Square1 Prototype: Build your own devices for collaborative learning

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As a class of forth-graders (9-11 year old children) is starting their semester, their teacher is introducing the study project: building of computing devices. The class visits a website with instructions, and teams of students look at and discuss illustrative examples. The students modify the provided designs. With the teacher, they place an order of electronic components that are needed to build the devices. The following week is spent at the school's workshop, where the class fabricates the device cases. Once the electronic components arrive, the students start assembling their devices. They download and install software and explore how to use their new tools together. After the building phase, the teacher integrates the devices in study projects, varying from environmental issues to space physics and from local history to globalization. The study projects follow the principles of selforganized learning environments (SOLE) (Mitra, 2010; 2013). The teacher poses a challenge and student groups of four use the devices to solve it. Finally, they prepare a presentation with the devices and present their findings to the class.

With connections to the Educational Sloyd movement and a recent revival of the "do-it-yourself" and maker culture, we designed a set of single-task dedicated learning devices for collaborative learning. The set is called *Square1*, and it consists of three different devices: (1) one for writing, (2) one for drawing, and (3) one central device for online and offline search as well as composing presentations (see Figure 1).

Figure 1. Arrangement of Square1 set on a table.

The history of designing computers for children is close to 40-years old. Based on Kay's (1972) esteemed vision of the Dynabook, a personal computer for learning, Papert (1993) considered technology as construction kit and "medium of expression" through which children can form relationships to knowledge domains, and recognize learning as a dimension of life. With the intention to broaden ownership of computational devices to all, the Simputer was developed in India in 2000 (Simputer Trust, 2000). The idea of a personal computer specifically for learning was materialized through the One Laptop Per Child NGO (OLPC, 2013) by designing a low-cost and durable laptop for learning in 2002. We observed that tablet computers, such as iPads, have generated vast interest in schools today. By design, Dynabook, Simputer, OLPC and tablet computers support the idea of computers as personal tools for efficient computing, assistance and media consumption. Children can switch between multiple applications and perform several tasks nearly simultaneously using the same tool.

With Square1, the design and use of digital tools and technology for learning is intended to be extended from personal to shared ownership, from individual to collaborative learning, and from all-inclusive to dedicated use. Distinct through the task performed with each device, students can choose when to collaborate and separate tasks, a pronounced characteristic of self-organized learning environments (Mitra, 2012; 2013). Square 1 is a powerful design in progress, because it fuses support for selforganized learning with educational aspects of making. Children will build the Square1 devices inside or outside of school.

Hacking as school practice

Educational Sloyd originated in Finland in the 1860s as an educational movement with a particular emphasis on handicraft-based general education. Technical drawing, woodwork, textile work and other forms of handicraft were practiced with the intention of strengthening intellectual capacities and an industrial disposition in children (Reincke, 1995; Leinonen, 2010). The movement followed the pedagogical principles of advancing from the concrete, known and simple to the abstract, unknown and more complex through the use of crafting tools. It was precisely the use of tools that was considered to educate children. While initially only focused on wood, textile and paper craftwork, today, Educational Sloyd practices also encompass the use of more complex manufacturing machinery. The exploration, playfulness and cleverness that some Sloyd implementations introduce to school are similar to Stallman's definition of hacking (Stallman, 2013). With Square1 we aim to introduce aspects of hacking in school learning on two levels: the process of building tools and the process of collaborative learning with these tools.

Through Contextual Inquiry, an essential and characteristic phase of Leinonen's research-based design approach (Leinonen, 2010), we observed trends towards a do-it-yourself culture and an increase of handcraft in schools over the past two years. For example, some of the recently installed workshop spaces in school buildings across Finland include, among other tools, laser cutters, milling machines and 3-D printers. This suggests that schools discern a value from investing in state-of-the-art workshop equipment and spaces, and that teachers are increasingly eager to include meaningful craft working activities in school learning. This is a global occurrence: educational practices outside of Europe with a strong connection to the underlying principles of Educational Sloyd are, for example, the Tinkering School (2012), a U.S. American foundation that empowers children to learn through building using power tools, as well as the MENTOR Makerspace program (2013), which aims to establish workshop spaces in 1000 schools across the United States by 2015. In Northern Europe, in accordance with Educational Sloyd principles, school workshops are utilized for students to master the

tools, first under guidance and later independently. Students are instructed to create products, traditionally, wood carved Sauna scoops and, today, also 3-D printed objects, such as cups and vases. However, these products do not necessarily have a distinct role in educational practice beyond creation besides a short playful use.

While the trend of craftwork for learning is increasing, including projects using electronic components, we recognized that hobbyist activities of building personal computers decreased dramatically. In the 1990s hacking of computer hardware was common: many European youths build computers using electronic components, affording the exploration and discovery of the inner workings of the machines. Hallnäs and Redstöm (2001) refer to the transparency of technical tools as "slow technology", which enables reflective activities. Designs such as the Raspberry Pi (2012), a small and affordable computer with options for connecting screens and other input/output devices, are efforts towards supporting children to develop an understanding of technology by building computers. Companies, such as SparkFun Electronics (2013), specifically support maker projects that involve computational tinkering by selling electronic components and workshops also to schools. However, the building of computers is seldom an integral aspect of school curriculum.

Based on the Sloyd principal of learning through the use of tools, the international interest of schools to invest in construction as meaningful learning activities, and the scarcity of integrating constructed objects into future learning activities, we designed the Square1 concept in close collaboration with children and teachers.

Designing with children and teachers

The idea for the Square1 set of devices emerged while exploring modes of interaction with 6-7 year old children during an open-ended participatory design session. The session design was based on Mitra's (2013) self-organized learning environments (SOLE), in which a teacher presents children with an open ended question, steps back and lets the children frame an answer using computers for research purposes. We posed the question: *"What would be an ideal computer for children who are learning at school in groups and present their finding to peers?"* All participating children were familiar with laptop and tablet computers; however, they were not specifically personally invested in learning about how computers work. Their focus lay in form and interaction. During the session, we crafted a cardboard prototype, a device in the shape of an equilateral cross. Together, we imagined separate workspaces for four children and a central space for collaboration. Using the cardboard prototype, we invented and performed a scenario in which two children typed text and two drew pictures. The children shared text and images by moving them to the center, and imagined that the individual workspaces could fold onto the center.

During the session, the children frequently mentioned their enjoyment of tactile and multimodal feedback. Not the expeditious completion of one or many tasks was their focus, but rather the way in which the interaction is carried out to support on-task concentration. In the design studio, through conceptualization of the children's comments, we developed the hypothesis for the Square1 set of devices: devices that afford slowness and tangible interaction, instead of efficiency and multi-tasking, should facilitate schoolwork. We further developed the prototype, for example, splitting the cross shaped device into three separate tools. A second cardboard prototype was developed to represent these ideas (see Figure 2).
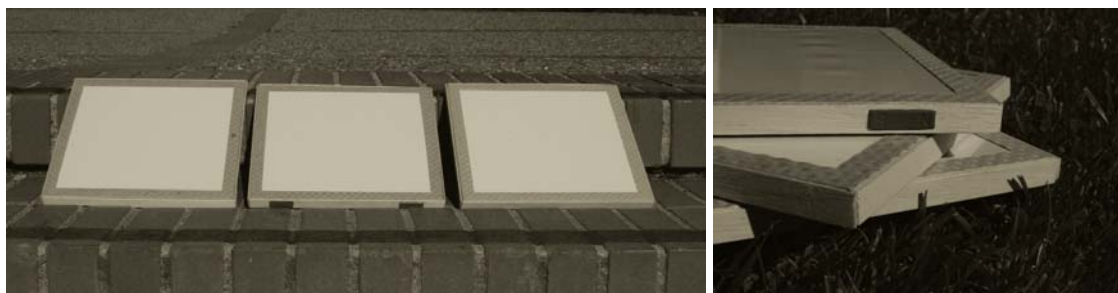
Figure 2. Square1 cardboard prototype.

This second cardboard prototype was discussed in two focus group sessions, one with two Finnish teachers and another with three German teachers. With the teachers, we elaborated the potential of building the devices in schools, and discussed learning scenarios for using the devices.

In participatory design, children are frequently referred to as design partners (Kafai, 1998; Druin, 2002). Through the interaction with, for example, colored pencils and paper, children can communicate their ideas and experiences at different point of the design process. Although aiming to create democratic design space with children, trained designers often have to decide when and how children can communicate their ideas. For this, it is interesting to note the astonishment of the children whom we performed the participatory design session with when they learned of our further development of the Square1 concept in the design studio. They asked why we had not invited them to participate, communicating a clear feeling of ownership of the design idea and process. While the following section focuses on the presentation of the Square1 concept and how it can be used in school learning, we consider the children's reactions an important consideration for further research.

The Square1 devices and how to use them in school learning

The Square1 set of devices is a design in progress that is planned to support collaborative and cooperative learning, by enabling writing, drawing, searching and the creation of presentations as tasks performed through separate devices. This task focus determines the physical design of the three devices.

The central device will be composed of a camera, magnetic connectors for four other devices, and two touch screens (one on each plain surface). The double screen creates separate spaces for two tasks: One screen will be for composing presentations, and the flipping the device will enable search. Students will be able to store searched images and text paragraphs to a library, which can be accessed by flipping the device back over to the composition screen. The writing device will consist of a screen, an off-screen keyboard, a scrolling wheel, and a magnetic connector. Written work will be organized in paragraphs, without files. Through physical connection, paragraphs can be shared to the central device for composition. The device for drawing will include a magnetic connector and a touch screen, affording paper like drawing, such as texture tracing. Drawings will be stored as transparent images to facilitate the composition of text and images on the central device.

Square1 is planned to include a blueprint of the device cases, a list of required electronic components, instructions of how to build the cases and how to assemble the components, as well as a package of open source software. Both, hardware and software are considered to be open for modification and repurposing.

Simplicity and tangibility are guiding design principles of Square1. For example, sharing will happen by connecting writing or drawing devices to a central device, and sweeping paragraphs or drawings to the center. Multimodal feedback in form of physical motion, adherence of the devices and on-screen feedback in form of a gentle audio-visual animation will confirm a successful connection.

Drawings, paragraphs and presentations will be stored on infinite desktops that expand to the left, right, top and bottom. Visual support for navigating the canvas is provided on the top right (see Figure 3). While paragraphs and drawings will be stored locally, objects shared to the central device will be saved online.
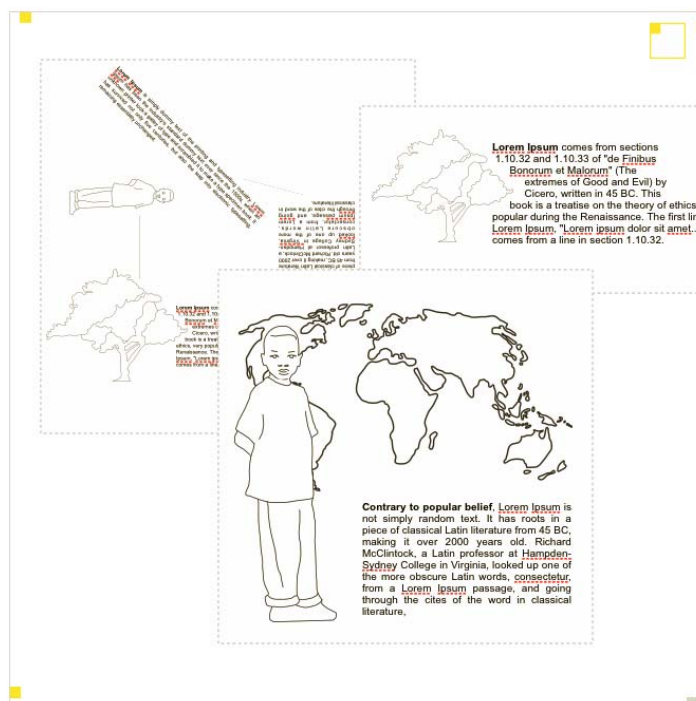
Figure 3. Square1 interface including navigation.

To support shared ownership of devices and work, once created, individual paragraphs or drawings cannot be removed. To delete content, devices may be restored. Further, to share paragraphs or drawings requires collaborating students to agree on physically connecting devices. Also to perform an online search collaboration and task focus is required. Presentation composition tasks need to be paused to flip the central device into search mode. This presents an opportunity to negotiate work processes.

Square1 is designed for school learning environments. One of the areas in which teachers who participated in focus group sessions considered the set of device promising is inquiry-based learning, such as progressive inquiry, a way for students and teachers to perform expert-like investigation (Hakkarainen, 2003). The Square1 task separation is intended to support students' smooth transitioning between content production, task sharing and discussion towards a consensus based shared result. For example, students can remove all writing and drawing devices from the central device to review and discuss shared work and generated ideas on one screen together. Students can then agree on further activities to improve their work, share tasks, and use the writing and drawing devices to produce missing material, which can be shared by re-connecting to the central device. The possibility to connect and disconnect devices is considered to support self-organized oscillation between collaborative and cooperative modes of learning.

Discussion and further work

We expect that predominantly teachers and students of schools with workshop and manufacturing facilities will consider Square1 interesting. Additionally, we assume that schools or other communities with ties to FabLabs, an open digital fabrication initiative by the Massachusetts Institute of Technology (MIT) Center for Bits and Atoms (FabLab, 2013), will be among the early adopters. Many schools are running on tight budgets, thus, asking schools to purchase additional tools can be a challenge. However, we consider that pairing the activity of building computing devices in school with a design that teachers can integrate in future collaborative and self-organized learning activities is powerful. We view precisely the activity of building collaborative computing devices in schools as educational and empowering. Children are considered to gain a deeper understanding of the inner workings of a tool, to practice using workshop tools, and to become active participants in the construction of learning tools.

Square1 has been carefully designed based on qualitative empirical research findings. While teachers consider Square1 to promote collaborative self-organized learning in school and to facilitate the integration of student build objects into future learning activities, the design is a hypothesis. Here, we would like to present aspects for future research and development.

Although the form of the devices is directing the way in which students collaborate and cooperate, the design is not preventing teachers and students from referring to other tools, such as students' personal mobile tools. By being able to connect and disconnect single-task devices, we assume that students are afforded to use Square1 devices for all project tasks. In understanding the role of single-task dedicated devices in supporting collaborative self-organized learning activities compared to multi-functional tools that are deliberately limit, experiments including a set-up of 5 existing tablet devices will be performed. Two of the five devices will be locked to a writing application and two locked to an application for drawing. The fifth device will be limited to a presentation composition application. All five devices will be connected through a cloud service to enable students to share content. The social implications of collaborating using single-task devices that are limited by design compared to using multi-purpose devices that are limited by the teacher will be the focus of these experiments.

With Square1, the use of digital tools and technology for learning is intended to extrapolate from personal ownership and all-inclusive use towards shared ownership and dedicated use. To identify whether the conceptualized form and modes of audio-tactile interaction are indeed advantageous for fostering self-organized collaborative learning, we will facilitate further participatory design and focus group sessions with children and teachers. These sessions will also shed light on the role of children within the research-based design process.

To further support SOLE, progressive inquiry and knowledge building learning approaches, Square1 software will be developed. Writing, drawing, searching, composing presentations and sharing tasks will be studied separately; nevertheless considering the development of consistent interactions. Ideas include facilitating the definition and visual mapping of research questions, storing of emerging tangents while working on a project, creating work process information visualizations for reflection, and visual support for task and role sharing.

The early empirical qualitative research findings, which indicate that Square1 is a pedagogical meaningful concept encourage us to pursue future research activities that focus on the design of the physical devices, the software interfaces as well as instructions for building Square1 in school. We plan to document our findings in future research publications.

Acknowledgments

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Digital dashboard for visualizing learning progress and well-being

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Data tracking is becoming a popular practice in very different domains ranging from sports to health, work productivity and learning, among others. Currently, the availability of personal informatics tools allows a growing number of people to collect personally relevant information for the purpose of self-reflection and self-monitoring[1]. The goal of initiatives such as the Quantified Self[2] is to develop understanding of different aspects of a person's life, such as behaviors, habits, and thoughts, through self-monitoring. These initiatives, also known as lifelogging, living by numbers and personal analytics, among others, open the door for self-knowledge through numbers.

Knowledge about oneself, that's to say self-awareness, has been considered as a critically important component of metacognitive knowledge (Pintrich, 2002). From this perspective, self-knowledge is a person's awareness of her strengths and weaknesses of their cognition and learning, as well as her motivations. Self-awareness is a valuable skill for decision making since it supports the prediction of outcomes and how comfortable one would be with them (Carlson, 2013). In this sense, acquiring a deep knowledge about oneself has been associated with a range of positive outcomes in interpersonal relationships, mental and physical health (Miller & Wrosch, 2007; Wilson, 2009). Furthermore, getting aware of oneself is key to critical thinking, since it implies questioning what, how and why we feel, behave and learn, in the way we do.

