de dispositivos y aplicaciones para entornos de aprendizaje auto-organizados. Ambos son ejemplos de DBI y contribuyen a la discusión sobre el rol de los artefactos como resultados de investigación. A través de estos casos, se afirma que el pensamiento de diseño es un enfoque significativo en la investigación sobre el aprendizaje colaborativo mediado por ordenador.

KEYWORDS / DESCRIPTORES
Methodology, design, research, learning, collaboration, cooperation, environments, tools.
Metodología, diseño, investigación, aprendizaje, colaboración, cooperación, entornos, herramientas.

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1. Introduction

Wicked problems is a term used to describe problems that are difficult to solve because they are incomplete, requirements are constantly changing, and there are various interests related to them. Solutions to wicked problems often require that many people are willing to think differently on the issue and change their behavior. Wicked problems are common in economics, social issues, public planning, and politics. Characteristic of wicked problems is that solving part of the problem often causes other problems. To wicked problems there are no true or false answers, but rather good or bad solutions (Rittel & Webber, 1973).

Teaching, learning with technology in general, and computer-supported collaborative learning (CSCL) in particular can be seen as a wicked problem (Mishra & Koehler, 2008; Leinonen 2010). Many problems related to collaborative learning and computers are incomplete and contradictory. In CSCL practices, there are many actors with various complex interdependencies, including teachers, learners, and the interconnected computers. According to Mishra & Koehler (2008), researchers working in the field should recognize the complexity of the situations in an educational context with learners, teachers and technology. In this sense, there is a growing demand for collaboration between researchers, designers, teachers, and learners during the process of designing technologies for learning (Dillenbourg & al., 2009; Bonsignore & al., 2013).

Design thinking has been identified as a meaningful approach to tackle wicked problems (Buchanan, 1992). For instance, according to Nelson and Stolterman (2003), design does not aim to solve a problem with an ultimate answer, but to create a positive addition to the present state of affairs. This way, design differs significantly from ordinary problem solving. Designers do not see the world in such a way that somewhere there is a perfect design they should discover; rather they aim to contribute to the current state with their design. So, design is an exploratory activity where mistakes are made and then fixed. Poetically, one may say that design is navigation without a clear map, relying only on current context and the information gathered from it.

The epistemological basis of design thinking is that most parts of the world we are living in are changeable, something we as humans can have an impact on. In design thinking, people are seen as actors who can make a difference. People can design relevant solutions that will have a positive impact. This way, design thinking is a mindset characterized by being human-centered, social, responsible, optimistic, and experimental.

In this article, we present design thinking as an alternative approach for conducting research in the field of CSCL. To demonstrate the results of design thinking-driven research in CSCL, we present two artifacts produced with the approach. We start with a general discussion about design and design thinking. We continue with a description of our methodological approach. We then present two results from our research in the field of CSCL, which we got by using a strong design-thinking approach. The results are applications designed for collaborative knowledge building (Scardamalia & Bereiter, 2003) and collaborative learning in a self-organized learning environment (Mitra, 2013).

2. Design thinking in context

Design research often starts with observation, reflection, and questioning. A questioning design researcher is especially interested in everyday life practices. He or she may realize that many things that are considered to be normal, natural, and unchangeable are actually problematic. A questioning design researcher is interested in reflecting upon his or her research's significance for human life in general and on different human practices in an everyday context. People involved in the research are seen as part of the same human reality. In the research, they are not objects of the research, but rather subjects in the research. A questioning design researcher does not see that his or her job would be to produce neutral facts or be neutral at all. Therefore, consideration and discussions on value and their impact on the research are a large part of the research. An inquiry by a questioning design researcher holds an ethical meaning as a valuator of human existence and behavior (Varto, 2009; Leinonen, 2010).

In questioning design research, the focus is not only on aesthetics and usability, much broader and fundamental issues are taken into consideration. For instance, Hyysalo (2009) categorizes design on five different levels. To illustrate the different levels of design, we may use the design of a mobile phone's power button as an example.

