PROBLEM-BASED LEARNING FOR THE 21st CENTURY

New Practices and Learning Environments

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TABLE OF CONTENTS

GENERAL INTRODUCTION

Ellen Christiansen, Leena Kuure, Anders Mørch & Berner Lindström

The title of this book, *Problem-Based Learning for the 21st Century: New Practices and Learning Environments,* announces a challenge that has shaken up the world of education since the advent of the Internet: Education has become available to everyone with Internet access and the ability to read and write, and the cultural and personal inclination to do so – anywhere, anytime. Monopolies and control systems will gradually break down while new ones are emerging. Moreover, this is experienced by all teachers on a day-to-day basis in a variety of ways. This book is about the struggle of teachers to keep up with and build new practices and, last but not least, to bring forth actual teacher experience reflected through the lens of problem-based learning.

From 2010–2012, a Nordforsk-funded network of researchers called *Teaching problem-based learning in virtual environments* with participants from fourteen universities in four Nordic countries has been collaborating to exchange experiences and find ways to cope with the challenges. At five seminars, we shared knowledge about teachers' work conditions and self-management in relation to Problem-Based Learning (PBL) and Virtual Learning Environments (VLEs). The network dubbed itself SCANDLE (*Scandinavian Approach to the Design of Learning Environments*).

This edited volume marks the outcome of our work at the seminars, informed by our discussions and the decisions we made. It draws together a collection of empirical studies and design initiatives in problem-based learning in virtual and collaborative learning environments. The cases are from within and outside formal educational settings, and as such represent and to some extent promote various stages in the life-long learning process of individuals.

The book as a whole is a multidisciplinary effort, and the chapters draw on multidisciplinary research. For example, many of the design initiatives build on the ideals of the 'Scandinavian approach' to information system development and user-centred design, focusing on user participation in design, quality outcomes, and prototyping (iterative design with end-user feedback (Greenbaum & Kyng, 1991). The researchers give examples of how the pedagogy of Problem-Based Learning (PBL) has been adopted and extended in different ways, e.g., by making use of new technologies and social media. Some of the cases transcend the dichotomy of formal and informal learning by making use of technology platforms for participation that apply in multiple contexts (school, work, and leisure to name the most prominent appearing in our studies).

PBL is not a new pedagogy or research area. The development of this paradigm has gone on for more than 40 years. It is a student-centred pedagogy in which students learn about a subject through the experience of collaborative problem solving, i.e., reaching a solution or clarifying a problem by interacting with peers and teachers. Students learn strategies for critical thinking, information seeking, and knowledge sharing. They acquire shared knowledge in personally meaningful ways. The goals of PBL are to help the students develop flexible knowledge, problem identification and problem-solving skills, self-directed learning, and effective collaboration skills (Hmelo-Silver, 2004). Working in groups, students identify what they already know, what they need to know, and how and where to access new information that may lead to the resolution of the problem. The role of the instructor is not to teach a predefined and fixed curriculum, but to facilitate learning by supporting, guiding, and monitoring the learning process. PBL represents a paradigm shift from traditional teaching and learning philosophy (Hung, 2011), which is more often lecture based. The methods and concepts for teaching PBL differ from traditional classroom-based teaching, being more in line with case-based instruction in professional education and workplaces, e.g., in business and medicine (Schmidt, Rotgans & Yew, 2011). However, most of the research in PBL has been carried out in educational institutions (Barrett & Moore, 2010). Survey studies of PBL have identified different ways of setting up and running problem-based learning courses using technology in a variety of ways (Savin-Baden & Wilke, 2006), and applying PBL across disciplines and countries. Despite this, PBL researchers have focused mainly on educational settings and comparing f2f to online PBL. This book provides examples from multiple contexts for problem-based learning, such as informal (out of school) settings and the use of web-based technologies to mediate PBL.

The approaches to PBL presented in this volume show a new direction for the development of PBL pedagogy: from small-group work within a classroom to larger and more open-ended communities of inquiry that sometimes begin within, extend beyond, and sometimes 'spin-off,' from the classroom. Jenkins (2007) predicted the trend of 'extending the classroom' with the notion of 'participatory culture' that he saw would force educators to support the development of a new set of social skills and cultural competencies for twenty-first-century education. The most important of these were the abilities to carry out play, simulation, performance, appropriation, multitasking, distributed cognition, collective intelligence, judgment, transmedia navigation, networking, and negotiation (Jenkins, 2007). The major objective of teaching and learning in this environment is to foster a culture in which learners have the opportunity to actively participate in open-ended problem solving. These cultures of participation (Fischer, 2011) take into account that problems have no stopping rules and that problem solvers cannot aim at optimal solutions. Instead, they need to settle for satisficing solutions (Simon, 1996), which means they should remain open and be allowed to develop over time (e.g., not constrained by fixed class hours). Searching for information and expertise via the Internet in conjunction with problem solving with peers, is one example of the approach to the PBL we profile (Mørch, 2013).

The issues of PBL we have identified have been the subject of joint scrutiny and discussions at five seminars in the SCANDLE Network 2010-12. At the Aalborg kick-off seminar, we mapped out the landscape of *teaching problem-based learning in virtual environments in the Nordic countries; at the Oslo seminar the theme was Scaffolding critical reflection,* whereas at the Gothenburg seminar we discussed the *Scandinavian approach to PBL.* In Jyväskylä, we asked ourselves: *Can we design futures for participa-*

tion and learning? Finally, in the concluding seminar in Copenhagen, we discussed the position of *Teaching analytics.*

This book is divided into three parts. The first asks what digital pedagogy is and how to design for it. The second part reports from a variety of case studies within education, using innovative mediating technology or design initiatives. The third part describes ways to 'extend' the learning environments beyond formal educational settings. Although presented separately and sequentially, several of the chapters address share concerns and interweave themes and material from other parts and chapters.

Designing ways of teaching within the new, collaborative, learning environments has not yet been established as part of the curriculum in most teachers' professional training (i.e., digital pedagogy); teachers have to learn it as they go along. To formalize a digital pedagogy, we need concepts, procedures, and ways to conceptualize the problems being addressed. In order to do this, teachers need a community in which they can reflect and discuss the dramatic changes we are all facing, and the contributions in **Part I** of the book provide input for this discussion. Gerhard Fischer examines first different collaborative learning environments, portraying the challenges and opportunities they have revealed for the future. The chapter aims at transcending narrow frameworks for learning, directing focus towards new and different kinds of learning opportunities. Hannele Dufva discusses the notions of language and learning, arguing for a holistic perspective. She also speaks for distributed classrooms that would allow the learners' trajectories to reach across informal and formal contexts. Juha Jalkanen and Peppi Taalas show how teachers may also be designers when challenged to employ digital learning environments. They conceptualize this practice so that other teachers in the same situation can prepare themselves for a similar experience. In the next chapter, Thomas Ryberg presents the CoED method, which has successfully helped groups of teachers design curricula in new digital learning environments. This is accomplished by helping them develop a shared language for change of practice. Finally, Torbjörn Ott's analysis of the public debate around the adoption of digital technologies in education in Sweden creates a picture of the multivoicedness of this debate in the Nordic countries, which can enable teachers to better confront the media storms with which they are faced in the public debate.

Part II of the book introduces different case studies in teaching. The emergence of new technologies and widened access to social media has increased the affordances of communication and collaboration technologies. Emma Petersson, Annika Lantz-Andersson, and Roger Säljö explore critically virtual labs as a context for learning about ocean acidification. They highlight the nature of the activities applied in the lab as well as the role of the teacher as essential in identifying opportunities for learning. Three of the chapters in the second part highlight the importance of considering pedagogic thinking among current teachers or teachers to be. Linda Bradley and Sylvi Vigmo discuss the blurring of traditional borderlines between learning sites and how this may transform the ways of language learning. They discuss how the practices of everyday life in terms of the use of digital media and the practices of education in school do not easily meet. In their chapter, Nina Bonderop Dohn and Lillian Buus draw upon an extended version of *The Collaborative E-learning Design Method* (CoED) in order to address the issue of empowering teachers to carry out action research and develop their understanding of the challenges and potentials of Web 2.0 in PBL settings. Leena Kuure, Tiina Keisanen, and Maritta Riekki likewise focus on a participatory project in guiding language students to anticipate language learning with new technologies and in envisioning their own changing roles as teachers. Furthermore, in their case study on social bookmarking and tagging in a biology class, Niklas Karlsson, Petter Karlström, Ola Knutsson, and Berner Lindström show how digital media may be applied in the classroom to bridge the gap between the learners' everyday thinking and scientific definitions. They propose that the procedure of tagging enables creation of boundary objects, where students' understanding and scientific definitions meet.

Part III of the book deals with extending the learning environment and addresses unconventional educational settings. The three chapters suggest the contours of problem-based learning in the 'wild'. The chapter by Kevin Mogensen, Janne Gleerup, Simon B. Heilesen, and Anders Siig Andersen discusses bridging formal and informal learning, joining learning by instruction in school and learning by apprenticeship in companies. The authors propose bridging the two learning environments with a user-driven innovation model, mediated by a web-based learning environment. The process of user-driven innovation involves extensive participation and interaction of apprentices, teachers, masters, journeymen, and researchers. In the following chapter, Renate Andersen and Anders Mørch adopt a similar model, to which they refer as mutual development. This depicts a relationship between two communities of practice, or, alternatively, two activity systems, with respect to commercial products and services, namely end users (customers) and professional developers. Mutual development is a model for how this interaction can occur. It is based on a case study of customer-initiated software product development, illustrated by the analysis of interview data with developers and end users. Next, Jens Ideland describes a purely self-directed learning environment, Guitar Hero, which is a 'hands on', engaging, game-like learning environment for playing the chords of a guitar to accompany a rock music tune. This type of environment shows, first of all, the importance of engaging the learner, of identifying tasks that are motivating him. Secondly, when this has been accomplished, new opportunities for learning emerge and their design can be addressed. In the final chapter, Marianne Lykke and Tom Nyvang address PBL in an organizational setting, i.e., when the students' learning revolves around real-life problems provided by organizations outside the university. They discuss how real-world problems can provide opportunities for learning. The goal of the chapter is to provide a bridge from university to industry by researching how identical problems are treated in the two different contexts.

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PART I

DESIGNING FOR LEARNING

SUPPORTING SELF-DIRECTED LEARNING WITH CULTURES OF PARTICIPATION IN COLLABORATIVE LEARNING ENVIRONMENTS

Gerhard Fischer

Introduction

Different kinds of problems require different kinds of learning approaches and different socio-technical environments to support them. Outside the classroom, much learning and problem solving takes place as individuals explore personally meaningful problems and engage with each other in collaborative activities while making extensive use of media and technologies. Many past educational systems have been built on the assumption that teaching is necessary for learning to occur (Thomas & Brown, 2011); that teaching and learning are inherently linked (Wenger, 1998); and that a curriculum can and should be developed to create a cultural literacy (Hirsch, 1988). In such a culture, teachers taught learners about the world and learning was conceptualized as an isolated process of information transmission and absorption. It ignored the fact that in today's world, more and more knowledge, especially advanced knowledge, is acquired well past the age of formal schooling, and in many situations through educational processes that do not center on the traditional school (Illich, 1971).

This paper focuses on different perspectives about learning. Rich landscapes of learning are needed to cope with complex, systemic problems. They provide a theoretical framework to argue for the importance of self-directed learning and cultures of participation in which all learners can not only obtain information but can also actively contribute information. To support these approaches, collaborative learning environments are needed because outside the classroom, much learning and problem framing and solving takes places as individuals engage with each other and use resources and tools that are available in the surrounding environment (Resnick, 1987).

Problems and Engagement: Making Learning a Part of Life

The twenty-first century brings with it a large collection of problems and challenges: environmental degradation, energy sustainability, economic disparity, and the disappearance of local cultures in the age of globalization, to name just a few. Can 'ordinary' people do more about addressing these problems than reading about them in newspapers and online? Is voting for a handful of candidates every few years the ultimate in public participation?

Richer landscapes for learning creating new theoretical frameworks are needed to cope with major problems our societies are facing today including:

» problems occurring in the context of *idiosyncratic, personally meaningful activities* in which people take control of their own learning, decide what would be valuable to them and what they want to learn (illustrated by the two narratives below);

» problems of a *magnitude* which individuals and even large teams cannot solve (example: to model all buildings in the world in 3-D as addressed by Google SketchUp and 3D Warehouse; see the Examples Section)

» problems of a *systemic nature* requiring the collaboration of many different minds from a variety of backgrounds (example: urban planning problems as addressed by the Envisionment and Discovery Collaboratory; see the Examples Section);

» problems being *poorly understood and ill-defined* and therefore requiring the involvement of the owners of these problems, because they cannot be delegated to others (example: software design problems as tackled by the open source software developments); and

» problems modeling changing and unique worlds being dependent on open, living information repositories and tools (example: courses-as-seeds; see the Examples section)

The following two narratives illustrate two specific activities in idiosyncratic areas of interest in which learners *want to learn rather than have to learn*.

Narrative 1: Costume Play (Cosplay)

Shea is a young adult who has developed a deep interest in 'Cosplay', a type of performance art in which participants don costumes and accessories to represent a specific character or idea. Characters are often drawn from popular fiction in Japan, but recent trends have included American cartoons and science fiction, as well as other pop culture and role play. Shea spends a large amount of her free time working with a group of friends designing and sewing their own costumes. Much of their effort is focused on preparation for special events such as Nan Desu Kan, an annual anime convention (which has grown from 200 attendees in 1997 to 21,000 in 2010; see http://ndkdenver.org/info). These events provide an opportunity to show off participants' work and creativity as well as to socialize with and gain inspiration from other Cosplayers, ranging from those who purchase their costumes to those who also design and create their own garb.

Shea's interest began when she was a preteen. Her social group became interested in anime, viewing Sailor Moon videos and subsequently role playing Sailor Moon characters. This led to other activities, such as drawing new characters and costumes and writing their own stories. Shea's own interest in writing grew through these activities, with the additional impact of her interest in history that expanded as she strove to place some of her fictional stories into specific historical contexts and wanted to provide as much historical accuracy as possible.

During college, Shea and her friends decided to combine her sewing skills and their design/sketching skills to create their own costumes, beginning with simple attempts for their first Nan Desu Kan. In subsequent years, much more elaborate efforts evolved into a year-round activity with a weekly sewing night. To avoid being overburdened with sewing, especially as additional members joined the group, Shea taught her friends how to sew their own costumes, and she migrated to more of an advisory role on many of the individual projects. Additionally, resources for Cosplay activities include forums at http://cosplay.com and extensive information on sewing techniques at numerous Web locations. Much information is learned and shared at the peer level as well as through local resources, such as sewing and hobby stores.

Narrative 2: Rocket Construction

October Sky (http://en.wikipedia.org/wiki/October_Sky) is an interesting film based on a true story illustrating many aspects of self-directed learning: a personally motivating event (seeing the Sputnik in the sky) serves as a source of interest in rockets and space science for boys in a coal mining town. The group pursues this interest and eventually wins the top prize at a national science fair. For all members of the group, this engagement represents a life-changing experience.

What additional opportunities would exist today to lower the threshold that supports such engagement? The four boys would be able to explore a wide variety of choices and tools for learning: the available courses, lectures, or movies on sites such as iTunes U, Udacity.com, or the Khan Academy; introductory college courses in astronomy offered on OpenCourseWare sites; sites such as Instructables.com offering ideas about building and operating a rocket; articles on Wikipedia or in books recommended by the readers at Amazon.com; or niche communities that share their interests.

Even though these resources are available today, the lack of guidance, mentoring, or organization of learning may not result in many successful learning outcomes, an issue briefly elaborated upon further in the chapter, as the trade-off between support and freedom of choice in learning activities.

Rich Landscapes for Learning

As the demands for learning undergo a period of profound transformation, there is a need for exploring innovative multidimensional aspects of learning. Figure 1 provides an overview of the multidimensional aspects of learning followed by a brief description of the essential issues related to the different aspects.

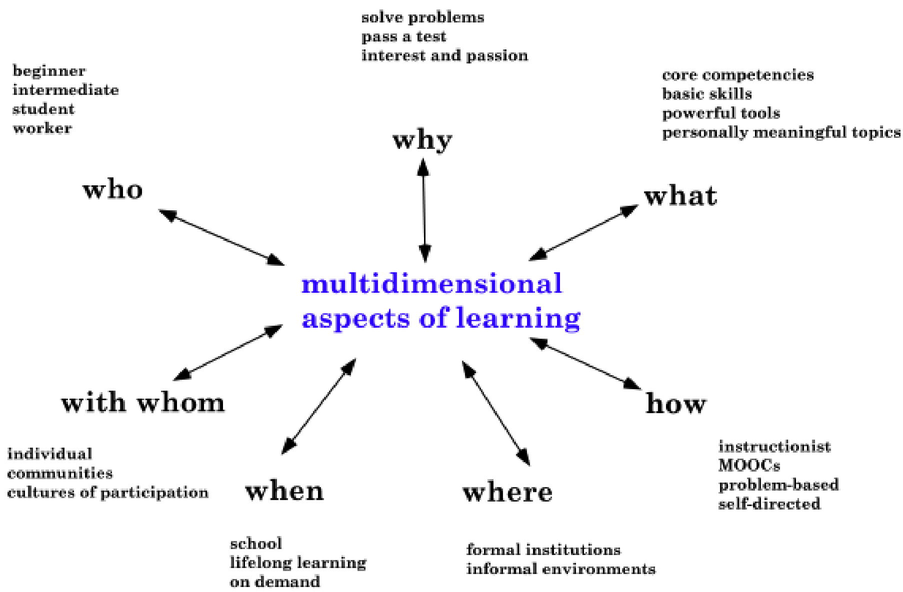

Fig. 1. Multidimensional Aspects of Learning

Who Learns: People at different stages. Learners may be students in different grades and institutions (ranging from K-12 to university education); persons working in industry; or curious citizens attempting to understand more about the world surrounding them. Some of the learners may be beginners, in which case general and uniform introductory courses may serve them well. Other learners may have a very rich knowledge background and very specific objectives requiring more individualized instruction.

Why Learn: Different Objectives. Some people learn because they need to pass a test or fulfill the requirements of a course in school or university; others learn because they are passionate about some activity (Collins & Halverson, 2009) as illustrated by the two narratives in the previous section.

What to Learn: Exploring Personally Meaningful Problems and Acquiring Basic Skills and Core Competencies. In formal learning environments, students' learning is determined to a large extent by a curriculum. Learners encounter few opportunities to gain experiences by exploring personally meaningful problems that need to be identified and framed. The engagement with personally meaningful problems should be complemented with learning opportunities to acquire the basic skills and core competencies for the twenty-first century (Collins et al., 2014). These competencies do not consist primarily of learning and memorizing facts, but should be focused on 1) acquiring and using information; 2) identifying, organizing, planning, and allocating resources; 3) collaborating with others; and 4) working with a variety of technologies.

How to Learn: Learning in Different Ways. Learning in today's world must be conceptualized as an inclusive, social, informal, participatory, and creative lifelong activity. Many problems (specifically design problems) are unique and ill-defined and the knowledge to address them is not 'out there' requiring contributions and ideas from all involved stakeholders. Learners in such settings must be *active contributors* rather than passive consumers and the learning environments and organizations must foster and support mindsets, tools, and skills that help learners become empowered and willing to actively contribute (Fischer, 2002; von Hippel, 2005).

Where to Learn: At the Right Places. Historically, schools provided the setting where individuals engaged in learning. The seeds of a new education system can be seen in the explosive growth of home schooling, workplace learning, distance education, adult education, and a variety of design spaces (museums, zoos, environmental centers, educational television and videos, computer-based learning environments, and Internet cafes). Research on everyday cognition demonstrates that formal learning in schools and informal learning in practical settings have important differences (National Research Council, 2009). What we discover about learning in schools is *insufficient* for a theory of human learning: schools are often focused on individual cognition, on memorization, and on learning general facts, whereas learning in the world at large needs to rely on shared cognition, use of powerful tools and external information sources, and situation-specific competencies (Resnick, 1987).

When to Learn: At the Right Time. Information overload and the rapid pace of change in our world have created new problems and new challenges for learning and education. People will have to keep acquiring new knowledge and skills throughout their lifetimes as their lives and jobs keep changing. New approaches are needed to circumvent the unsolvable problems of *coverage* and *obsolescence. Learning on demand* (Fischer, 1991) is a promising approach for addressing these problems because it: 1) contextualizes learning by allowing it to be integrated into work rather than relegating it to a separate phase; 2) lets learners see for themselves the usefulness of new knowledge for actual problem situations, thereby increasing the motivation for learning new things; and 3) makes new information relevant to the task at hand, thereby leading to more informed decision making, better products, and improved performance.

With Whom: Transcending the Individual Human Mind. Systemic problems require more knowledge than any single person possesses because the knowledge relevant to either frame or resolve these problems is distributed among stakeholders coming from different disciplines (Fischer & Sugimoto, 2006). The 'Renaissance Scholar' (meaning a person who is knowledgeable in all relevant fields) no longer exists (Csikszentmihalyi, 1996). To deal with complex multidisciplinary problems, people need to use the powerful tools technology provides for finding, analyzing, manipulating, and communicating knowledge. Bringing together different and often controversial points of view to create a shared understanding among these stakeholders can lead to new insights, ideas, and artifacts. In the past, most computational environments have focused on the needs of individual users. Our research has evolved from empowering 'Renaissance Scholars' in specific domains (e.g., with domain-oriented design environments) to creating shared understanding among 'Renaissance Communities' as communities of interest (Fischer, 2013a). Bringing together people with different background knowledge and different value systems, overcoming the biases and barriers of their separate languages, integrating different educational experiences, and eliminating the lack of reward structures will not be an easy undertaking.

Self-Directed Learning

In traditional classrooms in schools where knowledge transmission is from teacher to students and based on instructionist approaches, students are not required to be active learners and can be passive recipients: all the information or knowledge related to learning is automatically transmitted through a teacher, irrespective of the students' needs or problems even if they are in their classrooms. In such situations, learners are not motivated to learn. In contrast, if learners solve their own problems for their own sake, they try actively to acquire required knowledge and skills. Therefore, active learning happens when learners are self-directed to learn for themselves by means of their need to solve authentic or personally meaningful problems.

Most learning that takes place outside of an instructionist classroom can be characterized as follows: humans are engaged in some activity (an action such as working, collaboratively solving a problem, or playing); they experience a breakdown and reflect upon it (e.g., the piece of knowledge missing, the misunderstanding about the consequences of some of their assumptions). Schön (1983) called this *reflection-in-action*. Because self-reflection is difficult, a human coach, a design critic, or a teacher can help the learner to identify the breakdown situation and to provide task-relevant information for reflection. Our own work has explored the possibility using computational critics (Fischer et al., 1998) to provide some of this support when humans are not present. Critics make argumentation serve design; that is, they support learners in their own activities.

Self-directed learning can be characterized as follows:

» it is less structured than instructionist learning;

» it is in many cases a group or joint activity;

» the goal of the activity is determined by the learner who has a choice of topic, time, and place;

» the activities are self-paced; and

» it is captivating and fun and there are frequent 'flow' experiences (Csikszentmihalyi 1990).

Engagement and support for self-directed learning are critical when learning becomes an integral part of life – driven by a desire and need to understand something or to get something done instead of merely solving a problem given in a classroom setting. A lifelong learning perspective implies that schools and universities need to prepare learners to engage in self-directed learning processes because this is what they will have to do in their professional and private lives outside the classroom.

Self-directed learning has many similarities to *problem-based learning*, an instructional method in which students learn through facilitated problem solving (Hmelo-Silver, 2004). Both approaches attempt to motivate people to become lifelong learners and effective collaborators. Our research in self-directed learning (supporting people in choosing their own problems) conceptualizes learning independent of learning objectives and themes defined by a curriculum; thereby, it emphasizes problem framing in addition to problem solving and allows people to focus on personally meaningful problems that may vary greatly rather than being defined and structured by a curriculum.

Cultures of Participation

Cultures of participation can address the problems articulated earlier in the chapter: they have unique productivity resources, unique diversity potential, and engage ownership of problems, which is important because ill-defined problems cannot be delegated.

Defining Characteristics of Cultures of Participation

In the past, the design of most media emphasized a clear distinction between producers and consumers (Benkler, 2006). The rise in *social computing* (based on social production and mass collaboration) has facilitated a shift from *consumer cultures* (specializing in producing finished artifacts to be consumed passively) to *cultures of participation* (in which all people are provided with the means to participate and to contribute actively to personally meaningful problems) (Fischer, 2011). Important characteristics of cultures of participation are shown below. Examples from which these criteria are derived are explored in Porter (2008) and Preece and Shneiderman (2009).

» People will participate in personally meaningful problems.

» Potentially only a small number of participants will contribute, but all must believe and have the means when they are motivated to contribute.

» Extensive support mechanisms are required to create low barriers for creating and sharing contributions with others.

» To become viable and be successful, it is critical that a sufficient number of participants take on the more active and demanding roles.