In personal informatics, tracking personal data about health and exercise supports informal learning and behavior change. In sports, some of the currently well-known body tracking products focused include Nike+[3] and its fuelband[4], Fitbit[5], Philipps directlife[6], Adidas Mycoach[7], RunKeeper[8] and Striiv[9]. Concerning wellbeing, applications such as mindbloom[10], Ubifit Garden[11] and Fish'n'Steps (Lin et al., 2006) offer opportunities to users to learn about their progression and undertake new challenges, in our case, in relation to healthy habits. In the health domain, the development of mobile apps for diabetes (Preuveneers & Berbers, 2008) is another example of how personal analytics can contribute to self-knowledge in aspects that improve life quality. A shared characteristic in many of these tools is that they make intensive use of infovis in order to show the users' performance.

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[1] http://personalinformatics.org/

[2] http://quantifiedself.com/

[3] http://nikeplus.nike.com/plus/products/gps_app/

[4] http://www.nike.com/us/en_us/c/nikeplus-fuelband

[5] http://www.fitbit.com/

[6] http://www.directlife.philips.com/

[7] http://www.adidas.com/fi/micoach/

[8] http://runkeeper.com/

[9] http://www.striiv.com/

[10] https://www.mindbloom.com/lifegame

[11] http://dub.washington.edu/projects/ubifit

In the field of e-learning, the high proportion of interactions that are computer-mediated has created an interest about how this data can be used for improving teaching and learning. Similarly to personal informatics, learning analytics take advantage of the possibilities of data tracking in order to understand and improve practices. According to the definition provided in the 1st International Conference on Learning Analytics & Knowledge[12], learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs.

The use of "big data" (Siemens, 2012) in education has been at the center of Learning Analytics movements. Despite learning analytics models seek to inform and empower instructors and learners, some critics have expressed concerns regarding the commercialization of the education sector, outdated indicators performance, simplistic uses of artificial intelligence in education, and the ethics of datasets and how they are used. One of the aspects that have been highlighted is that "analytics could disempower learners, making them increasingly reliant on institutions providing them with continuous feedback, rather than developing their own meta-cognitive and learning-to-learn skills and dispositions" (Buckingham & Ferguson, 2011, pp.5).

In line with authors such as (Duval 2012, Cloud 2012, Kruse & Pongsajapan , 2012), learning analytics should be considered as a tool for the student. There is a lack of tools addressed to students that help them to develop a visual overview of their learning performance, as well as of the elements and resources that have an impact on it. From this perspective, the student is the owner of the data and therefore the main one interested in making sense and reflecting on it. However, as is the case with personal informatics systems, self-understanding doesn't seem to be as one of the main goals to achieve when using learning analytics. Qualitative aspects that might have an impact on the learning performance, such as the students' wellbeing, are not included in the data tracked by learning analytics.

Although stress and training effectiveness have been at the center of much research during the past several decades, there has been very little research intended to integrate these two areas (Le Pine et al., 2004). In learning analytics, indicators concerning the students' stress levels and how they feel, are not taken into consideration when, they could actually provide useful insight about their learning capabilities. In this sense, the project builds on the idea that the integration of well-being and learning performance information, in a learning environment could contribute to develop a more personalized approach to learning.

Considering the stated arguments, this research proposes an innovative approach to learning analytics that combines data about wellbeing with learning performance. By combining these two datasets, focused on wellbeing and learning, the system will provide the students with information about themselves and, therefore, promote self-understanding. The project seeks to contribute to the students' self-regulation skills by offering them a tool that shows the interrelation between their level of wellbeing and their learning capabilities.

Information visualization as a tool for reflection

Data collection, as well as the review and analysis of this data are central aspects of personal analytics. Li et al. (2010) introduce a stage-based model of personal informatics in which

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[12] https://tekri.athabascau.ca/analytics/

they identify five stages: Preparation, Collection, Integration, Reflection, and Action. While preparation and collection refer to the selection and capture of relevant data, integration, reflection and action deal with the analysis and understanding of this information. In other words, enable insightful reflection. Depending on the persons' conclusions, the reflection process can lead to a need to change behaviors, that's to say, to take action.

Some of the questions that emerge from this context, is how to make large volumes of data meaningful for users. How should this data be displayed in order to improve self-understanding, reflection and critical thinking?

One of the great strengths of data visualization is the human's ability to process visual information much more rapidly than verbal and textual information. Therefore, large datasets are usually presented visually, rather than as the raw numbers. Detecting data patterns and trends is far more cognitively demanding when looking at the raw numbers, than a visual representation of the same. In this regard, information visualization (infovis) is seen as a powerful tool for reducing cognitive load, offloading short-term memory, allowing for easier comparisons, and generally facilitating inferences (Shneiderman, 1996; Tufte, 1990 and 1997). At the same time, visualizations support the process of sense-making, in which information is collected, organized, and analyzed to generate knowledge and inform action (Heer & Agrawala, 2008).

In the learning field, infovis can be a powerful tool for teachers and students. As Duval (2011) suggests "For learners and teachers alike, it can be extremely useful to have a visual overview of their activities and how they relate to those of their peers or other actors in the learning experience". In this regard, dashboards are seen as critical data visualizations since they display the most important information needed to achieve one or more objectives. Few's definition (2004) also highlights that this data should be consolidated and arranged on a single screen so all the relevant information can be monitored at a glance.

Regardless of dashboard technology gaining popularity, there are still some challenges to providing the right information according to user's needs. Few (2006) noted that, although visually appealing, many dashboard technologies lack the ability to provide truly useful information. Dashboard technology could do well to develop in the areas of identifying the most relevant data, as well as the integration with technologies that support collaborative data sense-making, predictive analytics, the identification of meaningful patterns, as well as seamless integration (Few, 2013).

The creation of a goal oriented visualization (Duval, 2011) that helps relating students' well-being with their learning patterns can help advance research in some of the areas outlined by Stephen Few. For instance, collaborative sense-making can help students develop a deeper insight into the data displayed in their visual dashboards. Due to the personal nature of the data visualized, sharing the data is an option that the students can voluntarily choose.

Visualizations, understood as a shared external representation, can contribute to collaborative learning by acting as boundary objects (Star, 1989) that support discussion between divergent viewpoints. From this perspective, information visualization connects with the knowledge creation framework of learning (Lipponen, Hakkarainen & Paavola, 2004), in which, according to the authors "The defining characteristic of creative collaboration is that it is focused on advancing certain shared objects, knowledge-laden or conceptual artifacts and the agents' relationship to them" (pp.12).

The interaction design of this visual dashboard, focused on well-being and learning, does not have to necessarily rely on computer screens. In this sense, more innovative concepts of how users interact with the visual displays of information, in a given space, would augment the role of infovis as boundary objects (Star, 1989) that mediate knowledge building processes.

Methods

This project builds on participatory design and a research-based design process (Leinonen 2008, 2010). Even research-based design is characterized by being iterative, four phases can be identified: contextual inquiry, participatory design, product design and software prototype as hypothesis.

To design tools that effectively assist self-reflection, it is crucial to understand how people think about wellbeing and learning in relation to their everyday practices. Therefore, we seek to involve users from the early stages of the design process, in order to incorporate peoples concrete wishes and expectations. To achieve this, 5 to 7 people, who are engaged in learning besides their work duties and that have a certain awareness about their wellbeing, will be interviewed. It is expected that the interviews developed during the contextual inquiry stage will help frame users' needs in relation to their learning progress and wellbeing.

The information gathered through the interviews will be used for creating some use scenarios that will present preliminary design concepts. These scenarios will be the starting point of a participatory design sessions that will be developed as a workshop. The results of the participatory design sessions will be further elaborated and developed as early prototypes. The prototypes will be developed through an iterative design-reflection process until they finally become working prototypes that can be tested with real users in their everyday learning situations.
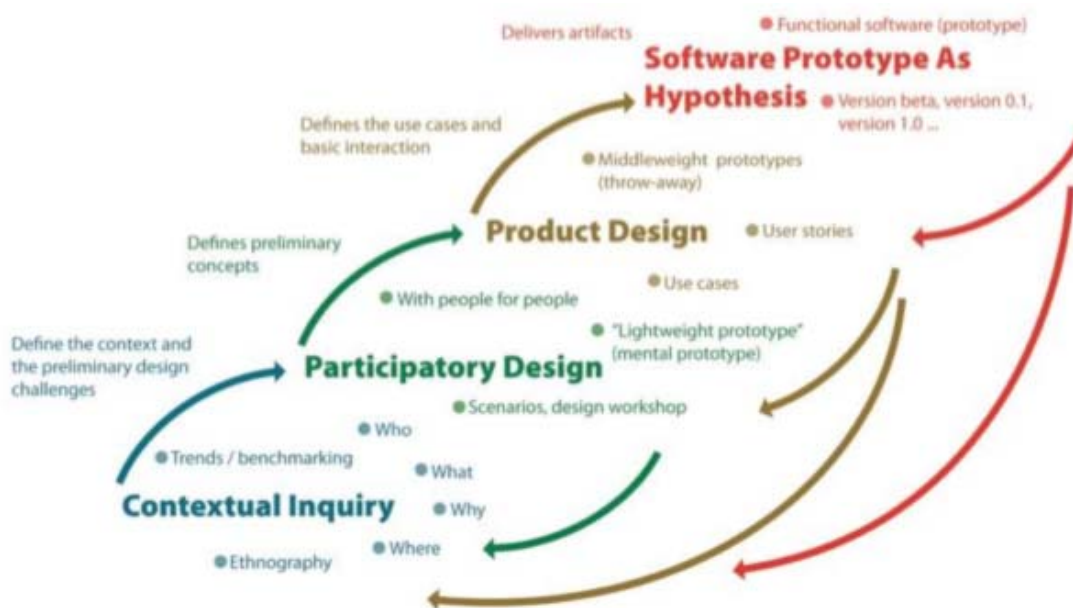
Figure 1. Research-based design process, based on Leinonen (2008, 2010).

Research proposal

This research proposal focuses on the design of a visual dashboard that combines objective and subjective data about students' well-being with their learning patterns. We expect that the creation of a goal oriented visualization, that gathers health data such as students' stress and recovery levels and mood, and represents this in relation to their learning performance,

would allow students to reflect about their lifestyle, and when considered relevant, take informed steps to improve their learning.

The research question that leads this project is how information visualization can support reflection and collaboration in learning. In this proposal, visualizations are understood as boundary objects that can be used as key materials for reflection and sense-making processes. The design of this visual dashboard follows Viégas and Wattenberg's (2006) communication-minded visualizations: visualization systems designed to support communication and collaborative analysis. The underlying idea of this approach is that participants learn from their peers when they build consensus or make decisions.

Scenario

Ari is a 34 years old architect that has decided to combine his freelance job with master studies in industrial design. On a daily basis, Ari's agenda is quite tight: besides combining work and studies, he has family duties. Although he started the master highly motivated, Ari is recently having trouble completing courses successfully. He feels stressed, tired and he has problems focusing on school tasks. Nevertheless, he considers himself able to cope with his multiple responsibilities.

Ari's study advisor has recommended, several times, that he takes things easier and carefully plans the amount of courses he takes. In order to help him to develop awareness and to better self-regulate his learning, he suggests that Ari uses a digital dashboard in which information about his learning performance is combined with data about his wellbeing. The wellbeing data is determined by monitoring Ari's heart-rate stress and recovery levels, as well as his mood.

Ari tries the system during three weeks. Ari's data visualization shows a correlation between his physical and mental well-being and his learning progress.

The periods when Ari has had slower heart-rate recovery levels, his mood was bad and his learning performance was poor. At first, Ari is surprised. He hadn't realized that such a pattern existed. He shares the data with his study advisor as well as with some of his classmates. Thanks to the discussions, he realizes that during the low performance days his schedules were quite chaotic: he slept very little, smoked and drank quite a lot of coffee, and he wasn't doing any sort of exercise. Some of his colleagues suggested that doing some physical activity could improve his resting hours and, therefore, his capacity to stay focused.

After a couple of days thinking about his peers' comments, Ari decides to do some changes in his everyday schedules. First, he chooses to enroll in fewer courses during the following semester and he starts to reserve 30 minutes for exercising on a daily basis. He also tries to be stricter with his sleeping hours. By slightly modifying some of his habits, Ari wants to see if there is any impact on his learning progress. He does the changes and collects the data during three weeks. During this time he can see how his heart-rate recovery gets faster and his learning performance improves. Furthermore, he is in a better mood.

Ari decides to continue using the digital dashboard. The collection of data about his wellbeing and learning performance offers him the opportunity to dedicate at some time to analyze it. Ari has never been keen on self-reflection and this tool helps him to improve his self-awareness. By developing a better understanding of himself, Ari realizes he is able to make better decisions and achieve the challenges he undertakes.
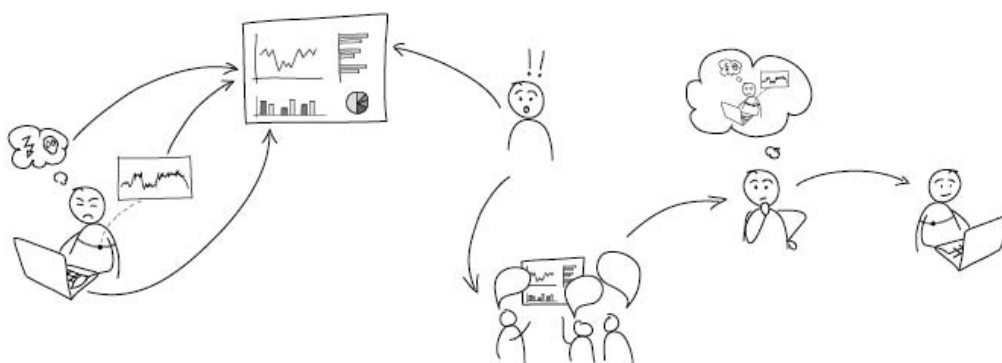
Figure 2. Scenario of use of the digital dashboard for visualizing learning progress and well-being.

Conclusion

In this paper, we have presented a design proposal for creating a digital dashboard that visualizes data about well-being and learning performance. We claim that this information visualization will contribute to people's self-knowledge, which is a key element for self-regulated learning and decision-making. This project is based on the assumption that information visualization can be a powerful tool for sense-making, specially when combined with tools for collaboration and communication.

This project seeks to contribute to learning analytics research by presenting an innovative approach, that presents learning performance in relation to other aspects that have an impact on it, such as well-being. The design proposal is student-centered since the main goal is to promote the students' reflection on their own data and, therefore, improve their self-knowledge.

Acknowledgements

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How to design learning in the 21st Century

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This paper looks at lesson planning as a design activity. We try to modify one design method, *Research-Based Design* (Leinonen, 2010) for the specific purpose of designing learning activities. The purpose is to communicate ideas from contemporary design methodology to another field of expertise with similar challenges. *Research-Based Design for Learning* brings participatory design into the classroom in an attempt to foster regular reflection on learning activities and teaching practices.

The rationale for using design-inspired model for lesson planning comes from rapidly changing skills requirements for today's learners. The basic assumption in 21st century skills discussion is that to succeed in a complex and dynamic post-industrial economy, there is a need for a different skill set than the one required for industrial economy. Possibilities for self and cultural expressions and requirements for good citizenship are also changing rapidly due to globalization, Internet penetration and political changes. The skillsets put forth by various groups advocating for 21st century skills include competencies in maths, science and technology, critical thinking, creativity, communication, collaboration, cultural awareness and expression, self-direction and accountability among others (Dede 2009, Silva, 2008; Jerald, 2009; 21st Century, 2010).

Dede (2009) divides 21st century skills into contextual and perennial skills. Perennial skills are lifelong skills, while contextual skills change depending on time and place. When contextual skills are included into curriculum and goals of education, then the goals of education have to be in constant change to reflect what contextual skills are deemed useful for learners in their adult life. E.g. information retrieval skills have changed greatly during recent decades. If the pace of the change remains the same or is faster, building curricula for teaching certain contextual skills may always lag behind the actual needs. Contextual skills also do not fit into continuous and objective evaluation across time: if goals change, evaluation metrics have to change. This puts contextual skills into a side track of education; they are recognized as worthy goals, but they are thought to be achieved while learning traditional, measurable knowledge-based school subjects.

Background

The challenge of 21st century skills resembles the challenge that has been recognized in fast paced technology development. The existing processes for manufacturing have been found to be slow to react to fast moving changes in requirements and new developments. Software development has met this challenge and developed its own Agile methodology to speed up reactions to changing environments.

The Agile methodology is a set of software development processes aimed at enabling quick incorporation of changes arising from the unpredictable nature of software requirements. The methods emphasize incremental approach, wide collaboration and

avoidance of setting fixed plans too far ahead. (Cockburn & Highsmith, 2001; Cohn & Ford, 2003). However, a key aspect that makes the agile methodology ill fitted for schools is that it is built around the customer-developer relationship, where customer makes requirements and demands and developers are a loosely organized group of hired experts to fulfill them. Teachers' and students' roles shouldn't be mapped into that. Some aspects of agile development, like incremental approach, quick designs and general preparedness for adaptation are something that should be applied in schools.