1) On the first level, design is about details. For instance, design of a mobile phone power button's physical shape, icon, and color is a design of details.

2) On the second level, there is the user interface design. A decision that one should hold the power button down for a second and after that the phone will give feedback with a vibration telling that it is starting up is one example of user interface design.

3) On the third level of design, the interest is on systems. The logic that the phone will keep its setting although it is turned off is design of the entire software system running on the phone.

4) The fourth level in design includes social issues. For instance, the functionality included in a mobile phone's power button making it possible to put it in silent mode or in meeting mode is a decision that pays attention to the social contexts in which the phone is used.

5) The fifth level in design takes into consideration broad societal implications. The decision that switching off with the power button will make the phone impossible to track can be a decision made to protect the user's privacy.

Decisions made on the different levels of design cannot be made separately. They are interconnected and influence each other. The complexity of design requires research, the ability to see both the whole and the details, and the skill to analyze them.

Design may provide people an idea of new ways of doing things and different perspectives and interpretations about the reality they are living in. This way, design can be a way to confront complexity and respond to people's intentions to deliberately change the world (Nelson & Stolterman, 2003). When including interpretations of complexity, design can never be a neutral activity. Behind design, we may find value-laden, even ideological, ideas and principles. As Bruce (1996) highlights, it is not only that the meanings of these artifacts are socially constructed, but the physical design and social practices around them are socially constructed. Understanding design as socially constructed and results of design as something that will have a real impact on the socially constructed reality people are living in, asks for responsibility and accountability from the designers and the people taking part in the design.

The Scandinavian tradition of participatory design is one of the earliest models of design thinking. In participatory design, the people who are expected to be the beneficiaries of a design are invited to take part in the process from the early stages. By involving people in the process, it is expected that the results as a whole will be better than if done without them. For instance, Ehn and Kyng (1987), who have done design research related to computers in workplaces, have noticed that the design of a computer tool is not just a design of a tool, but it also has consequences on the work processes and the entire workplace. The adoption of collaborative learning in education presents similar challenges, since it requires rethinking the classroom culture as well as the curricular goals and the institutional framework (Stahl, 2011). Therefore, recognizing people as the primary source of innovation is crucial in order to reach designs that will serve the needs of the people who will work, learn, or teach with the designed tools. This means that at the same time as the design of the tool, the community is asked to partly reconsider and redesign their current work processes.

First, design thinking, in the case of designing tools for CSCL, means that the design researchers will work simultaneously on all the different levels of design. Rather than enabling just collaboration, a successful collaborative learning environment creates the conditions for effective group interactions (Dillenbourg, 2009). When designing tools, design researchers must adopt a complex understanding of group interaction and consider the social implications of their work, but they also make decisions on the user experience, interface, and their details. Secondly, in the design of CSCL tools, we must be aware of the different interests among the different stakeholders. In the case of education, there are, for instance, different value bases, ideologies, and pedagogical approaches that are often hard to consolidate. The designers must stand for something and be transparent about the value-based decisions in the process. Thirdly, teachers and learners must have a voice in the design process, and the object of design should not only be the CSCL tool, but the entire learning process and practices of the school.

3. Methodological approach: Research and design interventions

To tackle the wicked problem of CSCL, we have used research-based design as a methodological approach (Leinonen & al., 2008; Leinonen, 2010). In research-based design, it is essential to see the results of the design –the artifacts– as primary outcomes and the main results of the activity. This way, the artifacts on their part are arguing the research results.

The research-based design process is a research praxis inspired by design theories (Ehn & Kyng, 1987; Schön, 1987; Nelson & Stolterman, 2003). It emphasizes creative solutions, playful experiments, and the building of prototypes. It encourages researchers and designers to try out various ideas and concepts. The research-based design process can be described as a continuous process of definition and redefinition of problems and design opportunities, as well as design and redesign of prototypes. Most of the activities take place in a close dialog with the community that is expected to use the tools designed. The process can

be divided into four major phases, although they all happen concurrently and side-by-side (figure 1). At different times of the research, researchers are asked to put more effort into different phases. The continuous iteration, however, asks researchers to keep all the phases alive all the time.