» To encourage and support *migration paths towards more demanding roles*, mechanisms are needed that lead to more involvement and motivation, and facilitate the acquisition of the additional knowledge required by the more demanding and involved roles.

» Reward structures (reputation economies, accumulation of social capital) are important as motivators that encourage people to contribute.

Self-Directed Learning in Cultures of Participation

The creativity potential is grounded in user-driven innovations supported by *metadesign environments* that take advantage of *breakdowns* as sources for creativity and exploit the *symmetry of ignorance*, meaning that all stakeholders are knowledgeable in some domains and ignorant in others (Arias et al., 2000). To increase the creativity potential of cultures of participation requires *diversity*, *independence*, *decentralization*, and *aggregation*. Each participant should have some unique information or perspective (*diversity*). Participants' opinions are not determined by the opinions of those around them (*independence*). Participants are able to specialize and draw on local knowledge (*decentralization*). Mechanisms exist for turning individual contributions into collections and private judgments into collective decisions (*aggregation*). Additionally, participants must be able to express themselves, requiring technical knowledge on how to contribute; they must be willing to contribute, and must be allowed to have their voices heard.

Cultures of participation are related to other conceptual frameworks, specifically to *communities of practice* (Lave, 1991; Wenger, 1998) and *expansive learning* (Engeström, 2001; Engeström & Sannino, 2010). Cultures of participation complement and transcend communities of practice with their focus on exploiting the creativity potential of *communities of interest* (Fischer, 2001) by supporting the integration of multidimensional expertise. They address new frontiers for expansive learning as postulated by Engeström & Sannino (2010).

Perhaps the biggest challenge for future studies and theorizing in expansive learning comes from the emergence of what is commonly characterized as social production or peer production (Benkler, 2006). In social production or peer production, activities take the shape of expansive swarming and multidirectional pulsation, with emphasis on sideways transitions and boundary crossing.

Social Distribution and Epistemological Distribution in Cultures of Participation

Cultures of participation can add to different kinds of contributions to create new kinds of artifacts and learning opportunities.

Social distribution makes activities more fun, more motivating, and shares the burden of coping with large problems ('getting the job done effectively and more quickly'), as illustrated by the information environments created by mass collaboration in table 1 and by the 3D Warehouse instance shown in the Examples section. In such settings, contributors can work individually and the work to be done is modularized into objects and activities doable by one person. This enables production to be incremental and asynchronous, pooling the efforts of different people with different capabilities, who are available at different times (Benkler, 2002). The heterogeneity of the community allows contributors with diverse levels of motivation to collaborate by contributing modules of different sizes, whose production therefore requires different levels of expertise and motivation (Preece & Shneiderman, 2009).

Epistemological distribution is required to support people cope with systemic problems that are tightly coupled and transcend the individual human mind (Arias et al., 2000). These problems are tightly coupled and cannot be modularized into parts that individuals can solve independently. Face-to-face environments supported by tabletop computing environments (as illustrated by the Envisionment and Discovery Collaboratory in the Examples section) are best suited to deal with such problems, as distances between contributors create significant barriers to the frequency and richness of communication and to reconciling ambiguities (Olson & Olson, 2001).

Metadesign: Nurturing and Supporting Cultures of Participation

Cultures of participation are facilitated and supported by a variety of different technological environments (such as the participatory Web ('Web 2.0'), tabletop computing, and domain-oriented design environments), all of which contribute in different ways to the aims of engaging diverse audiences, enhancing creativity, sharing information, and fostering the collaboration among users acting as active contributors and designers. They democratize design and innovation (von Hippel, 2005) by shifting power and control toward the users, supporting them as both designers and consumers ('prosumers') and allowing systems to be shaped through real-time use.

Metadesign (Fischer & Giaccardi, 2006) is focused on 'design for designers'. It creates open systems at design time that can be modified by users acting as codesigners, requiring and supporting more complex interactions at use time. Metadesign is grounded in the basic assumption that future uses and problems cannot be completely anticipated at design time, when a system is developed. At use time, users will invariably discover mismatches between their needs and the support that an existing system can provide for them. Metadesign contributes to the invention and design of socio-technical environments in which users can express themselves and engage in personally meaningful activities. It is a particular instantiation of the 'Scandinavian approach' to system design (Greenbaum & Kyng, 1991) and it shares many objectives with the 'Maker' culture (Anderson, 2012).

Metadesign supports cultures of participation as follows:

» *Making changes must seem possible*. Contributors should not be intimidated and should not have the impression that they are incapable of making changes; the more users become convinced that changes are not as difficult as they think they are, the more they may be willing to participate.

» *Changes must be technically feasible*. If a system is closed, then contributors cannot make any changes; as a necessary prerequisite, there need to be possibilities and mechanisms for extension.

» *Benefits must be perceived*. Contributors have to believe that what they get in return justifies the investment they make. The benefits perceived may vary and can include professional benefits (help for one's own work), social benefits (increased status in a community, possibilities for jobs), and personal benefits (engaging in fun activities).

» *The environments must support tasks in which people engage*. The best environments will not succeed if they are focused on activities that people do rarely or consider of marginal value.

» *Low barriers must exist to sharing changes*. Evolutionary growth is greatly accelerated in systems in which participants can share changes and keep track of multiple versions easily. If sharing is difficult, it creates an unnecessary burden that participants are unwilling to overcome.

» *Defining the role of metadesigners*. They should use their own creativity in developing socio-technical environments in which other people can be creative by shifting from determining the meaning, functionality, and content of a system to encouraging and supporting users to act as designers. They must be willing to share control of how systems will be used, which content will be contained, and which functionality will be supported.

Metadesign allows significant modifications when the need arises. It reduces the gap in the world of computing between a population of elite high tech scribes who can act as designers and a much larger population of intellectually disenfranchised knowledge workers who are *forced* into consumer roles.

Establishing New Discourses: Motivation, Control, Ownership, Autonomy, and Quality

Cultures of participation are establishing new discourses, including the following:

Motivation. Human beings are motivated by different things. We act not only for material gain, but for psychological wellbeing, for social integration and connectedness, for social capital, for recognition, and for improving our standing in a reputation economy. The motivation for going the extra step to engage in cultures of participation is based on the overwhelming evidence of the IKEA effect (Ariely, 2010), where people are more likely to favor a solution if they have been involved in its generation even though it might not make sense otherwise. Creating something personal (such as hand-knitted sweaters and socks, home-cooked meals), even of moderate quality, has a different kind of appeal than consuming something of a possible higher quality made by others.

Cultures of participation rely on intrinsic motivation for participation by providing contributors with the sense and experience of joint creativity, by giving them a sense of common purpose and mutual support in achieving it, and, in many situations, by replacing common background or geographic proximity with a sense of well-defined purpose, shared concerns, and the successful common pursuit of these.

Control. Cultures of participation support users as active contributors who can transcend the functionality and content of existing systems. By facilitating these possibilities, *control* is distributed among all stakeholders in the design process. There is evidence that shared control will lead to more innovation (von Hippel, 2005): *'Users that innovate can develop exactly what they want, rather than relying on manufacturers to act as their (often very imperfect) agents.'* (A similar argument surfaced in the interview with the geoscientist described earlier). Cultures of participation erode monopoly positions held by professions, educational institutions, experts, and high-tech scribes (Fischer, 2002).

Ownership. Our experiences gathered in the context of the design, development, and assessment of our systems indicate that cultures of participation are less successful when users are brought into the process late, thereby denying them ownership, and when they are 'misused' to fix problems in addressing weaknesses of systems that the developers did not fix themselves.

Quality. Many teachers will tell their students that they will not accept research findings and argumentation based on articles from Wikipedia. This exclusion is usually based on considerations such as: *'How are we to know that the content produced by widely dispersed and qualified individuals is not of substandard quality'?* The online journal *Nature* (http://www.nature.com/) has compared the quality of articles found in the *Encyclopedia Britannica* with Wikipedia and came to the conclusion that *'Wikipedia comes close to Britannica in terms of the accuracy of its science entries'.* There are many more open issues about quality and trust in cultures of participation to be investigated, including: 1) the existence of errors, resulting in learners acquiring the important skill of always being critical of information rather than blindly believing in what others (specifically experts or teachers) say; and 2) ownership as a critical dimension, where the community at large has a greater sense of ownership and thereby is more willing to put an effort into fixing errors.

Examples of Collaborative Learning Environments in Different Application Domains

This section describes three different *collaborative learning environments* that illustrate different challenges and opportunities for learning and engagement in order to support specific aspects of a rich landscape for learning. The theoretical framework articulated earlier in the chapter does not dictate or provide recipes for effective learning environments but creates frames of references and perspectives for guidance, design, reflection, and experimentation with self-directed learning and cultures of participation.

Collaborative Efforts in Large Scale Projects
This section provides an overview of a sample of environments created by cultures of participation (see Table 1) with unique features with one of them (SketchUp and 3D Warehouse) described in some detail.

SketchUp, 3D Warehouse, and Google Earth: Sharing 3-D Models. Google is interested in modeling the whole world in 3D and uses Google Earth for exploring this world (see figure 2 for an example). However, he developers at Google cannot achieve this objective by themselves. The most feasible approach is engaging the whole world in this major undertaking by developing and supporting cultures of participation. To do so poses a number of challenging problems for participants acting as active contributors. They need to learn 1) *SketchUp***,** a high functionality environment for 3D modeling (http://sketchup.google.com/); 2) the mechanisms of how to share 3D models by uploading them from SketchUp to the 3D Warehouse; and 3) how to download models from the 3D Warehouse and from SketchUp and view them in Google Earth if the models have a location on earth. In order to motivate and empower enough people, we have explored, in close collaboration with researchers from Google, new learning mechanisms for SketchUp to allow users who want to contribute to learn how to do so by reducing the 'thickness' of the input filters.

The *3D Warehouse* (http://sketchup.google.com/3dwarehouse/) is an information repository for the collection of models created by all users who are willing to share their models; it contains tens of thousands of models from different domains. It supports *collections* to organize models and supports ratings and reviews by the participating community. It lets viewers connect with the owners of models. It has *weak input filters* such as content policies, mechanisms to ensure the quality of user contributions such as tagging and ratings, and an *emerging set of output filters* such as search support and different sorting algorithms. It is integrated with SketchUp as the design environment and Google Earth as a viewing environment that has the capability to show 3-D objects, which consist of users' submissions and were developed using SketchUp.

Site	Objectives and Unique Aspects
Open Source	a success model of decentralized, collaborative, evolutionary development
Wikipedia	web-based collaborative multilingual encyclopedia with a single, collaborative, and verifiable article; authority is distributed (http://www.wikipedia.org/)
iTunes U	courses by faculty members from 'certified institutions'; control via input filters; material cannot be remixed and altered by consumers (http://www.apple.com/education/itunes-u/)
YouTube	video sharing website with weak input filters and extensive support for rating (http://www.youtube.com/)
Encyclopedia of Life (EoL)	documentation of the 1.8 million known living species; development of an extensive curator network; partnership between the scientific community and the general public (http://www.eol.org/)
SketchUp and 3D Warehouse	repository of 3-D models created by volunteers organized in collections by curators and used in Google Earth (http://sketchup.google.com/3dwarehouse/)
Scratch	learning environment for creating, remixing, and sharing programs to build creative communities in education (http://scratch.mit.edu)
Instructables	socio-technical environment focused on user-created and shared do-it-yourself projects involving other users as raters and critics (http://www.instructables.com/)
PatientsLikeMe	collection of real-world experiences enabling patients who suffer from life-changing diseases to connect and converse (http://www.patientslikeme.com/)

Ushahidi	tools for democratizing information, increasing transparency and lowering the barriers for individuals to share their stories; originated in the collaboration of Kenyan citizen journalists during crises (http://www.ushahidi.com/)
Stepgreen	library of energy-saving actions, tips, and recommendations by citizen contributors for saving money and being environmentally responsible (http://www.stepgreen.org/)

Table 1. Environments Created by Cultures of Participation with Unique Features

Figure 2 shows the downtown area of the city of Denver in 3-D. We are assessing the effectiveness of different reward structures in motivating users to participate in the collaborative effort in modelling the whole world, including recognition by the community gained by featuring the best models on Google Earth.

Fig. 2. Downtown Denver in 3-D

The Envisionment and Discovery Collaboratory (EDC)

The EDC (Arias et al., 2000), representing a *socio-technical environment,* is a long-term research platform that explores conceptual frameworks for democratizing design in the context of framing and resolving complex urban planning by bringing together participants from various backgrounds in face-to-face meetings. The knowledge to understand, frame, and solve such problems does not exist in advance, but is constructed and evolves during the solution process. The EDC incorporates a number of innovative technologies, including tabletop computing, the integration of physical and computational components supporting new interaction techniques, and an open architecture. It has proven to be an ideal environment to study and support metadesign and social creativity by making all voices heard.

During the last decade, in our research into the EDC as it fosters and supports cultures of participation within collaborative design activities, we have observed the following:

» Each urban-planning problem is *unique*: it has to take into consideration the geography, culture, and population of specific locations.

» More creative solutions to problems can emerge from collective interactions with the environment by *heterogeneous communities* (such as *communities of interest*, which are more diverse than *communities of practice*).

» Boundary objects are needed to establish common ground and establish shared understanding for communities of interest.

» Participants must be able to express naturally what they want to say.

» Interaction mechanisms must have a 'low threshold' for easy participation and a 'high ceiling' for expressing sophisticated ideas.

» Participants are more readily engaged if they perceive the design activities as personally meaningful by associating a purpose with their involvement.

Obstacles to the further investigation of the above observations lie in the difficulty of democratizing the design of the EDC (von Hippel, 2005) by providing more control to the participants. Currently, EDC developers have to customize the system at the source-code level to reflect the specific characteristics of the city and its urban planning problems. As urban planning deals with ill-defined problems, the domain- and context-specific knowledge is sticky, tacit, and difficult to transfer from local urban planners to the EDC developers. Figure 3 illustrates how the EDC supports problem-framing and problem-solving activities by bringing together, in face-to-face meetings, those individuals who share a common problem . The EDC supports reflection-in-action (Schön, 1983): the horizontal table represents the action space and the vertical displays represent the reflection space. A problem is discussed and explored by providing participants with a shared construction space in which they

Fig. 3. Face-to-Face Collaboration in the EDC

interact with computationally enhanced physical objects that are used to represent the situation. Computer-generated information is projected back onto the tabletop construction area, creating an augmented reality environment. This construction in the tabletop environment is coupled with information displayed on a vertical electronic whiteboard relevant to the problem currently being discussed. A key aspect of the EDC that makes it a critical and unique component (and sets it apart from other environments such as the Google 3D modeling environment) is the need and emphasis on the *collaborative construction of artifacts rather than on the sharing of individually constructed items.*

Courses-as-Seeds: Nurturing and Supporting Communities of Learners

A culture of participation perspective for learning and education is focused not on delivering predigested information to individuals, but on providing opportunities and resources for learners to 1) engage in authentic activities, 2) participate in social debates and discussions, 3) create shared understanding among diverse stakeholders, and 4) frame and solve personally meaningful problems. It is grounded in the fundamental belief that all humans have interest in and knowledge of one or more niche domains and are eager to *actively contribute* in these contexts.

Over the last decade, we have reconceptualized and reinvented our teaching activities and grounded them in socio-technical environments in which 1) communities of mutual learners act simultaneously as learners and as active contributors (based on the assumption that being a teacher or a learner is not an attribute of a person but an attribute of a context); 2) peer-to-peer learning is supported and teachers act as 'guides on the side' rather than as 'sages on the stage'; and 3) courses are considered as seeds rather than finished products (Fischer, 2002).

Courses-as-seeds (dePaula et al. 2001) is an educational model that explores metadesign in the context of fundamentally changing the nature of courses taught in universities. Its goal is to create a culture of informed participation (Fischer and Ostwald 2005) that is situated in the context of university courses and transcends the temporal boundaries of semester-based classes. The major role for new media and new technologies from a culture-of-participation perspective is not to deliver predigested information and nonchangeable artefacts and tools to individuals, but rather to provide the opportunity and resources for engaging them in authentic activities, for participating in social debates and discussions, for creating shared understanding among diverse stakeholders, and for framing and solving personally meaningful problems.

Over the last decade, our teaching objectives and practices have increasingly sought to reconceptualize learning in courses from a cultures-of-participation perspective. Our courses use wikis as course information environments (for examples, see *http://l3d.cs.colorado.edu/~gerhard/courses*). Traditionally, the content of a course is defined by the resources provided by instructors (such as lectures, readings, and assignments), but in courses-as-seeds, the instructor provides the initial seed rather than a finished product. By involving students as active contributors, courses do not have to rely solely on the intellectual capital provided by the instructors but are enriched on an ongoing basis by the contribution of all participants.

Courses-as-seeds represents a *community-of-learners* model (Rogoff et al., 1998) and explores new middle ground between *adult-run* and *children-run* education. All participants are active and the more skilled partners (experienced teachers and coaches) can provide leadership and guidance. The learners have opportunities to become responsible and organize their own learning, exploit their previous interests, and sustain their motivation to learn by having some control over their contributions.

The courses-as-seeds model represents a system of values, attitudes, and behaviours that differ radically from the traditional educational culture in which courses are conceived as finished products and students are viewed as consumers. Courses-as-seeds creates a culture based on a *designer mindset* that emphasizes habits and tools that empower students to actively contribute to the design of their education (and eventually to the design of their lives and communities).

Challenges and Opportunities

Our attempt to explore rich landscapes of learning emphasizes that different approaches complement rather than replace each other. Self-directed learning and cultures of participation will not mark the end of the lecture, but they are important alternatives to end the monopoly of the lecture. This section briefly discusses some challenges and opportunities associated with self-directed learning and cultures of participation.

Making Learning a Part of Life with Self-Directed Learning

Learning and education should be a distributed lifelong process by which one learns material as one needs it. New conceptualizations of learning are needed to circumvent the difficult problems of *coverage* (i.e., trying to teach people everything that they may need to know in the future) and *obsolescence* (i.e., trying to predict what specific knowledge someone will need or not need in the future). Learning should be part of living, a natural consequence of being alive and in touch with the world, and not a process separate from the rest of life (Rogoff & Lave, 1984). What learners need, therefore, is not only instruction but *access* to the world in order to connect the knowledge in their head with the knowledge in the world (Norman, 1993), and a chance to play a meaningful part in it. Table 2 contrasts and summarizes different aspects of school learning and lifelong learning (Fischer, 2000; Resnick, 1987).

	School Learning	**Lifelong Learning**
emphasis	'basic' skills	learning as a fundamental aspect of life
problems	given; well-defined focus on problem solving	constructed; ill-defined focus on problem framing and problem solving
new topics	defined by curricula, assigned-to-learn, decontextualized	arise incidentally, need-to-know, on demand, contextualized
structure	pedagogic or logical structure	interests, problems, work activities; learning often takes places without teaching
cognition	knowledge in the head; individual cognition; general learning	distributed; use of tools and external information resources; shared cognition; situation-specific competencies

roles	expert-novice model; teacher and learner = f{person}	reciprocal learning; teacher and learner = f{context}
teachers	expound subject matter ('sage on the stage')	engage in guided discovery learning ('guide on the side')
learners	consumers	active participants
mode	instructionism (knowledge absorption)	design; making; constructionism (knowledge construction)
drawbacks	decontextualized, not situated	important concepts are not encountered

Table 2. A Comparison of Different Conceptualizations of School Learning and Lifelong Learning

In formal learning environments, learning is often restricted to the solution of well-defined problems. Lifelong learning includes these approaches but also transcends them by supporting self-directed learning in the context of realistic, open-ended, ill-defined problems.

Lifelong learning is a continuous engagement in acquiring and applying knowledge and skills in the context of self-directed problems and should be grounded in descriptive and prescriptive goals such as:

» learning should take place in the context of authentic, complex problems (because some learners will refuse to quietly listen to someone else's answers to someone else's questions);

» learning should be embedded in the pursuit of intrinsically rewarding activities;

» learning-on-demand needs to be supported because change is inevitable, complete coverage is impossible, and obsolescence is unavoidable;

» organizational and collaborative learning must be supported because the individual human mind is limited; and

» skills and processes that support learning as a lifetime habit must be developed.

A Challenging Design Trade-Off: Support versus Freedom of Choice

Self-directed learning provides learners with the freedom to pursue personally meaningful questions (two specific examples are provided by the narratives in the Examples section). This creates the fundamental challenge of addressing the dual objective of giving learners enough *freedom* to become active in the process of pursuing personally meaningful problems, and giving them enough *guidance* so that their activity results in the construction of useful knowledge and artifacts and support when they encounter breakdowns. Teachers can provide guidance much more easily in an instructionist classroom in which they discuss problems and present knowledge with which they are familiar. This familiarity may not exist when learners engage in their self-directed learning activities.

The same trade-off between support versus freedom of choice governs the distinction between two computational learning environments:

» *intelligent tutoring systems* (Anderson et al., 1995), in which the problem is given by the teacher or the system, and

» *interactive learning environments* such as LOGO (Papert, 1980), in which tools are provided that allow learners to explore problems of their own choice.

Intelligent tutoring systems can provide substantially more support because the designers of the environments know (at design time) the types of problems on which the learners will work (at use time). In interactive learning environments, little support is given when a learner is stuck since they support autonomous learning. In order to support self-directed learning, the environments need to be augmented with mechanisms (such as domain-oriented design environments, critiquing systems, and context-awareness) that can offer help and support for learners who get stuck or who do not know how to proceed when the information needs to be contextualized according to the task at hand and to the learner's needs and interests (Fischer et al., 1998).

Drawbacks of Cultures of Participation

Cultures of participation open up unique new opportunities for mass collaboration and social production, but they are not without drawbacks. One such drawback is that humans may be forced to cope with the burden of being active contributors in *personally irrelevant activities* that can be illustrated by 'do-it-yourself' societies. Through modern tools, humans are empowered to perform many tasks themselves that were done previously by skilled domain workers serving as agents and intermediaries. Although this shift provides power, freedom, and control to customers, it also has forced people to act as contributors in contexts for which they lack the experience that professionals have acquired and maintained through the daily use of systems. Professionals also have the broad background knowledge to do these tasks efficiently and effectively, for example, companies that offload work to customers.

More experience and assessment is required to determine the design trade-offs for specific contexts and application domains in which the *advantages* of cultures of participation -- extensive coverage of information, creation of large numbers of artefacts, creative chaos where all voices are heard, reduced authority of expert opinions, and shared experience of social creativity -- will outweigh the *disadvantages*, including accumulation of irrelevant information, wasting human resources in large information spaces, and lack of coherent voices. The following research questions need to be explored:

» Under which conditions is a *fragmented culture* with numerous idiosyncratic voices -- representing what some might characterize as a modern version of the 'Tower of Babel' and others might call refreshingly diverse insights -- better or worse than a uniform culture that is restricted in its coverage of the uniqueness of local identities and experience?

» If all people can contribute, how do we assess the *quality and reliability* of the resulting artifacts? How can curator networks effectively increase the quality and reliability?

» How can we avoid the problem of *participation overload* (potentially a more serious problem than information overload)? Being an active contributor requires more effort and more time than being a passive consumer. Active contributors are often domain professionals, competent practitioners, discretionary users, and engaged citizens — all of them experiencing numerous demands on their time.

Massive Open Online Courses (MOOCs)

Massive, Open, Online Courses (MOOCs) are receiving worldwide attention as a means to revolutionize education. The interest and hype around MOOCs are reflected by phrases such as 'Most Important Educational Technology in 200 Years' and public attention has moved beyond academic circles. Most of the discussions surrounding MOOCs have been grounded in economics and technology, with few considerations coming from the learning sciences. MOOCs are

» '*massive*' because they are designed to enroll tens of thousands of students (and have done so in numerous cases);

» '*open*' because anybody with an Internet connection can sign up;

» '*online*' because they are available on the Internet and refer not only to the delivery mode but to the style of communication; and

» '*courses*' because they do not only deliver content (as was the case with MIT's Open Courseware) but include all aspects (lectures, forums, peer-to-peer interaction, quizzes, exams, and credentials) associated with courses.

Over the last few years, numerous MOOC providers (including MIT's and Harvard's edX project (http://www.edxonline.org/) Coursera (https://www.coursera.org/) and Udacity, (http://www.udacity.com/) two private companies founded by faculty members associated with Stanford University), are shaping and organizing numerous MOOC developments.

There are currently two major developments: 1) *cMOOCs* focusing on knowledge creation and generation; and 2) *xMOOCs* focusing on knowledge transmission and delivery (that are getting most of the attention). A description and overview of currently existing MOOCs is provided at http://www.mooc-list.com/.

Important potential *strengths* of MOOCs are:

» an innovative, new effort that is shaking up all learning institutions (they changed the distribution method, but in many cases not the actual product);

» generating a discussion that transcends the narrow confines of academic circles;

» making the knowledge of some of the world's leading experts from the best universities available to anyone free of charge;

» attracting and affecting large numbers of people;

» experimentation with different approaches (e.g., standalone versus hybrid course, course with fixed time duration versus courses to be taken anytime, etc.); and

» serving as a forcing function for residential, research-based universities to reflect and focus on their core competencies.