Design has also recognized its overt reliance on design tradition when designing products for people outside designer's familiar cultural context. Design addresses users' needs, and this requires that the designer understand those needs. This has created various design methods which involve subjects of the design in the design process to improve the design or designer's understanding of the challenges.

The prototyping process relies on the users' ability to give feedback on tangible products rather than on imaginary ones. The process involves an initial stage where ideas about an envisioned system are collected from users and afterwards, on experimentation with a working model as a basis for further iterations of development and user review. (Naumann & Jenkins, 1982; Burns & Dennis, 1985)

Prototyping focuses on products in a way that doesn't translate well into classroom setting: there may be no motivation to justify iterating on learning activities for long period, if there are several subjects and fields of knowledge that should be learned. With iterative prototyping, it may take longer than necessary to arrive at suitable learning activities.

The Research-Based Design (RBD) is a design process inspired by both Prototyping and Agile methodology that aims at producing tools and artifacts as end products by employing research as a means of achieving these outcomes (Leinonen, 2010). Its elements of iterations and people involvement allows the designer to build a deeper understanding of the context. RBD consists of four phases: *contextual inquiry, participatory design, product design* and the *production of a tool as hypothesis* (Leinonen, 2010). These phases are shortly described below.

Contextual inquiry aims at understanding the existing work practices and identifying problems in them. It involves the observation and analysis of users at work. Participatory design is about collaborative meetings where subjects and designers develop and work with improvement ideas. In product design the knowledge gathered in contextual inquiry and participatory design is refined into a design. Production of a tool as hypothesis implies that the prototype built from design is presented back in the cycle as a suggestion of a solution, which should again be evaluated and refined with methods of earlier phases.
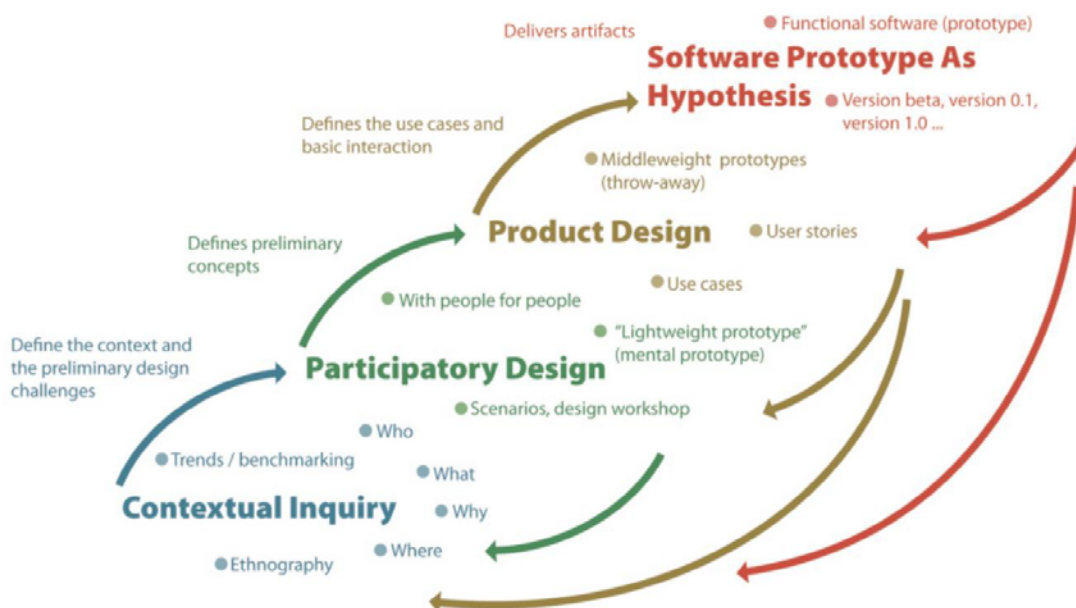
Research based design method

Figure 1. Research based design process (Leinonen et al. 2008).

Hypothesis

The main hypothesis in this paper is that RBD can be applied in the design of learning activities with the entailing model having features that make it feasible and useful for its purpose. After describing *RBD for Learning*, we make two additional hypotheses about its benefits.

To apply RBD in the design of learning activities, the method's end product is replaced with learning activities which are the desired outcome. Following this adjustment, RBD for Learning can be applied as follows:

RBD for Learning scenario: Collaborative research on war history

Mika, a schoolteacher wants to work with his 6th grade students on how to do historical research. His school has decided to incorporate the 21st century skills into the curriculum. For this purpose, Mika wants to adopt a collaborative learning strategy since collaboration is one of the key 21st century skills that students should acquire.

1. **Contextual inquiry:**
   a. If not at the first cycle, the method and its efficiency from previous cycle is analyzed together and it is decided if the learning activities are suitable for the subject or should be improved.
   b. Teacher introduces the learning objectives and motivations.
   c. Learners' needs, current knowledge levels and interests are queried in classroom.

This is not the first time that Mika is planning collaborative learning. He knows from previous experience the students' performance can be very diverse: exciting for some and frustrating or meaningless for others. He uses RBD for Learning in order to get student's

input on how collaborative learning could be suitable for them. Mika introduces the study subject and its objectives - Conducting historical research & the acquisition of collaborative skills. He inquires about the students' knowledge, and interests in the subject, current learning activities and methods being used and those that the students are familiar with. Mika also identifies learning resources in use and available to students are also identified.

2. Participatory design: Learning activities for the students are designed with students. The information gathered in the first phase - contextual inquiry is taken as input in this phase.

From contextual inquiry the class moves into participatory design where they identify and ideate on possible ways to study methods of historical research. The students suggest working outside the class if they so desire e.g. in a public library to access additional study materials and in more relaxed environments. They also suggest working with peers in other classes as one option for working collaborative working. For evaluation, the students suggest regular team presentations of results and team work.

The class also revisits the first phase as it is realized that there may be a need for more contextual information on the subject.

The students suggest making a visit to a war history museum to get some specific pieces of history.

3. Lesson design: Teacher uses her/his expertise to design lessons and activities based on the activity ideas devised in the participatory design session.

Mika uses students' ideas designs as a springboard for designing learning activities. Mika prepares preliminary learning activities that involve the students learning in other environments other than the classroom, including the public library. He plans collaborative working so that students can work with their peers from other classes. He also plans a class excursion to a war history museum where students can gain more detailed information on topics of interest.

The preliminary learning activities designed Mika are referred to previous phases and reviewed with the students to see how they could be used or improved to suit the identified learning objectives and various students' interests. Mika is especially interested in how the students may record their learning progress as well as present their collaborative work.

The students suggest using a social networking service to form working groups and video sharing services to record their team reflections. They also express interest in using an online collaborative writing application for the collaborative report writing task.
*   Mika uses the suggestions to refine the preliminary learning activities. He includes weekly team reflection and report review as evaluation methods during the course.*

4. Learning activities as hypothesis: Learning activities are taken into use with the emphasis that they are not fixed and can be reflected upon, improved and made anew.

The students implement the learning activities in their learning. They form groups with their peers and commence research. They record group reflections every lesson where they tell of their progress and challenges they are experiencing. Some groups report

having difficulties in determining how to collect and put together pieces of articles, pictures, maps and videos in a presentable manner.

The class revisits the Participatory Design phase where groups propose the alternative of using videos, and slideshows to document and present their work. They also feel that this will enable them to communicate their findings in an interesting way. Mika implements this suggestion to the design of learning activities. Using visuals for reporting also makes it easy for him to follow the progress of the group work.

In summary, RBD for Learning attempts to introduce student involvement in the design of learning activities. This happens in phases 1, 2 & 4. Phase 3 is done by teacher who is seen as a learning design expert - who brings together learning activities ideas generated together with students in a way that they are usable given a specific learning environment, resources, and students' preferences. The participatory design sessions provide information and ideas that the teacher develops further by using her expertise. If step (3), lesson design by expert is omitted, the result will be a 'design by committee', which usually provides to be unsatisfactory for all. The duration of the design cycle may vary but we suggest short durations so there is timely reflection and refinement of learning/teaching practices.

The main theoretical challenge for RBD for Learning is to justify using teaching time for activities that have previously been done outside the classroom. We have two hypothetical benefits that can pay back the loss of teaching time.

i) By making learning activities into common topics of classroom discussion, teachers are able to implement suitable teaching practices based on relevant and timely consultation with the students.

ii) For students there is potential for enhanced engagement in learning since the learning activities are designed to suit their preferred learning methods, and tools and resource that they may want to use.

In discussion we try to evaluate if the two hypotheses can hold and compensate for loss of classroom time dedicated for teaching the subject matter.

Discussion

In this section we discuss about some of the risks and possible arguments against using RBD for Learning.

The sessions dedicated to contextual inquiry and participatory design may be perceived as time consuming and without a clear impact on the students' learning. Nevertheless, it is worth to invest some time in getting information the students' prior knowledge, as well as involving them in the design of the learning activities since it will reverberate in their motivation and their understanding of the learning objectives. This is especially important in order to promote metacognition, self-regulation of learning and the inclusion of 21st century skills to the curriculums.

Time dedicated for contextual inquiry and participatory design is not necessarily time away from learning about the subject matter. Both phases require framing of the subject matter within the larger context or explicating the need why this needs to be learned. These discussions have always been a part of teaching in any subject matter, now it only has its own dedicated time for it. Also participatory design will require inquiry into the actual subject matter in order to find possibilities of how it could be learned.

Uncertainty of learning outcomes still holds for skills that are not evaluated. RBD for Learning can be fitted to existing requirements and evaluation methods, they are just

assumed as prerequisites for design. Short cycles of RBD help determine if the learning activities and teaching practices are suitable for specific learning objectives.

There may be reluctance in involving students in lesson planning as they lack expertise in that area. However, the quality of their input to collaborative design is not the important factor, as teacher's expertise is applied in the consolidation of the design ideas. Moreover, students' ideas have potential to uncover alternative learning methods and improvements that are personalized and tailored for them. Student involvement in the RBD process also enables them to reflect on their learning, especially in the learning of challenging subjects.

RBD for Learning can be seen to emphasize too much teacher's need for professional development instead of learners' needs for personalized learning. RBD for Learning is teacher-centric. We think that a real student-centric learning is not possible if the teacher doesn't have deep understanding of her/his involvement and effect on students. It is not a topic that can be ignored or assumed to be transparent or changed at will. Teachers have a strong presence in the classroom that is difficult to change and it should be used to support students to find their focus.

Iterative and collaborative approach to learning activities is especially suitable in context of 21st century skills. Cycles of RBD for Learning always require communication and exercise of meta-cognitive skills and evaluation of learners needs. RBD for Learning is also an easy framework to tinker any 21st century skills into learning. Since participatory design is led by teacher, and actual lesson design is still teacher's responsibility, the design work can be scaffolded according to learners' capacity without the result being detrimental for learning.

RBD for Learning can help teachers and learners in reshaping learning methods and environments in an iterative manner. It may help learners to accommodate changes as well as refine their methods or activities to suit their needs and goals.

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Possibilities for Computer Supported Collaboration in Intensive Software Engineering Courses

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University education and information technology teaching is going through a time of change. Learning is changing to be more interactive and the importance of collaborative learning and teamwork has grown (Okamoto, 2004). At the same time intensive courses and team-based rapid development methods are growing more popular in software engineering education. In these approaches the goal is not only to have the students cooperate in groups, but to help each other achieve their learning goals, for example by sharing newly learned knowledge with each other and then applying it to improve their group work. These methods have been proven to work in tertiary level education in both domestic and international studies (Davies, 2006; Porras et al., 2007, 2005). However, often these kinds of teaching efforts are separate from similar efforts in computer supported collaborative learning (Stahl et al., 2006), where the element of collaborative learning is brought to computer-based and distance learning courses. Could courses where all or some of the students are working in the same space still benefit from computer-supported collaboration?

Collaborative learning in intensive courses (the Code Camp course series) has been studied previously in LUT and some cooperating universities (TKK, TUT) (Alaoutinen et al., 2012; Porras et al., 2007, 2005). In these courses the students are divided into 3 to 5 person groups, are allowed to pick a programming topic from a set theme and are given one to five days of time to complete their programming project. All the teams share a common space, usually a classroom, and collaboration between the different teams is allowed in both sharing ideas and solving technical problems. In this study the research concentrated on discovering and analyzing the patterns of collaboration that occur during these courses. Information for the study was gathered with team interviews, individual surveys and recording time-lapse video for analysis from two of the courses.

The patterns of collaboration were analyzed by modeling the communication patterns with the help of graph theory. Each interaction, the interaction context and reason for the interaction were recorded from the available raw material. The lists of interactions were collated into a directed graph, where the nodes represent individual students and the edges represent communications between the nodes. The graph was analyzed by inputting it into a graph analysis software, Gephi (Bastian et al., 2009), and using the software to identify influential nodes, forms of cooperation between groups and repeating patterns of collaboration between the nodes. A graph of one of the observed Code Camp courses is presented in the following Figure 1. Each node represents a student and the connections (edges) represent collaborations between the students, with the thickness of the line representing the strength of the collaboration. The nodes have been colored from most influential (red) to least influential (blue) using values from the PageRank algorithm (Page et al., 1999), which can be used to measure influence of nodes in social networks (Java et al.,

2006; Scott, 2012). Most notable patterns in this graph are the strong collaboration between the student groups A and B, and the isolation of student group E.
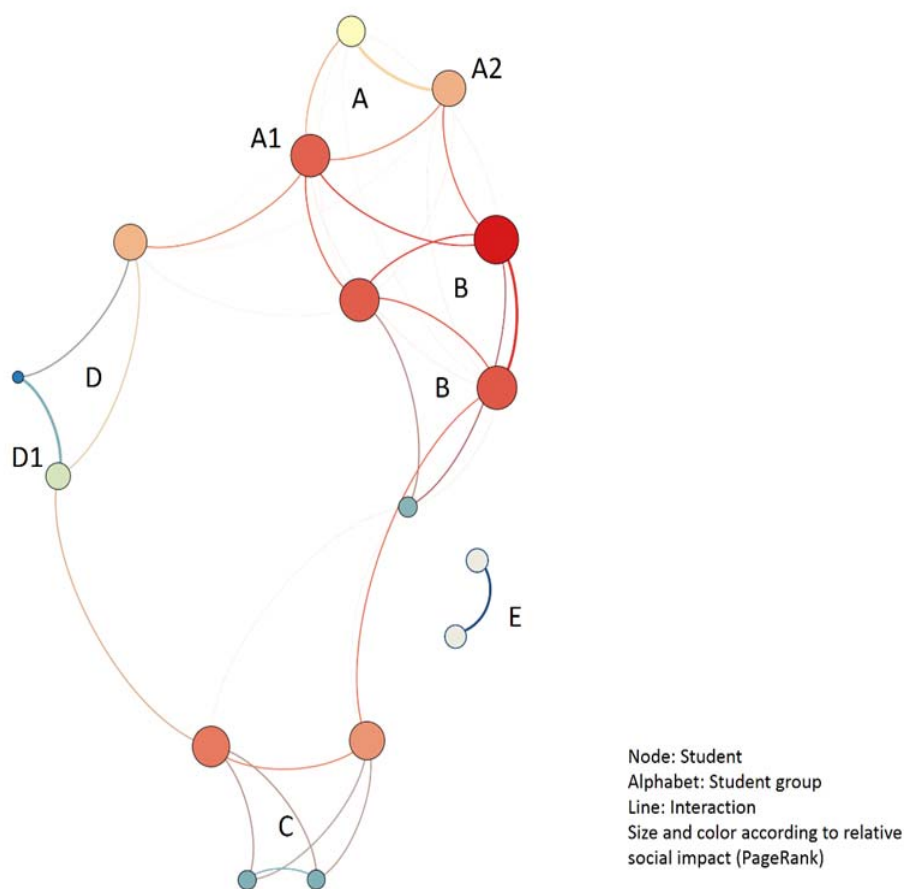

Figure 1. Student Collaboration Communication Pattern Graph.

When using other gathered data and interviews to place the collaborative interactions in context, it was found that the strongly collaborative members of teams A and B were sociable, with roughly similar backgrounds and interacted a lot during the social event held at the start of the course, forming the most influential social cluster of the course. They collaborated a lot, even if their chosen programming assignments were different from each other. Similarly, the student D1 collaborated mostly with her friends and people from the same social groups, even while the student A2 struggled with the same issues. The other notable pattern was the lack of intergroup cooperation with the group E. The members of group E, senior and experienced students, told interviewers that they were open to helping others, but no one had approached them for collaboration. At the same time other students felt that they were difficult to approach, because the students were unsure what the group E was working on and it wasn't certain if they should be disturbed.