In the first phase –the contextual inquiry– the focus is on the exploration of the socio-cultural context of the design. The aim is to understand the environment, situation, and culture where the design takes place. The results of the contextual inquiry are better understanding of the context by recognizing in it possible challenges and design opportunities. In this phase, design researchers use rapid ethnographic methods, such as participatory observation, note-taking, sketching, informal conversations, and interviews. At the same time as the field work, the design researchers are doing a focused review of the literature, benchmarking existing solutions, and analyzing trends in the area in order to develop insights into the design challenges.

In the second phase –participatory design– workshops with the stakeholders are conducted. The workshops are based on the results of the contextual inquiry. In small groups of 4-6, the results of the contextual inquiry are discussed and developed further. A common practice is to present the results as scenarios made by the design researchers containing challenges and design opportunities. In the workshop, the participants are invited to come up with design solutions to the challenges and to bring to the discussion new challenges and solutions. Later, the participatory design workshops are organized to discuss the early prototypes.

The results of the participatory design are analyzed in a design studio by the design researchers and used to create early prototypes that are then tested and validated again in participatory design sessions. By keeping a distance from the stakeholders, in the product design phase the design researchers will get a chance to analyze the results of the participatory design, categorize them, use specific design language related to implementation of the prototypes, and finally make design decisions.

Ultimately, the prototypes are developed to be functional on a level that they can be tested with real people in their everyday situations. The prototypes are still considered to be a hypothesis, prototypes as hypothesis, because they are expected to be part of the solutions for the challenges defined and redefined during the research. It remains to the stakeholders to decide whether they support the assertions made by the design researchers.

Research-based design is not to be confused with design-based research (Barab & Squire, 2004; The Design-Based Research Collective, 2003; Fallman, 2007; Leinonen & al., 2008). In research-based design, which builds on art and design tradition, the focus is on the artifacts, the end-results of the design. The way the artifacts are, the affordances and features they have or do not have, form an important part of the research argumentation. As such, research-based design as a methodological approach includes research, design, and design interventions that are all intertwined.

4. Results: FLE4 and Square1 prototypes

By using the design-thinking approach and research-based design process described in the earlier sections, we have designed and developed two prototypes of the CSCL tools: (1) the fourth version of the Future Learning Environment (Fle4), a web-based software program for collaborative knowledge building, and (2) Square1, a collection of learning devices designed for collaborative learning at school.

Fle4 and Square1 both rely on social constructivist

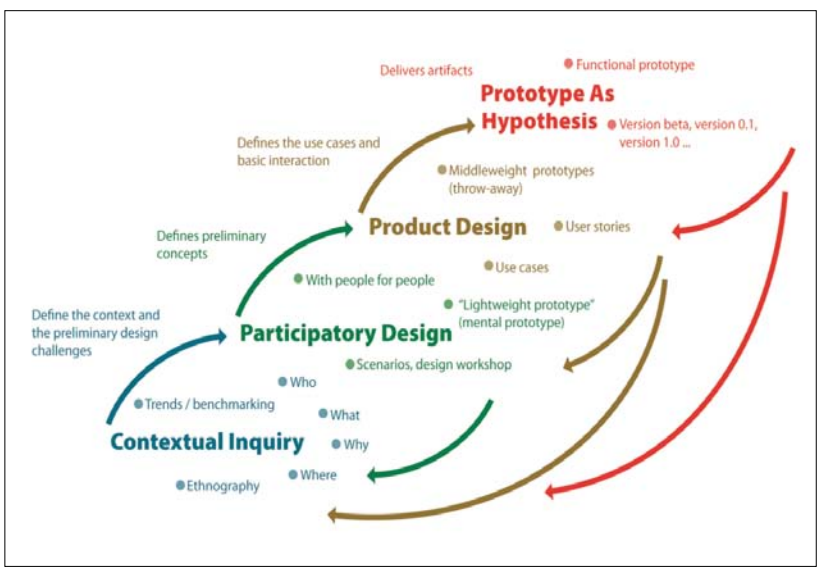

Figure 1. Research-based design process.

learning and Lev Vygostky's theory of the proximal development zone. The prototypes are designed to help and guide the learners' social process of knowledge construction that is distributed among the people and their tools in use. The pedagogical foundation has had a great impact on the design of prototypes. For instance, prototypes are designed so that learners do not only construct knowledge but also have a role in the co-creation of their learning environment.