Following are important potential *weaknesses* of MOOCs:

» By focusing on lectures, they often provide only a change in form, not in content (the new technology component makes lectures appear innovative, but the additional enrichment activities are still quite limited). Participating in a MOOC is not too different from 'traditional' teaching: a teacher talks and students listen, an approach that we characterized as 'gift wrapping' (Fischer 1998).

» By virtue of their very low teacher/student ratio, MOOCs are no substitute for intensive, interactive, small-group learning situations.

» They were unable to create a community of mutual learners in the classroom, in which the roles of the teachers and learners were not assigned to specific individuals but to specific contexts; the teachers acted as 'guides on the side' rather than as 'sages on the stage' and learners were given many opportunities to be active contributors.

» The instructionist nature of most xMOOCs is not well suited to aspects of learning that grow out of longer-term mentored relationships and self-directed learning, i.e., settings in which learners of all ages take advantage of new learning opportunities in order to pursue their own personal interests, made available by innovative technologies.

» They provide little support for self-directed learning and cultures of participation.

Interesting questions to ask based on these developments are (Fischer 2013b):

» *What is covered by MOOCs?* (free, open, and large-scale, offering learning analytics opportunities based on very large numbers of participants), and

» *What is not covered by MOOCs?* (focused on a traditional model of an instructionist classroom, and thereby providing little support for self-directed learning, debate and discussions, and reflective conversations).

MOOCs enrich the landscape of learning opportunities and they have the potential to reduce the digital divide by providing education for everyone. They challenge residential, research-based universities to reflect, define, and emphasize their core competencies. They move away from large lectures, where learners listen to teachers, toward active learning environments characterized by personal attention from teachers and with opportunities for participation, thereby looking beyond the simplicities of information to the complexities of learning.

Conclusions

People are different, with different wants and needs specifically with respect to learning. New media provide the foundation for socio-technical environments in support of a rich landscape of learning. The research activities documented in this paper are focused on creating frames of reference to assess the strengths and weaknesses of different approaches to learning with a focus on self-directed learning and cultures of participation in the context of collaborative learning environments. These approaches enable learners to control their own learning, allowing them to decide what they consider important and valuable and what they want to learn rather than have to learn.

The future of why, what, how, when, where, and with whom people learn is not out there to be discovered, but it needs to be designed. The learning sciences and the designers of new, theoretically grounded socio-technical environments should consider this objective the 'grand challenge' of their research agenda.

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LANGUAGE LEARNING AS DIALOGUE AND PARTICIPATION

Hannele Dufva

Introduction

Today, we see how globalization, with its cultural flows, and technology with its new developments constantly create new types of contexts and new kinds of language practices. Thus it would not be unreasonable to say that *language itself* is changing. Also, these large-scale changes create new environments for learning languages, and these environments, potentially, will influence how we conceptualize *learning itself.* Thus, as the contexts and usage change, it is possible that the theoretical basis of language learning needs to be rethought. Further, this gives us a reason for rethinking the pedagogical practices of language education. This paper discusses the two central concepts of second and foreign language learning research -- ’language’ and ’learning’ -- and the potential consequences of how their reconceptualisation might influence practices of language education and pedagogy.

To redefine ‘learning’, we need to transcend the traditional dichotomy between social and cognitive descriptions that has been typical for second language acquisition (SLA) research. In recent years, we have observed a movement from the strict cognitivism of the early SLA towards socially oriented arguments, some of which have turned out to be exclusively social in their position. As an alternative to these polarized views, language learning will be regarded here as a *social-cum-cognitive* process: an activity in which the social and the cognitive are involved and intertwine. A holistic view is advocated, in which cognition is not placed ‘internally’ in the learner’s brain, but is extended to ‘external’ activity in the social and physical environment. Here, I will draw on arguments from the following sources: Vygotskyan and neo-Vygotskyan views (e.g., Lantolf, 2000; Lantolf & Thorne 2006); systemic psychology (Järvilehto, 1994, 2006); distributed views on cognition (Cowley, 2004, 2006; Steffensen, 2009); ecological views (Gibson, 1970; van Lier, 2004, 2007); and the Bakhtin Circle dialogism and neo-dialogism (Linell, 2009; Dufva, 2010; Dufva et al., 2011).

It will be argued that learning is distributed cognitive activity. This is to say that the *individualist* notion of learning is rejected and argue that learning occurs in collaboration with and is *mediated* by other people and/or by different tools and artefacts of the social world[1]. As language or linguistic resources are being *shared* in the activities in which people *participate*, they are also constantly *recycled*. What is important to note is that this process is not seen as *transfer of information* from 'outside' to 'inside'. Learning is not regarded as an *acquisition of abstract forms* but as linguistic resources being *appropriated* by persons participating in a certain activity.

The reconceptualization of 'language' below draws upon the recent debates in which the traditional twentieth-century concepts have been dismantled and deconstructed (see also, e.g., Makoni & Pennycook, eds. 2007). However, I will focus in particular on the dialogically oriented views of language and the Bakhtinian notion of heteroglossia. It will be argued that to emphasize the dynamicity and relationality of language, language learning should be regarded as appropriating different situated practices, or *heteroglossic languaging*.

Learning: a social-cum-cognitive and mediated process

To see learning as a social-cum-cognitive -- or distributed -- process rejects the Cartesian interpretation in which cognitive refers to 'internal' actions and social to 'external' ones. The view challenges both the cognitivism of early SLA (second language acquisition) studies but also those contemporary socially-based arguments that fail to give an account of the individual person and his cognizing. Cognitivism that was characteristic of the

1 The view that is discussed here does not exclude the aspect of language as an embodied and material process or that this is not, strictly speaking, a social world but a material one. For the sake of brevity, the argument for the material basis will not be developed here.

traditional SLA studies was influenced to a great degree by Chomskyan thought and rationalist philosophy. It turned away from the arguments that included the social world (social interaction, societal circumstances). The new social focus, however, has frequently resulted in the failure to consider the cognitive aspects; for a more detailed discussion, see Dufva (2010). Here, I will aim at showing that both aspects can be included to form a new, non-Cartesian and holistic viewpoint on learning.

To see mind and observable activity as inherently connected is not at all a new idea: it was a strong presence in L.S. Vygotsky's work and the sociocultural tradition that followed. Pointing out that one needs to study the history and development of cognitive phenomena in order to understand them, Vygotsky himself aimed at showing that human mind is social in origin and that 'higher cognitive faculties' for intellect, reasoning, and learning are essentially collective in origin. The social world, with its artefacts, tools, and patterns of social action that have developed over time as a collective effort of mankind, is the natural environment of each infant and each child respectively develops his intellect and reasoning in social and collaborative activity. Therefore the social world cannot accurately be described as 'external': it is also the cognitive world -- or cognitive workspace – into which each of us is born and in which we continue to operate.

If we go on using words such as 'social' and 'cognitive', they are not to be understood in their Cartesian sense. 'Social' does not refer to explicit interaction with other people or to the societal sphere as 'external' context, but is also a feature of human activity that is traditionally understood as cognitive or psychological. As Lantolf (2004, pp. 30-31) notes, sociocultural theory is not a theory of the social or cultural aspects but, actually, a theory of mind.

Therefore, it is seen as unhelpful to continue the reductionist arguments of either cognitivism or the radical extremist views of socially oriented paradigms. Between cognitive and social worlds there exists a reciprocal relationship that was also a central theme in Voloshinov's philosophy of signs. Voloshinov (1974, pp. 33-41) argues that *outer signs*, inherently connected with ideology, need to be 'engulfed' by *inner signs.* There is an interplay between the inner and the outer signs: outer signs gain their life force by becoming inner signs when appropriated by persons, while inner signs are returned to the outer dialogue when uttered. Drawing upon these arguments, language learning can be seen as process of *recycling* of the socially and culturally available linguistic resources; see also Dufva et al. (2011).

When analysed dialogically, linguistic signs have two aspects: while being 'ideological' as to their content, they need to have materiality in order to be *mediated*. As Voloshinov (1973, p. 26, pp. 90-91) observes, human consciousness needs 'gesture, inner word, outcry' to become manifest. Thus language needs to be spoken, written, signed, or mediated by using other potential means of expression, that is, by different *mediational* means. If we use the Vygotskyan sociocultural formulations, the language environments involve *symbolic artefacts,* language itself being the prime example, but also *material artefacts:* books, pens, paper, and computers. Regarded in this light, language learning is a mediated process in which different *mediational means* are at play: these include textbooks, classroom interaction, teacher-directed talk and the various resources to which language learners are exposed, such as gaming or watching television, in out-of-school contexts.

As this view of learning does not regard *mediation* as transfer of information from 'outside' to inside, it is natural to continue the argument that the environment is not an 'external' scene but part of the learning process itself. We could say that the environment is part of the *cognitive working space* of the person(s) involved.

Learning: a systemic, ecological, and distributed process

Where does learning occur, then? It was commonplace to understand the cognitive processes as happening in the individual's mind and/or language being stored and processed in its linguistic components, as the rationalist Chomskyan argumentation put it. Today, many researchers implicitly identify learning with social interaction and do not go beyond describing what happens there. Both positions base their arguments on the interpretation of social and cognitive as external and internal, and are, as I would like to argue, led astray in this. If we consider where cognizing happens, or where language learning occurs, we should not look into the black box of the (internal) mind, or seek direct equivalents in the human brain, or identify cognizing with the behaviours in social interaction.

The views expressed within early sociocultural and dialogical perspectives by thinkers such as Bakhtin, Voloshinov, and Vygotsky do provide some of the philosophical and psychological starting points. These views find support from other, more contemporary lines of thought. These make it possible to re-examine various issues and aspects of learning (e.g., how memory works) that were previously given a cognitivist analysis and remodel them in frameworks such as systemic psychology (Järvilehto, 1998), ecological psychology (Gibson, 1970; van Lier, 2004) or distributed cognition (Cowley, 2006; Steffensen, 2009) that go beyond the individual and/or his brain.

These views suggest a need to extend the research focus beyond the individual, something that was recognised already, and importantly, by Vygotsky. The importance of other people is present in Vygotsky's notion of learning -- 'first external, then internal' -- is the thought that learners have a 'zone of proximal development' in which they proceed, supported by others -- parents, teachers, and peers. The perspective is also present in the concept of *scaffolding* that draws upon Vygotskyan thinking but is developed by Jerome Bruner. As neither Vygotsky nor the contemporary research sharing this perspective assumes a Cartesian separation between mind and activity, it is clear that we do not talk about giving 'input' to learners. Rather, we talk about 'sharing' resources with them. As Suni (2008) has shown in her study of conversation between native and non-native speakers, native speakers can share their linguistic resources with non-natives in the joint cognitive working space that is created in talk.

Further, Järvilehto (2012) argues that the organism and its environment should not be regarded in terms of *two* systems but *one.* In not separating environment from the mental activity of the organism, Järvilehto's views provide a theoretical basis for understanding memory and, at the same time, for some aspects of language learning. In Järvilehto (1994, pp. 154-155) the metaphor of memory as an internal storage is challenged. His argument is that the processes of remembering should be studied by regarding not only the ways in which the organism itself is organized, but should also expand the perspective to include the environments of both present and past. Memory, then, does not refer to a place, location, or storage, but rather, *remembering,* the ability to operate in the *current* environment relying on the environments in one's *past*. When we learn something new, there is a change in the organization of the organism-environment-system.

If we accept Järvilehto's (1994) argument, the metaphor of 'internal language storage' with its 'mental representations' should be rejected. Instead, 'mental knowledge' can be considered as *action potential.* This view may sound radical at first: against the classic cognitivist assumption of language learning as 'internalisation' -- acquisition of rules and items – learning now is seen as a process in which the persons develop in their 'skilful linguistic action' (Cowley, 2012) the potential to detect different linguistic resources present and their ability to act upon these as affordances (van Lier, 2004). Today, we have not developed fully ideas of how to reconceptualise the mental knowledge of language or a person's language proficiency. Still, a tentative argument can be presented that language proficiency is not to be modelled as internal, individual, (semi) permanent knowledge of rules and items. Rather, the theoretical arguments seem to suggest that it might be regarded as processual knowledge, which consists of essentially situated and dynamic skills that allow learners to operate across time and space.

Järvilehto's (2006) perspective of learning extends beyond the borders of the individual organism-environment systems, that is persons: 'All efficient learning presupposes the participation of both the teacher and the pupil (or the trainer and the trainee)'. Järvilehto's views resonate with other non-individualist, or 'extended', perspectives on cognition (e.g., Hutchins, 1995; Cowley, 2006). These argue that cognition is 'spread' among the participants, is 'shared' by them, or 'emerges' in the interactivity between the human agent(s) and the resources / tools present. Thus also the ability to learn language – either first or additional ones – can be understood as ways in which human agents are capable of perceiving and acting in their different linguistic environments, with other people and artefacts present.

Language: What is it that is learned?

Criticism of 'language' as a system

Another set of questions is concerned with how to define 'language'. That is, what is the object that learners set out to learn? What is the object of teaching at school and other institutions that provide instruction in languages? When one looks both at the research of language learning and the pedagogical discourses and practices, one finds several persistent metaphors and dominant conceptualisations. These include 1) the influence of written language and literacy, 2) the impact on the national language ideologies and 3) the influential Saussurean view of language as an (abstract) system. These ideas have led to the idea that learners are supposed to *internalize a system of abstract rules and contextless lexical entities*. For a critical discussion, see Dufva et al. (2011).

The written language bias of linguistic inquiry has promoted the idea that units of 'language' are similar to those found in written forms of language (for criticism, see, e.g., Linell, 2005; see also Voloshinov, 1973). A literacy-based, written language bias can also be found in the ways languages are taught and language proficiencies are assessed. The written word is strongly present in classrooms where textbooks and literacy-based ideals still rule. For a survey in the context of Finland, see, e.g., Luukka et al. (2007). Also, learners' proficiencies are still often evaluated and assessed by literacy-based standards in spite of the continuing critical discussion. Thus it is almost inevitable that the written language bias is present also in language learners' *beliefs.* In their studies on foreign language students' conceptualisations -- with learners' self-portraits, narratives and questionnaires as data -- Kalaja et al. (2008) have found a consistent presence of textbooks and written materials. Their findings suggest that learners see that their goal as learning the contents of textbooks, grammars, or dictionaries, that is, the decontextual descriptions of language rather than how to use language. These beliefs are no doubt advanced by the textbook-centred practices of foreign language classrooms, but they are also supported by the discourses, metaphors, and vocabularies of linguistic research.

Another idea that has been much criticized during recent years is how we have regarded languages as internally homogeneous entities, still categorically different from others. This idea of language, influenced by the ideologies of nation states, not only conceptualizes languages as boundaried entities (Finnish, French, German) but also promotes a monolingual bias, an ideology that still often dominates the educational discourses and language classrooms where borrowing, hybridity, and mixing are 'wrong' and where use of more languages than one may be judged as pedagogically unfavourable. Further, the assumed stability and singularity of norms and the entailing policy of 'one correct answer' is maintained in classrooms, exams, and language tests. The alternative views advocate subjecting the norms and language use to negotiation, and not only for tolerating but also promoting 'translanguaging' in the classrooms (see, e.g., Blackledge & Creese, 2010).

The third notion that needs a rediscussion is whether language as (an abstract) system consisting of, e.g., syntax, morphology, phonology, and lexis, should actually be seen as the goal of the language learner. It has been commonplace in the study of language learning as a process in which a language system is internalized. However, as has been pointed out by many authors since Voloshinov (1973), a system of this kind is necessarily an *artefact* produced by the linguist's analysis: a selective description of the formal properties of language use. Valuable as they may be, these artefacts are not to be confused with the actual reality of language use or 'first-order languaging' (see, e.g., Cowley, 2005; Steffensen, 2009); grammars -- whether linguistic or pedagogical -- inevitably select, summarise, and reduce the material they choose to describe and systematize.

It should be also pointed out that the conventional linguistic and grammatical descriptions may not be adequate *at all* to describe the processes by which language users actually operate. Although it has been exceedingly popular in (psycho)linguistic research to speak about *mental* grammars and *internal* lexicons, the metaphor may be faulty in many senses: as both the early dialogical and sociocultural arguments (see, e.g., Voloshinov, 1973, p. 38) and recent research seem to indicate, the nature of mental language knowledge is very much an open question. To this point, Steffensen (2009) argues that 'there is no reason to posit internal representations of linguistic units'. With Cowley (2011, p. 21) we can say that language is to be found not in one's internal storage, but with 'the resources of the world's language stores'.

Finally, if language proficiency is seen in terms of decontextualised formal knowledge, the repercussions involve a decontextual approach in language teaching. It is at the very core of the conservative tradition of language teaching to focus the classroom practices and homework routines on decontextual practices, to focus on memorising grammatical rules, lexical items, and formal translation equivalents. Instead of seeing situated and contextual practices as their target, the learners grow to dis-associate the 'knowledge of language' from its use.

The viewpoint of heteroglossic languaging

The contemporary discussion around the notion of 'language' often stresses its *dynamic* qualities, and also, many scholars point to its *relational* character. The dynamicity -- the flow-like character -- of language is present in the formulations of language as *languaging* (Maturana, 1995; Becker, 1991). For a closer discussion, see Dufva and Pietikäinen, (forthcoming); as *communicative activity* (Thorne and Lantolf, 2007); as *doing* (van Lier, 2004); and as *practices* (Pennycook, 2010). Many new formulations also frequently embed a notion of language use (and learning) as c*ollaborative* or *systemic* activity. If these qualities of language are highlighted, it seems to follow that, implicitly, the views also highlight *functional* and *meaningful* elements rather than formal and structural ones. In all, language is regarded as a purposeful rather than a mechanical process -- and it may well be regarded as 'the game rather than the building blocks'.

Here, I will draw particularly upon the linguistic arguments of the Bakhtin Circle and the notion of languaging. I will suggest that the goal of the learners is to appropriate language practices that are heteroglossic in nature. The implication of the notion of *heteroglossic languaging* is to see the learners' goal not in learning a 'language' (as a singular entity), but *learning situated usages (practices).* In this, both the quality of doing/action and the essential diversity of language usages is highlighted. This seems to indicate that doing things with language and participating in different types of activities are at the core of language learning and should also be a focus of teaching.

With its 'concretist' and contextual perspective, the arguments of the Bakhtin Circle help us to regard *language as use* but also to claim that language use is *about something*. Arguing that language is tied to its use and its social context at large, Voloshinov (1973, p. 70) says that 'words are always filled with content and meaning drawn from behavior or ideology'. Thus language use relates to the ways language is used in the community but also to concrete situations where people use language to express personal meanings.

The contextual emphasis is not only theoretical, but leads to a view that language in context should be at the core of language education. In his criticism of Saussurean concept of language, Voloshinov (1973, p. 69) actually comments on language teaching, arguing that students should become acquainted with linguistic forms only in their concrete contexts and situations. In a similar vein, grammar is also regarded as a contextual and stylistic phenomenon. As Bakhtin (2004, p. 12) says, 'One cannot study grammatical forms without constantly considering their stylistic significance. When grammar is isolated from the semantic and stylistic aspects of speech, it inevitably turns into scholasticism'. These few comments on early dialogism are echoed today in many contemporary discussions on the principles of language teaching (van Lier, 2012).

A related observation is that the Saussurean preference for invariance is replaced by Bakhtin's insistence on the importance of diversity and variation, and by his view of language as *heteroglossia* (Bakhtin 1981, p. 291). To simplify, this means that there is no 'language' but rather 'languages' -- that is, all sorts of usages that vary across different contexts, speakers, and modalities and that are liable for change and diversification over time. If language is regarded as heteroglossic, the goal of learning a language-as-a-boundaried-system becomes an impasse, as do the single norm policies exerted in the classroom. The view pushes us to consider language as activity or practices that differ both contextually and modality-wise.

Language learning: Theoretical considerations and pedagogical implications

Language learning as recycling

To summarise the views presented above, language use and learning can be regarded ***as*** *social (inter)activity and (distributed) cognitive (inter)activity***,** without making a Cartesian distinction between social and cognitive. Language use emerges in (inter)activity in an environment where different resources -- both artefacts and people -- will be used. The processes of (inter)activity is where and also how language learning happens, by the power of social, observable practices but also by the power of activity that is produced by distributed cognition (Cowley, 2006). There is much cutting-edge research available on how people in healthcare (Steffensen et al., 2010) or in dance (Kirsh, 2010) achieve cognition in interactivity that is embodied in nature, but the context of language learning and teaching is largely unstudied.

I would like to stress in particular, however, that we should not fail to take into account the individual and personal aspects of cognizing that are for so many reasons important in the research of learning. First, we need to be able to explain the aspects of each particular person as a language learner. Second, although we aim at understanding learning as interactivity or as a distributed process, we also need to consider that this interactivity emerges from the efforts of participating agents or subjects. Without the agents, there is no interactivity. I will refer to these personal and subjective qualities here as *agency*.

Consequently, agency can be conceptualized here as the ways in which learners (as organism-environment-systems) *perceive and act upon* the different environments in which they are involved. Agency is thus not an individual property in the sense of the Cartesian, rationalist reading, but a relational faculty that has a strong personal component and background. First, as persons, we are uniquely positioned in time and space (Bakhtin, 1993), and we each have different learning paths or learning histories as language learners. As language learners we also have different preferences, abilities, and qualities of how to connect to environments. Second, we are also members of different cultural and linguistic communities and, in a sense, we are products of particular cultural-historical developments, working under particular social constraints. Third, we are also embodied agents in the universal sense of human beings: thus attached, in various ways of embodiment, to our physical environment(s). Agency is thus essentially a concept that describes the human ability to connect. But it also seems to be a useful concept as it can easily be given a 'positive' reading: in other words, it may be a pedagogically wise concept that can be used to mediate an atmosphere for learning as action and activity.

Thus, language learners are regarded as agents who relationally engage with different resources provided by the linguistic environments and turn these into *affordances.* Defined originally by James J. Gibson (1979, p. 127), affordances are 'what (the environment) *offers* the animal, what it *provides* or *furnishes,* either for good or ill'. In particular, van Lier (2004) has continued to argue for the importance of this concept for language education and pointed out that affordances need to be understood as *relational*. This means that linguistic resources as such are not yet affordances, what is needed is a *connection* – involving a process of noticing and perhaps reflection -- between the learner and the resource. It is thus the reciprocal relationship between an agent and a resource that makes something into affordance.

To continue, learning is *not* considered as internalization. Instead, I will be using the word *appropriation* to refer to the notion of learning that highlights participation and dialogue: whatever learners learn, part of it remains 'out' as a shared property of the societal and cultural languaging, while part of it becomes one's own. This is a dialogue of recycling in the Bakhtinian sense:

> *The word in language is half someone else's. It becomes 'one's own' only when the speaker populates it with his own intention, his own accent, when he appropriates the word, adapting it to his own semantic and expressive intention. Prior to this moment of appropriation, the word does not exist in a neutral and impersonal language (it is not, after all, out of a dictionary that the speaker get his words!), but rather it exists in other people's mouths, in other people's contexts, serving other people's intentions: it is from there that one must take the word, and make it one's own* (Bakhtin, 1981, pp. 293-294).

Thus, as suggested above, there may not be any need to hypothesise an internal 'language' (in the sense of grammar and lexicon). Instead, agents must be allowed different processual *skills* of interactivity that help them to respond and take initiative in different types of situations, at the same time relying on their experience of situations encountered in one's own past. To go back to Bakhtin's notion of words, we might imagine that it is not words *in their formal and decontextual sense* that we learn, but rather, how to interpret usages in concrete situations, how to use them meaningfully, but also, necessarily, how to perform different types of articulations and manual operations that are involved in language use in different modalities (speech, writing, typing, etc.). It needs to be said that what we can say at present is largely hypothetical, and that we need substantial research to support the arguments. It can be suggested that the skills by which we understand and use language are largely procedural and context-sensitive, not static and abstract in nature.

As to the question of *how* humans learn languages, we have some clues. When we say metaphorically that language practices are 'recycled', this means that they are borrowed from others through participation in diverse social practices, copied for further use, and reused in appropriate situations. The view can be associated with the recent research avenues on *imitation, copying, and repetition*. As the neurological evidence shows, individual agents have a mechanism, the mirror neurons (Arbib, 2002), for imitating and copying the others' behaviours, an ability that is not exclusively human (see, e.g., Gross, 2006 for primates' capacity to imitate). Suni (2008) shows how interaction between second language learner and native speaker can be seen as a forum for shared attention, shared cognition, and as a step for the learner to share the 'native' language repertoire by negotiations of meaning and repetition.

Importantly, one needs to note that repetition should not be regarded as *mechanical* copying. It is also, to varying degrees, regeneration and relocalisation. Language practices are appropriated, made one's own,' populated with own intentions' as Bakhtin (1981) put it. Each speaker has a unique voice in the sense of articulation, but also more metaphorically: words will be adjusted according to the perspective of the speaker; they will be uttered in contexts other than the original; and they may be modified to serve quite different purposes. Thus speakers in many ways -- both meaning wise and articulation wise -- personalize the public linguistic resources when they add them to their personal repertoires. Linguistic resources undergo 'fertile mimesis', to borrow Pennycook's (2010) expression. There will be modifications, by creative and playful practices, innovations by novel usages, hybridity by converging usages, diversified use when communities diverge, and 'copying errors' by random or repeated mistakes.