Analyzing the repeating collaboration patterns between the groups over the two observed courses revealed the following issues:

- More socially outgoing people collaborate more between teams, even if the teams work on different topics.

- Some communication patterns follow social structures established outside the context of the course.
- Many people waited for others to come and collaborate with them, but found it difficult to initiate requests for collaboration, because they did not know which students could help.
- Less outgoing people do not collaborate with people who are not immediately adjacent to them, even if their problem topics are close to each other.

Our hypothesis is that the issues discovered in classroom collaboration can benefit from computer-supported collaboration tools. Common issue during the courses were that the students did not realize that they had similar problems, which caused hesitation in initiating communication.

Software tools can be used to publicize commonly encountered problems and to find people who are struggling with the same problems for collaboration (Treude et al., 2011). Tools like these could help students find each other without spending time on discovering partners and accidentally disturbing people who are concentrating on individual problem solving. An additional benefit would be that the problem and the following conversation would be recorded for other participants to view later in the course if they struggle with a similar problem. For example question and answer sites with reward systems have seen wide use in the field and could be also applied inside classroom. Additional tools, like projectors or mobile clients, could be used to publish unanswered questions and the most useful solutions.

Online courseware tools like Blackboard or Moodle are now seeing more use in classroom environments (Rößling and Kothe, 2009), but their usage focus is often to provide course literature, assignments and accept returns. While they do allow things like peer review of assignments, this style of collaboration is teacher controlled and usually more slowly paced. This study shows that collaboration in the Code Camp style of courses could be improved and that the standard tools available do not have many features for collaboration in intensive courses. This means that improved software tools could be used to provide more opportunities for collaboration within classrooms and should be investigated in future research. Computer-based communication tools do require the presence of computers in the learning environments and this could a drawback in adopting the tools. However, in software engineering courses computers are already present as development tools and using computer-based collaboration tools will most likely have a lower barrier for adoption than in other fields of education.

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Presemo - a live participation tool

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Motivation and Previous work

In educational domain, research on audience response system has been widely adopted and studied (e.g. reviews by Kay and LeSage, 2009). They discribe systems that allow students to vote from given options. Benefits of adapting these systems improve attendance and attention, therefore engaging the students more. Also, learning improvements were discussed, such as potential to adapt the teaching based on the feedback given from via the audience response systems and in improved learning outcomes. However, the interaction provided by audience response systems is extremely simple, the students vote for one option, even while the modern software would allow more interaction methods to be used, such as direct text entry.

These systems are called backchannels, which are mostly text-based chat systems which the participants can use to communicate without interrupting the main presentation. Previous work on applying backchannels have used these systems in conferences (e.g. McCarthy and danah Boyd, 2005; Harry et al., 2009), university classes (e.g. Anderson et al., 2003; Bergstrom et al., 2011; Du et al., 2009), and small groups discussions at the university(e.g. Harry et al., 2012).

One may ask for the motivation for using these kind of systems. Fischer (2011) suggests that modern computing capabilities can be used to support and enhance culture of participation. He suggests that the goal is to "*engaging diverse audiences, enhancing creativity, sharing information, and fostering the collaboration among users acting as active contributors and designers.*" Even while his work mostly focuses on large systems, such as Wikipedia, work on backchannel tools suggest that similar benefits, and previous works suggest both encouraging, e.g. the empowering feeling of being heard, the possibility to discuss and exchange views, and the potential for coordinating activities, and discouraging outcomes, such as cognitive overload and disre- spectful content have been reported (e.g. McCarthy and danah Boyd, 2005; Harry et al., 2009; Anderson et al., 2003; Bergstrom et al., 2011; Du et al., 2009; Harry et al., 2012).

However, these systems must be described as socio-technical: the social aspects impact the use significantly. As Fischer (2011) states, one of the challenges of these systems is to build technical environments which encourage participation, not only technically support it. The backchannel systems have different kind of approaches that have supported participation. For example Harry et al. (2009) have suggested a system where each of the messages could be voted, which was used to create a collaborative filter. Similarly, Bergstrom et al. (2011) suggest that anonymity is important to support shy students to participate. However, less empirical evidence is given to justify these design choices, but they were seen to encourage participation.

Our work focuses on a live participation tool Presemo, which we have developed and studied for several years. Firstly, we outline the previous designiterations shortly and present

the current system in section 2.2, also suggesting a new concept of cochannel instead of backchannel. Lastly, we presentsome of our current ongoing work to (1) empirically validate the design of theparticipation tool and (2) applying multimodal and sensor based approach in participation systems.

Presemo

This section discusses the history of Presemo-system, the current approach and the emerging concept of a co-channel, which we argue differs from a backchannel.

History

Presemo system has been develop over five years. Initially we tried SMS based audience responding in a large lecture setup. In this setup audience sent SMS-message to a specific SMS-modem that automatically posted the messages to a website. This tool was considered useful, used often in lectures and since the lecture was targeted for professional audience, some of the audience members decided to use system also in professional seminars. The demand of the SMS-wall systems initiated the idea of creating a web service for SMS-messaging wall. Hence, a system that would automatically generate a SMS-wall for a lecture or seminar.

After several design iterations of the SMS-wall came the idea of using browsers of mobile devices to complement the SMS-messaging. Initially the browsers were thought preferably for two reasons: 1. feedback for the sender, 2. cheaper messaging. Year 2008 and 2009 mobile phone browsers had several drawbacks. The screen size was poor, significant amount of phones did not have touch screens and hence navigation was slow and complicated, performance of the browser was poor, network quality and pricing was not optimal was browsing and browsers did not support all widely supported web standards such as full support for Javascript. Due to these reasons it was not praactical to think that mobile phones would be the primary device for audience interaction.

Through 2008 until 2010 Presemo was designed and drafted, but no serious development focus was focus to it before a research project allowed grant for developing hybrid audience interaction system for messaging, polling and collecting implicit feedback through biosignal collection. The first prototype of Presemo had following features: big screen visualization, mobile web client for interacting through chat and polling, mobile application for collecting and sending real-time biosignal feedback, server system for managing communication between server and clients. This version was develop for one reference mobile device (Nokia N900), and targeted for experimental uses. The idea of audience response was considered as basic hypothesis for the system, but the nuances of the system were not optimized for wide deployment. However, the early trials with the system showed that audience interaction was easy to use and comprehensive, whereas the implicit feedback did not provide comprehensive practical value and could be considered more as technological demonstration and research tool.

Next version of Presemo had did still support sensor collection, but did not have special focus to it, but more focus on interaction control (creation of interaction phases and visualized control tools) and visualization. This version had also presentation support features (capability to send slides to audience, and upload new slides through Google Presentation API) and group working features (divide the audience in to groups through Google Spreadsheet). Ultimately this version was developed further and simplified in to a standalone interactive presentation product called Slides & Polls, which is still available through Mac

App Store. This version had one client that provided media management, presentation and audience interaction control, communication server between clients and display rendering.

During the development of Slides & Polls an alternative design was also explored. A system that would provide audience interaction features without dedicated Mac OSX client. Advances of such system could be wider deployment base (not Mac OSX proprietary) and distributed control and presentation. The first web-based audience response system prototype was developed under authors supervision by a student group and called W?. However, the design of the first system had some fundamental problems and arcitecture did not allow scalability.

Lessons learned with Slides & Polls and W? led to the development of current Presemo version, which is also called the Mixed platform. The platform has four fundamental characteristics: 1. three main interface types (participants, shared big screen and control interfaces) but there can be also more interfaces that are synchronized and rendering is performed through the control interface, 2. Control is distributed, 3. Interaction types are not limited to certain basic interaction modes but the platform can be extended (we call these extensions interaction blocks), 4. Users can be identi_ed and platform supports features that require pro_ling. In the next chapter the main structure of the platform is explored further.

Table 1. Examples of affordances, constrains and feedback mechanics of different activities.

Activity	Affordances and Constrains	Feedback mechanics
Chat	anonymity, profile information, message amount, message lenght, response types	visuzaliation, social feedback, computational analysis, gamification
Voting	voting method, number of votes, selection of items to vote	visuzalization, multimodal feedback

The Web Mixer and Blocks

Above we have presented previous attempts by others and our previous at- tempts on creation of backchannels. Our latest attempt is called the Web Mixer, and it's based on the concept of different kind of participation blocks. Each of the blocks have their own engagement rules, i.e. they have different affordances, constrains and feedback mechanics[1]. This is an important aspect that can be made possible when seeing the system as a software product that can be adapted to suite certain functionalities: *the rules of the software can be changed and adapted to suite a pedagocial goal*.

To illustrate the categorization, in Table 1 some of the blocks and their affordances, constrains and feedback mechanics are discussed in detail. To elaborate, let's focus on the chat-type of activity. For example, we suggest that anonymity as an affordance: it allows and directs the participants to behave in a certain way; also the amount of messages per participant is a rule that impacts the behavior, and is a constrain. The feedback may be given by peers, who are allowed to vote (e.g. like) for the messages send; this is an example of social feedback.

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[1] Terms are adapted from Norman (1988) influencial work on usability.

Towards a co-channel?

We argue that the Web Mixer approach with block creates something different than a backchannel. We use the term of co-channel to reference to this phenomena, and briey outline the two elements: control and co-presence, which we suggest to construct a co-channel.

Firstly, different blocks and the rules embodied in them enables the control of participation. Unlike backchannels, the Presemo system enables the presenter to choose the method of participation and adapt the method based on temporal dynamics and aspects. In practice, the presenter may choose to allow an anonymous discussion during the Q&A-session, but disable this possibility during the presentation.

Secondly, looking at the older backchannel discussions, they were not present in the physical space, rather only in the virtual domain. Naturally, the more current backchannel systems, such as Harry et al. (2009) were present in the space via video projectors or other forms of visualization. Presemo-system has also this physical co-presence attribute in the form of the big screen described above. Therefore, we suggest that co-presence is an attribute that describes also the Presmo-system. Also, the control is present in the co-presence, the presenter is able to impact the content present in the public screen.

Based on these two attributes, control and co-presence, we argue that term *co-channel* describes the system better than the traditional independently run backchannel.

Future work

We are interested in the practices of using live participation tools in educational settings. Our research is constructive: we focus on developing and designing live participation tools and related practices. Currently we focus both in elementary and secondary schools, universities, adult education, as well as professional events. We apply several methods, including action research, experimental studies and field trials.

The previous research has focused much on describing the events of use and the activities, such as highlighting anonymity as a potential method of to support participation. However the exact impact of those design choices is not shown on the previous work. We argue that to support the development of live participation tools, more extensive analysis of the impact of the design choices and the participation would be useful. To illustrate this, our quasiexperimental system in progress indicates that anonymity may lead to more equal participation, as shown in Figure 1.
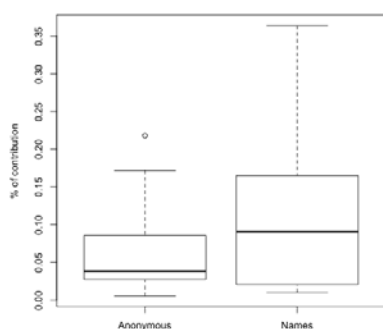

Figure 1. Level of contibution in anonymous and named backchannels.

Also, we have analyzed the content, structure and tone of discussion in live participation platforms. Preliminary results indicate e.g. that certain kind of opening statements have fundamental inuence in the discussion in that thread of conversation. And by understanding the socio-psychological processes behind the interaction can be important tool for facilitating fluent and purposeful participation with the tools.

The potential of using multimodal interaction methods to increase the us-ability are are in our interests: how can we apply senses, such as touch and hearing to increase the presence of the co-channel.

Lastly, we have above suggested the term *co-channel* and work on this concept, demonstrating cases where the presenter uses the co-channel to support the participation goals.

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Collaborative Games in Language Teaching

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Collaborative Games in Language Teaching

The research presented here is a part of an ongoing Active learning spaces project that aims to promote the use of social media and games in foreign language teaching. The project is a large scale, multidisciplinary collaborative project, led by Tampere Unit for Computer-Human Interaction. Our part of the project, Social media and games in foreign language teaching, focuses on pedagogical interventions, that are based on individual teachers' interests and proficiencies, rather than imposing the technology and applications on the teachers. The strategy behind the project is design-based research, which emphasizes the close connection between theory and practice. The underlying idea is sustained innovation. In practice this means feedback from the teachers affecting new stages of design which again are rapidly tested in the field. (Bereiter, 2002)

In this paper, I briefly discuss an on-going intervention employing games in teaching English as a foreign language in collaborative building-projects. I will also expand on the preliminary results and suggest further courses for iterations.

Why do we need games in language teaching?

The outset for this paper is that language teaching employs too narrow methods of teaching. Studies show, that students feel that teaching focuses too heavily on traditional methods of instruction (Luukka, 2008). A popular way of conceptualizing ways of instruction is depicted in Figure 1. The Cone of Experience (Dale, 1954) is often misquoted with percentages of how much we remember through each channel of experience (Lalley 2007: 67-68). Nevertheless, it neatly depicts teaching methods from abstract to more concrete ones. Current author does not regard it as hierarchical depiction of modes of instruction. What is important here is that traditional ways of teaching are at the top of the cone, whereas the lower tiers are not as widely employed. The Dale's observation seems accurate even after decades of good intentions of changing the emphasis of language teaching to more communicative approach. Even the national curriculum (2003) emphasizes the importance of individual learning strategies and styles. Learning styles, of course, are an over-simplified model of a complicated phenomenon (for what they have been criticized, for discussion, see Coffield et al, 2004) However, employment of different modes of instruction in schools yields results (Smith et al, 2002), and from this point of view, we have a lot to do in order to create a diverse learning environment.
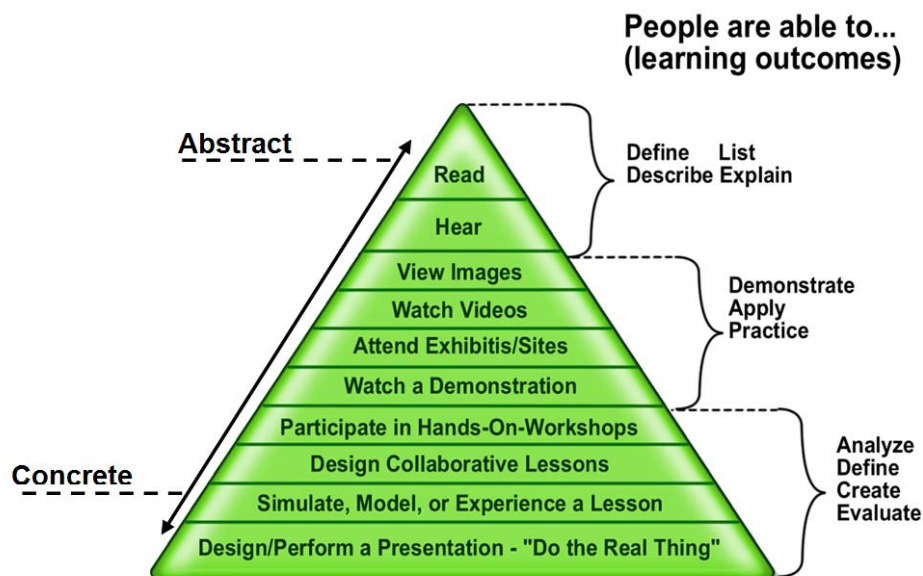
Figure 1. Dale's Cone of Experience. Modified from Anderson (2012).

One way of diversifying traditional classroom environment is via games. Digital games as a media form, has taken its place among traditional media and in some ways has surpassed them in Finland (Mediabarometri, 2011). Games and play themselves have always been parts of any given culture (Huizinga, 1980) but their prominence has increased at the wake of digital gaming. In terms of learning, Prensky (2004) points out that current generation has never known a world without games, and compares teaching them without games to talking to them in an odd accent. To expand on the idea, games require mastery of sometimes complex rules and employ various ways to convey them to players. Players, usually voluntarily, learn these rules in order to play the game. They are used to digesting difficult concepts in the context of games. Accordingly, we should adopt similar strategies in schools to accommodate these new ways of learning.

The potential of digital games in teaching has been recognized now for almost a decade (Prensky, 2001, Gee, 2007), but the adoption rate has been remarkably low (Opeka, 2012). In my opinion games can no longer be ignored as a tool for teaching. In fact, a recent study revealed that learning results in upper secondary schools are greatly affected by games (Uuskoski, 2011). What was found, was that the average grades of non-gamers were 0,5 lower compared to gamers who play at least five hours per week and 1,5 lower compared to active (+15h/w) gamers. To clarify, I do not think every student will be an active gamer; nor should they be. However, we cannot afford to neglect such an influential media in language teaching: it should be employed in classrooms like other form of media, text, music and film, already are.