Fle4 and Square1 have been designed based on the latest research in CSCL, where researchers have emphasized the importance of engaging students and teachers in coordinated efforts to build new knowledge and to solve problems together (Dillenbourg, Baker, Blaye & O'Malley, 1996). Similarly to other environments such as CoVis[1], CoNotes, Beldere[2], and CLARE, research on the two prototypes has focused on building upon and testing the theories of collaborative production, knowledge building discourse, and scaffolding. In the following, we present the tools, Square1 and FLE4, and describe in more detail the design research in different phases of the research-based design process.

4.1. FLE4 – Future Learning Environment 4

Fle4 (Future Learning Environment 4) is a tool for knowledge building designed to work on the WordPress blog platform (http://fle4.aalto.fi/about). Fle4 is the latest iteration and version of the FLE research started in 1998. During the years, we have released four functional prototypes, FLE (1988-1999), Fle2 (2000-2001), Fle3 (2002), and Fle4 (2012). FLE was originally addressed to children, teachers, and parents in Finland. Later the research was continued in a European context. In the case of Fle3, the tool has been used in all the continents, and the user interface has been translated into more than 20 languages. Even today, Fle3 is used in some primary and secondary schools.

The challenge that motivated the original design of FLE was the observed lack of student-centered knowledge building activities in schools in Finland. Although these ideas were discussed among teachers and in teacher-training schools, the actual practices in classrooms were seen to be traditional and hard to change. Therefore, FLE was intended to support Progressive Inquiry learning (Hakkarainen, 2003), a learning model developed side-by-side with FLE. Progressive Inquiry is a way of learning where teachers and learners are engaged in sustaining continuous knowledge building across different school subjects. The idea is to imitate practices of knowledge-intensive work – a process that is common among scientific research groups.

Similarly to other tools focused on collaborative inquiry, FLE aims to facilitate higher-level understanding by asking learners to present questions, to generate explanations and theories for the phenomena under investigation (Bruner, 1996; Carey & Smith, 1995; Dunbar & Klahr, 1988; Perkins & al., 1995; Scardamalia & Bereiter, 1993; Schwartz, 1995). Engaging learners to formulate new questions and explanations is a key issue as learners are more used to find answers to pre-existing questions rather than posing new ones.

The hypothesis of the FLE prototypes was that a well-designed computer supported collaborative learning tool could drive the inclusion of more knowledge building activities in the classroom and therefore change the existing pedagogical practices in schools. As the first full prototype of the FLE, the Fle3 offered a digital space in which members of the learning community could find: 1) Web-tops for learners to collect and share information, 2) a Knowledge building tool for scaffolded online discussion with the aim of increasing the group's level of knowledge and understanding about the topic under investigation, and a 3) jamming tool for the collaborative design of digital artifacts.

As the latest version, the Fle4 builds on the work carried out in the design of the Fle3. The FLe4 offers a tool for knowledge building that can be integrated and used with a blog service. When compared to the Fle3's knowledge building tool, the Fle4 provides visual and zoom-able network views to the discourse (figure 2). This is expected to help learners keep track of the various activities in the knowledge building discourse as well as organize notes according to their importance. Fle4 also provides more advantaged ways to explore the knowledge building discourse by clustering notes according to authors and used knowledge types. Learners may also view the notes on a timeline.