Language pedagogy

The way to develop language education in institutional contexts is to reconsider many of the fundamental metaphors and also many of the practices. The ways of speaking are powerful: if we stop using metaphors such as learning as 'internalization' and language as 'grammar and lexicon', and start using expressions of learning as 'activity', 'doing', and 'participation' and language as practice, this also gives the learners different expectations. However, the learners also need to be engaged in activities and practices: doing things in language, through language, and with language. This can be done in any classroom, but the language pedagogy could -- and should -- give more thought to how to combine the practices at school with out-of-school activities.

Thus to reconsider the conceptualisations of language and learning means to give some thought to the practices of pedagogy and teaching as well. It is obvious enough that there are several good examples, some of them dating back many years, and that in some cases everyday practices may have been ahead of the theoretical developments. It would seem timely now to establish a firm connection between theory and praxis in order to develop both: it is a dedicated goal of (critical) applied linguistics to see that not only are the outcomes of research 'applied', but that theoretical developments are genuinely informed by societal circumstances and existing practices. The theoretical views discussed above resonate with research and/or pedagogy on, e.g., language awareness (van Lier, 1995), authenticity, extended notions of learning as formal and informal (Benson and Reinders eds., 2012), learning in virtual environments (Zheng & Newgarden, 2012), and various others.

With the enhancement of the learners' agency as the main goal and the development and sophistication of their linguistic repertoires in mind, the pedagogies should nurse aspects that encourage participation. For that, both perception and action need to be addressed: on one hand, it is important to enhance the ability to notice and reflect different features of both language and learning, and, on the other hand, the skills of action and participation are similarly necessary. I will sketch below some aspects that might be highlighted in contemporary pedagogies.

Take heed of learning opportunities. First, learners should notice the linguistic resources around them and learn to reflect upon different matters that are linguistic, interactive, or cultural in nature. Thus language awareness is precisely as social as it is a cognitive phenomenon: learners are encouraged to reflect upon their development in context. As the beliefs of learners may act as tools for further action (Alanen, 2003), the 'negative' ones work against learning. Far too often learners simply miss learning opportunities because they are 'misled' by conventional notions of language and learning. Learners may see themselves as 'poor learners', the language skills as 'non-useful', or the language in question as 'unpleasant' (see, e.g., Kalaja et al., 2011).

Expand your learning environments. One popular misconception is that learning of languages takes place at school and/or it is a process led by a teacher (Aro, 2009). As many new directions, both in research and in pedagogy, point out, learning does not happen only in school, but that informal and formal contexts and ways of learning can be mixed and mingled. Thus the learners should understand that they can also bridge the gap, bringing in knowledge and skills acquired in other contexts and environments.

Become a language detective. Many learners need tasks that activate their ability to notice and *detect* linguistic resources and opportunities for learning in their different environments, not only in the context of school or institutions, but in different face-to-face and virtual contexts of their everyday life. From being a novice language detective, one can go on to becoming a proper Sherlock Holmes with his skills of *deductive reasoning* and sharp intelligence. Such tasks that invite learners to compare, dissect, find patterns and regularities while, at the same time, observing irregularities and abnormalities that work towards heightened language awareness (van Lier, 1995).

Become an anthropologist. Learners could be trained as anthropologists: sending them to do fieldwork in virtual and non-virtual environments alike, to make observations of cultural behaviors and the underlying norms, to take notes or write diaries. In all tasks of this kind, the learners work in specific environments with specific types of languaging, always tied to the context. By observing language use, students learn *about* language use and its diversity and variations -- which can be subjected to discussion in the classroom -- but they also learn actual language use themselves.

Become a participant. From observation and along with observation, any learner needs to become an increasingly active participant in various contexts and modalities. What are the means of encouraging agency, participation, and dialogue? Collaborative tasks, group work, crowdsourcing, social media … and also simply talking. The new developments in linguistics and cognitive science that aim at dismantling the individualist view of learning are also unanimous in their view of interactivity and collaboration as considerable strengths in many different types of tasks.

Do languaging. While it may be futile to erase the conceptualization of a 'language' -- after all, this is how different educational institutions conceptualise and practice it -- it may be useful to encourage learners to see language as doing, action, and activity. Doing *is* -- if we believe arguments that have been presented above -- learning. Pedagogically, 'languaging' could simply mean doing all sorts of things with language. This does not refer to 'productive' activities alone, such as speaking or writing. 'Receptive' activity, such reading, listening, or watching, is also active in nature, and is thus languaging. (For the active view on perception, see, e.g., Noë, 2004.)

Do multimodal languaging. To continue, if we say that language use in different modalities is important, we in a way we go back to the traditional Four Skills (of reading, writing, speaking, and listening). This view positions itself against teaching where formal decontextualized knowledge is given a primacy, but it also raises questions about views that are biased either towards literacy or oral communication skills. The heteroglossic, contextual view suggests -- as do observations on contemporary language use -- that not only different modality-specific, but also *multimodal* usages, should be at the core of instruction.

Do metalanguaging. Finally, a word of caution may be in order here: the view noted above does not exclude traditional grammar or the acquisition of theoretical or structural knowledge of language. Rather, the perspective gives these a new position and imagines new types of activities. Thus it is almost inevitable that we need to see metalinguistic activities as a part of our language curricula. However, in these activities one should stress tasks that tap into the learners' language awareness and develop their skills of noticing, reflection, and analysis. Those views that speak of grammar as 'grammaring' are a good example (e.g., Larsen-Freeman, 2003; van Lier, 2007).

Conclusion

By rethinking concepts of language and learning and by regenerating the pedagogical practices and materials, we invite learners to ‘enter upon the stream of communication’ as Voloshinov (1973, p. 81) said. Ideally, what could be achieved is ‘distributed classrooms’, the idea that learners’ trajectories could reach across both informal and formal contexts. As to the learners, the aim is that each learner has the potential to develop a strong personal language learner agency that helps him or her to proceed towards what has been chosen as a personal goal, either an institutional one of a proficiency diploma or a degree or a more personal one of becoming a member in their chosen language community. The following example, from an interview of a language learner, may illustrate how languages are best learned along doing:

> *I’ve been lost and found my way in French, I’ve taught myself how to make goulash in German, I’ve discussed relationships in English and I’ve cleaned fish in Swedish’. (Translated from the Finnish)* (Dufva et al., 1996).

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DESIGNING FOR SUSTAINABLE PEDAGOGICAL DEVELOPMENT IN HIGHER EDUCATION LANGUAGE TEACHING

Juha Jalkanen & Peppi Taalas

Introduction

In the field of education, as well as in language teaching, major efforts have been undertaken to support and encourage teachers to use information and communication technologies (ICTs) in their classroom. All this has been done with a policy-level goal of a permanent transformation in educational practices. However, very few of these initiatives and plans have had sustainable effect on teachers' pedagogical practices (Cuban, 2001; Taalas, 2005). In retrospect it can be assumed that this is at least partly due to the lack of ownership of the change processes, of their objectives, and even more importantly, of their benefits to an individual teacher (Fullan, 2007a; Hargreaves & Shirley, 2009).

Amidst the rapid and unforeseen changes in society, learning has become the very core of all societal activities and functions (OECD, 2000). Globalisation, increasing mobility, labour market changes, and fast technological development all have had a tremendous impact on how our lives and the context in which we live have become more multicultural, multilingual, and multimodal.

This chapter builds on our recent research into onsite pedagogical development in higher education language teaching (Jalkanen, 2010; Taalas, 2005). We will argue that there is a growing need for a better understanding of the mechanisms of change and to develop research methodologies and approaches that enable us, together with teachers, to develop and create new practices. The central concepts in this chapter are agency, expertise, sustainability, and organisational learning, which we place within a design framework for pedagogical development with qualitative evaluation tools. These concepts are operationalised in an organisational context where research and development are combined to create a dynamic environment for action.

Changing operational environment

Language education, too, is under pressure to change, renew, and rethink its practices, structures, and learning goals. Technologisation alone has greatly changed the way in which our social networks are shaped and developed, the way we communicate and use language, and the way in which we study or work (Cope & Kalantzis, 2000; Gee 2004; Hargreaves, 2003; Jenkins, 2006; Kern, 2000; Pennycook, 2010; Weller, 2011). The concept of knowledge has simultaneously changed: an increasing number of people have access to information and knowledge, and, particularly in Western society, we are also relatively free to produce and share information.

The interpretation by Lankshear and Knobel (2003) of two parallel but conflicting mindsets outlines the conflicting views on the existing practices and transforming practices of education, existence, and thinking. In the world described in the first mindset, people operate in a traditional way, and technology has primarily an instrumental value. It enables the use of new kinds of communication media and ensures that citizens have access to information, but the conceptions regarding the nature of knowledge and learning have remained largely unchanged. In this society products are still material, and society aims to educate citizens who have sufficient knowledge and skills to produce these products. The world thus appears rather similar to what it used to be; it is only slightly more technological. By contrast, the second mindset of a postindustrial knowledge society differs fundamentally, according to the authors, from the first mindset. This new world is characterised by unpredictability and change. In addition to material products, the operation of societies is increasingly based on immaterial products, and their character and diversity are difficult to predict. Economic success depends increasingly on one's ability to create, productise, and sell different services, expertise, knowledge, and skills. The entire society operates in a more networked and collaborative manner. Indeed, knowledge and expertise are possessed not only by individuals but ever increasingly by communities. The nature of knowledge is collective and shared, no longer stable, ad hoc, and bound to institutions.

In a postindustrial knowledge society, technology does not only have instrumental value, but it affects above all people's activities with texts, language, and other people (see also Kress, 2003). The operating culture is characterised by interaction, speed, and multimodality. It is important to understand that people's participation in different multilingual and multicultural communities also shapes their identities and relationship to the surrounding world. Furthermore, this changes and affects the way in which individuals interpret the world and participate in it in different languages and media (see, e.g., Lankshear & Knobel 2006; Kern 2000). These kinds of practices should not be isolated from language teaching at schools (including teaching mother tongue), and they should not be seen as separate and irrelevant even from learning and competence development. This is supported by Scardamalia and Bereiter as they highlight the static attitude of schools to information and knowledge (Scardamalia & Bereiter, 2006). They talk about 'knowledge of' and 'knowledge about' as two very different approaches to teaching and learning. They claim that the content offered at school is superficially 'nailed' to texts books, exams, and curricula, which only seldom is constructed into authentic and meaningful knowledge for the learner.

This prompts us to rethink and reform language teaching and learning pedagogies but also to develop research methods that take into account the complexity of the research setting and that give support to more sustainable structures of change to develop as part of the research and its implications for teaching and learning. These methods should include teachers as codesigners and codevelopers of their own work. This way, the development efforts are neither top-down nor bottom-up, but something in between, something that takes place in the space created in the development process. So far, the development has often happened outside the classroom, during data collection visits in the classroom, or in a 'researcher's chambers', and the teachers are the recipients of the results if the results ever reach them.

Conceptual framework

The most central concept in this chapter is the notion of design, which carries different meanings and refers to different aspects and perspectives of the development process and the research around it. Pedagogical design refers to the act of structuring and analysing the teaching practices and their outcomes in a given teaching setting. Organisational design, in turn, highlights the processes taking place and planned for the development of organisational learning, development of new structures, and the act or rethinking of current practices. The interplay of these concepts is discussed at the end of the chapter.

Dynamics of sustainability in education

Sustainability is a complex concept as it has various connotations, some of them even political. Although there has been prominent research interest in educational change for the past few decades, the issue of sustainability has, however, remained largely unexplored. More recently, it has become a research agenda of its own, and the meaning of sustainability has also evolved. Whereas in the 1980s and early 1990s sustainability referred mainly to the maintenance of innovation (Rogers, 2003; Elmore, 1996), the contemporary definitions stress the dynamic nature of sustainability (Fullan, 2005; Hargreaves & Fink, 2006; Docherty et al., 2009), often linked with ecological metaphors. The role of higher education as a change agent for sustainability is also acknowledged (Gough & Scott, 2007). A great body of literature dealing with sustainability is concerned with environmental issues, but common ground for all sustainability research is the orientation toward future.

Sustainability in the educational context seems to be threatened, especially in situations where an initiative has the aim of permanently changing current practices while the practitioners see it only as one event in the flow of never-ending initiatives and interventions. In many cases, the existing structures in the school or teaching organisation are not negotiated properly nor are they aligned with the goals due to the lack of systemic thinking. According to Senge (2000), most schools are drowning in events and simply resort to quick fixes to survive the day-to-day pressures. This creates an 'attention-deficit culture' in which people become very skilled at solving crises instead of looking for ways to prevent them. In this way, they lose sight of the cause and effect chain and concentrate on correcting problems instead of the reasons behind them. This in turn creates an environment where development cannot become sustainable and there are very slim chances of establishing permanent practices at any level of the organisation.

Many teachers do take part in various development projects and initiatives. Bielaczyc (2006, 302), however, states that long-term development work calls for a theory-level understanding of the reasons why certain practices are effective for learning while others are not. The theoretical aspect is often lacking in school-based development projects and can partly explain why many of these development projects are short lived and over when the funding ceases or when the project has come to an end.

In this paper, we define sustainability as informed and future-oriented decision making that incorporates being proactive (rather than reactive) in designing for future development. Moreover, we emphasise the dynamic nature of sustainability. In other words, the point is not to push for a continuous change or to maintain something that has been developed earlier, but rather to respond to the changes taking place in the operational environment. Creating sustainability is a collaborative endeavour that places learning at its core (Shani & Docherty, 2003). As Docherty et al. note (2009, p. 11), learning-based change for sustainability underpins organisational change for sustainability. In our context, the major changes in the operational environment are the transforming student body and the heterogeneity of it combined with the media rich environment within which students live, study, learn, and work.

Organisational development

It seems evident that learning has become a condition of survival for organisations in modern society (Engeström, 2001; Senge, 1990; Taalas, 2005). In the early 1990s, Senge introduced the learning organisation model based on systemic thinking. According to him (1990, p. 3), learning organisations are 'organisations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together.' Since the 1990s, a vast body of research on learning at work has drawn from theories of situated learning (Lave & Wenger, 1991; Wenger, 1998). However, in recent years, discussion has arisen about whether new kinds of theories for organisational learning are needed as work life has become increasingly complex and multidimensional (Blackler, 2009; Engeström, 2009; Wenger, 2010)[2]. Respectively, Engeström, Kerosuo, and Kajamaa (2007) point out that 'some recent studies of organisational transformations have begun to approach learning as a more multilayered, multisited and temporally dispersed phenomenon, simultaneously both incremental and radical´.

In organisational learning, the subject of learning is often the individual. According to Senge (1990, p. 139) 'organisations only learn through individuals who learn. Individual learning does not guarantee organisational learning but without it no organisational learning occurs'. As Huysman (2000) notes, Argyris and Schön (1978), for example, talk about organisations while in fact they are referring to learning individuals within organisations. The subject of learning can, however, be a community or an operational system from which case learning emerges as an expansion or transformation of activity (Engeström, 1987/2001). In line with the preceding view, Huysman (2000, p. 315) defines organisational learning as 'the process through which an organisation constructs knowledge or reconstructs existing knowledge'. As noted by Boreham and Morgan (2004, p. 308):

> *[M]ost contemporary researchers define learning as organizational to the extent that it is undertaken by members of an organization to achieve organizational purposes, takes place in teams or other small groups, is distributed widely throughout the organization and embeds its outcomes in the organization's system, structures and culture.*

This is also echoed by Docherty et al. (2009, p. 10), who state that in sustainable development learning 'must take place at all levels in the orga-

2 Even though Argyris and Schön, and Engeström come from very different backgrounds and traditions, they do have some similarities, for instance, their interest in the work of Bateson (1972).

nization: the individual, collective, and organizational levels, and indeed, beyond that … '.

Profound changes have taken place in ways we access, consume, and produce information. The accelerating pace of technological development highlights the importance of proactive action instead of reactive or, as Senge's (1990) states, more *generative learning* is needed to ensure sustainability along with *adaptive learning*. In other words, pedagogical development should be in advance of technological development, not the other way around. Thus, this is an organisational challenge since many educational organisations lack the structures of supporting learning at work. It is also worth noting that, while learning, organisations also create their futures. Similarly, Engeström (2009, p. 58) goes on to say:

> *People and organizations are all the time learning something that is not stable, not even defined or understood ahead of time. In important transformations of our personal lives and organizational practices, we must learn new forms of activity which are not yet there. They are literally learned as they are being created.*

However, the problem is that, due to the dynamic nature of change, there is no such thing as a competent teacher, as Engeström (2009) declares. In this view, organizational development endeavours are based on learning together rather than training. This approach indicates a shift from content-based designs to activity-based designs, in which the ability to gain ownership and authorship of the activity is the key. This kind of a shift requires agency, and therefore we suggest that agency should be placed in the central focus of organisational and professional learning.

To summarise, the challenge is in combining the 'Engeströmian' and 'Sengeian' perspectives into a functional frame of action and analysis. Where Engeström states that change is dynamic, fluid and unpredictable, Senge reminds us of the importance of understanding the systemic nature of change and to see all levels of action affected by change efforts. Engeström talks about the artefacts around which the (group) learning activity takes place, whereas Senge talks about the individual's need to understand the purpose of activity. Engeström also highlights the importance of cultural and historical aspects in understanding development.

All in all, both of these views are relevant and important and genuinely complement, not conflict with, each other.

Agency and expertise

A growing interest has been placed on designing environments that support the development of agency in the learning process (Ellis, Edwards, and Smagorinsky, 2010; Lipponen and Kumpulainen, 2011). Agency is a central concept in learning and in becoming an expert. It is directly linked to concepts related to self-regulation and learner autonomy (see Hunter and Cooke, 2007; Benson, 2001). Expertise and being an expert are complex concepts. From the point of view of competence and knowledge, expertise is built on three areas of knowing/knowledge: theoretical knowledge and understanding, practical knowledge including self-regulation, and reflective and metacognitive knowledge (Bereiter, 2002; Bereiter and Scardamalia, 1992). There are various subconcepts under the main concept of expertise; for instance, *an adaptive expert* may refer to the behaviour of a person who is constantly willing and able to extend his or her expertise outside the core competences and become a novice once again (see Bransford et al., 2006). This behaviour is characterised by a desire and ability to discover new solutions and interpretations. Schön (1983), in turn, talks about *the reflective practitioner* who is able to become aware of and criticize his or her tacit understandings through reflection, which is a basis for professional learning.

In this chapter we have framed the concepts of expertise and agency in a three-tier concept of access, ownership, and authorship. These concepts portray a level of agency in relation to the ability to create and design pedagogical activities that incorporate new types of elements that support learning – in this case, various technologies. Access refers to the stage where the teacher has in general good access not only to technology, but also to different examples of integration in the form of activities and plans. Ownership in turn happens where the teacher starts to feel in control of the constant change and uncertainty of school and classroom events. S/he feels that there is territory to explore and that there are no right or wrong solutions to the way in which teaching should be organized and structured. Authorship can be considered the highest level of agency, and autonomy in dealing with change -- trying out new things –

is actually transforming not only the teachers' outlook on classroom practices, but the way in which learners are offered opportunities for taking charge of their own learning. The stages aren't always clearly separated, nor is the expanding teachers' thinking always tied to certain behaviours or goals. We use these concepts as tools for analysing and understanding what actually happens during the different phases of pedagogical development.

Opportunities and challenges in onsite research
The starting point for the research is two-fold:

» As members of the organisation in question, we are interested in organisation structures and processes that contribute to sustainable pedagogical development.

» As educational researchers, our interest is in the learning processes involved in the development work.

Consequently, the research prods into the cluttered reality of collaborative pedagogical development in a language teaching organisation in higher education. This is done through examining aspects of different local development projects in which authors have been involved in different ways. Documenting the development processes from an organisational perspective also allows us to go beyond the end products and investigate the learning trajectories and the tensions involved. One of our main concerns and interests is to see if and how we can create coherence, continuity, and structure for development in the teachers' increasingly fragmented and turbulent work.

Conducting the onsite research described in this chapter raises many methodological questions. First of all, the researchers have a dual role, as they are simultaneously members of the organization and researchers conducting research into the organisation. Second, because the objective of the research is to produce a sustainable infrastructure for pedagogical development and workplace learning, traditional means of data collection are too narrow for capturing the multilayered process of action. The data collection should ideally result in data that both accounts for the learning processes and helps the organization to adjust its actions. Third, the research must have a solid theoretical foundation that is also adaptive to the complex organisational context within which the research takes place. Finally, the number of cases under the lens of investigation is limited, which has to be taken into account in the description of research ethics.

Design-based research

Design-based research (DBR) has been proposed as a research approach that can help bridge the gap between research and practice (van den Akker et al., 2006) as it seeks to explain how design functions in authentic settings. However, Engeström (2007) very rightfully criticizes *design experiments* for being too superficial. According to him, '[t]he emphasis is on completeness, finality, and closure may be partly explained by the idea of design experiments as "refinement". The implication is that the researchers have somehow come up with a pretty good model which needs to be perfected in the field'. He claims that no model is ever finished or ready, but in a constant state of change. He draws on von Hippel and Tyre (1995, p. 12) for support and continues to claim that an approach such as this overlooks the fact that one might never 'get it right, and that innovation may be best seen as a continuous process, with particular product embodiments simply being arbitrary points along the way'. The approach adopted in this chapter adheres to this idea.

Design-based research is often described as a development and research process that transpires in an iterative cycle of design, enactment, analysis, and redesign (Design-Based Research Collective, 2003). Mixed methods can be applied to collect and analyse data; the approach does not in itself dictate certain methodological choices. In the current study, the design-based research approach has been complemented with narrative research methods (Webster and Mertova, 2007).

Design-based research has a dual objective: on the one hand, it seeks to respond to local needs, for example, by developing the learning environment. On the other hand, it strives to increase our understanding of learning (Barab and Squire, 2004; Barab, 2006; Design-Based Research Collective, 2003). In other words, DBR as a research strategy allows for conducting research on multiple sites, timescales, and levels. The objectives are intertwined and can be considered as the main feature of design-based research in addition to its iterative nature. As Barab and Squire (2004, p. 5) note, the 'design-based research strives to generate and advance a particular set of theoretical constructs that transcends the environmental particulars of the contexts in which they were generated, selected, or refined'. Furthermore, the researcher's role is dynamic: s/he can function as the teacher or cooperate with the teacher (Barab, 2006; Confrey, 2006), as is the case in this study. We see these principles as key from the perspective of the research project in question.

The design-based research approach allows for multilayered research design and use of data. On the organizational development level, a qualitative analysis took place. The field notes written by the researcher were translated into a narrative that was then used as a basis for the analysis of the process. To promote the validity of the findings, the analysis and interpretations were discussed by the two researchers.

Problem-mediated approach to pedagogical development

The ability to pose relevant questions, set up problems, and develop plausible solutions have been considered elements of high level expertise. In the contemporary knowledge society, collaborative problem solving is a key feature of expertise (Engeström et al., 1995). Even if this chapter does not directly adapt problem-based learning as an approach or method, we strongly see a link between our conceptual framework and PBL. As PBL is defined as an 'approach to structuring curriculum which involves confronting students with problems from practice which provide a stimulus for learning' (Boud & Feletti, 1997, p. 15), our research setting aligns very well with the core idea. Our development projects can be seen as the curriculum within which the teachers taking part in the study are faced with problems where they have to reflect on their current practices to create and combine new approaches and solutions. The problems mediate pedagogical thinking and can be shared, discussed, and analysed. The mediation process functions as a lens through which all participants focus on the same themes and issues. Eventually and as an outcome of the process, the teacher's learning becomes visible in the transformed activity.

The model introduced here is derived from the design-based research process; thus, it is an outcome of this research. However, for the sake of clarity it is described here as a foundation for discussion of the process in section 7.

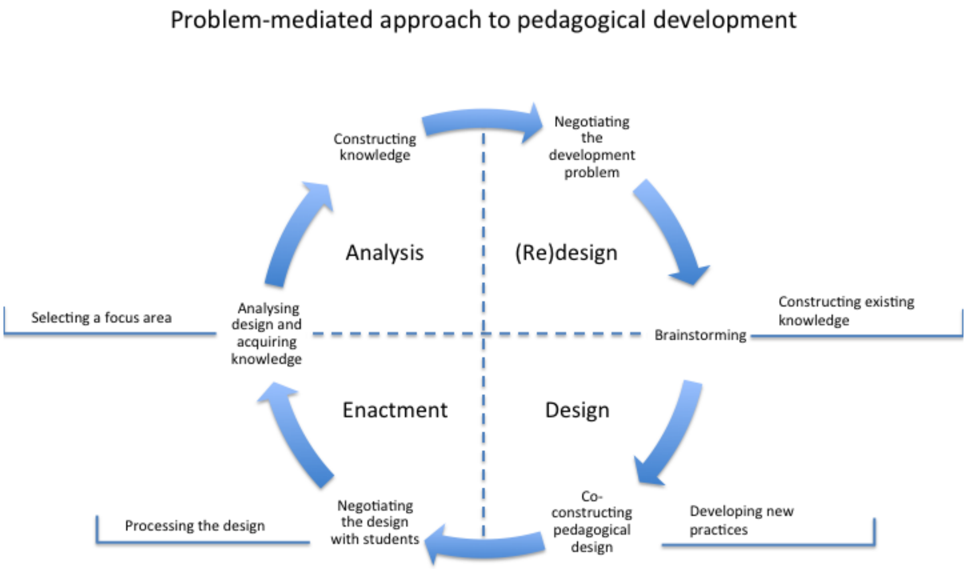

Fig. 1. Problem-mediated approach to pedagogical development.