Providing context for authentic language use

In our project, games are used to enable authentic communication and collaboration. Both terms, authenticity and collaboration, are integral parts of language learning and their importance is shortly related here along with description of how they are applied to gaming environment.

In research, collaboration has been usually perceived through its results, but more recently there has been a shift in focus to the process itself (Arvaja & Mäkitalo-Siegl, 2006).

Common European Framework of Reference for Languages (CEFR), the guiding document for language teaching in the European Union, dedicates a page for goal-oriented co-operation as a communication strategy. This shift that the CEFR, too, reflects is suitable in terms of language teaching, where learning collaboration is the end, not the means. On the other hand, focus on authenticity in language teaching has been a topic of discussion for years (Kaikkonen, 2004), but so far the term has mainly referred to authentic materials. However, as Gilmore argues, the scope of authenticity is much broader (2007). In this context, authentic communication is understood through the learner's experience: meaningful contexts for communication provided by experiential and project-based learning enable to authentic communication to take place.

The game used in the intervention is Minecraft. The popular sandbox-game was selected because it inherently supports collaboration and, via Finland-based modification called MinecraftEdu, provides extensive teacher tools for managing class. Like many virtual worlds that have been used in language teaching, Minecraft gives the student an online presence through avatars. What is different though, is Minecraft's world that is open to customization by the students. The world is constructed of lego-like bricks all of which can be broken and reassembled. Blocks of different materials can be combined to form new items. For example, combining a wooden stick with a chunk of coal produces a torch. The game comes with next to none documentation, which coerces the students to find relevant information elsewhere, or better yet, distribute it among classmates, fading out the boundaries between formal and non-formal learning (Hausrath, 2008). The game encourages building with different blocks acquired from the world, and in this study, collaborative building projects provide the context for authentic communication.

There are several ways in which games could enhance the learning experience. (Gee, 2007) In this particular intervention, the concrete acts of building could facilitate students with difficulties with abstract concepts. I hope, in some ways, to provide opportunities for kinesthetic learners to get instruction in foreign language in their preferred way, and to enable situations for action learning, too. Some of the situations we consider learning problems could perhaps be solved by providing more diverse ways of learning.

Initial findings and thoughts for future applications

The first building projects were student-initiated. The course employed a blog for developing, coordination of and reporting about the projects. On the blog, students proposed ideas for building projects, and, after a round of ideas, voted a city of their own design as the project. The only limitations given were collaborative building and use of English. The initial enthusiasm has sparked novel buildings, such as lava-lamp building and ad-hoc Berlin Wall to separate two groups of players.

As a dynamic virtual world, the Minecraft server is open outside of lessons, too, and students are encouraged to play on their own time. However, this resulted in many players resorting to Finnish, at least occasionally. Unlike many games, MinecraftEdu modification allows for strong teacher presence in the game, and in future iterations, teacher(s) of the course should visit the world, as their presence seems to reduce the amount of inappropriate language use and resorting to mother tongue. To summarize, the project suffers from the superficiality of target-language use. Despite the lack of enthusiasm to use the target-language, the students did collaborate to create some novel and imaginative structures, and collaboration occurred in a natural way:

> *It started when I thought about making a huge water fountain.*
> *When I had placed some pillars of wood Antti came and asked me what was I doing I told him I was building water fountain and he started to help me out. When the woodblocks were placed Joonas came up after problems with getting minecraft working and started working with us. After we got the water flowing correctly we thought that it looked bit dull so we decided to but glass around it so it would look more like a building.*

Future iterations of the pilot will hopefully operate in cross-cultural context. To provide environment for truly authentic communication, the use of target language should not be an enforced option but necessity arising from the context. This type of project, restricted to students' own classroom, can serve as a stepping stone for cross-cultural projects. It serves an important role in introducing the medium and modes of operation. Moreover, the findings suggest that some familiar features of gaming could be transferred to classroom environment. For example, the students felt the game to be engaging and meaningful, as the following excerpt from a blog post aptly illustrates:

> *Like I told you at my first post I have never before played Minecraft. I have died few times after I came from underground where I was mining and lost lot of iron and coal. But today I found my first diamonds! It may sound stupid but [sic] im proud I have found diamonds! Now i can do something fun with my diamonds.*

This resonates with the ways of learner engagement presented earlier: artificial goals can become meaningful if presented in a right way. This also illustrates the importance of learner autonomy, as this "quest for diamonds" was intrinsically motivated.

The potential of the platform to support collaboration is not questioned here. The early findings suggest that the platform does indeed seem to coerce collaboration among the students. Instead, we are faced with the problem familiar to many language teachers: how to provide authentic the environment for communication in target language?

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Software development project as a part of learning process

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Software-development processes integrated as a part of learning process is nowadays suggested to a student at University of Applied Sciences. The main aim is to get students to understand how in the real-world software project have to be work, and that time schedule is mandatory. The project deadlines mean that the planned modules have to be developed on time.

Software project as a part of research study means that it is possible to explore how Action Design Research Method (ADRM) is suitable to a student software project. The research objective is to study ADRM usability and how it can be, in reality, to apply. According to Järvinen's (2012, p.10) taxonomy, the study belongs to approaches for empirical studies and theory testing.

The software project was carried out with two degree programme (Information Technology and Transport Management at Hamk). The customer is Liikenneturva, Central Organization for Traffic in Finnish. The purpose is to explore how we can organize this type of development project with a customer, students of two degree programme. The steering committee was arranged so that the members were Liikenneturva, degree programme Transport Management and a researcher representing degree programme Information Technology. The students who participated to the project were one student of Transport Management and three student of Information Technology.

The development project started in January 2012, and the software and database will be installed to production servers by May 2013. The main part of project work has been done during March and May 2012. The testing period and modification have been carried out starting in September 2012 and ending in January 2013.

Literature review

Information Systems researchers face two challenges. They create design science contribution and participate and assist in exploring current and anticipated problems in real-world. As researchers we have to clarify and develop theoretical models and methods, which can be explored and demonstrated. Information Systems researcher's practical contribution to solve wicked problems is closely tightened ability to present models and methods in a way that practitioners can apply models and method in every-day software-development work.

The relevance of Information Systems research is according to Benbasat and Zmud (1999) defined by investigating whether an article includes problems that interest IS professionals, the result of the research is applicable. The research focus is current, and style is easy to understand. Davenport and Markus (1999) in their response to Benbasat and Zmud point out that Information Systems research must develop their own theory and models, take evaluation research into account. Considering practitioners and consultants roles in utilizing theories and models, we should not underestimate their work. Davenport and Markus emphasize undergraduate and master students as an important research consumer.

According to Järvinen (2012), the roles of researchers depend on the phases of the research process in field experiment, action research and design research. At the beginning

and during the process, the role of the researcher is dominant. She or he is a main actor in the research process. Practitioners' role is dominant at the end of the research process. They are capable of evaluate the IT-artifact. They should evaluate how applicable IT-artifact is and does it meet specified criteria and requirements. During the action research processes the researcher takes a non-dominant role. The researchers are working together with practitioners in the real research process. At the end of the process, the researcher's role is twofold, namely the role is dominant, when we consider how properly the scientific evaluation is carried out. The role can be collaborative in practical evaluation. Järvinen (2012) emphasized the dominant role of researchers in design research projects. Hevner et al. (2004) see also the researchers as an active participant and expert during the research process. The new artifact is derived by requirements and features, which are based on the researcher's idea.

Hevner (2007) offers a design research cycle that is based on Hevner et al.'s (2004) IS a research framework. The research relevance cycle starts by taking environment into account, when specifying requirements of IT-artifact and carrying out field testing. The second phase is the design cycle. The build and design process utilizes the accepted design science research process. The third phase is a rigor cycle. The research process and its outcomes are considered by how well during the process are utilized IS theories and methods. Essential part of research is to consider how the outcomes enhance the knowledge base.

The action design research method (ADRM) is proposed by Sein, Henfridsson, Purao, Rossi and Lindgren (2011). Sein et al.'s argumentation for the need of new research method is based on premises that IT artifacts are actually developed by the organizational context and research process includes building, intervention and evaluation activities integrated to the one stage. The starting phase is problem formulation that includes two principles. The second phase is building, intervention and evaluation, which are defined by three principles. The third phase is reflection and learning. Building, intervention and evaluation activities produce information how we can find solutions to the specified problems and what we can learn during the process. At the end of the research process, we can formalize our learning and try to generalize outcomes.

The ADRM is different compared e.g. to Peffers et al.'s (2008) method. The design science research method (DSRM) is process model, which includes six phases and proposed four research entry points.

The selected literature is reviewed that the software development process is possible to carry out following rigor research methodology and to select suitable research method. The main objective of the research project is to explore how well ADRM model can be applied to software development project. The next section is described more detail ADRM model and how it is applied to project.

Research methodology and method

The action design research method (ADRM) is selected to research the method. The first reason is that model offers solid base to guide and to explore development project. ADRM integrates to project to action research, and its phases organize the software project. The second reason to select ADRM is to demonstrate, how well the method can be applied to student's software project. The third reason is to explore ADRM because the proposed method is new, and it has been applied only three research projects. Sein et al. (2011) demonstrated the method the research project which was started 1999, and that time applied method was canonical action research. Saarinen (2012) applied the ADRM to his dissertation research. Rothengatter (2012) used also ADRM in his dissertation. The slightly

different point of view Bilandzic and Venable (2011) applied participatory action design research method (PADRM). Wieringa and Morali (2012) added technical aspect to action design research method (TADRM). The interesting point is that Papas, O'Keefe and Seltsikas (2012) classified ADRM as the meta-method.

To my own interest to apply ADRM is based on to see the method's usefulness to research projects. According to Rossi (2009), the development process of an artifact, the starting phase integrates design science defining problem and action research diagnosing the real-world situation. The software-development project started a need to create web-based application for school route analysis. So we can argue the problem must be defined using by design science research method and recognizing the organizational situation and practice.
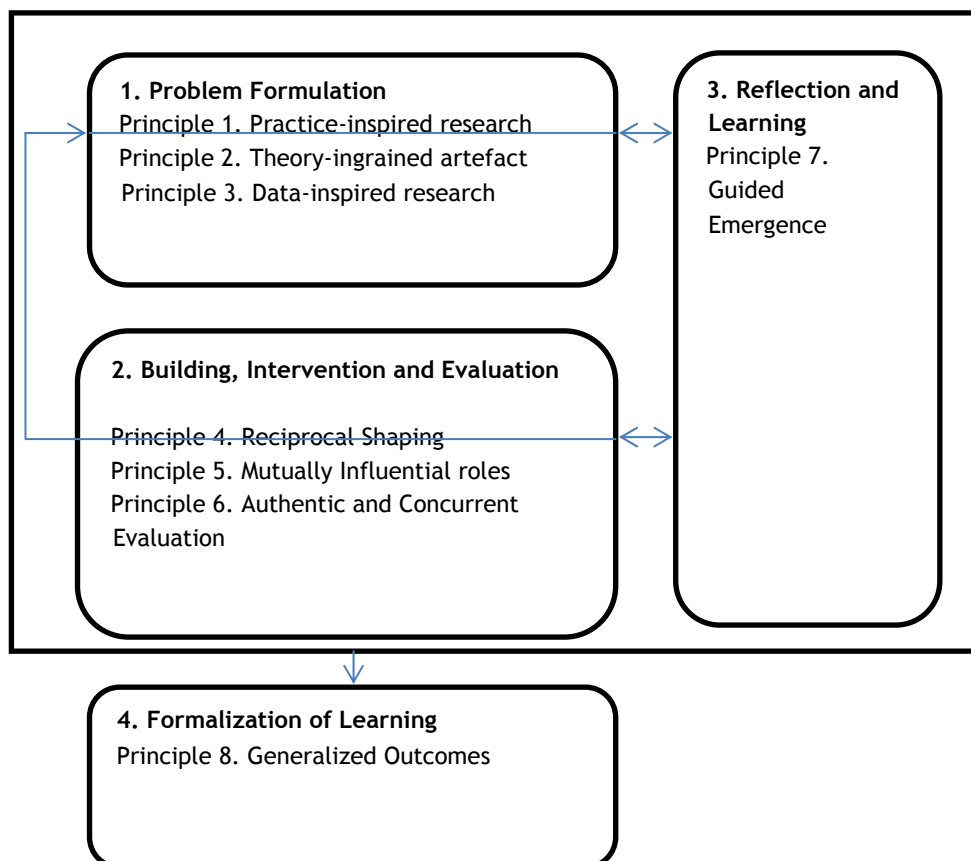

Figure 1. The action design research method modified from (Sein et al. 2011).

The first phase, Problem formulation consists of three principles. The identification of research situation and possibilities can arouse practical real-world problem, or the main interest is theoretical issues, or real-world problem is how to organize data and information. The current data and information problem is "Big data" questions. It is true that many organizations have huge databases and amount of data is growing continuously. I propose the new principle 3 for situation where data oriented practical problem issues need a brand-new solution.

The second phase of ADRM integrates building software, collaborative interactions between researcher, developer and organizational participants. It is important to knowledge the role of evaluation, which is carried out continuously during the building activities. Sein et al. (2011) recognized IT-dominant building, intervention and evaluation process and organization-dominant building, intervention and building process. However, following to

principle 3, I propose Data-dominant building, intervention and evaluation process. I argue this important to recognize, when we are dealing large databases and the purpose is to develop business intelligence application for to support decision making.

The third phase, reflection and learning are very important to carry out as an ongoing process at the beginning after the research problem has been defined and before starting the second phase. The student developers need self- reflection and current feedback concerning how they have succeeded to the defined artifact and to collect users' requirements. If the features and requirements of an artifact are weakly collected and analyzed, then during building process will be difficult and might take more time. Learning happens, when developers and other participants discuss the problem and proposed solution alternatives.

The fourth phase, formalization of learning means that the researcher's role is dominant as Järvinen (2012) proposed. The software-development project, its outcomes and how well the ADRM method has been followed during the project must be explored and discussed. The development project has been finalized, so it is possible to analyze the process, its activities and what has been learned.

Data collection

I started to gather research data from the first meeting. The main part of data consists on meeting reports, UML diagrams, and discussions. At the first meeting, we discussed about the objective, and the purpose is to transfer paper guide to the electronic format. The manual guide was developed ten years ago. Developed UML diagrams for pupil's role and teacher's role revealed the typical process and its activities. Software developers defined UML diagrams, and these were used, when functionality of the application was designed.

Table 2. Steering group and developers meetings.

	Steering group meeting	Developers meeting
Discussions and presentation	10 meetings	23 meetings
Comments	Steering group meetings were arranged as needed or developers presented web-pages and planned features of the application.	Software developers and I discussed together weekly. A typical meeting was one hour. During the meeting we considered what has been done last week and how to continue next week.

I emphasize that developers meeting followed loosely Agile method, even we do not named it so. The weekly meeting was useful for me and for students, therefore we can update the progress and we can discuss possible difficulties. We tried to solve problems together. I should say that my role a partly active participant and the other hand as a researcher.

Development process

The software-development project started as a proposed by Liikenneturva to the head of degree programme Transport Management in January 2012. The project was suggested as a suitable for students of Information Technology. My roles as supervising and being the researcher started in February 2012. I accepted the project, and the agreement was signed. I and head of the TM discussed how we can find students who are willing to participate on the

project. The student of TM participates in the project, and the main purpose is to act as transport expert and to write the thesis. Three students of IT were selected after they accepted invitation, and I discussed with each one and with as a group.

Table 1. Development process and its phases.

Phases	Description	Comments
Problem formulation	We analyzed development problems together with representatives of Liikenneturva and teachers, who participated to meetings. The application will be used by browsers. The application's first version will be development by the end may.	An important problem was that teachers' authentication must be resolved so that they can use e.g. Google, Facebook or other login methods. We decided to apply a general method, which is common for Google and Facebook's authentication.
Requirement and features	The application requirements were defined by analyzing teachers', and pupils' roles. The student of TM defined needed requirements that are based on traffic knowledge.	These roles were described using by UML use case diagram.
Building, intervention and evaluation	The platform, we selected is based on students' experiences and how they were willing to learn a new programming language. The selection is Microsoft C# and ASP.NET architecture. During the development phase regular discussions with students and teachers were organized.	The Microsoft platform means that the server is Windows 2008 and Web-server is IIS. The database is MySQL. The server environment was hired from a service operator. The test environment was hired for a year. The domain name for testing purposes was also reserved. Tables of database were defined using by UML class diagram.
Reflection and learning	The project time schedule was organized in a way that students can to participate in other courses at spring period. Lesson learned continued from February 2012 to December 2012. I argue that the time delay was useful for students and also other participants. Students learning experiences collected by writing individual learning reports.	Students commented that time schedule was demanding. They had to learn new things and how to solve existing problems. The development work was organized so that the first student concentrated on database development. The second student developed web-pages using by ASP.NET and the third student developed authentication and how to draw the map to web-page.