In the design research of the different versions of FLE, the contextual inquiry of the research-based design process has been focusing on the practices of school learning and the possibilities to change some of them. By studying school children, teachers and parents were able to recognize a need to change the practice, although we also realized that it can be very hard and may take very long time. Another key observation deals with the changes happening in the whole knowledge infrastructure: the Internet connections and computers in schools were supposed to challenge traditional school learning, although at the same time, services such as the Learning Management Systems (LMS) provided for schools were relying on the traditional methods of teaching and learning. With the

FLE, we wanted and still want to present an alternative approach to use computers and the Internet in school learning: more student-centered with a strong emphasis on collaborative work with knowledge.

As part of the design-based research process in the FLE research, we have conducted numerous participatory design sessions with teachers and schoolchildren in several European countries. In these, we have designed features with teachers and children and tested paper prototypes and early versions of the software.

In the product design phase of the research-based design process, we have analyzed the qualitative data gathered from the participatory design sessions and have made design decisions related to the prototypes. Often we have found out that what teachers or schoolchildren want is not what they need, and by negotiating these conflicts, we have often reach a good consensus with most of the people who have taken part in the sessions.

Later in the research-based design process, we have developed the prototypes by following the principles of agile software development, which consists of short cycles of development that allows getting immediate feedback from the people using the software. In the case of FLE prototypes, they have been tested by thousands of users. From this testing we have collected both quantitative and qualitative data that has been analyzed to inform design decisions for the next iterations of the prototype.

Parallel to the design and development of FLE, learning methods based on collaborative inquiry processes were designed and communicated to thousands of teachers in order to validate the pedagogical approach. By building an FLE prototype and introducing a new learning model –the progressive inquiry– we were able to raise awareness among the educators but not necessarily to change school learning. Still, we may claim today that the experiments carried out with the various FLE prototypes and discussions around them, have shaped in a small way the research field of technology-enhanced learning and computer-supported collaborative learning.

4.2. Square1

Square1 is a prototype that consists of several learning devices designed for collaborative learning at school. The design builds on Sugata Mitra's Self-Organizing Learning Environments (SOLE) (2012, 2013; Mitra & al. 2010). In SOLE, schoolchildren, working in groups of four in front of a single computer, are given relatively open-ended questions they must answer by searching information from the Internet and by developing their own explanations. While studying in small groups, they may visit other groups and see what they have found out and they can also change groups if they want. This kind of collaborative construction of explanations is expected to engage children in the learning process that Perkins et al. (1995) have characterized as a process of understanding by «working through». By searching and trying to understand in small groups, students are empowered to work with various information sources, to evaluate them, to combine from them explanations with their own level of understanding, and to have sensible and meaningful discussions on difficult topics.

Square1 connects with the move from personal to interpersonal computers (Kaplan & al., 2009). This has strong implications in how we conceptualize collaborative work, learning, and the sort of interactions that we intend to happen in face-to-face situations. In the original SOLE model, four children work in front of a single computer. In practice, the computers are used only to search information related to the topic under study. With the Square1, we wanted to experiment with how devices could exist that are precisely designed for SOLE or a similar kind of collaborative process, that, in addition to searching information from the Internet, supports students to negotiate on the findings, to organize them, and to create new knowledge such as problems, hypothesis, and conclusions about the issues under study.

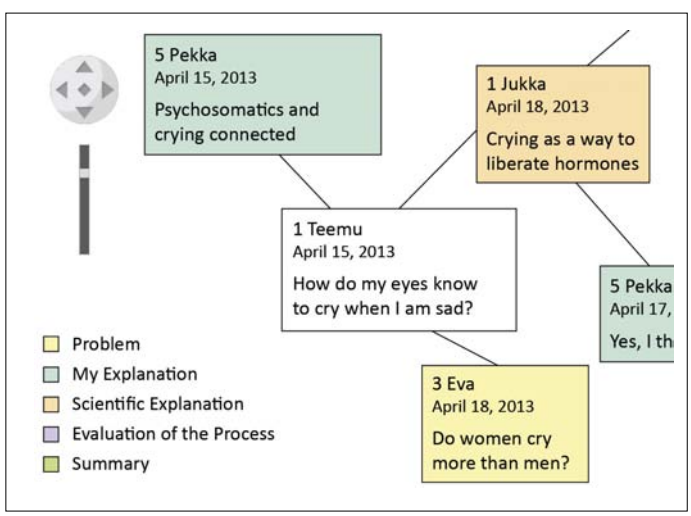

Figure 2: FLe4 knowledge building tool's map view.