The first step of the process is selecting the course to be developed that works as the mediating tool for problem-solving activity. The process structure has been influenced by the ideas presented by Cope and Kalantzis (2000), by Engeström's concept of expansive learning (1987), and finally by the Linköping PBL model (Abrant Dahlgren et al., 2005). The first stage of the cycle is design, within which the development design problem is negotiated between the teacher and the researcher. The key principle is that the development work is initiated by the teacher, but the object of the activity is negotiated. Following the definition of the problem, ideas for development are brainstormed. Brainstorming is based on constructing existing pedagogical knowledge. Based on the ideas developed in the brainstorming session(s), an initial design for the course is co-constructed. The design is the basis for the development of new practices.

In the next stage, the design becomes an action, as it is reconstructed in the actual classroom situation. A prerequisite for establishing the new design is that it is negotiated with the students. The negotiation process requires a clarification of the learning objectives (both shared and individual) and the alignment of the objectives to the new practices. During the enactment stage, the design is processed by the teacher and the students. In this phase, the researcher acts mainly as an observer.

The third phase of the cycle is analysis. Reflection on the new practices and the new design lay the groundwork for selecting a focus area for a more detailed analysis. This phase includes a literature review conducted by both researcher and teacher, combined with regular meetings for discussion. Data collected during the course are analysed in light of the focus area, and the results are aligned with educational theory. The results are the basis for redesigning the course for the next cycle. Redesign begins with a redefinition of the design problem.

The development phases have their counterparts in the design-based research design. Research stages are placed on the inner cycle. The problem-based approach and the design-based research are very similar in the way in which the activities are organised within a predefined cycle of activities. Both approaches lead to a deeper understanding of the issue or theme introduced at the start of the process, and both aim at deepening the theoretical underpinnings of the issue.

Language teaching organization as the context for action

Following the idea of *multimodal pedagogy* (Taalas, 2005), an e-learning platform[3], Moodi, has been in development since 2003 at the University of Jyväskylä. The development has been coordinated by Peppi Taalas and her coauthor has also been actively involved in the development process. The most significant goal motivating the development work has been to encourage teachers to rethink their pedagogical designs in terms, for instance, of the core content and working modes. The environment itself is not locked within a certain pedagogical ideology but rather allows the

3 We use the term e-learning platform (also platform) here to refer specifically to the technological construct. In our view, it becomes a virtual learning environment (VLE) or to some extent a personal learning environment (PLE) as a result of the pedagogical practices taking place.

teacher to make new constructs and learning paths quite freely for the learners.

To initiate a discussion about learning environments and pedagogical practices, the new platform was introduced to teachers in May 2009. The introduction was made by explaining the pedagogical thinking behind the creation of the platform. With the help of case examples, the teachers were given a walk thru as to how things might be done differently and even in an exciting way. After the first presentation, more than 20 teachers expressed their interest in hearing more, and some even scheduled a personal meeting to look at their course plans to see how these could be developed further using the platform.

The meetings with teachers led to a development of several courses. The courses represented different ways to integrate technology into teaching practices: some of the courses took place completely online whereas others expanded the face-to-face teaching space into virtual environments. In the following section we will examine aspects of these cases in greater detail.

Pedagogical development in the design framework

This section draws on several local development cases within which the authors have been involved and within which the problem-mediated design framework has been developed. In this exploration, we will discuss emerging issues in the development work in the light of our conceptual framework.

Rethinking expertise in the design work

Recent research on agency and expertise supports the view that some workplace activities are too complex to be managed individually (see, for instance, Edwards, 2011). This can be considered to be the case in developing new kinds of structures and practices for language teaching and learning. The teachers and researchers involved are all experts in their own fields, but the new practices and structures are an unknown territory and thus require new kinds of expertise that do not yet exist. Against that background we suggest that combining different kind of expertise at different stages of the design process fosters the creation of new pedagogical artefacts (both conceptual and material) that go beyond contemporary uses of tools and environments and aim at the transformation of practices and cultures. The notion is well aligned with the concept of an adaptive expert discussed above. This line of thinking has been the point of departure for the design work.

Traditionally, designing a course is a process that relies to great extent on a teacher's individual expertise. In the organization in question, we have established a new staff profile, namely, the post of a pedagogical developer[4]. This new staff role has been introduced to teachers as a resource for rethinking existing practices and developing new ones. From the expert point of view, this has provided teachers with an opportunity to bring different kinds of expertise into pedagogical development. It can thus be seen as an organizational resource.

In this approach the course design functions as a kind of 'boundary object' for the shared meaning that can be further negotiated. Therefore, to construct a space for sharing expertise, the course design needs to be created at an early stage (step 3 in the model). The course design, then, facilitates the pedagogical discussion. Whereas different kinds of artefacts have been created to guide the design work and to construct a shared understanding of the process, the most significant artefact that has mediated the negotiation of meaning has been the course design itself. During the design process the teachers and the researchers discussed questions that relate to language learning in a broader sense than merely activities, tasks, or course materials. Drawing upon this observation, we claim that the course design mediates the teacher's pedagogical thinking and makes it accessible for the researcher[5].

In terms of agency, this stage could be seen as the construction of access (discussed above). When the new course design is coconstructed and negotiated, ownership and authorship of the design as well as the process are expected to develop.

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4 The pedagogical developer is the same as the other author of this chapter. For the sake of clarity he is referred to in the text as a researcher. When we talk about researchers, we mean the both authors.

5 This can be compared to the pedagogical discourses that teachers often echo when discussing their beliefs and perceptions of pedagogical concepts. Either way, it is a question of researcher's interpretations.

In our minds, expertise is considered as situational, and the repertoire of expertise expands as the development process unfolds. In this case it means that during the development process the stakeholders gain a deeper understanding of the new practices, processes, and structures that eventually become a part of their expertise. This form of professional learning takes place through reflection on the action. However, the notion of expertise can also be a barrier to professional learning. For instance, shared space for expertise might be constrained if a teacher resists taking the position of an adaptive expert and holds onto the position of being an expert.

Research and development intertwined

Retrospectively we can identify three kinds of resources with which our project has provided the teachers: technical, pedagogical, and professional. In practice, the technical resources meant that the teachers were provided with individual and ad hoc assistance in constructing new virtual spaces for their teaching. This was needed in many cases due to lack of time or technical skills. The pedagogical resources, in turn, provided the opportunity to expand the horizon of pedagogical possibilities by combining different kinds of expertise in the design process (as discussed above). Finally, the professional resources were operationalized in this case in the form of design-based research.

Some members of the organization who were involved in the development work were also interested in engaging themselves in research on the development work, and the cooperative nature of design-based research provided an opportunity to make use of it as a resource for professional learning. In the stage of analysis, the data were analysed by the teachers and the researcher in a collaborative manner[6]. During the data analysis sessions, different types of expertise were combined: the teachers were experts in the content area they were teaching and the researcher was the expert in learning in multimodal settings. To mediate the discussion during the data sessions, the researcher provided

6 For information on teachers engaging in research as professional development, see Honan (2007).

the teachers with relevant literature – and vice versa.

The flexibility of the development setting also allowed involving more people in the stages of enactment and analysis. Some future teachers were interested in engaging in data collection and conducting their theses on the development work. As their research progressed, the issues arising were discussed with each other, which presented opportunities for professional learning.

From the design perspective, the development work has staked a claim for research-based pedagogy. Following the design-based research strategy, the design has been theoretically supported, but the research has also contributed to the understanding of the design in context.

Dissemination of the results in peer-reviewed academic journals and conferences have served three purposes: first of all, it has supported teachers' academic careers and made the professional learning visible in that sense. Second, the new practices have been negotiated with the academic community to ensure a scientific quality of the development work, and third, the dissemination has documented the development work as part of organisational activity.

Sustainable pedagogical development

The pedagogical development described in this chapter has been underway for three years. During that time, several courses have been developed in different ways. The guiding principle in the development work has been supporting t he construction of agency in the development setting. Following the principles of design-based research, the development work has taken place in iterative cycles, and the organization-level understanding of how to guide and support the process has increased.

The introduction of new pedagogical practices and structures is usually followed by conflicts within working and learning cultures. These tensions between the old and the new are arenas for mutual learning and from which new cultures of learning and working emerge. Thus, it is by analysing these tensions and conflicts that we begin to understand the enacted design, its affordances and its constraints. In retrospect, it seems that it is of utmost importance to support *critical reflection* between the development cycles. In the development process, critical reflection has taken place in discussions between the teachers and the researcher. In line with our view of sustainability, recognizing the points where the direction of the development needs to be adjusted is one of the most important aspects of the process.

Teachers often claim that the lack of certain technical skills prevents them from using technology for pedagogical purposes (cf. Sulla, 1999), but despite the major efforts to develop teachers' ICT skills, only a little transformation has taken place on the level of pedagogical practices. The underlying idea has been to help the teachers to eventually become familiar with the e-learning platform, not as a technological tool but as a vehicle to expand the teachers' pedagogical thinking and learning opportunities for the students. The focus was heavily on pedagogical development and to ensure it, the teachers were not expected to handle the technological side but were offered technological assistance. Instead, technological competence and autonomy in using the platform were built gradually during the process. This approach establishes the evolution of pedagogy as the sustainable element.

The design process has also been discussed with the administration to ensure support and interest on the organisational level. As has been the case before in the larger development undertakings at the organization, the development goals have always been combined with administrative commitment for allocating time and resources needed for the work.

Discussion and conclusions

The aim of this chapter was to examine learning trajectories and emerging tensions in the pedagogical development work within the organisational context. A set of development cases was examined from the perspectives of expertise, research and development, and sustainability.

The chapter adheres to the notion that designing for sustainable development necessitates a systems view of the learning setting that is, in this case, the organization. This view takes into account different contextual variables while acknowledging the unpredictable nature of learning. In other words, the development is planned and carried out together with teachers and the larger organisational goals and factors in mind, while also recognising the possibility that something completely unplanned and unexpected might emerge as a result. Due to this complexity it is not possible to pinpoint the moments where learning takes place without more intense methods for data collection in place. Instead, this chapter has tried to provide a description of the process from the researcher's perspective and some snapshots of the different parts of the process.

The rapid pace of changes is often exhausting for teachers whose main responsibility is to teach and to 'produce results' in one form or another. Learning how to use new tools is not really part of the job, and opportunities and time for pedagogical development are not always available. For that reason, we have originally started to develop the kind of activity-centred design framework that places the teacher's capacity to act (agency) in the central focus and emphasises the negotiation of meaning where the teacher is encouraged and expected to bring his or her own pedagogical thinking to the discussion. The development of the framework has been complemented with organizational resources, such as the post of pedagogical developer.

By looking at the teachers' design practices, it is possible to see patterns of change and presume how change takes place. The development process as we have discussed it here supports the view that, in the development work, agency and expertise are relative and progress from access to ownership to, finally, authorship. This, however, presupposes that the teachers are offered the chance of being codesigners and the teachers are willing to take on that task. As a result of the cooperation between the teacher and the researcher, something new is created and new practices emerge. At this point, it can be only assumed and predicted that these new practices have sustainable elements on the microlevel.

At the organisational level, both the pedagogical and technological resources were allocated for the development work as needed, and it is important to ensure that both are available for the teachers whenever they are needed. A constant dialogue between the teachers and the administration is needed to ensure the goals are negotiated and renegotiated as things progress.

The dissemination of these new practices takes place more naturally through academic channels, i.e., journals and conferences, but not as horizontally within the organisation. However, our preliminary observations indicate that the dissemination has made the new practices more accessible to other teachers, too. This can be interpreted from the fact that, following the dissemination of our different cases, many of the teachers have contacted the researcher and have proposed collaboration in terms of pedagogical development.

Drawing on these results, we argue that designing research-based, dynamic teaching and learning environments supports sustainable educational development. Most, if not all, development work should be built on teachers' existing pedagogical thinking, and not on the objectives laid out in the research and development project. During the research-based design process the teachers need to share freely their current thinking and course designs, and, likewise, and the researchers need to share their thoughts. When this happens, a negotiation of meaning will take place, and a shared understanding can be reached. As Fullan (2007b) advises, it might be useful to tone down the term 'professional development' and start talking about 'professional learning'.

In this chapter we have described a research setting that is still very experimental and exploratory. The results so far seem quite encouraging even if only time will tell how sustainable the practices developed during this research will be. Nevertheless, we feel it is crucial that more research is done in the area. The research should focus specifically on the mechanisms involved in supporting and developing authorship as part of the sustainable development of teaching. For instance, qualitative accounts of the negotiation of meaning in the development work could provide some new insights into the dialogic relationship between teachers and researchers.

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DESIGNING PROBLEM-BASED LEARNING IN VIRTUAL LEARNING ENVIRONMENTS – POSITIONING TEACHERS AS COMPETENT PRACTITIONERS AND DESIGNERS

Thomas Ryberg

Introduction

In recent years Virtual Learning Environments (VLEs) or Learning Management Systems (LMS) have been widely adopted within Higher Education and other educational domains. However, it seems that these widespread changes have had more effect on administrative practices than on fundamentally reshaping pedagogy. Many proponents of technology-enhanced learning (including myself) view technologies as vehicles or opportunities for reshaping existing pedagogies, typically toward more active, student-centred, dialogical, collaborative, and knowledge-creating modes of learning. However, the pedagogical realities of VLE implementation seem to include less radical pedagogical changes (Dalsgaard, 2006; Hannon, 2012; Jones & Dirckinck-Holmfeld, 2009; OECD, 2005). Often VLEs become more or less static repositories containing course descriptions, curricula, readings, lecture notes, and slides with only little interaction, collaboration, and critical dialogue. As described by Dirckinck-Holmfeld & Jones (2009), this has led many e-learning pioneers to view VLEs as retrograde step in terms of pedagogical development. This is reflected in current debates about Personal Learning Environments (PLEs) (or social software and Web 2.0) vs. Virtual Learning Environments. In this debate, particularly in the blogosphere, we find loud calls for a shift away from institutionally controlled, walled-garden and static VLE-silos, as these are said to enforce a 'traditional', teacher-centred pedagogy of transfer where students consume and reproduce existing knowledge. The alternative is presented as a move towards student-owned and controlled PLEs, which are positioned as reflecting a 'progressive', student-centred pedagogy where students become collaborative producers of knowledge. In particular, Web 2.0 technologies have become the rhetorical lever for realising these techno-pedagogical changes, as Web 2.0 tools are key ingredients in notions of PLEs as loosely coupled collections of personally owned tools for students' self-directed or collaborative learning (Attwell, 2007; Dalsgaard, 2009; Drexler, 2010).

I agree there are good reasons to fundamentally revisit pedagogical practices within higher education and move toward student-centred collaborative learning and knowledge creation. Likewise, I agree that Web 2.0 technologies have tremendous potential for education. I argue, however, that we should be very careful in assuming that 'new' technologies will automatically lead to such changes. We run the risk of falling into the technological determinist trap of assuming that the next 'technological fix' will generate a wave of pedagogical change within institutions, while the history of e-learning or networked learning teach us otherwise (Selwyn & Grant, 2009; Selwyn, 2012). I believe there is a need to step back from discussing advanced tools and reflect more on the role of teachers in these debates, and how we can support them in these processes of change. In particular, I feel this is important and timely, as much of the rhetoric around Web 2.0 basically reiterates well-established pedagogical ideals, particularly those associated with PBL as observed by Dohn and Johnsen (2009) and Dohn (2009). For example, Aalborg University has practiced a radical student-centred PBL pedagogy since 1974 and online programmes based on this pedagogy since the 1980s (McConnell, Hodgson, & Dirckinck-Holmfeld, 2012). Additionally, it might be worth recalling that VLEs or other web-based technologies, which are now argued to embody a 'teacher-driven', 'instructional' pedagogy, were envisioned to transcend and change just such pedagogies.

The lack of pedagogical transformations may have many different causes within and across institutions, but a general observation is that many teachers find it difficult to meaningfully adopt new technologies into their practices (Hatlevik, Ottestad, Høie Skaug, Kløvstad, & Berge, 2009; Holm Sørensen, Audon, & Twedell Levinsen, 2010). It should be noted that my purpose is not to locate teachers as the source of the problem, as this is not an issue that concerns only 'teachers'. Rather, it is a part of the larger ecology of implementing in organisations what Bygholm and Nyvang (2009) call new 'educational technology infrastructures'. Furthermore, one of the central problems seems to be the very assumption that new technologies will 'automatically' drive pedagogical changes. While great economical investments have been made in the acquisition of hardware and network infrastructures, the need to simultaneously educate and help teachers to make pedagogically meaningful use of the technologies has been somewhat neglected (Hatlevik et al., 2009; Holm Sørensen et al., 2010). Therefore, my aim in this chapter is not to locate teachers as 'a problem', but rather as a part of the solution.

Shifting from an instructional or teacher-centred pedagogy towards, e.g., a Problem-Based Learning approach is not just a matter of adopting new, collaborative technologies or environments. More fundamentally it is about changing the power relations and accountability-structures between students and teachers (Tambouris et al., 2012). Such changes are not merely about 'using new technologies', but more fundamentally about changing and renegotiating organisational and individual practices, identities, and beliefs about learning. This encompasses a change of tools, but also includes potentially changing more deeply seated ideas and practices of what it means to be a teacher or student. Therefore, there is a need to have a more thorough debate of what we might mean by student-centred learning or, rather, Problem-Based Learning, which is of particular relevance to this book. And there is a need to develop conceptualisations and mediating artefacts that can help teachers in navigating this landscape, supporting them in redesigning their teaching and learning practices.

Thus, I focus on teachers as competent practitioners and designers, and argue that, rather than viewing technologies as the vehicle or lever for change, we should look at mediating design artefacts (Conole, 2010) as ways of promoting teacher-driven innovation of their own educational practices.

In this chapter I therefore present and discuss the CoED method, which I view as a mediating design artefact. The CoED method is a specification or inspirational guide for how to conduct design-oriented workshops that help practitioners and designers in designing (online) learning courses, modules, or other educational activities. However, the method also involves steps that prompt the participants to collaboratively discuss and reflect on their more deeply seated values and beliefs about learning (which are often more diverse than participants expect). In this chapter I present, discuss, and analyse experiences with the CoED method as a mediating design artefact. I discuss its role in facilitating teacher-driven innovation of learning designs with a particular focus on PBL in virtual learning environments. I initially present a view of PBL as practiced in Aalborg University and the principles associated with this model. However, this is an approach that is deeply embedded in the whole organisation (practiced university wide) and also a rather ‘radical’ PBL-model, both in terms of students’ ownership of the problem and the temporal extent of the collaboration process. Implementing a similar model would probably be out of reach of most teachers or even teacher teams, as it would include larger organisational and institutional changes. I, therefore, offer a theoretical discussion and conceptualisation of PBL, which can be helpful in understanding and designing for varied types of PBL practices. This conceptualisation was also used as part of the CoED workshop described in our example.

A conceptual model to understand different types of PBL practices
PBL is most often positioned as a student- or learner-centred pedagogy focusing on learners’ active and often collaborative creation of knowledge through engaging with real-world problems or cases. While PBL has become a widely adopted concept, there is a wide range of different (and sometimes conflicting) interpretations of what PBL is. It is not a commonly agreed upon concept, but rather encompasses a number of different interpretations and practices (Kolmos & Graaff, 2003; Ryberg, Glud, Buus, & Georgsen, 2010)”container-title”:”International Journal Of Engineering Education”,”collection-title”:”International Journal Of Engineering Education”,”page”:”657-662”,”volume”:”2003”,”issue”:”19”,”abstract”:”Problem-based learning (PBL.

> *As even superficial inspection of a few of the available sources can reveal, the label `PBL’ is used to cover an amazing diversity of educational practices, ranging from problem-oriented lectures*

to completely open experiential learning environments aimed at improving interpersonal relations (Kolmos & Graaff, 2003, p. 657).

Different articulations of PBL range from presenting students with math problems or cases during a lecture, to models where students work collaboratively for months on addressing self-chosen, real-world problems, as is the case with the Aalborg University model of PBL (Barge, 2010; Kolmos, Fink, & Krogh, 2004). I initially present this model and associated principles as a paradigm case of what is meant by PBL and student-centred learning. In this model, at least in theory, the idea is that the problems and projects with which students work are mandatory parts of the curriculum, rather than the curriculum being limited to course curricula and decided mostly by teachers or institutions.

The Aalborg PBL model

At Aalborg University (AAU), a particular PBL model has been employed as a university-wide pedagogical approach since the University's inauguration in 1974 (although with some variations). In AAU students work with problem-based projects every semester. This means that half their time (15 ECTS) is allocated to and assessed through courses and course work. The remaining time (15 ECTS) is used on and assessed through the project work and report. Furthermore, courses are designed to support the students in their problem-oriented project work by providing introductions to relevant theories and methods that students can potentially employ in their project work. The project reports usually number approximately one hundred pages and document and reflect the process of a group of students solving or addressing the problem. The project work lasts 3-4 months, in which the students go through different types of enquiry: problem identification, problem formulation, theoretical and methodological inquiry, data collection, analysis, and discussion. In this way the project work is quite similar to, e.g., the process of doing research (albeit on a smaller scale). This model has more recently been formally described in a number of principles. For the purpose of this chapter I focus on the principles stated in relation to the 'educational vision' of PBL. These are: problem orientation, project organization, integration of theory and practice, participant direction, team-based approach, collaboration, and feedback (Barge, 2010).

Problem orientation: Refers to the idea that problems or questions should always serve as the basis for the learning process. Problems can take different shapes within different fields, e.g., purely theoretical or practical; often, however, it is an important component that the students themselves identify, formulate, and are genuinely interested in the problem. *Project organization:* The written project and work process is the means through which the students address the problem and realise the articulated educational objectives. The project refers to both the problem-based enquiry the students go through and the final written report (the product). *Integration of theory and practice*: Faculty members and project supervisors facilitate the students' process of connecting the specifics of the project work to broader theoretical, methodological, and practical knowledge embedded in the curriculum; it is part of courses and course work. From this integration, students may better see how theories and empirical/practical knowledge interrelate. *Participant direction:* One of the key principles is that it is the group of students who define the problem and make key decisions relevant to the successful completion of their project work. *Team-based approach:* The vast majority of students' problem/project work is conducted in groups of three or more students. *Collaboration and feedback:* Students use supervisor and peer critique to improve their work throughout the process of the project work. The abilities to collaborate, give feedback, and reflect are important outcomes of the PBL model in terms of the students' learning, i.e., the principles of a team-based approach are important.

Mapping various PBL-practices – a conceptual model

The Aalborg PBL model is one particular interpretation and orchestration of PBL among many others. In addition, it is a quite 'radical' model in terms of participant/student control; additionally, because it is applied as a university-wide approach, it has a huge impact on how the curriculum of programmes is structured, and is embedded in the physical and administrative infrastructures of the university (e.g., space for group meeting rooms). Thus, adopting a similar model full scale is an organizational change process rather than a matter of adopting a particular pedagogy in a course or programme (Graaff & Kolmos, 2007). Such a change process would often be outside the reach of individual or even groups of teachers. However, I believe that individual teachers or teacher teams can be inspired by the principles and implement models that are similar to the Aalborg PBL Model, although they might embed them on a smaller scale. I therefore present a conceptual model, which can be helpful in understanding and designing for different types of PBL practices.

In an attempt to capture central aspects of different orchestrations of PBL, Barrows (1986) proposes three variables that can be used to differentiate various PBL practices. The first concerns the design and format of the problem: Is the problem given to the students or self-chosen, and how open is the problem? Are students given a detailed description of the problem along with references about how to solve the problem, or is the problem more ill-defined enquiry. Secondly, Barrows distinguishes between whether the learning processes are teacher or learner directed. The third variable concerns the sequence in which problems are given and information acquired, in terms of whether cases/problems are provided before or after additional information is presented.

Similarly, several authors argue that PBL is grounded in the belief that problems should be the starting point for the learning process (Dirckinck-Holmfeld, 2002; Kolmos & Graaff, 2003; Savery, 2006; Savin-Baden, 2007). In line with Barrows, these authors argue that important aspects of PBL are: the design of the problem, who formulates the problem, and who is responsible for the major decisions in relation to the problem-solving process (teacher or participant directed). They furthermore highlight the importance of experience learning, where students build on their own experiences, and the notion of learning through active engagement in actual practices or real-world problems involving research activities, decision making, and writing.