The development process is presented using by Sein et al.'s (2011, p42) generic schema, which is modified to application project.
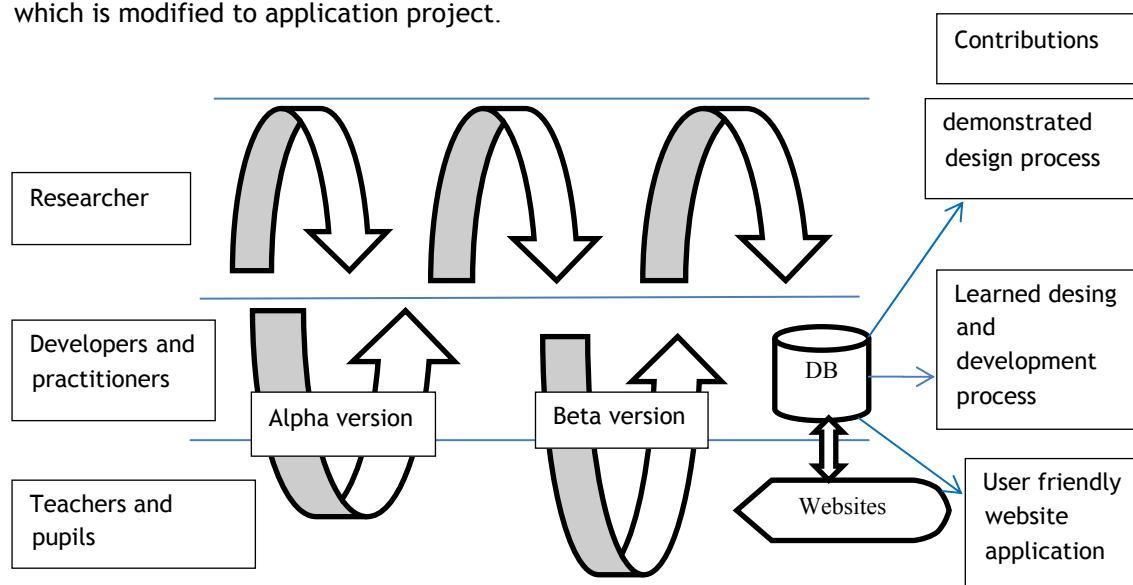

Figure 2. Web-site application schema modified from (Sein et al. 2011).

The researcher's role and possible contributions for action design research method during the development process were to consider how well the generic schema fitted to this application project. I argue that Sein et al.'s proposed schema rather good can be used to describe an application project. The developers learned how to apply the design science schema to the specified project, even they did not recognize at beginning what the schema is. The practitioners participated to test the alpha version at the first round. The second round practitioners, developers and a small group of pupils tested the beta version. The comments were collected and documented for to use further development.

I admit that we did not apply any software method directly to the development project. Students were not familiar enough any Agile method. The students knew some basic principles behind the method. However, we decided not to apply the method.

Conclusions

To summarize development project, I emphasize, students' role as active developers during a curriculum period is useful for students. Students can integrate their courses and working, even it is time to time difficult. Students pointed out that spring season 2012 to be full of work. However, we managed to organize development group meeting weekly.

Looking through the researcher's lenses the development project and trying to apply action design research method to process, I argue the method is promising tool to organize research project. Furthermore, I emphasize ADRM need more research in the real-world development projects, e.g. software companies' projects.

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The Design and Use of a Math Learning Game in Real-life Educational Contexts

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Digital game-based learning has opened many new opportunities for authentic, interactive, and engaging learning experiences, both formal and informal (Kiili 2007; Kirkley, Kirkley & Heneghan 2007; Spires 2008). At its best, game-based learning offers personally meaningful and relevant learning experiences. (Kankaanranta 2007; Prensky 2006). Games have also been recognised to promote both intrinsic and extrinsic motivation (Garris, Ahlers & Driskell 2002) as well as to enable all-absorbing flow experiences (Chen 2007). Learning games provide possibilities to be fully immersed, interested, and actively participating in the learning activity, which, in turn, is expected to lead to better affective and cognitive learning outcomes (Pivec 2007; Prensky 2001).

Furthermore, good educational games enable users to explore the world safely and to practice so-called 21st century skills related to ways of thinking and working as well as to skills needed to use tools for working and living in the world (Binkley, Erstad, Herman, Raizen, Ripley, Miller-Ricci & Rumble 2012; Spires 2008). In fact, 21st century skills such as complex communication and expert problem solving are dominant features in most game genres (Spires 2008). Digital games also enable the practicing of skills related to technology and other skills such as collaborative knowledge building (Mayrath, Clarke-Midura & Robinson 2012).

However, despite the rapidly growing understanding of the characteristics of good learning games, it is their design, development, deployment and effectiveness evaluation which remains a huge challenge. There is a need for more understanding about how to apply what we know about teaching and learning to optimising game-based learning (Kebritchi & Hirumi 2008; Kirkley et al. 2007). There is also a clear need for developing systemic learning game design procedures that take into account, first, shared prerequisites for adopting learning materials in any educational context, and, secondly, context-specific requirements, such as those expressed in a school curriculum and those reflected in the everyday educational practices. These requirements include aspects such as the vision, aims, and content of the curriculum, the learning activities, teacher's roles, availability of materials and resources, location, scheduling as well as student grouping and assessment (see van den Akker 2010).

This paper presents work-in-progress research that aims at 1) augmenting usable and practical, relevant knowledge about the design and use of learning solutions in real-life contexts and 2) formulating procedural principles and methods for a cyclical development process. The paper is based on a large-scale value network project called Systemic Learning Solutions (SysTech) led by the University of Jyväskylä. The SysTech project aims at promoting

the teaching and learning of 21st century skills by validating, implementing and disseminating innovative learning solutions including educational games (Kankaanranta & Neittaanmäki 2011). The SysTech project is based on the user-driven principles of involving different stakeholders (company representatives, researchers, teachers, learners and parents) in the collaborative design and use processes (see Nousiainen, Kankaanranta & Varsaluoma 2011).

This paper presents preliminary insights from the design and use phases of one learning solution, namely the web-based learning environment 10monkeys. 10monkeys is a cloud-based single-player math skills building game for children aged 6-10. In the game, monkey characters lead children into basic math challenges such as understanding numbers, addition, subtraction, division, multiplication, word problems, and money-related calculations (for more information see 10monkeys.com).

Research approach and methods

The SysTech research activities are implemented through six intertwined work packages focusing on the design and use of learning solutions, for example, on user involvement, usability, testing, implementation and effectiveness evaluation. However, before entering the cycles of the work packages, each learning solution is assessed by an expert evaluation. The use studies of various learning solutions are conducted first in short initial pilots and, after that, in extended trials. Such research design requires a multidisciplinary and mixed method approach that combines qualitative and quantitative research techniques in order to gather rich, multidimensional data from both technological and pedagogical perspectives.

This paper focuses on the cyclical processes through which the learning solution 10monkeys has proceeded so far. The preliminary results describe the strengths and weaknesses of 10monkeys and its applicability to learning situations. We also pay attention to the learning experience as well as to the technical usability (system functionality and user interaction with the solution) and the pedagogical usability (feasibility in educational context) of 10monkeys as perceived by the users.

Expert evaluation

The first phase of this study was an expert evaluation of the learning solution performed by researchers and content area experts. The main aim was to evaluate the pedagogical and technical usability of the solution and to assess its degree of readiness for use. The expert evaluation was completed in spring 2012. In assessing technical usability, we utilised the criteria of Nielsen (1993) and Nokelainen (2006). In addition to this, we analysed the accessibility of the solution with different devices. When assessing pedagogical usability, we utilised the requirements of the Finnish National Core Curriculum (National Board of Education 2004), the 21st century skills as defined in the Assessment and Teaching of 21st Century Skills project (see Binkeley et al. 2012), and Nokelainen's (2006) criteria for pedagogical usability. The experts also estimated how well this learning game met the criteria for an effective learning game (see e.g. Kiili 2007; Kirkley, Kirkley & Heneghan 2007; Spires 2008; Garris, Ahlers & Driskell 2002).Finally, we created a variety of pedagogical scenarios for the use of the learning solution in different learning environments. The evaluation report was sent to the company's representatives and a meeting was arranged in order to discuss the experts' recommendations for further development.

Use scenarios for the initial pilots

As the results of the expert evaluation indicated that the learning solution was mature enough to be taken into the school environment, we invited Finnish preschools, primary schools and afternoon clubs to take part in a short-term pilot study. The initial pilots were implemented in spring and autumn 2012 in one kindergarten (6-year-old learners), two primary schools (7- to 10-year old learners; classes from the first to fourth grade), and one afternoon club (7- and 8-year-old children). Pedagogical scenarios formulated in the expert evaluation were redesigned into use scenarios that met the curricular content, phase of the semester and characteristics of the user groups. For example, not all children in the kindergarten could read yet, so we decided to use the pair-teaching method; the child who could read guided the child who could not read. This method was also expected to be beneficial as previous research shows in that observing the pair-teaching situation may reveal usability problems that would not have been possible to uncover, for example, by using just a questionnaire (e.g. Höysniemi, Hämäläinen & Turkki 2003). The pair-teaching method use scenario also allowed us to see how well this game, originally designed for one player, could be used in pairs.

Initial pilots

During the short-term pilot study, 95 children (N=50 girls and 45 boys) tested the game. There were three sessions in each pilot environment. In the short-term pilot study we used an observation framework created for observing the user experience, usability, strengths and weaknesses of the learning solution as well as the actual learner activity. One or two researchers observed each pilot session. The teachers' reflections, which took place during the pilot sessions, were recorded and ideas from both teachers and learners were actively noted. Users also gave oral feedback after each session. Finally, self-assessment questionnaires for users served as an additional way of gathering information about the user experience. We also included the System Usability Scale (Brooke 1996) as a part of self-assessment questionnaires for teachers as, despite its limitations, it provides some indicators regarding technical usability.

Extended trials

The results from the short-term pilot study showed that the 10monkeys learning game met the criteria set for the technical usability in a real-life context and it was determined that it contained enough support material for the pedagogical deployment of the learning solution. Thus, in spring 2013 we organised extended trials in various schools. Several class groups from various primary schools and preschools (N=approximately 300 children) are currently participating in a long-term pilot study. The aim of the extended trials is to evaluate the effects for learning and also the pedagogical practices related to the use of 10monkeys. The focus is on both Finnish Math curricular contents and cross-curricular 21st century skills. In addition to teachers' and students' perspectives, also parents' perspectives will be examined since the game can also be used at home. All of the aforementioned groups will receive a questionnaire prior to and after the test. Teachers assess the game usage by observing the individual students during the pilot. We will also use embedded assessment tools provided by the solution (e.g. user specific information about the total time spent playing the game, the number of correct and incorrect responses, and a list of tasks completed). After the evaluation of the long-term pilot study, we will discuss the need for further iterations with the company. The results of this phase will not be discussed in this paper, as the trials are still ongoing.

Results and discussion

The diverse research phases have resulted in further development of the web-based math environment 10monkeys. In the expert evaluation, the technical usability of the game was found to be relatively good but there were some suggestions for improvements, such as clearer navigation. Navigation was subsequently further developed by the company. From the pedagogical usability viewpoint, the game was seen as easy to integrate into the Finnish Math curriculum. Nevertheless, the experts saw a need for creating instructional material for teachers in order to facilitate the design of lesson plans. The company answered to this need by creating planning tools for teachers where the integration of all activities can be easily visualised. Although the game enabled the practising of 21st century skills, the experts suggested adding more elements to support processes such as deep problem solving, creativity, and collaboration.

In the initial pilots, the general usability of the game was perceived to be very good. Children considered the game complete and functional as it was. Excluding some reported bugs, the difficulties in playing the game were mainly related to the learning content, not the actual gameplay. Some improvements, such as modifying the user interface so as to improve the game flow, were implemented immediately after receiving the direct feedback from the users. Learners also suggested additional configurable elements such as "more styles for the triumph dance after each section" (a video clip shown after completing a set of tasks), or a wider selection of clothing for game characters. Many such suggestions have already been included in the new version of the game.

Researchers, teachers, and children all asked for more personally involving, engaging, and motivating game-like elements. As a result, easily personalised learner profiles and rewarding systems such as stars and badges that pop up and can be systematically collected have been added to the game. Both educators and learners also hoped that the 10monkeys game would give more feedback regarding the learning process and student progress. These aspects have been further developed, for example, by creating user-friendly evaluation tools that support process evaluation on both the individual student and group levels and provide statistics on individual and group progress for educators. The company also took note of the importance of creating easy-to-use grouping capabilities and access control, especially when working with young children.

As an example of the designed use scenarios, the pair-teaching method was found pedagogically very functional as it gave opportunities for building communication and collaboration skills. Moreover, it enabled receiving more feedback from users as it activated them to discuss the process more vividly. It also gave ideas for the developers to add more collaborative elements to the game.

All stakeholders participating in the project were satisfied with the design and use processes. For the researchers, it has been an excellent way to test, and further develop procedural and substantive design principles in real-life contexts. Many good ideas regarding the methods or contents came directly from the various experts. The company members expressed their satisfaction regarding this process as it has helped them in modifying their learning solution in order to answer better to the needs of different educational contexts. They have also received plenty of ideas for further development.

Furthermore, involving children in the design process has given these youngsters an opportunity to act as experts in a real-life product development process (see Nousiainen 2008), something that, in itself, can be considered as "going beyond the classroom experience" and as a way to practise 21st century skills. One teacher participating in the process commented that children have been excited about their expert role as game co-developers and instead of being passive users, they have been keenly analysing the usability

of the game. These children have been able to see how the game has developed based on their ideas, something that is likely to make using the game more personally meaningful. This experience has also helped teachers to see that participating in the design of learning solutions can actually give them an opportunity to have learning solutions that are customised based on the specific needs of their learning environments.

What is then the added value of the 10monkeys math learning game within different learning contexts both in relation to the core curricular contents and cross-curricular 21st century skills? Based on the studies conducted so far, 10monkeys has proven to be a good tool for teaching and learning the Math curricula in Finland. Teachers also found that the game was feasible for teaching differentiation. Nevertheless, some children requested more challenging activities which may indicate that the potential "future mathematicians" could be taken better into consideration. This could be done, for example, by enabling the inclusion of student-created content in the game.

The game was also viewed as a very motivating way to study math. A remarkable added value of the 10monkeys learning game in the school environment is that it helped children to feel that learning math can be fun. Learners were very keen and enthusiastic about learning math with this solution. Although more elements related to learning cross-curricular contents and so called 21st century skills such as deep problem solving were desired, we noticed that it was possible to include practising these skills as a part of several pedagogical use scenarios. It was also observed that children were naturally practising both collaboration and technological skills when supporting one another both with math problems and when facing difficulties related to the technical use of the tool. In addition to this, enabling social sharing within the game has also been suggested so as to provide more opportunities for collaboration and communication.

Conclusions

One of the challenges faced during the project was how to find time and align the timelines of researchers, companies and schools together so as to be able to schedule authentic design and use sessions. Neither is it easy to develop user-friendly and cost-efficient data gathering tools nor to design pilots as a part of the everyday routines in an educational environment. In the future, more participatory methods such as writing diaries or organising design workshops could be included as a part of the learning activities in which learning solutions are designed and tested.

Our findings so far support the findings of previous studies showing the value of learning games in creating engaging and personally meaningful learning environments in which learners can be fully immersed and participate actively. At the moment this tool has been used together with other learning materials. We look forward to obtaining the data from the extended trials in order to analyse the transferability, scalability, impact and sustainability of the 10monkeys learning game on a wider scale. One of the greatest challenges is how to permanently integrate learning games together with educational practices in learning environments. This is something we intend to tackle with the help of a cyclical development process.

The SysTech project promotes active participation of learners and teachers as a part of authentic multidisciplinary team aimed at designing tools for improving both affective and cognitive learning processes. Moreover, for teachers this kind of project provides opportunities to take into use tools that answer to their specific professional needs. In this way different educational stakeholders could participate in companies' minimum viable

product testing with the aim of developing their own educational practices towards teaching and learning skills considered important for the 21st century.