The Square1 prototype set includes three devices: (1) one for writing, (2) one for drawing, and (3) one central computer device for search and presentation composition (figure 3). With these devices, a group of four schoolchildren can do searches on the Internet with the central piece, write notes with the writing devices, and draw pictures with the drawing devices. Working with the central piece is expected to generate negotiation on the reliability and selection of sources, which will be used in the presentation of their research. With the writing and drawing device, children are expected to create content that will be included in the presentation of their findings and explanations. The things written and drawn with the devices can be moved to the central piece, where they are again composed together to be the presentation of the research.

A distinguishing aspect of the Square1 prototype is its connection to and fostering of a maker culture. The Square1 is designed to be assembled by children in school. The blueprints of the cases can be downloaded from a website and manufactured either with computer-aided manufacturing tools such as 3D printers and laser cutters or with traditional handicraft tools such as saws and screwdrivers. From the website, children may also find information about the components needed to assemble the devices and download all the software needed. In this sense, Square1 relates to some extent to the principles of Educational Sloyd, an educational movement started in Finland in the 1860s, which advocated handicraft-based general education. Other references in the Square1 concept come from initiatives, especially in the United States, that promote children as makers (e.g., Tinkering School[3], the Mentor Makerspace[4] program, and Otherlab)[5].

The hypothesis of the Square1 prototype has been that by introducing a set of computer devices that are built by children and precisely designed for SOLE purposes, children will reach a higher level of ownership of their learning, get a better understanding of the technology used in their everyday life, and get engaged to the SOLE kind of learning projects. The experience of building their own learning devices and by using them in learning where they are responsible for the results of learning is expected to have a long-lasting empowering effect on the children.

The design of the Square1 prototype also carries the idea of slow technology. The slowness does not mean slowness of the software running in the device but rather being slow with some tasks when compared to the time needed to complete them with a pen and paper or a laptop computer. This approach is aligned with slow technology where, according to Hallnäs & Redström (2001), slowness is a key factor that could bring forth, and make room for, reflection. In this regard, slow technology should be considered as an attempt to discuss the foundations for design as such in information technology (Glanville, 1999).

During the contextual inquiry of the Square1's research-based design process, we have visit several schools in Finland to observe their ways of using laptops, tablets, and smartphones as well as trends related to handicraft teaching in schools. In many schools, there are good facilities to assemble devices like the Square1, and the lack of deeper technology education with the information and communication technologies has been recognized by many teachers. The SOLE model is known by some teachers, and there is interest in trying it out in schools. The information gathered and the analyses of it done during the contextual inquiry helped us to define the design challenge.