Basically, it seems that different articulations of PBL can be expressed in terms of the distribution of power and responsibility between teachers and students (Ryberg, Koottatep, Pengchai, & Dirckinck-Holmfeld, 2006) e.g. is a problem given or identified? Who decides how to organise the problem solving process, and is there a definite solution to the problem or is it open ended? Based on these distinctions, and building on Ryberg et al. (2006), I propose that we can extract three important characteristics of PBL, which can be used to distinguish among and to design various theoretical and practical constructions of PBL. I suggest that we can distinguish between whether teacher or student has control or ownership of *the problem, the work process, and the solution*. 'The problem' opens up questions about who controls or owns the formulation and design of the problem: teacher, student or others. 'The work process' is concerned with how working processes are organized and who controls them. Who chooses in what way to investigate the problem (theories, methods, empirical investigations, etc.)? Is the work process controlled and designed by a teacher or the students? Finally, one can ask who owns 'the solution', meaning to what degree are the students expected to discover a predefined solution or as opposed to being involved in a process of exploration and knowledge production. The three dimensions can be thought of as stretched out between two ends of the continuum of teacher and participant control:

Fig. 1. Central dimensions of Problem-Based Learning

This conceptualisation can be used to understand or analyse different practical articulations of PBL and has, for example, been adopted in Tambouris et al. (2012) to describe and discuss the final design of different online courses that were part of the EU-project EAtrain2. In Tambouris et al. (2012) the model was used to depict graphically the degree of teacher or student control over different elements in a course. However, the model can be used equally as a conceptual design tool to promote teachers' reflections on existing and future practices. I shall return to this in the case example, where I discuss how it was implemented as part of the CoED method.

The CoED Method

The Collaborative E-learning Design (CoED) method is a common methodological framework initially developed by Nyvang and Georgsen (2007) and further used and developed by Tom Nyvang, Marianne Georgsen, Lillian Buus, Louise Nørgaard Glud, Jacob Davidsen, and me as a loosely coupled CoED group or collective. The method is developed with input from research on:

» systems development and design – with a focus on designing information and communication technology;

» collaborative learning – emphasis is on designing for learning, and learning through the design process; and

» facilitation of creative processes – where the aim is to develop something new.

Thus, the CoED method is inspired by existing theoretical frameworks and methodologies, and incorporates practical methods for facilitating creative processes (e.g., by drawing on known concepts, such as card sorting and future workshops). The CoED method is a specification or inspirational guide on how to conduct design-oriented workshops that help practitioners and designers in designing (online) learning courses, modules, or other educational activities. It aims to support domain, qualification level, and subject experts in designing targeted networked learning. The emphasis is on bringing focus and structure to the early stages of the design process; to develop design specifications and/or early prototypes within few hours of work; and to support the collaboration between different types of experts and practitioners. For example, the aim could be to bring together e-learning experts, teachers, and technologists in an effort to create a number of high quality courses or modules (subject and content-wise) that are also pedagogically and technically innovative. Another goal could be to bring together teachers from particular semesters or programmes to develop online or blended learning courses in a newly adopted Learning Management System.

In the following I outline the principles and phases in the CoED method. For a more thorough discussion of the theoretical and methodological background to the method, we refer to earlier work (Buus, Georgsen, Ryberg, Glud, & Davidsen, 2010; Nyvang & Georgsen, 2007).

CoED method – phases and principles

The CoED method facilitates a design process by following five overarching *principles* and splitting the early design process into three *phases*.

Principles - the CoED method:

1. Facilitates conversations about e-learning design.

2. Structures conversations about e-learning design.

3. Produces design specifications and/or actual designs rapidly.

4. Involves e-learning experts, domain specialists and future users of the e-learning design.

5. Involves at least two people in the design process.

The principles are relatively straightforward and act as guidelines for the overarching purpose of the CoED method: To support structured dialogues and concrete design activities among a diverse group of participants (more than two), and ideally with participants from different domains. Following principle number four, the design process *ideally* involves learning experts, domain specialists, and future users of the learning design.

Phases

1. Focus the e-learning design process (presentation).
2. Identify overarching values and design principles (card sorting and prioritisation).
3. Specify design (card sorting and design).

To give an overview of the method, I describe briefly the purpose of the three phases and go into more detail in the specific case examples of how the activities in the phases have been carried out and adapted to different contexts. The first phase is usually conducted as an 'expert' presentation, whereas the latter two phases involve different card sorting and design tasks. However, the more specific organisation and content of the workshop can and should be tailored with a view to the purpose and context of the workshop.

First phase

The first phase of focusing the e-learning design process is intended to be an 'expert' presentation of e-learning design. In this phase a presenter, who is usually one of the workshop facilitators, may give an introduction to general e-learning design principles, e.g., outlining differences between more content-oriented and more dialogical approaches, the functionalities of a certain learning management system, particular challenges of online learning, or focus on the meaning of collaborative learning or Problem-Based Learning. The purpose is to provide some central concepts and establishing common ground before entering the design phase.

Second phase

In the second phase participants are tasked with a card sorting exercise. From a number of **value cards** (Fig. 2) with value statements or learning orientations, the participants need to gradually boil down the overarching design values and principles that should guide their own design. Value statements can be, e.g., 'collaborative learning', 'skill and drill', 'open educational resources', 'reflection-on-action', or the like. Often different value cards will reflect 'contradicting' or opposing values, e.g., collaborative learning vs. individual learning, content vs. process, teacher control vs. student control.

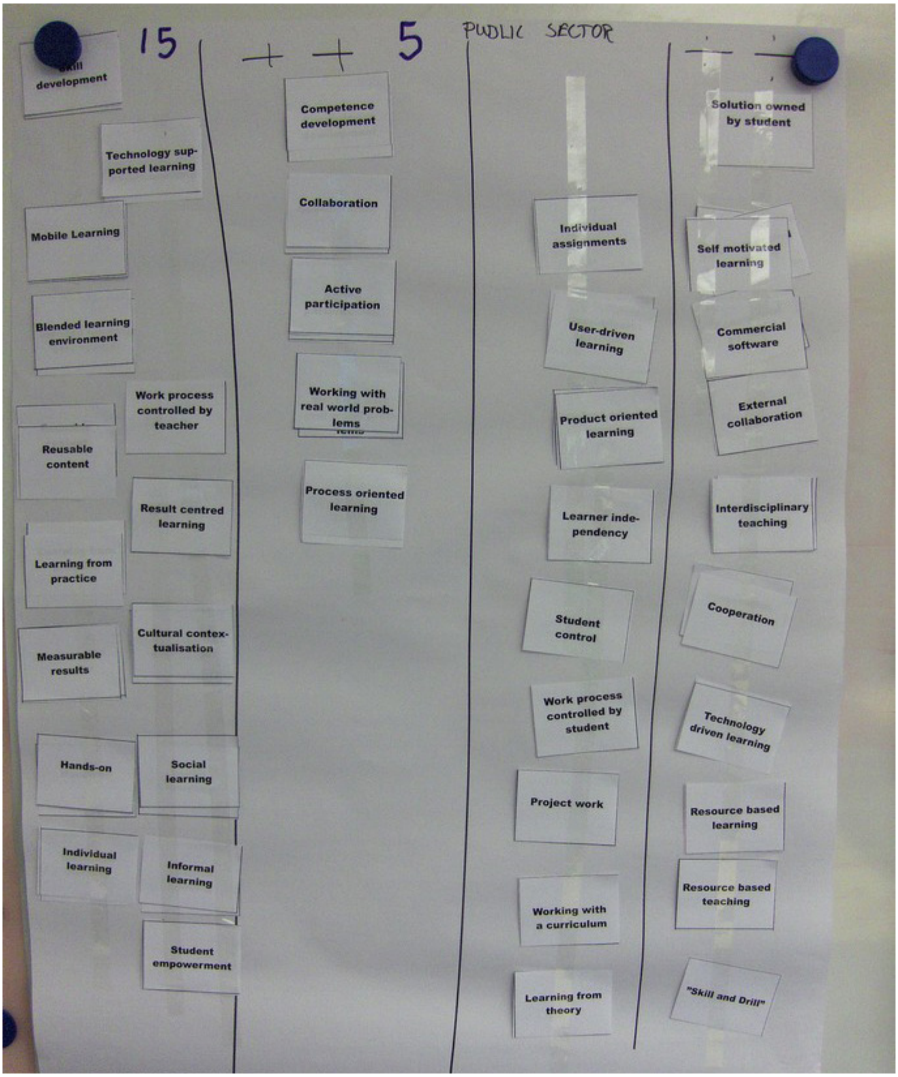

Fig. 2. Example of CoED Value Cards

Value cards are, however, often designed to be open ended, ambiguous, or synonymous to prompt participants' reflections and discussions, rather than representing clear-cut values or learning orientations. The participants will finally have to choose, e.g., five value cards, which they believe are the most important values and design principles. The purpose of the phase is to engage the participants in discussion and reflections on the educational and pedagogical values or principles. Thus, the activity of the phase aims at facilitating and structure conversations about e-learning design.

Third phase

The third and final phase is a more concrete design task, where participants use a number of **design cards** within three categories to actually design a course, a module, or an activity (see Fig 3.). As a rule, posters and pens are provided, as participants place the cards on the poster, add extra cards they feel are missing, and present their final design as a visual presentation. The design cards are grouped into three categories,where we have often used a distinction among *Resources*, *Activities*, and *Infrastructure*. Resources can be, for example, e-books, blogs, teachers, case descriptions, or articles. Activities can be discussions, blogging, collaborative writing, or supervision. The final category is (technical) infrastructures and can be, for example, intranet, wireless network, learning management systems, location-based services.

The purpose of this phase is to engage participants in the concrete design of a course, module, or activity and use the design cards to prompt reflections and visualise relations between, e.g., resources and activities or the pedagogical intentions of using a blog for a particular activity. The cards are there to remind participants of the vast amount of resources and activities, which can be part of an online course, and how these should be facilitated technically.

To support the practical work of running workshops based on the CoED method, an online CoED card generator has been developed (see http://old.ell.aau.dk/coed). The card generator basically produces an RTF file with design cards and a header card. As mentioned, the design cards fall into three categories, where users of the generator can choose the categories themselves (and use categories other than activities, resources, and infrastructure). Under each of these categories, users can create as many cards as they see fit (e.g., activities such as blogging, writing, discussing, etc.).

In the following I present a practical example of how a CoED workshop has been organised and adapted, and how different decisions have been made in terms of organisation of the workshop, for example, in

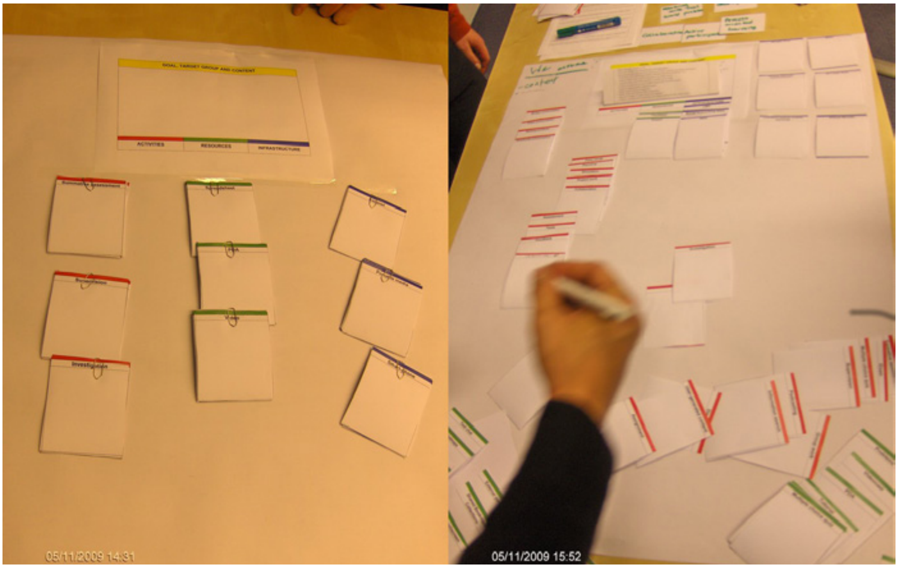

Fig. 3. Examples of design cards

terms of how value cards and design cards have been designed by the facilitators and how the overarching goals of the workshops have been framed.

Case Example:
Facilitating the Adoption of PBL Principles in Online Courses on 'Enterprise Architecture'

In the following I present an example of a CoED workshop carried out in relation to the EU-funded research project 'Innovative Enterprise Architecture Education and Training Based on Web 2.0 Technologies' (EATrain2). The overarching aims of EATrain2 project were:

> *[...] to identify the training and educational needs of employees in both public and private sector and university students regarding EA and to fulfil these using innovative pedagogies and practices based on Web 2.0 technologies and active, problem-based learning approaches.*[7]

7 http://www.ell.aau.dk/research/projects-a-h/eatrain2/

The EATrain2 project consortium was comprised of partners from six European countries and stakeholders from business, the public sector, and academia. It was composed of four main work packages (WPs), which ran consecutively from January 2009 to December 2010 with half a year allocated for each work package. The task of WP1 was to identify stakeholders' needs regarding Enterprise Architecture Training. The outcomes were overviews of the relevant skills, knowledge, and attitudes of an Enterprise Architect to be attained in courses within the university, public and private sectors. The objective of WP2 (with which the author was primarily involved) was to extend the work from WP1 by developing a Problem-Based Learning methodology capitalising on Web 2.0 technologies. The learning methodology would then feed into the concrete course production and platform development, which was the main task of WP3. Three online pilot courses on 'Enterprise architecture' (designed for business, the public sector and academia respectively) were developed, run, and then evaluated as part of WP4.

For the purpose of this chapter, I do not mean to go deeply into details about the project and the work conducted as part of WP2. This work has been further described in Glud et al. (2010), Buus et al. (2010), Ryberg et al. (2010), Tambouris et al. (2012). However, as part of the learning methodology, we (the WP2 team[8]) conducted a CoED design workshop with the intention of producing a number of preliminary course designs primarily topicalising the use of Web 2.0 technologies and appropriation of Problem-Based Learning principles.

We used the CoED method as our foundation, but customised the orchestration of the workshop and the *design* and *value cards* in relation to Web 2.0 learning, and the main principles of PBL. In relation to PBL we used the conceptual model (fig. 4) to create some of the *value cards* to specifically reflect the tensions between student and teacher control and curriculum vs. problem orientation (e.g., working with real-world problems vs. curriculum, student control vs. teacher control, problem formulated by student/teacher, work process controlled by student/teacher, solution owned by student/teacher). Other *value cards* were, e.g., individual learning, learning from theory, learning from practice, class-

8 Thomas Ryberg, Marianne Georgsen, Lillian Buus, Louise Nørgaard Glud, and Jacob Davidsen

room teaching, and copresence. Likewise, design cards were specifically designed to reflect Web 2.0 activities, resources, and technologies (infrastructures), such as microblogging, podcasting, geo-tagging, and social bookmarking (but also cards such as formative assessment, tests, or information retrieval).

First phase

In the first phase of the workshop (Focusing the e-learning design – 1 hour), the facilitators began by giving an introduction to key issues in the pedagogical design of Web 2.0 mediated learning and Problem-Based Learning. This was done to focus the attention on central issues that surface when adopting Web 2.0 practices and Problem-Based Learning. In relation to this, the conceptual model of PBL was introduced as a thinking and design tool (fig. 1).

Second phase

In the second phase (Identify overarching values and design principles – 1.5 hours) the participants were divided into two 'course design' groups (private sector/academia) – and these groups were further divided into two subgroups. In these subgroups they conducted the first card sorting exercise using the *value cards*. The participants were initially asked to put the various value cards into groups of 1) the most important, 2) the important, 3) the less important, and 4) the unimportant (marked by ++, +, -, -- on an A1 poster; see Fig. 2). Following this, we asked them to completely remove the cards from the categories less important and unimportant. In the third part the subgroups within the private sector and academia reunited and compared what they had placed in the categories 'most important' and 'important'. Thereafter, the two groups had to renegotiate and agree on five overarching values to guide their more specific design. The particular organisation of this phase can vary and, e.g., be split into more or less subphases of gradual refinement of the values. Likewise, different categorisations and visualisation can be used (e.g., concentric circles where favourite values are placed from centre to the periphery or in a black hole).

Third phase
In the third phase the participants continued the work in their two design teams. Each group had a facilitator asking critical questions, in order to support the group in formulating a design, which would reflect the five core values. These were taped to a header card placed on the A1 poster, which participants used to discuss and on which they placed their *design cards*. The design cards were made according to the categories: resources, activities, and infrastructure. The design results or preliminary designs can be seen in figure 6. These tentative designs, however, were not the most valuable outcomes of the workshop. One practical problem with the workshop was that only a few of the participants would actually be teaching the courses, and therefore had difficulties getting into more specific discussions of the course designs. However, several issues, tensions, and contradictions surfaced during the discussions. Would it be possible to do a PBL course without a teacher/facilitator? Were there contradictions between the intentions of adopting PBL principles, Web 2.0 learning, and the forms of institutional assessment to which partners would have to adhere? Were there tensions between the intended level of the competences and the proposed designs?

Outcomes of the workshop
In this particular instance, the value of the applying the method was not intimately connected to the actual designs that surfaced from the workshop, as these were not very detailed (and therefore might not have had strong impact on the final design). However, the contradictions and tensions identified by the participants during the CoED workshop had a broader impact on the continuing process of designing the courses. These became ongoing topics of attention, and even though some of the contradictions identified were difficult to resolve in practice (e.g., identified tensions between collaborative work and highly individualised grading), they were helpful in ameliorating or reducing the tensions, as teachers and course designers were conscious of these potential problems. Likewise, it became apparent during the discussion and design phases that the different partners held very different ideas of how their courses would be run and supported. These differences had not previously been transparent or articulated among the partners. Equally valu-

able were the participants' discussions on the notion of PBL and their different conceptualisations of how much ownership could be relegated to the students, and what were the role and responsibilities of the teacher. In this particular instance of a CoED workshop, the important outcomes were not really the initial and unfinished design posters that the groups produced. However, the process of negotiating and reflecting on others' and one's own values regarding teaching and learning were very productive (Buus et al. 2010).

The potentials and limitations of the CoED method

The CoED method can support teams of teachers and other practitioners in collectively renegotiating and designing, for example, the structure of a course, a semester, or educational units at other levels of scale. It offers a design specification or guide on how to conduct workshops that allow teachers to come together, discuss, and negotiate their ideas, while it also focuses on producing tangible and early prototypes for a course, all with the help of a facilitator. In the case I have outlined, the designs were in their earliest stages and premature, but in other cases, the CoED method has been used to produce prototypes and designs that have been ongoing objects of negotiation throughout a project (Nyvang & Georgsen, 2007). As mentioned in relation to the EAtrain2 case, the particular designs may not have had a deep, final structuring impact on the courses in terms of design, but the tensions and contradictions that surfaced in the workshop were common points of investigation and enquiry.

CoED is a very flexible method in the sense that value cards and design cards can easily be redesigned to reflect a particular challenge. In the case of the EAtrain2 project, we deliberately embedded in the value cards the pedagogical tensions between student and teacher control over various elements of problem and project-based learning, and we reconfigured the design cards to focus on Web 2.0 technologies. In this way we ensured or suggested that participants reflected on, for example, the distribution of power between students and teachers.

I argue that particularly the CoED model's focus on initial discussions of values is a very useful exercise for teachers or teams of teachers in trying to renegotiate their current ideas and align with others. This can help teachers that might be teaching different subjects or are from different institutions to understand and articulate variations in their pedagogical views and ideas (Bach Jensen & Houman Nyrup, 2009). Likewise, the facilitators should continuously ensure that the participants return to and reflect on these values when working with the more practical design tasks and design cards.

From conducting and organising a number of CoED workshops, it is our experience as a research collective that participants always manage to devise sensible and interesting preliminary designs for courses. Within typically a half or full day of work, participants succeed in producing early design visualisations, prototypes, and ideas about, e.g., posters and with the use of the design cards. However, we have not yet managed to follow these design representations over lengthier periods of time in order to study more intimately the trajectory or distance between the workshop designs and the final course designs. In other words, in what ways have the insights and ideas generated in workshops had an impact on the final course designs? We know that the design workshops generate temporary design artefacts, but whether people return to these or how they are translated or changed into other design artefacts, and finally a course, is not yet fully apparent to us. While we had have experiences in projects where a relationship between the initial designs and the final product can at least be inferred or teased out, we remain to collect more rigorous data and untangle what happens between participants in the stages between initial design ideas, other design representations and discussions, and the final product. However, it does not mean that the initial processes have not been valuable if there is no apparent similarity between initial designs and the final design. The initial processes could very well have motivated changes, which over time mutated and transformed slowly into something that seems far removed from the initial ideas, but still had a strong influence on the early phases of the work. Likewise, students who work with problem and project-based learning also work with multiple definitions and changes in what constitutes their problem (or even the theme of the project). This does not mean that the initial problem formulations and enquiries have been in vain; instead, it suggests or indicates a learning and development process. We are, however, yet to study these mutation or transformation processes in more depth in relation to the method.

Furthermore, the innovation potential of the method has been questioned by others. Houmann Nyrup and Bach Jensen (2009) applied the method as part of an organisational process of redesigning a number of blended learning courses. Their aim was to facilitate a pedagogical development process in which they wanted to stimulate teachers to rise above their current pedagogical thinking. While they found that the method was well suited to reaching common ground and creating a pedagogical model, which was agreed on by a team of teachers, they simultaneously felt that the designs the teachers finally produced were more conservative than they expected and for which they had hoped.

This might have something to do with the theoretical inspirations and historical background of the method. The method specifically aims at empowering participants and giving them a decisive voice in terms of creating designs that they view as sustainable within their own context. The idea is to facilitate participants' collective inquiry and position them as knowledgeable practitioners and designers of their own future practices (inspired by the traditional Scandinavian approach to systems design). In this way, the method does not necessarily aim at creating revolutionary designs, but rather sustainable evolutionary designs, which do not exceed the comfort zone of teachers and practitioners. I maintain that this is an advantage, rather than a shortcoming per se. As I initially argued, there is a wide(ning) gap between institutional realities of technology adoption and institutional rhetoric or the more advanced ideas pursued by pioneering educational technologists (such as ourselves). While it might look easy, straightforward, and promising for a professional educational technologist or researcher to include blogs and twitter in a course, it might look very difficult from the perspective of a newly educated biology teacher, who may not be using these technologies in his or her everyday practice. The CoED method aims to empower participants by facilitating and supporting them in developing sustainable changes to their existing practices, rather than provoking participants to produce designs that might be innovative but difficult to implement in practice. This certainly does not mean that the CoED method is inherently conservative or that it seeks no innovation. Facilitators are there to support the process, give an initial inspirational state-of-the-art presentation, promote debate, and challenge the participants. However, the method aims at letting participants collectively formulate their own goals and aspirations. In this way, the ownership of the problem, to put it in PBL terminology, rests with the participant and not the facilitator(s).

This also has some implications in terms of running workshops and who should be included or chosen as facilitator(s). It might be an advantage that the facilitator is not a stakeholder in the organisational change processes, but serves as a more 'neutral' observer and organiser of activities. Alternatively, the true aspirations and goals of the workshops should be very clear and transparent to the participants. The method is designed to let participants negotiate and align their perspectives and to create designs which resonate with their organisational realities. CoED sits somewhere between a radical change agenda and a more modest, step-wise, evolutionary model of development.

Some final critical comments on the method are related to questions of the method's longer-term impact on design processes. In practice, I have experienced how people have aborted valuable discussions in order to rapidly designing something and live up to the facilitator's demands, e.g., 'Oh we have ten minutes left and we need to put something on a poster'. While it is difficult to avoid some pressure on participants to produce work in a short period of time, we must note whether the designs are forced and produced to respond to short-term goals, i.e., completing the design task as required by the facilitator. Somewhat related to this, we/I have equally had concerns about whether such collective design processes promote a certain level of 'compromise' and temporary agreements, rather than spurring heated, but productive, debates among pedagogical beliefs. In literature on groups, this is a well-documented problem, which seems to become stronger the less dependent the participants are on each other or how well they know each other.

To briefly sum up, I believe that the CoED method has some potential for supporting teachers or other practitioners in negotiating and creating initial design proposals, for example, in relation to implementing more student-centred learning pedagogies or PBL in online courses. I believe that it is one potential way of engaging teams of teachers in productively renegotiating current values and beliefs about learning while also producing initial design ideas and prototypes. More importantly, I believe that there are some inherent values in the method that supports teachers in framing these change processes within their existing organisational practices and comfort zones. While the CoED method should not in and of itself be expected or assumed to produce radically, innovative course designs, I argue that it can be used to prompt step-wise, evolutionary, sustainable changes, which are rooted in and aligned with the teachers' or practitioners' own goals, aspirations, and realities.