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Gamification Increases Usage of e-learning Environment

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Gamification Increases Usage of e-learning Environment

Learning is an important issue in ICT business nowadays. Learning the Java programming language is hard. Javala - an open eLearning was created to help people to get started with programming. Javala is totally open which in this context means free, non-commercial, easily available (in seconds) and usage of pseudonyms to make it safe. Javala was released in Sep 2004 and it has now been up and running for seven years. The run button seen in Fig.1 has been pressed over 750000 times during this period.

| viikon parhaita kävijöitä			
Nimimerkki	**pisteitä**	**%**	**taso**
onkila	56	100	Javakuningas
koira666	44	78	Javaguru
JanneR	28	50	Peruskoodari
elanne	23	41	Peruskoodari
java	17	30	Java-aloittelija
pr0mille	6	10	Javaturisti
kissa	6	10	Javaturisti
kaheko	4	7	Javaturisti

Gamification has a strong effect on motivation. The idea of Javala is that you get points by completing exercises. When a user accomplishes an exercise in Javala, the nickname deserves some points and the nickname gets higher on the top 100 list (seen on the right in Fig. 1). On 1st of Jan 2013 gamification was removed from Javala. The change shown in Fig. 1 was made.
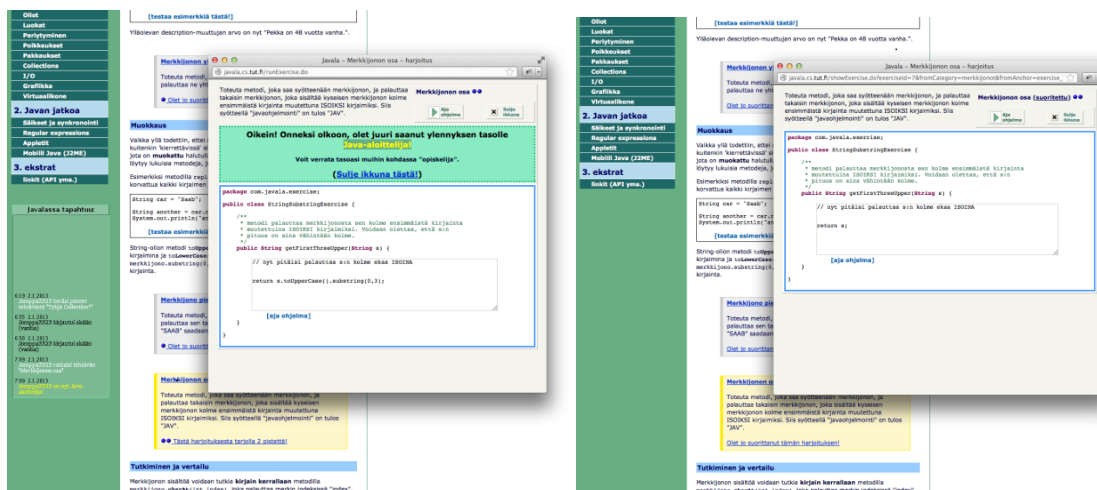
Fig. 1. Javala before removal of game-like events on the left and after the change on the right.

Every game-like feature was removed. These features included points in exercises, badges (like Java Beginner or Java King) and the accomplishments pane on the left sidebar. Also the top 100 list disappeared.

The changes made affected the behavior of users a lot. In Fig. 2. you can see the number of users that used the system during years.
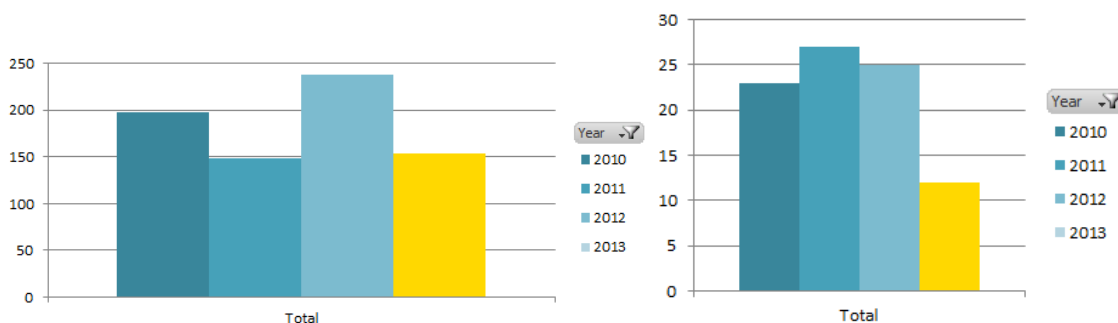
Fig. 2. On the left: the number of users in January. On the right, number of users that collected 50 per cent of points.

On the left is the number of users that collected at least one point during January. January is the month when schools begin and people seem to use Javala a lot then. For example, in January 2011 there were 148 users and year 2013 altogether 153 users. On the right you can see number of users that collected 50 per cent of the points: the number seems to drop dramatically when gamification was removed (Years 2011 and 2013 from 27 to 12 accordingly although there were as many beginners).

A Chi-Square test in Table 1 supports this perception. The users were divided into two groups: the users that had game-like elements in Javala and the users that did not have them. It was then observed if this affected their willingness to collect at least 50 per cent of points. The P-value of Pearson Chi-Square test is below 5% ie. gamification seems to affect usage of an e-learning environment.

Table 1. Chi-Square tests for gamification on or off and the fact if a user collected 50 per cent of points.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4,471[a]	1	,034		
Continuity Correction[b]	3,942	1	,047		
Likelihood Ratio	5,296	1	,021		
Fisher's Exact Test				,038	,017
N of Valid Cases	4239				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 17,19.

b. Computed only for a 2x2 table

A quick conclusion is: you can make learning a lot more interesting and addicting if you use game-like elements. If you remove gamification, the motivation seems to drop and people do something else instead.

TIIVISTELMÄT

Abstracts

Lähtökohtia matematiikan verkko-oppimisympäristöjen käytettävyyden tutkimiselle harjoitustehtävien virheitä analysoimalla

Hannu Tiitu (s. 4-11)

Tietotekniikan mahdollistama murros matemaattisen ajattelun esittämisessä tulee vaikuttamaan oppimateriaalien ja opetuksen sisältöihin. Tulevaisuuden tietotekniset oppimisympäristöt saadaan hyödyllisiksi, kun uusien välineiden tarjoamat mahdollisuudet ymmärretään ja tuodaan käyttöön tavoilla, jotka edistävät oppimisen prosesseja. Tässä artikkelissa esitellään lähtökohtia tutkimukselle, jossa perehdytään matematiikan oppimisympäristöjen hyvään käytettävyyteen opiskelijoiden tekemiä virheitä analysoimalla. Tutkimuksen kohteena on Aallon insinöörimatematiikan ensimmäisen opiskeluvuoden kevään peruskurssin Stack-järjestelmässä tehdyt viikkoharjoitukset sekä perinteisesti palautetut välikoevastaukset.

Tuotteen tai järjestelmän käyttökelpoisuudelle on vaatimuksena hyvä käytettävyys ja toiminnallinen hyödyllisyys. Oppimisympäristöjen yhteydessä käytettävyyttä kutsutaan tekniseksi käytettävyydeksi ja toiminnallista hyödyllisyyttä pedagogiseksi käytettävyydeksi. Opiskelijan käsitemaailman muuttuminen ja kehittyminen näkyy hänen tekemissään virheissä. Toisaalta oppimisympäristön käytettävyys on keskeisessä asemassa siinä, millaisia virheitä oppilas tekee. Käytettävyys on siis osa kokonaisuutta, joka johtaa opiskelijan käsitteenmuodostuksen kehittymiseen ja muuttumiseen.

Tutkimus tehdään virheluokittelulla, jonka avulla analysoidaan, onko oppimisympäristö johdatellut opiskelijoiden käsitteenmuodostusta johonkin tiettyyn suuntaan. Myös tehtävät luokitellaan sen mukaan, millaisilla oppimisympäristön ominaisuuksilla ne on toteutettu. Tällöin voidaan arvioida, suosiiko järjestelmä tiettyjä tehtävätyyppejä. Lisäksi saadaan näkökulmia siihen, miten matematiikan oppimisympäristön käytettävyydellä voidaan vaikuttaa opiskelijoiden matematiikan käsitteenmuodostuksen kehittymiseen.

Avainsanat: matematiikka, oppimisympäristö, pedagoginen käytettävyys, laskuvirhe, virheanalyysi, Stack, Mumie, S3M2

Tietokoneavusteisten matematiikan tehtävien vaikutus lukio-opiskelijoiden minäpystyvyyden uskomuksiin ja asenteisiin

Johanna Ojalainen, Matti Pauna (s. 12-18)

Tämän design-pohjaisen tutkimuksen tarkoituksena on selvittää tietokoneavusteisten matematiikan tehtävien vaikutusta lukio-opiskelijoiden minäpystyvyyden uskomuksiin ja asenteisiin. Ensimmäinen tutkimussykli käynnistyi marraskuussa 2011 keräämällä aineistoa seitsemältä (7) lyhyen matematiikan lukiokurssilta. Tutkimukseen osallistui 135 opiskelijaa, joista 94 oli tyttöjä ja 41 poikia. Kurssin alussa ja lopussa järjestettävillä kyselyillä mitattiin opiskelijoiden minäpystyvyyden uskomuksia, asennetta matematiikkaa kohtaan, motivaatiota ja mies-naiskäsityksiä sekä tietoteknistä osaamista. Tavoitteena on selvittää, 1) verkkotehtävien vaikutus minäpystyvyyden uskomuksiin, asenteisiin ja oppimistuloksiin ja 2) luokitella opiskelijoita minäpystyvyyden uskomusten, asenteiden, tietoteknisten valmiuksien ja oppimistulosten perusteella. Lisäksi tarkoituksena on kehittää tietokoneavusteisia opetusmenetelmiä ja -käytänteitä.

Avainsanat: matematiikka, minäpystyvyys, asenne, verkko-opetus, automaattinen palaute

E-oppimiskäyttäytymisen analysointi ReadIT-ohjelman avulla

Meri-Tuulia Kaarakainen, Osmo Kivinen   (s. 19-25)

Analysoimalla ReadIT-opetusohjelman avulla kerättyä lokidata-aineistoa tarkastelemme 424 varsinaissuomalaisen yhdeksännen luokan oppilaan verkkolukemisen tapoja. Klusterianalyysillä selvitämme aineiston jakautumista erilaisiin e-oppimiskäyttäytymisryhmiin. Lisäksi analysoimme ryhmien välillä havaittuja eroja suoriutumisessa luetun ymmärtämistestissä sekä sukupuolten välillä havaittavia eroja e-oppimiskäyttäytymisessä.

Asiasanat: e-oppimiskäyttäytyminen, lokitietojen analysointi, klusterointi

Verkkopohjainen harjoittelu osana matemaattisen ajattelun kehittymisprosessia

Antti Rasila   (s. 26-33)

Artikkelissa tarkastellaan tapoja, joilla tietotekniikkaa voidaan käyttää skemaattisen matemaattisen ajattelun kehittämisessä. Erityisesti pohditaan, miten konsepteja voidaan avata opiskelijalle käyttämällä verkkopohjaisen järjestelmän avulla toteutettuja pelimäisiä harjoituksia. Toteuttamisalustana voidaan käyttää esimerkiksi avoimen lähdekoodin järjestelmiä kuten Stack ja Mumie. Käsiteltävät esimerkit liittyvät yliopistotasoiseen matematiikan ja läheisten tieteiden opetukseen. Laajempana tavoitteena on tutkia verkkopohjaisen harjoittelun mahdollistamia pedagogisia uusia ratkaisuja. Artikkeli on jatkoa aikaisemmalle automaattista tarkastamista käsittelevällä tutkimukselle Aalto-yliopiston matematiikan ja systeemianalyysin laitoksella.

Avainsanat: matematiikka, verkko-opetus, yliopisto-opetus, automaattinen tarkastaminen, skemaattinen oppiminen, pelimäinen oppiminen

Koulun kumppanuudet ja verkostot

Tiina Korhonen, Kati Sormunen, Minna Kukkonen, Jari Lavonen   (s. 34-49)

Koulun kumppanuudet ja verkostot - hankkeessa tarkastellaan koulua ja koulun lähialuetta kokonaisuutena, oppimisympäristöjen verkostona ja luodaan innovatiivisen kouluun käytännön toimintamalleja teknologiaa hyödyntäen. Hankkeessa kehitetään tapoja hyödyntää tieto- ja viestintätekniikkaa tämän päivän ja tulevaisuuden oppilaiden oppimisen tukena. Kehittämistyö kohdistuu erityisesti tieto- ja viestintätekniikan monipuoliseen hyödyntämiseen koulussa sekä vanhempien ja lähialueen toimijoiden yhteistyössä.

Hanke rakentuu kolmesta osahankkeesta: Mobiililaitteet personoidun oppimisen tukena, Tieto- ja viestintätekniikka kodin ja koulun yhteistyön tukena ja Tieto- ja viestintätekniikka koulun, päiväkodin, vanhainkodin ja kirjaston yhteistyön tukena. Hankkeessa tukeudutaan design-tutkimukseen, jossa on keskeistä tutkijan toimiminen yhteistyössä tutkittavan kohteen toimijoiden kanssa ja että kehittämisprosessi on luonteeltaan iteratiivinen. TVT:n käyttöä innovaationa tarkastellaan Rogersin innovaatioiden omaksumisprosessia tarkastelevan teorian avulla. Artikkelissa tarkastellaan kolmen osahankkeen taustoja, tutkimus- ja kehittämisprosessia, aineistoa ja hankkeen ensimmäisiä tuloksia.

Avainsanat: Tieto- ja viestintätekniikka, innovaatio, personoitu oppiminen, kodin ja koulun yhteistyö, yhteistyö, vuorovaikutus

Formaali tieto oppimisverkoston sosiaalisen pääoman kasvattamisen haasteena

Mika Sihvonen, Miikka Sipilä (s. 50-54)

Tämä tutkimus käsittelee oppimisverkoston sosiaalista pääomaa ja verkoston jäsenten suhdetta jakamaansa tietoon. Tutkimuksen kohteena on useassa eri taustaorganisaatiossa toimivien hankkeiden muodostama formaali hankeverkosto. Tämän tutkimuksen taustalla on hypoteesi, jossa yhteiseen toimintakulttuuriin ja luottamukseen liittyvät haasteet suuntaavat verkoston informaatiosisältöjä kohti organisaatioiden formaalia tietoa, kuten esimerkiksi julkista viestintää, jolloin varsinainen hankkeen toimintaa koskeva informaatio ei välttämättä tule esiin.

Avainsanat: Oppimisverkosto, formaali tieto, yhteisöllinen media, hankeviestintä

Opettajayhteistyö ja opettajatiimit tieto- ja viestintäteknologian opetuskäytön tukena

Teemu Mikkonen (s. 55-60)

Suomessa peruskoulujen tieto- ja viestintäteknologisia (TVT) ratkaisuja on 2000 -luvulla hankittu suhteellisen suurilla rahamäärillä. Suomi on ollut kärkimaita Euroopassa, kun sen käyttämiä rahamääriä on suhteutettu muihin Euroopan maihin. Tästä huolimatta TVT:n hyödyntäminen on Suomen koulujen arjessa verraten vähäistä (ks. OPH, 2011; ESSIE, 2013). Esittelemme tässä artikkelissa LeaD -tutkimushankkeen osaprojektin, jossa pohdimme syitä sille miksi opettajat eivät ole opetuskäytössä hyödyntäneet koulujen tarjoamia TVT -ratkaisuja aktiivisemmin. Mietimme mikä on syynä siihen, että joissain kouluissa ja oppilaitoksissa TVT on otettu aktiiviseksi osaksi koulun arkea ja toisissa sitä ei hyödynnetä juuri lainkaan. Taustatekijänä kaikessa on laitteisto- ja opetusresurssit, mutta vähintään yhtä tärkeäksi vaikuttavaksi tekijäksi ovat nousemassa erilaiset opetustyön kulttuurit (kts. Mikkonen, Sairanen, Kankaanranta & Laattala, 2012; Tynjälä, 2004; Hargreaves, 1994). Opettajan toimintamahdollisuuksia ja opettajayhteisön todellista yhteistoimintaa mahdollistavat kulttuurit saattavat erottua edukseen. Tutkimuksessamme selvitämme mitkä ja miten eri opetustyön kulttuureihin liittyvät tekijät vaikuttavat opettajien keskinäiseen TVT -käytäntöjen ja oppimateriaalien syntymiseen, oppimiseen ja jakamiseen. Aineistonkeruun ollessa käynnissä, tarkempien tutkimustulosten analysointia ei tässä artikkelissa tehdä. Artikkeli rajautuu esittelemään tutkimuksen lähtökohtia ja tulevaisuuden kehitysnäkymiä.