In the participatory design phase of the research-

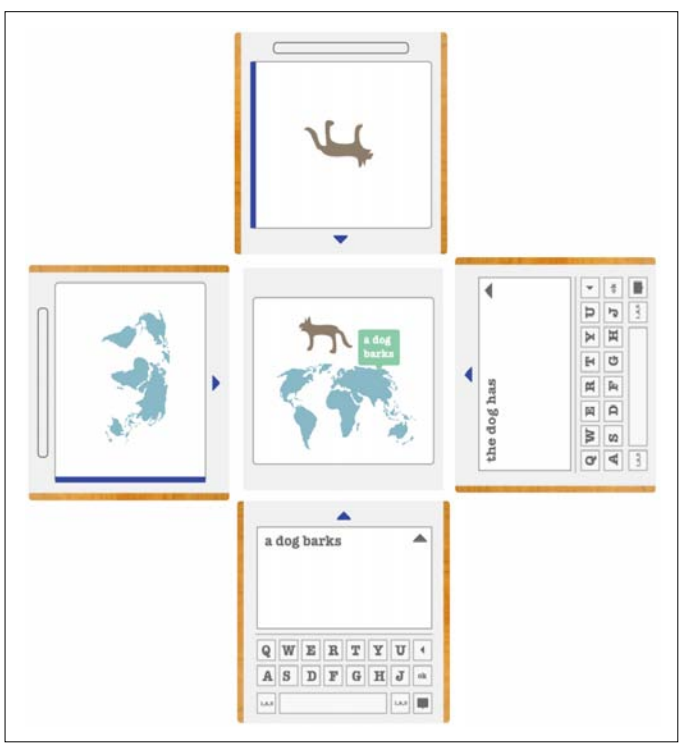

Figure 3: Visualization of the Square1 November 2012 prototype (by Anna Keune).

based design process, we have run 12 workshops with schoolchildren in Finland and in the United States. In these participatory design sessions, children have been creating the initial idea and have developed it further with paper and cardboard prototypes. In the research group, we also have played SOLE with the cardboard prototypes to get a first-hand experience on the learning model and its possible implementation with the Square1 prototype.

Back in our design studios in Helsinki (Finland) and Berkeley (USA), we have analyzed the data from the participatory design sessions and have made design decisions on the development direction of the prototype. Parallel to the hardware design, we have started working on a software prototype. Furthermore, we have started to test potential components available in the market. This way, the product design is already partly mixed with the production of the first functional prototypes.

Square1 is still in the stage of being an early prototype, and the research is a work in progress. Initial testing of the first functional prototypes in a classroom environment will start in the autumn of 2013. In the first stage of testing, we will focus on the use of the devices in the SOLE and then move to the second stage of testing, where children will be asked to assemble their own devices.

5. Discussion and conclusion

As a methodological approach, design thinking and the research-based design process relies on a shared, social construction of understanding with the people who will later use the tools. For instance, Bonsignore et al. (2013) have proposed participatory design techniques in the design of technologies for collaborative learning. When using the design-thinking approach, we may also see that the insights are gained in a dynamic process of «reflection-in-action», where action is used to extend thinking and reflection is governed by the results of action (Schön, 1987).

Design thinking is deeply human-centered system thinking. In the case of CSCL research, it can help researchers take into consideration both the students and the teachers in a system. With research-based design, design research can conclude with prototypes that will have a real impact on the everyday practices of teaching and learning.

The research-based design process aims to meet the challenge of designing for use before it actually has taken place – design for use before use (Redström, 2008). In order to achieve this goal, it is crucial to involve the participants in the design process, allowing them as «owners of problems» to act as designers and to keep the prototypes open for further development (Fischer, Giaccardi, Ye, Sutcliffe & Mehandjiev, 2004). In the research-based design process, it is not possible to decide at first what the problems are and what is needed. Therefore, it is essential for designers to engage in an open dialogue with participants and collaborate with them in a process of shared meaning construction.

Approaching CSCL research with a design-thinking mindset opens the door for more experimental prototypes in which failures are also considered as results. Although in research-based design it is important to be systematic and analytical, creativity, serendipity, and intuition that comes from the art and design traditions can offer valuable input.

Another aspect to take into consideration in the discussion about design thinking and research-based design in CSCL research is the designers' commitment to service. The tools designed are there to serve the learners and teachers and this should be a driving force throughout the design research process. The utilitarian service approach doesn't mean that designers should not be aware of theories of pedagogy and social science – quite the opposite. Designers must understand pedagogical ideas and be able to use them in their designs and enrich the field with their contribution. Therefore, we consider that design thinking can be an interesting, alternative approach in CSCL research, especially when the aim is to provide learners and their teachers with CSCL tools that will serve them.

Notes

[1] CoVis: www.covis.northwestern.edu (02-09- 2013).

[2] Beldevere: http://belvedere.sourceforge.net (02-09- 2013).

[3] The Tinkering School, 2012: www.tinkeringschool.com/about (02-09- 2013).

[4] Mentor Makerspace, 2013: http://makerspace.com/tag/mentor-makerspace (02-09- 2013).

5 Otherlab: www.otherlab.com (02-09-2013).

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