In pursuing more student-centred pedagogies, I believe that such step-wise, evolutionary models of development can help position teachers and other practitioners as competent designers of their future practice, i.e., implementing PBL in virtual learning environments.

Concluding remarks

In this chapter I have initially highlighted the pronounced gap between the ideals of student-centred, collaborative pedagogies and the institutional realities and implementations of VLEs in education. I have argued that teachers often find it difficult to adopt digital technologies into their teaching and learning practices. This is potentially further aggravated if teachers are expected to, or want to, implement more student-centred pedagogies such as PBL. Therefore, there is a need to support teachers in working with the design or redesign of courses when relocating these in virtual learning environments and adopting student-centred learning principles such as PBL. From my perspective, PBL is not merely a useful pedagogy or script for how to teach the same effectively. PBL, as practiced at, e.g., Aalborg University, is a radical redistribution of power among teacher, student, and curriculum, which challenges traditional notions of learning and also, potentially, teachers' identities and more deeply seated values.

While I have outlined an understanding of PBL as based in the Aalborg PBL model, I have also introduced a conceptual model to distinguish between and design for different types of PBL practices. For many teachers, a shift to more student-centred learning principles, as embedded in many PBL models, can be a difficult and challenging step. In particular, such shifts also imply changes in power and responsibilities between teacher and learner, and thus concern teachers' conception of their own professional practice and identity. However, I believe that the conceptual model I have outlined can help teachers to think about such development processes in steps and at different levels of scale. A teacher might want to delegate power and ownership to the students in terms of their work processes, while being the one to design and formulate the problem.

For teachers to work in practice with reconfiguring and rethinking their teaching and learning approaches, I have suggested that they may need mediating design artefacts as a means to rethink, renegotiate, and reshape these approaches. In this vein I am suggesting that the CoED method can be a fruitful method to support teachers' as they create their own practice. I have equally outlined how central PBL principles or tensions can be embedded into the script of running a CoED workshop through reconfiguring the design and value cards (and the initial presentation). I believe that the CoED method can serve as a valuable mediating design artefacts to support teachers' in a step-wise, evolutionary change of their learning and teaching practices, while remaining attentive to their organisational realities and their own goals and aspirations rather than those of the facilitator (or institutional rhetoric). In this way I am suggesting and promoting the viewpoint of positioning teachers as competent practitioners and designers when designing for PBL in virtual learning environments.

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COMMON CONCEPTIONS OF MOBILE PHONES IN SCHOOL SETTINGS

Torbjörn Ott

Introduction

The history of learning in projects and the tradition in the spirit of John Dewey reveal several examples of one question: how do we manage the learners' own democratic learning in a way that keeps it free from, but yet close to, the curriculum? This has resulted in an ongoing discussion between progressivists and traditionalists (Säljö, Jakobsson, Lilja, Mäkitalo, & Åberg, 2011). This strife has often been about whether it is the process or the product of learning that is relevant. Dewey, progressivist and a proponent of a process orientation, warned about focusing on the product of learning. His ideas have become even more relevant over the last few years in the political debate on school and education, being opposite to the more instrumental view of knowledge in the debate (Säljö 2010).

Speaking for the progressive side, Shear, Gallagher, and Patel (2011) warn that there is a gap between what students experience inside and outside of the classroom and between the skills they learn in school and what they need in life. 'It is an increasingly accepted truth that education systems must evolve to meet the needs of the students and societies they serve, changing their mission from knowledge transmission to preparation for future learning' (Shear et al., 2011). This is an approach favouring the process of learning over results.

Shear et al. (2011) find that innovative teaching supports students developing the skills they need in life, stating that even though ICT is common in teaching in the schools' included in the SRI research, it is still an exception that students use ICT in their learning. New technologies can be of use for students in the process of learning through projects, since they open up the classroom. It enables new ways for communication, cooperation and participation (Chan et al., 2006; Säljö et al., 2011).

Learning in projects and case learning is related to the problem-based learning (PBL) approach and PBL as a concept has been transferred into curriculums on several occasions, more or less adequate (Pettersen & Torhell, 2008). But learning in projects does not share the open-end emphasis with PBL (Bereiter & Scardamalia, 1999). Mobile learning is, as we shall see, another option, which in many of its apparitions shares this open-end characteristic with PBL. The term PBL has been used with such various meanings. Barrows (1996) points to six criteria that have to be met if a learning space (notably education and teaching) is to be defined as problem based: 1. Learning must be student centred; 2. Learning has to take place in small groups; 3. The teacher's role must be as a facilitator or guide; 4. The learning process must be based on authentic problems; 5. The problem is used as a vehicle to develop skills and knowledge; and 6. Gathering new information to solve the problem is the learner's task utilizing resources in the real world. These criteria are in many ways similar to the ideas of mobile learning and another approach to learning; seamless learning. Mobile and seamless learning are relevant to discuss in relation to PBL since these concepts open up for using mobile phones. The mobile phone is a technology that is significant in the life of most people, including children and youth (Bjärvall, 2011).

According to Chan et al. (2006) seamless learning is the use of the mixture of available technologies for learning. This means learning across contexts, switching between formal and informal learning, social and individual learning, using all available technologies including mobile phones, basically on a *one-to-one* basis.

Mobile learning shares a lot of its characteristics with seamless learning, but with the demand on the technologies to be mobile. Which technologies that can be accounted for as being mobile has been discussed, but the mobile phone is a given case.

Mobility is not only a spatial phenomenon, but also a temporal and contextual (Kakihara & Sørensen, 2002). Hence, it not only relates to the geographic learning space, but also to the schedule and the subjects' curriculum. Merging mobile learning, using the mobile phone, with the traditional classroom practices is then not done without friction. Mobile phone technology has challenged education as well as the traditional views of what learning and school is about, the teacher's agenda and the curriculum (Campbell, 2006; Kukulska-Hulme et al., 2009; Sharples, 2006; Sharples, Taylor, & Vavoula, 2005; Traxler, 2007).

Mobile activities can be a problem, not easily connected to formal education. Students bring their own technology into the classroom and they want to continue to be in control of the technology that they possess (Norris & Soloway, 2010). To deal with this without loosing the mobile learning experience is one of the challenges (Kukulska-Hulme, 2006). This challenges our habituated view of knowledge hierarchies in school. Is the teacher necessarily the one who is the knowledge authority, Säljö and Linderoth (2002, p. 21) ask.

Formal and informal learning are often delicately intertwined and not easy separable. It is of importance to examine the relationships between formal and informal learning in relation to wider contexts. Particularly important this is when considering empowerment and oppression (Malcolm, Hodkinson, & Colley, 2003). This chapter acknowledges that claim.

The subject is quite delicate since there are a number of aspects to take into consideration – educational, technological and political. On the intersection between the educational and the political aspects, this chapter discuss consequences of the political race for votes on implementing mobile learning and seamless learning in school using mobile phones. This discussion is grounded in an empirical study of how news articles highlight the challenges of mobile phones schools and classroom.

Mobile Learning and PBL

In the school law from 2010 the Ministry of Education and Research states that: "The education shall rely upon scientific principles and proven experience[9]" (Ubildningsdepartementet, 2010). But what are the scientific principles about innovative teaching and learning using mobile phones and mobile learning?

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9 Utbildningen ska vila på vetenskaplig grund och beprövad erfarenhet. Skollagen §5 (Ubildningsdepartementet, 2010)

The ways of empathizing what distinguish mobile learning differs and there are numerous of articles published. Evidence from mobile learning research should be treated with carefulness; it is a rapidly growing field, the studies have often been small with few participants and running over a short time. However, there are studies showing that mobile learning systems within the classroom can be beneficial for example when working with open questions. When moving from individual responses, to group collaboration consensus, to classroom discussions (Sharples, 2013).

Treated with caution, some key features of Mobile learning can be conceptualized in relation to the six criteria of PBL specified by Barrows (1996) (see above):

1. *Student centred;* That Mobile learning should be student centred might be one of the core issues in the conflict with the traditional formal education institutions. The mobile phone shares many features with tablets and portable computers. But it also has some unique characteristics, for example a high degree of personalization, by the features the user equip it with, the personal communication it enables and not the least by not easily being shared. Bjärvall (2011) argues that in a world on the move, the mobile phone is the users personal key to a virtual society and new media, tightly connected to the users identity. As a key to the virtual society the mobile phone in a classroom reaches outside its walls, putting the user in multi context environments not in control by curricular rules and regulations. Mobile phones are generally not offered by the school but if they are, it is yet necessary that the learner experience an ownership. "Ownership of technology helps to promote ownership over learning", Naismith & Corlett (2006, p. 16) says. In fact, Naismith and Corlett (2006) argues that the experience of personal ownership is a critical factor for the success of mobile learning.

2. *Learning takes place in small groups*; The devices facilitating mobile learning, for example the mobile phone are most often networked and even though mobile learning does not have to take place in actual physical groups meetings, the devices enable

communication with other both on the Internet and by calling or sending messages when and where physical meetings are needed (Quinn, 2011). It is a collaborative learning space that is highly virtual or online, much like what is described by Thomas and Brown (2011) The connectivity is yet another of the factors of success for mobile learning stated by Naismith and Corlett (2006).

3. *Teachers are guides*; Norris, Hossain, & Soloway (2012) argues that mobile technologies will be the primary tools in one-to-one school settings in the near future, and these settings have been observed to promote a change in the teachers role from didactic instruction to project/inquiry-based and highly collaborative teaching and learning.

4. *The learning process must be based on authentic problems*; Mobile learning can be a mixture, consisting of a human-technology co-evolution, although with the learner at the center. As mentioned, one of the benefits of mobile learning that has been put forth it that it reaches outside the formal regulated classroom (Cuban, 1986; Liedman, 2011). Mobile learning can also be ubiquitous and not easily separated from mundane activities such as making conversation, watching TV or reading. Learning can take place whenever a person has to overcome a problem and learning can generate as well as satisfy goals. Interacting with available resources – teachers, peers, technologies etc – in environment the learner is dynamically reconstructing the context (Kukulska-Hulme et al., 2009; Sharples et al., 2005).

5. *The problem is used as a vehicle or tool to develop skills and knowledge*; The learners with mobile devices can use e.g. the smartphones to carry out learning tasks whenever they have a spare moment (Wong, 2012). Doing this during a problem solving assignment would from a socio-constructivist view on learning put the learner in a position where he or she is developing skills and knowledge about the world.

6. *Gathering new information is the learner's task using the real world's resources*; One of the offerings of mobile learning is to provide means to connect formal and informal learning, to promote a learning process that continue outside the lab or classroom, in authentic settings (Sharples, 2013). Mobile learning is partly driven by mobile information technologies, such as mobile phones, PDAs, media players, video cameras, tablets and so on. Most of these technologies can be used when the learner is on the move and are networked (Traxler, 2009). This make mobile learning dependent of how the technology is recognized. The mobile phone can be a device for communication but also for collaboration and the MP3-player enables an individualistic listening experience but also a social induced activity, listening in a group (Kukulska-Hulme, 2006). Mobile IT could be only amusement but also something more, something the learner can use for organizing his or her learning (Quinn, 2011). This is no different from most people's everyday practices outside school.

Given this description, mobile learning can be seen as sharing many characteristics with PBL. Even though PBL is not a controversial learning method in many formal learning institutions, Sharples (2006) state that mobile learning is not implied without friction with the same institutions. He is picturing two systems in school; one, the youth culture impenetrable to adults; the other is school with its curriculum and teachers, deciding the acceptable discourse. Mobile technology -- and the possibilities it unleashes with social networking and collaboration -- is part of the youths' system. In the classroom there is a clash with the formal system. However, over time the formal institutions will digest the mobile technologies and remain stable, in the same manner as earlier technologies (Sharples, 2006).

To understand this issue as a problem of either/or, that is school has a structure too fixed for successful coping with new technologies, or on the other hand school has a structure too weak to harness new technology and media, is to simplistic. Trying to solve problems on these premises can be successful in a short perspective. But no paying attention to the world going on around school, these understandings do not create any possibilities for long-term fruitful development. The challenge must be to seek to combine structure and freedom in order to create something new (Thomas & Brown, 2011, pp. 48-49). Traxler (2009) states that mobile technology changes the nature of knowledge work, and that mobile learning is not just learning that is mobile. Mobile learning is mobile learning, something original. That might be, but Sharples (2013) believe that the formal and informal learning can connect, a view shared by Kukulska-Hulme (2006), Naismith and Corlett (2006) and Thomas and Brown (2011) in developing a new culture of learning, a culture less confrontational. They also argue that the new culture of peer-to-peer learning can coexist and complement the traditional formal classroom education. It is not about mobility pushing the learner out of the classroom, which has often been the explicit or implicit premise in mobile learning research projects.

Changes brought about by new technologies both motivate and challenge. According to Thomas and Brown (2011), the twentieth century was about creating a sense of stability. The twenty-first will be about embracing change. This means that the future should be looked upon at as a set of new possibilities rather than adjustments of the present. Traxler (2009) raised the question that maybe formal education is especially challenged.

Technology and school; a dilemma

ICT in schools is nothing new. Ever since the art of printing books was invented, new technologies have been meet with both great expectations and great fear. Mobile IT is no different; what had earlier revolutionized education, for example, the pencil and the book, can now be fit into various handheld devices (Soloway et al., 2001).

Karlsohn (2009) analysed the discussion surrounding the introduction of ICT in schools during mainly the 1990s. In his rhetorical analysis of, e.g., articles from the Swedish teachers' union press, he put forth the fact that during his period of research almost no critical voices opposing ICT were given any space. This was a consequence of the IT-friendly climate in society at the time. The IT companies were booming and all voices heard said that ICT was the future, not the least in education. When the so-called IT bubble burst in the year 2000, the rhetoric got more nuanced (Karlsohn, 2009).

The ICT of the 1990s were mainly computers. In this study the aim was to see how mobile phones in a school context had been described in the Swedish press. The material used turned out to be mostly from the time after the IT boom. I had no desire to investigate the actual effects of the daily press on public opinion, because the material and format of the survey were too limited. I investigated only the content of the articles. Which conflicts could be found in the material? How does the approach to technology in the material meet the scientific approach to mobile learning?

In his book *Hets! En bok om skolan*, Liedman (2011) writes about the contemporary rhetoric surrounding the school in Sweden in general and he is worried. Liedman describes a situation where the debate regarding the school system is conducted primarily using anecdotal evidence. As satisfying and comfortable it can be to talk about school this way, it is worrying when the anecdotal evidence is the foundation of political debate (Liedman, 2011, pp. 14-15). Liedman does not address mobile phones in particular, but the material in the study shows that the approach to mobile phones in school reveals several arguments that could be related to the use of anecdotal evidence as pointed out by Liedman.

According to Liedman the present Minister of Education Jan Björklund of the Liberal Party, build his career on the question of school and during the examined period he raised from local politician in Stockholm to Minister of Education of Sweden (Regeringskansliet, 2013).

In articles in *Dagens Nyheter*, he outlined his policies, Liedman (2011) states. The other strong Swedish political force, the Social Democratic Party, initially opposed Björklund. Over time they joined with Björklund in criticising contemporary school practices, with some differences,. However, the initiative is with Björklund, and every opponent must motivate his or her divergent opinions (Liedman, 2011, p. 104).

The debate might be characterized by reliance on anecdotal evidence. A scientific study with 166 participants at a college in USA indicated that most students were negative about mobile phones in their college classrooms. Mobile phones are mainly seen as a device for cheating (Campbell, 2006). The conclusions drawn from this limited study should not be overestimated, and the result needs to be discussed further.. Campbell does this by focusing on the special affordances of the classroom. The empirical material is however too limited to be able to draw any far-reaching conclusions.

School, and the classroom in particular, is a place with special conditions. It is an environment with a heightened sense of normative expectations. That makes the mobile phones more problematic there than in most other contexts (Ling 2004). For example, the typical silence of the classroom makes disturbances more noticeable (Campbell 2006).

Other factors that might have an effect on the opinions about mobile phones are, for example, rumour or reputation. Based on hearsay, these factors can cause misunderstandings and inaccuracies when being regarded as facts. One example of this was when Princeton University's law school was ranked among the top ten in the world even though there is no law school at Princeton (Liedman, 2011). Is there any sign that technology affected the articles used in this study?

Several questions were raised in the analyses: How has the mobile phone been portrayed in the daily press? What rhetoric has been revealed in the debate about mobile phones? Is there any epistemological approach to be traced in the debate? Which connections are made between mobile technology and learning?

The study

Ott (2013) investigated the debate on mobile phones and school in two Swedish newspapers. This chapter present and further discuss how the public conceptions of mobile phones in school settings can have relevance for understanding the preconditions for PBL approaches like mobile and seamless learning in the Swedish school systems.

Treated as primary historical sources newspaper articles captures and reflects influential opinions and conceptions of the past, both political and public (Tosh, 2011). The debate represented in the material tells us of the politicians' ambitions and it analysis, reacts to and reflects consequences in the society. Politicians need votes and appearing in newspapers is one way to gather those votes. "[…] even a short exposure to a daily newspaper influences voting behaviour as well as some political opinions" (Gerber, Karlan, & Bergan, 2006, p. 18). They are though not sure about what is of most importance; the content of the articles or the political affiliation of the newspaper.

Politics, federal laws and curriculums are powerful factors in governing school and for setting the framework of the classroom. Kukulska-Hulme et al. (2009) points to the situation in the U.K. where politicians have acknowledged that mobile learning can be part of the future school environment, it has however not been transferred to strategy. On the contrary schools all over Europe prohibit the use of mobile phones, but the mobile phones are being used for school work anyway (Kukulska-Hulme et al., 2009). Research utilizing news articles helps us to understand which conceptions have been prevailing regarding the mobile phone technology and the governed traditional classroom context. From those results some conclusions can be drawn on the preconditions for innovative teaching and learning through the PBL related seamless learning and mobile learning in Swedish schools.

Material and method

The study presented in Ott (2013) was based on material collected from the Internet database Mediearkivet that provides texts from numerous Swedish newspapers. The newspapers selected for analysis were *Dagens Nyheter* and *Aftonbladet*. They were selected on the basis of being two of the biggest newspapers in Sweden and that they are both headquartered in Stockholm but cover the whole country. Using articles as historical sources, it is important to ask what value they have in describing the past.

First, approaching the material is critical; it could have deficiencies in that it might not be complete. A search in a database is dependent on the search terms. The subject of interest was mobile phones and school. So the material was selected from two searches in the database. The first one was conducted on the mentioned keywords 'mobile phones' and 'school'; the second was done on the keywords 'mobiles'[10] and 'school'.

Second, doubts could also be raised regarding whether the articles are authentic. Is it the texts that were actually published on paper? I judge the material as being quite good in this aspect; Mediearkivet is being used by universities and is therefore under constant examination. Furthermore, several of the texts come with a viewable digital copy of the original.

10 The word in Swedish was 'mobiler'.

Third, what do the sources tell us? How representative is such limited material? Being remnants the newspapers are parts of the past in which they were created, and conclusions could be drawn regarding that situation (Kjeldstadli, Persson, Åmark, & Torhell, 1998). In the start-up phase of the study I initially used newspapers derived from another database, Presstext, with the search terms 'mobile phones' and 'school'.[11] The material from that search involved totally 27 different newspapers or news agencies. However, the different sources in that search were not comparable due to differences in dates of entry into the database. But reading through the articles there was no sign of any trend that diverged from the trends found in the more limited but comparable material from *Dagens Nyheter* and *Aftonbladet*. It should be noticed that it is important to be very cautious in drawing conclusions from the material on matters on the outside of the material.

The newspapers were also chosen with an eye to political affiliation and preference. *Dagens Nyheter* is unaffiliated liberal, and *Aftonbladet* is unaffiliated Social Democratic. All published material is judged on what is suitable for the public consumption of media (Tosh, 2000), but the newspapers' political views are not a problem in this study. I do not wish to recreate a course of events, for which the material is not sufficient. It tells us only what was written, not what actually happened. But it does tell of the most influential political and social approaches at the time of publication, and it does so chronologically (Tosh, 2000). In this way, the political view of the newspapers is significant for the analyses. As a means of studying the written debate in the newspapers, the material can be judged as suitable.

Fourth, since the newspapers are a primary source, the criterion of time is not a problem.

By a normative analysis of the content, I investigated whether the material could be sketched and précised according to any norms or patterns (Asp, 1986), when analysed according to the questions listed above. The method is both qualitative and quantitative, examining both patterns in the rhetoric and in the chronology of the debate. In Mediearkivet, *Dagens Nyheter* dating from 1991 is available, and *Aftonbladet* is

11 The words in Swedish were 'mobiltelefoner' and 'skolan'.

available from 1994. The oldest article found on the topic is from 1996. The search in the database resulted in 174 hits in *Dagens Nyheter* and 271 in *Aftonbladet*. Sorting through the articles, 55 articles in *Dagens Nyheter* (36 news articles and reports, 10 editorials, 5 polemical articles and 4 letters to the editor) and 54 from *Aftonbladet* (36 news articles, 10 editorials, 4 polemical articles and 4 chronicles and comments) were considered relevant. These were articles that reported directly about school or learning and mobile phones.

In the study the articles were all read and an analysis made regarding the rhetorical context surrounding the mobile phone in the texts. Keywords that often occurred were sought out, a grading of genre of the texts was made, and finally notes were made on what the author of a particular article wrote about the mobile phones.

Reading through the newspaper articles, different genres were found. A classification was done based on the nature of the texts. A news article is a text that reports news, for example, new legislation. News articles could also have some analytic content. Reportage is grouped with the news articles since they are supposed to be objective reporting, even though there is always an angle to journalistic material. Categorising an article as belonging to a specific genre was occasionally rather problematic. Some articles fit more than one genre. In those cases a choice of a genre was made.

There were also several polemical articles in the material, often posted by politicians or spokesmen and women of the teachers' trade unions. Another genre was the political editorial articles relevant to the topic. In *Aftonbladet* there were also columns and comments addressing the issue and in *Dagens Nyheter* there were letters to the editors from readers speaking out about mobile phones in class.

The published debate

In the analyses of the material (cf. Ott, 2013) some overall trends in the material are visible. As figure 1 show the mobile phone and school is not a topic that is written about equally every year in the period.

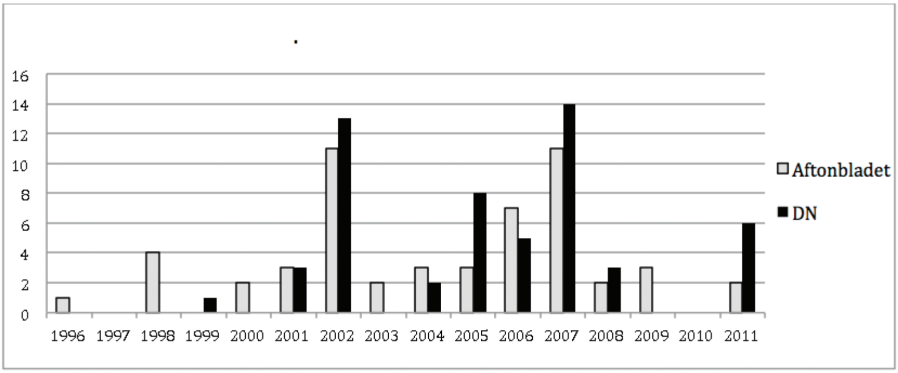

Fig. 1 Number of articles published per year (from Ott, 2013).

When there are elections coming up in 2002 and 2006 the mobile phone and school are a more frequent topic in the newspapers. Most in 2002 when Aftonbladet had totally 11 pieces and Dagens Nyheter 13, mainly from the time before the election. The other height of articles on the topic is from 2007.

1996-2003

The first article in the material was from the years of the IT-boom. It was published in Aftonbladet on the 23:e of May. It reported of a school in Stockholm where pupils from first class use mobile phones as a modem to connect to the Internet when they are not in the classroom. The schools' ICT investment is launched as a project between the city of Stockholm and Apple.

This article is quite unique, because it is both at the start of the chronology and positive about mobile phones. With Karlsohn's (2009) analysis in mind, this can be understood as an expression of the ICT friendly climate in the society as a whole. Liedman (2011, p. 205) describes the period as naïve and credulous and that it faded out with the stagnation of the IT business in the beginning of the twenty-first century. The material examined here does not contradict that description. But the problems with classroom disruption could not have been so widespread in 1996. Mobile phones were not that common; only 50 percent of Swedish households owned one in 1996. In 2007 this number rose to 96 percent (NORDICOM n.d.). It is hard to believe that the children of the families who had one of the still quite rare mobile phone in 1996 were allowed to bring it to school. The problems expressed later in the debate about the disruptions are not yet to be seen and consequently in the material there are no articles found from 1997. But on January 13, 1998, *Aftonbladet* reports from a school. Now the mobile phones are written about in a negative context. A secondary school is reported having problems with rude behaviour and bad language in the classrooms. The pupils do not respect their teachers. The school has decided to ban scruff and mobile phones. Caps will not be permitted in the classrooms anymore. The connection between the problems with bad language and the mobile phones is not described beyond the teachers claim that the phones they do not belong in the classroom.