Avainsanat: TVT:n opetuskäytön kehittäminen, yhteisöllinen oppiminen, opettajayhteisöt, learning design

Lapset ja nuoret videojulkaisemisen kynnyksellä — kOuluTV julkisuuskasvatuksen ja mediarohkaisun välineenä

Laura Palmgren-Neuvonen, Tuula Myllylä-Nygård, Riitta-Liisa Korkeamäki (s. 61-68)

Lapset ja nuoret viihtyvät vuorovaikutteisten, yhä visuaalisempien medioiden parissa, eikä koulutyö perinteisin menetelmin innosta kaikkia. Oppijalähtöistä videotuotantoa käytetään opetuksen välineenä jo monessa koulussa, mutta tuotoksien julkaisemiseen digitaalisissa medioissa suhtaudutaan varauksellisesti. Oppijoiden tekemien videoiden julkaisualustaksi luodulla kOuluTV-kanavalla tuotoksia on julkaistu varsin vähän. Tässä tutkimuksessa selvitetään, millaiset tekijät vaikuttavat oppijoiden haluun julkaista videoita verkossa. Tavoitteena on myös tutkia, millaisen lisäarvon videotuotanto tuo opetukseen, kun lähtökohtana on tuotosten verkkojulkaiseminen. Aineistoa on kerätty haastattelemalla oppijoita ja vanhempia sekä opettajia ja rehtoreita. Alustavien tulosten mukaan erityisesti

alakouluikäiset ovat innostuneita tekemään videoita koulukontekstissa, mutta iän myötä innostus näyttää laantuvan ja myös julkaisemisen kynnys nousevan. Osalle opettajista videotuotanto on luonteva opetusmenetelmä, jonka avulla oppijoita rohkaistaan ilmaisemaan itseään mediassa turvallisesti. Haastatellut vanhemmat suhtautuvat koulussa tehtävien videoiden tekemiseen ja julkaisemiseen myönteisesti.

Avainsanat: digitaalinen video, verkkojulkaiseminen, mediarohkaisu, julkisuuskasvatus, osallisuus

Työkalu TVT-kehitystyön kehittämiseen ja tutkimukseen

Heikki Sairanen, Mikko Vuorinen, Jarmo Viteli (s. 69-75)

Arvioimme, kuinka Tampereen yliopiston TRIM tutkimuskeskuksen kehittämällä Opeka-palvelu toimii tieto- ja viestintätekniikan kehittämisen apuvälineenä suomalaisissa kouluissa. Opeka on verkkopalvelu, jossa opettajat voivat arvioida omaa TVT:n käyttöään ja ympäristönsä TVT-valmiuksia. Kyselyyn vastaaville tarjotaan tietoa ja vertailukohtia muiden käyttäjien vastauksista. Samalla kootaan raportit kouluille ja kunnille. Palvelu on kerännyt vuoden käytön aikana merkittävä määrä vastauksia (n = 3375). Analysoimme tässä paperissa, onko Opekasta hyötyä yksilön ja opettajayhteisön tasoilla. Metodologiana käytämme yksinkertaista tilastollista analyysiä kyselyyn liitetyistä palautekysymyksistä, teemahaastatteluja (3 kpl) ja kenttätyötä. Opeka palvelu näyttää olevan hyödyllinen noin viidennekselle vastaajista oman ilmoituksen mukaan. Vastauksista saadaan viitteitä siitä, että hyödyt ovat enemmänkin yhteisön tasolla opettajien vastausten perusteella, mitä muu aineisto myös tukee. Palvelu on kuitenkin muuttunut tarkastelujakson (2.5.2012 - 2.4.2013) aikana myös yksilötasolla paremmaksi. Palvelun ainutlaatuisuus tekee Opekasta kuitenkin vaikean arvioida.

Asiasanat: TVT-kehittäminen, arviointi, kyselyjärjestelmä, oppimisanalytiikka, TVT-valmiudet

Ubiikki oppimisympäristö

Turo Nylund, Johanna Nyholm, Tommi Lahti (s. 76-81)

Sosiaalisen median palvelut ovat olleet huimassa nousussa ja nykypäivän opiskelijat käyttävät tottuneesti näitä palveluja opintojensa ohessa. Oppimisympäristö on muuttumassa vanhasta luokkatilasta avoimeksi ja paikasta riippumattomaksi, jossa oppiminen tapahtuu arkisten asioiden keskellä. Hämeen ammattikorkeakoulun tietojenkäsittelyn koulutusohjelmassa on alustavasti kehitetty tähän tarkoitukseen sopiva palvelu, koska koulutusohjelma tarvitsee yritysten kanssa tekemänsä yhteistyön takaamiseksi työskentelyyn sopivampia verkkotyökaluja. Tällaisen palvelun tarjoaminen opiskelijoille, korkeakoulun henkilökunnalle sekä yritysten edustajille yhteisissä projekteissa on todellinen etu, koska tiedon pitää olla yhä helpommin saatavilla tilanteesta riippumatta.

Palvelu on koottu sovelluksista, jotka liittyvät projektinhallintaan, videoneuvotteluun ja tiedostojen jakamiseen. Sovellukset ovat keskitetty sivustolle, josta ne ovat helposti käyttöönotettavissa. Erilaisilla kursseilla pedagogiikasta riippuen palveluiden soveltaminen on usein erilaista, mutta palvelun on taivuttava koulutusohjelman tarpeisiin, ei toisin päin. Sovellusten valintaa on ohjannut koulutusohjelman vaatimukset sekä ubiikin oppimisympäristön periaatteet.

Koulutusohjelman vaatimuksiin on lukeutunut muun muassa palvelun skaalautuvuus, tiedon saavutettavuus, ajasta ja paikasta riippumattomuus sekä monimuotoisuus. Monimuotoisuudella tarkoitetaan, että palvelu toimii opiskelujen sekä projektien tukena ja sovellukset ovat käyttöönotettavissa ilman erillistä pyyntöä. Avoimen lähdekoodin sovellukset mahdollistavat palvelun muokkaamisen koulutusohjelman tarpeita vastaavaksi. Ubiikin oppimisympäristön periaatteisiin kuuluvat tiedon pysyvyys, saavutettavuus ja välittömyys.

Lisäksi periaatteisiin voidaan lisätä vuorovaikutus asiantuntijoiden kanssa ja oppiminen arkipäivän tilanteiden kautta. Viimeisenä ehtona oppijan täytyy saada oikea tieto välittömästi, riippumatta siitä minkälainen päätelaite heillä on käytössä.

Nykyisellään palvelu on edellä mainittujen teknisten ja koulutusohjelman vaatimukset täyttävä, mutta vailla palautetta, joka on peräisin käytännön opetustilanteista. Palvelua on kehittämistyön aikana käytetty virtualisoidussa ympäristössä ja palvelun laajempaa käyttöönottoa varten se on siirrettävissä pilvipalveluympäristöön mutta tällöin täytyy huomioida tietoturvaan liittyviä seikkoja ja tehdä yhteistyötä korkeakoulun tietohallinnon kanssa.

Avainsanat: Oppimisympäristö, ubiikki oppiminen, avoin lähdekoodi'

Design-tutkimuksella kohti toimivia aktiivisia kielenoppimistiloja

Laura Pihkala-Posti   (s. 82-91)

Monitieteisen Tekes-arvoverkon Aktiiviset oppimistilat tutkimusprojektissa Sosiaalista mediaa ja pelejä kieltenopetukseen tartutaan uuden teknologian koulukäytössä ilmenneisiin haasteisiin. Hankkeen erityinen painopiste on teknologian kehittämisessä pedagogiikkalähtöisesti. Uusia käytänteitä ja sovelluksia kehitetään siksi yhteistyössä kielenopettajien kanssa tavoitteena realistiset teknologian integrointiratkaisut, jotka otettaisiin kouluissa pysyvämpään käyttöön. Tutkimustoiminta tapahtuu osana normaalia lukion kielen opetusta, toistaiseksi yhteistyössä vajaan kymmenen kielenopettajan kanssa, jolloin saataneen jo varsin luotettavaa tietoa erilaisten sovellusten käytön eduista ja ongelmista. Hankkeessa avataan perinteistä luokkahuone- ja pulpettikeskeistä lähestymistapaa täydentäviä kielenoppimisen tiloja. Luodaan uudenlaisia todentuntuisia ongelmaratkaisu- ja viestintäoppimistilanteita, jollaisissa kehittyviä valmiuksia perinteiset lähestymistavat eivät ole mahdollistaneet, mutta jotka voivat monipuolistaa kielenopetusta ja myös uudistaa esim. arviointia. Vapaa-ajalla käytetystä sosiaalisesta mediasta tuttujen välineiden avulla oppilaat tuottavat koulussa ja kotona omaa sisältöä yhdessä toisten oppilaiden kanssa. Erityisesti vieraan kielen suullisen viestinnän formaali harjoittelu ei aiemmin ole juuri ulottunut luokkahuoneen ulkopuoliseen maailmaan ja kotitehtäviin, vaikka nykyiset teknologia-alustat sen jo mahdollistaisivatkin. Tässä artikkelissa esitellään tutkimuksen taustaa, teesejä, toteutussuunnitelmaa ja teoreettisena viitekehyksenä design-tutkimusta.

Avainsanat: sosiaalinen media, kielenoppimisen uudet konseptit, koulun teknologistuminen

Square1 Prototype: Build your own devices for collaborative learning

Anna Keune, Teemu Leinonen   (s. 93-99)

In this paper we present the concept of Square1, a set of computing devices for collaborative inquiry learning. The set consist of three single-task dedicated devices: (1) one for writing, (2) one for drawing, and (3) one central device for search and for composing presentations of content created by students. Square1 joins educationally meaningful aspects of collaborative learning, self-organized learning, Educational Sloyd and the more recent do-it-yourself movement. Children are considered to build the devices in schools. In this paper, the illustration of the background of Square1 is followed by a description of our participatory design process with children and teachers. Further, we present the most recent design of

Square1 with images and describe the kind of collaborative learning Square1 devices are primarily intended for. We claim that there is a growing demand for computer devices that are designed for self-organized collaborative inquiry learning and for accommodating children in building the devices themselves. We see that precisely the combination of these activities is educational and empowering.

Digital dashboard for visualizing learning progress and well-being

Eva Durall (s. 100-107)

The research proposal focuses on the design of a visual dashboard that combines objective and subjective data about the students' well-being with their learning patterns. It is expected that the creation of a goal oriented visualization that gathers health data and learning performance will allow users reflect about their lifestyle and, when considered necessary, take action to improve their learning.

The main goal of this project is to analyze how information visualization can support reflection and collaboration in learning. In this proposal, visualizations are understood as boundary objects (Star, 1989) that can be used as key materials for reflection and sense-making processes. The design of this visual dashboard follows Viégas and Wattenberg's (2006) communication-minded visualizations: visualization systems designed to support communication and collaborative analysis. The underlying idea of this approach is that participants learn from their peers when they build consensus or make decisions.

Similar way as data related to studies are proposed to be shown for learners in a learning analytics scenarios (Duval, 2012), indicators concerning students' well-being could provide useful insight about their learning capabilities. In this sense, the project builds on the idea that the integration of well-being indicators and learning performance information in a learning environment could contribute to develop a more personalized approach to learning.

This project builds on participatory design and a research-based design process (Leinonen 2008, 2010). Users will be involved in the early stages of the design process in order to incorporate people's concrete wishes and expectations. Currently, the project is in a contextual inquiry stage. Immediate actions to undertake next include the development of focus groups with end-users.

How to design learning in the 21st Century

Jukka Purma, Kiarii Ngua, Eva Durall (s. 108-114)

Our proposal is focused on lesson planning, conceiving it as a design activity. This approach is based on the adaptation of the Research-Based Design (RBD) method (Leinonen, 2010) for the specific purpose of designing learning activities. We attempt to find ways how teaching can accommodate changing learning requirements, especially in the light of 21st century skills.

We recommend a design approach that involves both students and their teachers in designing learning activities and methods. We present a revised RBD model - RBD for Learning and how it can be applied as follows:

1) Contextual Inquiry – In first cycle, the teacher introduces study subject and its objectives, and inquires about the learners' knowledge, needs and interests in relation

to that topic. In other cycles, the suitability of current learning activities in meeting subject objectives and student needs is assessed.

2) Participatory Design - teacher and learners envision together future learning activities and methods that would be suitable in covering the subject objectives while taking into consideration the needs and interest of the students. Evaluation metrics, reflective of subject objectives are also envisioned together.

3) Lesson Design – the teacher designs future lessons, so that the learning and evaluation methods agreed upon in phase (2) are included in the learning activities.

4) Learning activities as hypothesis - the designed learning activities are used in learning but are also intended for review, improvement and remake to reflect the changing students' needs and preferred ways learning as well as curriculum changes.

It is important to return to previous phases, to review the effectiveness of the designed learning activities to the study subject, student needs and interests.

The motivation for using RBD for Learning is to design learning that adapts to changing curriculum and varying students' needs and interests. In this sense, RBD for Learning can help shape learning and classroom environment in an iterative, progressive manner.

We suggest two benefits for using the RBD for Learning. These are; 1) improved teaching practices based on relevant and timely review and planning with students and 2) increased student engagement in learning as they become involved in the design of how they learn and are evaluated. Moreover, RBD method is a framework that can be used to incorporate the 21st Century skills into the curriculum or classroom activities.

Possibilities for Computer Supported Collaboration in Intensive Software Engineering Courses

Antti Knutas   (s. 115-118)

University education is becoming more collaborative and at the same time more tools are being developed for computer supported collaboration learning (CSCL). The study examines collaboration patterns between students in intensive software engineering courses using social network analysis and identifies places where the course could benefit from CSCL tools. Issues related to collaborative matchmaking were found. It is suggested that one of CSCL tools is adopted for further study in intensive courses in order to see if the tools improve collaboration patterns.

Keywords: computer supported collaborative learning, software engineering education, intensive learning, social network analysis

Presemo - a live participation tool

Matti Nelimarkka, Kai Kuikkaniemi, Jukka Reitmaa, Petri Lievonen   (s. 119-123)

This work presents Presemo, a tool enabling participation in co-located environments. We discuss the existing tools, which in our view are too static: we suggest that by changing the affordances, limitations and feedback mechanics could support achieving in the goals of participation. In this work, we present the previous work on backchannels, explain the Presemo system. We also discuss the future research and developments, such as multimodal interaction and more detailed analysis on the participation, such as analysis on the persons who participate or the content created by participants.

Collaborative Games in Language Teaching

Mikael Uusi-Mäkelä   (s. 124-128)

Games are not widely used in Finnish schools. Surveys show that language teachers, especially, are reluctant to adopt games in their teaching. However, there seems to be potential in games to enhance learning. Firstly, they broaden the range of instruction compared to traditional classroom by offering more concrete ways of learning. Secondly, games are engaging and they can teach us how to engage the students learning subjects as well. Games are commonly defined as voluntarily using unnecessarily inefficient means to reach a goal. Why would we spend so much time playing something like that? Thirdly, multiplayer games can offer an authentic environment to use the language, instead of using it for the sake of learning it. In this paper, I will shortly relate advantages of game-based learning and describe a case study, in which sandbox-game Minecraft was used to provide authentic environment to collaboration and language use.

Keywords/avainsanat: game-based learning, collaboration, authenticity, Minecraft

Software development project as a part of learning process

Raimo Hälinen   (s. 129-135)

The main aim of the software-development project is to create web-site application for Liikenneturva. The objective of the research project is to demonstrate Action Design Research Method (ADRM) in student based software process and to try to find out how well newly proposed research method supports the project.

   The development project started from the beginning of 2012 with accepting agreement and organizing steering group and development group. Development group consisted from three students of information technology and one student from traffic management degree programme. The members of steering group include three teachers and three members of Liikenneturva.

   The alpha version of the software was ready to pilot test by the end May 2012. The beta version was mainly tested during from September to December 2012. The final software will be tested during 2013.

   The research project revealed that ADRM was suitable to a development project. I admit that more systematical work to explore the method is needed in the future.

Keywords: Software, development project, Action Design Research method

The Design and Use of a Math Learning Game in Real-life Educational Contexts

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Digital learning games can offer excellent opportunities for practising skills such as communication, collaboration, and problem solving in an engaging and personally meaningful way. This work-in-progress study aims at developing substantial and procedural principles related to the design and use of a digital math learning game for children. The study is part of a large-scale value network called Systemic Learning Solutions (SysTech) aimed at promoting the teaching and learning of 21st century skills by validating, implementing, and disseminating technological learning solutions in various educational contexts. In this study a multidisciplinary and mixed method approach and participatory methods are employed during the cyclical design and development process consisting of expert evaluations, creation

of use scenarios, initial pilots and extended trials. The results of the initial pilot, which included 95 children age 6 to 10 years (N=50 girls and 45 boys), are in line with previous studies indicating that game-based learning can augment learners' motivation, active participation, and collaboration. The game was also seen as useful for differentiated learning. Thanks to the expertise of the children and educators who participated in the study, the game developers have been able to improve the technical and pedagogical usability of the game. Moreover, for educators, participating in the project has provided opportunities to co-design learning solutions and use scenarios that are customised based on the specific needs of their learning environments. The effectiveness of the math game will be examined in the ongoing extended pilots.

Gamification Increases Usage of e-learning Environment
Timo Lehtonen (s. 143-144)

Javala is an open e-learning environment for learning the Java Programming language. It includes exercises and gamification features like points and achievement badges. Javala has been up and running since 2004 and its "Run Program"-button has been pressed nearly million times. When all gamification features were removed in the beginning of year 2013, the willingness of the users to complete the exercises lowered considerably. Using gamification in an e-learning system increases its usage.