The debate reflected in the material was from this article forward, with a few exceptions, rather similar. Mobile phones were being grouped with various objects that were disturbing the order in the classrooms. In the material from the newspapers a pattern emerged. In short, the reports on mobile phones in school were generally focusing negative effects. The technology was regarded as a disturbing factor, similar to for example cheating, fireworks and narcotics. Rather than bridging the gap between inside and outside of school and the school and the student's life, mobile phones are regarded as opening up the classroom to numerous disruptive and dangerous influences from the outside world.

An editorial Dagens Nyheter on the 17:th of January 1999 is an example. The author argued that a peaceful learning environment can not contain, quarrel over mobile phones, Walkmans and outer garments. Rules are needed. The same editorial praised Björklund for raising funds for new schoolbooks in the Stockholm schools. Books, on the contrary, created structure and must once again be part of learning, explains the author.

In 2000, there are only two articles found, both from *Aftonbladet*, and both report on problems with mobile phones. On October 29, 2000, there is a report from a school in Norway that calls the mobile phone a nuisance in school; the other article is from November 26 and reports on the dangers of radiation on children. Even though it does not address disturbance in the classrooms, the article about radiation focuses on the downside of the technology. Who wants their child to be exposed to radiation in school?

In 2001, 85 percent of Swedish households had a mobile phone in their possession (NORDICOM, n.d.). As the development of new models evolved, the old, often still working phones were cast off for new models and passed on from parents to their children (Bjärvall, 2011). As mobile phones became more widespread, the number of them in the classrooms increased, and so did the number of articles on mobile phones in school. From 2001 forward, six articles are found in the material, three from *Aftonbladet* on March 3, April 12, and April 22, 2001. They all reported on cheating by sending sms. The latest of those articles strengthens the message, explaining how much better things have become since they banned mobile phones in a school. Cheating with sms might have been new, but as it is with most things, it had its ancestors (Liedman, 2011), in this case the passing of notes. What is new is the media, not the manner.

Dagens Nyheter had articles on the topic on the March 31, April 21, and May 28, 2001. Mobile phones were becoming more and more of a problem, not only because of the ringing. Mobile phones were also used for gaming and cheating, the editorial states on March 31. But from one school, another voice is heard. A headmaster is quoted saying that a ban is the wrong way to go; the school should instead teach students how to handle their mobile phones. This might be a similar approach to what Sharples (2006) suggests: schools might not welcome the technology but shouldn´t condemn it either. Schools shouldn't just adopt it into the ordinary school context? Such an approach might have been an advance for mobile learning and seamless learning using mobile phones, but in the year of 2002 as there was an election for parliament coming up; and there was no indications of things going that way. In the debate of the phenomenon of mobile phones in school was used for strengthening political messages. This is evident from the stakeholders societal positions, the opinions they express in pringt and from the dates of the published material.

In 2002, the material provides 13 articles from *Dagens Nyheter* and 11 from Aftonbladet. Not all of them will be presented here, but I will point to some pieces that help bring out a pattern. In the debate prior to the elections for parliament, the subject of school was heavily debated. The Liberal Party was profiling itself towards questions about school. Their spokesman in Stockholm, Björklund, together with the leader of the party at the time, Lars Leijonborg, stands out in the material because of their uncompromising stance on order and discipline in the classroom. School is described mainly as a place where chaos rules. One of the chaos-creating objects is the mobile phone. In the two months before the election, there were six articles in *Aftonbladet*, and nine in *Dagens Nyheter* portraying mobile phones as a technology not belonging in the classroom. But the Liberal Party's message is not the only one acknowledged. In *Dagens Nyheter* on August 24 2002 the journalist in an analysis calls Björklund's proposition on the right of teachers to confiscate mobile phones shameless populism. But Björklund is supported by Bo Lundgren, leader of the Moderate Party, saying that mobile phones are a disturbance in the work environment of schools. It is important to make the students more knowledgeable, he states, but it is not further précised how to do that, beyond saying that the students must be forced to be more responsible.

The creed goes on and in *Dagens Nyheter* on September 1, 2002, Leijonborg says in an interview that he believes that people appreciate the Liberal Party for their plain language on *self-evident* topics such as not using mobile phones during class. The different pundits in the debate support Leijonborg's rhetorical statement that the issue is *self-evident*. There are not really any other points of view found in the pre-election debate. The Social Democratic Minister for Education, Thomas Östros, wrote a polemic article in *Aftonbladet*, saying that it is not *self-evident* issues such as mobile phones being turned off in class that determine the future of Sweden.

On the whole both political sides are against mobile phones in class. And the mobile phone is regarded as an instrument of disturbance. In the rhetoric it is grouped together with what o often are called 'other disturbing objects'. Even though these objects vary, the mobile phone stands out as the principal disturbing object.

There are some keywords that can be noticed occurring over and over in the debate, for example, 'atmosphere of work' (arbetsro). Maybe the material could have been broadened, searching also for 'atmosphere of work', but the pattern occurring is still evident, and the focus might have been led from mobile learning as a representation of the progressivists' approach. The debate is mainly focused on the environment in the classroom and how that environment is ruined by lack of order and discipline. This endangers the keen students' performance. Those who do not want to study constantly disrupt those who wish to study. One of the obstacles that is causing the disruption is the mobile phone. According to the articles found, it is used for ringing, gaming, filming, and loud talking. That the mobile phones are a technology that could be used for pedagogical purposes such as those suggested in the article from 1996 is not noticed in *Dagens Nyheter* at all until April 26, 2011.

The election was won by the Social Democrats, and in Stockholm Björklund had to resign from the municipal government. However, on the national level the Liberal Party did well and increased their share of votes from 4,6% to 13,3% (Valmyndigheten, n.d.). The material does not tell us what role the *self-evident* questions actually played in the inconsistent results of this election, but an analysis of the material from 2002 and 2003 give a suggestion. In this material there are two articles, both in *Aftonbladet* published after the election in 2002 that differed from the general pattern. Published the 14:th of November 2002 and January 25:th 2003, both reported from the same school in Stockholm. Published on November 14, 2002, and January 25, 2003, they both report from the same school in Stockholm, where the headmaster claimed that mobile phones are a essential tool in education. The students use them for ringing when they do fieldwork. The school is working with Apple. One thing noticeable in the article is that Björklund is quoted saying that one may use mobile phones in teaching, but during class they shall be turned off.

In the material from 2003 there is an article, from the 8:th of November, which discussed Leijonborg's successful leadership of the Liberal party. The strife for a ban of mobile phones was pointed to as an important part of their package of political topics regarding school, and school was considered an important concern to many people. But remember, no politician, found in the debate reflected in the material, was opposing the Liberal Party's opinion. Mobile phones were not considered being a technology that could be of use in a pedagogical context. The voices of the politicians in the debate were rather competing on how to be most against mobile phones in school. Even the reporting news articles in the material displayed a negative view.

2004-2007

In the debate on mobile phones in school settings, there is also another aspect shining through both on a meta- and mesolevel. As the technology evolves, there are new problems introduced into the debate. In this research, on a metalevel, the emerging technology of the hardware of mobile phones is regarded as causing problems during the whole period. On the mesolevel it is reported that the functions of the software, as they evolve, cause disruption. At the start of the period in question, the problems are not described at all and later it is the ringing and sending of sms that are disturbing. In 2004, as new functions were developed and integrated into the mobile phones, problems with pictures taken with the mobile phones' cameras are reported in two articles in *Aftonbladet* and one in *Dagens Nyheter*. The other two articles in the material from 2004 are one in *Aftonbladet* reporting on the dangers of radiation on children, and one in *Dagens Nyheter* in which the Minister for Education, Social Democratic Ibrahim Baylan, is quoted as saying that it is self-evident that disturbing objects like mobile phones must be confiscated by the teachers. Sten Tolgfors of the Moderate Party is quoted in the same piece, saying that it is important to have a school that drives towards knowledge rather than process. Also Björklund is quoted, but not on mobile phones. The impetus for the article is a report from OECD, showing that Swedish pupils are falling behind in math, problem solving, and reading comprehension.

In 2005 new technologies occur again and there were eight articles from *Dagens Nyheter* and three from *Aftonbladet*. Reports of disturbing MP3 players arise and no matter the genres of the articles published, they all oppose mobile phones.

In *Aftonbladet* on February 27, 2005, the chairman of Lärarförbundet, Eva-Lis Preisz, is quoted as saying that the mobile phone has become a symbolic question of importance. In the same article four students are interviewed; they are against the proposal to ban mobile phones and other beeping devices. They are afraid that the teachers will not judge what is disturbing in a fair manner. In an editorial in *Aftonbladet* on July 5, 2005, one can read that banning mobile phones is not a dangerous proposal. What is dangerous is that this question dominates the debate.

In 2006, there are five articles in *Dagens Nyheter* and seven in *Afton-*

bladet. It was an election year, but the issue of mobile phones in school is not as frequently debated as in 2002. In *Dagens Nyheter* three articles were published in September and October and in *Aftonbladet*, six articles were published during the same period. Most of them are critical of mobile phones, but opinions start to shine through that state that mobile phones are not the big issue in school. Further, they state that teachers already can handle the problems they cause and that the debate is misleading. In two articles, MP3 players together with mobile phones are described as a problem.

But mobile phones are still, as Preisz said, a symbolic question. One article published in *Aftonbladet* on September 2, 2006 is rather interesting in this regard. The article is about a man who has been severely beaten up by a group of youngsters out on the town. He has spent a long time in the hospital and is injured for life. One of his solutions for getting rid of this kind of violent assaults is more discipline in school. Ban caps, mobile phones, and MP3 players.

In the beginning of the period covered, the material show that in the debate the Social Democrats plead for further investigations by the National Board of Education (Skolverket). Björklund, on the other hand, said that it was typically for the National Board of Education to carry out investigations; now it was time to take action. When the right wing coalition, the Alliance, won the election in 2006 and Leijonborg was appointed Minister of Education and Björklund Minister of School they could in 2007 pass their laws. Thus 2007 was one of the peaking years regarding the number of articles published. In Aftonbladet there were eleven and in Dagens Nyheter fourteen, most of them displaying a negative view on mobile phones in school. On March 9, Aftonbladet reported of pupils in a primary-middle school in Mölndal who were opposing the Björklund policy. They wanted the school to allow mobile phones and MP3-players. One pupil also wanted the school to get a swimming pool, or even better having the school closed. The pupils were being ridiculed as naïve.

The sweeping phrase *mobile phones and other disturbing objects* is further defined in *Dagens Nyheter* on March 21, 2007. The objects listed in the text as disturbing are: videogames, sticks, knives, drugs, fireworks, narcotics, and mobile phones. This list adds to the earlier-mentioned objects such as chewing gum, MP3 players, and caps.

In an article in *Dagens Nyheter* on April 25, 2007 and the day after in *Aftonbladet,* the Social Democratic Party leader Mona Sahlin criticises the Liberal Party and their struggle against mobile phones in school as being stuck on minor questions. The schools' problem is greater, she says, than whether mobile phones should be banned or not.

Aftonbladet reports on the new law on June 2, 2007, stating that the law gives teachers the right to confiscate disturbing objects in the classroom, objects such as mobile phones and fireworks. Confiscating disturbing objects had probably not been impossible before. It is hard to get the answer from the material, but based on the voices in the articles from representatives of the teachers' trade unions the rules had not been perceived as clear enough. Teachers had not known for sure what they were allowed to do.

Most articles this year are published before July 1, when the law went into effect. After that there are fewer articles on the topic. There is also a small change noticeable in the theme of the articles. With the new law pending, most articles are about the chaotic schools and disturbance caused by the mobile phones. After the bill was passed, the focus is instead on successful school environments, where the mobile phones have already been banned under local regulations for some time. Articles are also published that further express that mobile phones might not be the worst problem, that banning them is too simplistic a solution to a bigger problem.

And after the law was passed, clarifying allowance for teachers to confiscate mobile phones from students, the subject lost some of its attraction for the politicians and pundits opposing the use of the technology in school. Towards the end of the examined period the politicization of the technology in the debate was declining. The number of articles opposing use of mobile phones in school was decreasing and the debate was also more nuanced.

2008-2011

During this period from 2007 to the fall of 2011, a small but noticeable change in the pattern occurs. From 2008 forward, there are only five articles in the material, one in Aftonbladet on September 24, 2008, describing a possible disciplinary use of the mobile phones in a school context. Parents could get an sms from the school when their child is skipping class.

The articles in *Dagens Nyheter* are mainly similar to those published earlier, but on February 20, 2008, a report from a school in the Stockholm region states that the pupils are allowed to use their mobile phones for calculating and listening to music if it does not disrupt the order in the classroom.

In 2009 there are three articles in the material and in 2010, none. But we shall halt at 2009; in *Aftonbladet* on December 5, 2009, a serious change in the debate can be noticed, with a bit of a surprise from a member of the Alliance. It is reported in a news article that Member of Parliament for the Moderate Party Oskar Öholm says that mobile phones are a part of our society and they should be used in school, too. On the other hand, the other articles from *Aftonbladet* in 2009 consist of one on brain tumours caused by radiation and one on the success of the law -- allowing confiscation of mobile phones -- generating peace and a good environment for studies in school.

On January 25, 2011, in a polemic article Erik Bengtzboe of the Moderate Party's youth argues that the debate should not be about whether to seize or not seize mobile phones but rather on how to learn from them and what to learn from them. The school must do better, he states, in using modern technologies. The debate on mobile phones is not over; the technology is still used in the argumentation, which is obvious in the last article in the material. On November 4, 2011, the Minister of Health and Social Affairs and leader of the right-wing Christian Democrats, Göran Hägglund, had an article of debate published in *Dagens Nyheter*, calling for more authoritarian teachers to seize mobile phones in class. Once again, politicians use the mobile phone to advance their own agendas.

Discussion and Conclusions

The debate and the different voices reflected in the debate tell us that mobile phones in school is a controversial issue. Integrating the technology into the traditional classroom context is not an easy task. But mobile phones are no different from other technologies in that they stir up feelings of both hope and fear. As Sharples (2006) predicted, there is a clash and the analyses presented here support this prediction.

The pattern that is clearly visible from the material is, in brief, that overall the reports on mobile phones in school have been about the negative effects. The technology is regarded as a disturbance similar to, for example, cheating, fireworks, and narcotics. Rather than bridging the gap between school and the students' life, it opens up the classroom to numerous evil things from the outside world. In the debate, technology has been used for political purposes, indicated both by the dates of the published material, the stakeholders, and their opinions in print. After the law was passed that allows teachers to confiscate mobile phones from students, the subject lost some of its attraction for politicians and pundits opposing the use of the technology in school. At the end of the period examined in this study, the politicization of the technology is declining. The debate is more nuanced and the number of articles opposing the use of the technology in school is not as overwhelming as earlier.

Dewey´s theories focusing on process rather than results have not been very current in the debate on mobile phones in the material. Rather, as mentioned in the beginning, the material has embodied the problems of keeping the learners free from distraction and close to the curriculum, one of the recognized problems with learning in projects. As Säljö (2010) put it, Dewey is present as an opponent to the instrumental view on knowledge, found in the material, as the participants of the debate argue for legislation. Even though some authors at the end of the examined period argue that since mobile phones are a part of the society they should be used in school as well, this is a thought acceptable to a proponent of learning in projects. The material reviews an absence of theories on learning and grounding of arguments in research. The debate is dominantly fuelled by anecdotal evidence, as Liedman (2011) describes.

In the Swedish political debate concerning school, the mobile phone has been well used as an argument. Even though the department of education and the Swedish School law passed by Björklund are clear that the education shall rely on scientific principles, the material and the debate have been focused on banning mobile phones in school. But the law is complex and challenging to understand. It also states that education shall rely on proven experience. How is this to be interpreted?

The Liberal Party made banning the mobile phones one of their main issues in the election of 2002. The Social Democrats did not oppose it, but attacked Björklund without any ideas of their own policy on the topic. The technology is, as the journalist in *Dagens Nyheter* states a bit bluntly on August 24, 2002, used in a populist way to score votes in the coming election. Mobile phones not being in the classroom are regarded as self-evident in most opinions. Björklund is, as Liedman (2011) writes, the conductor of the debate. In the pre-election eras of 2006 or 2010, there is not as much focus on mobile phones.

In the articles where the politicians are either writing the text or are the subject of the texts, they describe a school where one of the main problems is the mobile phone. The articles that, for example, interview teachers indicate other problems. The opinions that are being heard there do not call for a ban of the mobile phones, but they do not call for the use of it, either. Rather they claim that there are other problems. The mobile phone is not the issue; the pupils know that they should turn it off. This is worth noticing since those who have the proven experience expressed in the school law must be the teachers.

What differs between the pundits in the early stages of the debate is that the Social Democrats want further investigation done by the National Board of Education. Björklund, on the other hand, says that should be action instead of investigations. After the election of 2006 and the shift in government, the Liberal Party could pass the laws they wanted to pass. Teachers were given a clearer mandate to confiscate disturbing objects. In the newspapers this can be noticed from the increasing number of articles on the topic during 2007. Confiscating disturbing objects has probably been allowed all the time; it is hard to get the answer from the material, but based on the articles and the voices from representatives of the teachers' trade unions, the rules have not been clear enough. Teachers have not known for sure what they are allowed to do. In 2011 Minister of Health and Social Affairs Hägglund exposes unexpected lack of knowledge on the rules, in a debate article demanding a clearer authority for teachers to confiscate mobile phones.

Sahlin, the Social Democratic leader in 2007, claimed that mobile phones were a minor issue in school. Even though they could not see what affordances the mobile technology would bring, what she and most of the other spokesmen in the debate miss might be the coming of a new culture of learning, where students are connected and learn together and from each other in various networks, communities, and collectives (Thomas & Brown, 2011). Mobile phones are not a question of the little; they might actually be a part of something huge. They might be the doors to a virtual room. Neither does Tolgfors of the Moderate Party in 2004 see this coming, but urges less focus on process and more on knowledge.

During 2007 most articles are published before July 1, when the law took effect. After that there are fewer articles on the topic. There is also a small change noticeable in the theme of the articles. With the new law pending, most articles were about the chaotic schools and disturbance of the mobile phones. After the bill was passed, the focus is instead on successful school environments, where the mobile phones have been banned in local regulations for a long time. The publication dates of the articles, both at their most frequent in 2002 and in 2006-2007, indicate that the mobile phone as a technology has been used as a rhetorical instrument for political purposes. It can be regarded as anecdotal evidence, since many voices are being heard in material that bears witness to the disturbance of mobile phones ringing in the classroom, in cinemas, etc. These do not always have a connection to education. Consequently the message carried out does not, as the school law of 2010 demands, rely upon scientific principles or the complex proven experience. This is a paradox, since it is the Alliance and Björklund who are responsible for the law.

It is not until 2009 that some politicians are heard in the debate, saying that mobile phones can be of use in school. Even though the politicians or pundits do not mention it, the debate on mobile phones in the material has been behaviouristic, one-sided, focused on creating peaceful environments in which learning is supposed to take place. The goal has been to get rid of technology that is regarded as creating disturbing behaviour in class. By eliminating the technology, the disrupting behaviour will cease and results will improve. Disciplining the students with rules restricting them against using new technology is regarded as doing this. The mobile phones and other mobile technologies are identified as problems and grouped together with what are often called *other disturbing objects*, as often said in the phrase 'mobile phones and other disturbing objects'. What these object are can vary; when the mobile phones are equipped with cameras, the cameras are called a problem. When the MP3 players were becoming popular, they generated articles, often together with mobile phones. So every new function and every new technology served as a new argument for those who wished to banish the mobile phone. The material is also illustrative for showing how society reacts to new technology. It is obvious that the ideas and consequences of mobile learning and seamless learning, using the mobile phone, are not corresponding to the political and public ideas of what school is about, as displayed in the material studied.

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PART II

CASE STUDIES IN TEACHING

VIRTUAL LABS AS CONTEXT FOR LEARNING – CONTINUITIES AND CONTINGENCIES IN STUDENT ACTIVITIES

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Introduction

While sceptics have been little convinced about the beneficial consequences that would follow from the introduction of IT in school, technophiles have continued to make claims about how such resources will contribute to solving pedagogical problems of various kinds, including changing the role of the teacher (cf., e, g., Postman, 1979; Selwyn, 1999). As Cohen (1988, p. 232) puts it: 'Since the end of World War II, educators, reformers, and school critics have seized on one technical innovation after another, seeing fabulous opportunities for better education in each'. One example of this line of argumentation is the repeated claim that it would be possible to individualize instruction by designing tools that would be self-instructive for learners with different cognitive abilities and/or learning styles. In our opinion, any claims about the beneficial effects of technologies must be substantiated through research and critical scrutiny of the practices that such resources afford. One persistent problem is the simplified view of learning adhered to in debates. Learning is often understood in terms of a straightforward conduit or transfer metaphor. 'Too often, technology is viewed as a way of automating education and reducing costs, without changing the traditional view of education as the transfer of facts from an authoritative source to a relatively passive student's memory' (Stahl, 2009, p. 2). However, developing people's ability to read, to express themselves in writing, to learn mathematical modelling, or to analyse complex problems is not primarily a matter of presenting and absorbing information. On the contrary, this is a minor part of the teaching and learning process.

Even if one does not adhere to the idea of the revolutionary impact of technologies on learning, it is obvious that students' constant access to mobile digital tools such as computers, smartphones, and tablets challenges both the traditional media used in schools, primarily textbooks, and the instructional practices designed according to the principles of print technology. Today, for example, the learning of science in areas such as astronomy, physics, the life-sciences, and many other fields may be supported by a range of digital tools and applications, many of which are free on the Internet (cf. below). Such artefacts open up new ways of making knowledge accessible if embedded in well-planned institutional arrangements; they provide new 'access points' to human experiences and knowledge as Giddens (2002; cf. Säljö, 2010) puts it.

One of the areas in which recent digital technologies open up new avenues of exploration and learning is environmental science (see Fauville et al., 2013, for a literature review on the use of ICT in environmental education). This multidisciplinary field poses one of the most important challenges to the educational system to engage in, given the threats to the environment posed by human exploitation of resources. Since the 1970s, environmental education is compulsory in primary and lower secondary education in Europe (UNESCO, 1975). Questions about environmental awareness, for example, those that concern the use of resources, the impact of human activities on the climate, or, what we will address in this study, issues that concern ocean acidification, are not easy to understand for most citizens. These issues are complex from a knowledge point of view and require insights into natural science, law, politics, social science, and many other areas. In the literature, the term socioscientific issues is often used to refer to this type of problem.

The aim of the present study is to explore virtual labs as a context for learning about ocean acidification. In particular, we are interested in the activities that evolve when students engage in virtual lab work. Our question concerns what the consequences are for interaction and knowledge-sharing between students in such contexts.

Learning through virtual experiments

Experimentation serves as a basic mechanism of scientific work applicable to many fields. Learning about experimentation as a mode of inquiry implies understanding how experiments are organized, how they are carried out, and what characterizes experiments as a mode of generating knowledge in relation to a particular problem (Laugksch, 2000; Norris & Philips, 2003). This is the core of an argument made by Dewey (1966) a hundred years ago: if students learn how scientists formulate questions and study them, they will develop an understanding of the nature of scientific knowledge in a more general sense. Dewey's point is that students should not just learn about the products of research, they should also learn some of the procedures that go into scientific work as a mode of inquiry. Learning about experimentation implies familiarizing oneself with specific procedures for organizing knowledge generating practices as well as a particular language for how to observe and codify the world in scientifically relevant manners (Wickman, 2004). This includes insights into procedures such as how to do laboratory work, how to formulate issues and convert them into hypotheses, how to manipulate variables, interpret data and communicate findings. An essential part of learning about experimentation is also to familiarize oneself with the concepts and categories that are relevant for organizing such activities, such as sample, control group, observation, variable, etc. (Lemke, 1990, 2004; Wellington & Osborne, 2001; Wickman, 2002).

Virtual labs: affordances and limitations

On the Internet there are, by now, many resources for engaging in virtual science work, including performing virtual experiments. There is an intense technical development, where major players in science, such as NASA,[12] large science museums and other institutions take active part. Such tools make it possible to perform activities such as simulating and modeling earthquakes, dissecting frogs, transplanting hearts, exploring and manipulating cells, and engaging in a wealth of virtual activities, including discovering the details of Nobel Prize- winning breakthroughs.[13]

12 http://www.nasa.gov/offices/education/about/tech_prod_e_edu_overview.html

13 For access to tools, see, e.g., http://www.accessexcellence.org/RC/virtual.php

Digital tools offer opportunities for students to engage in inquiry learning activities that in some ways are reminiscent of those practised by scientists (for an extended literature review, see Bell et al., 2010; Gordin & Pea, 1995). Most research on virtual labs within the field of education has primarily focused on the design of such tools (cf. Furberg, 2010). For example, Ramasundaram et al. (2005) and Heermann and Fuhrmann (2000) developed virtual laboratories with the aim of enhancing students' learning. The authors argue that the virtual tools improve learning as they offer better instructional opportunities compared to traditional teaching (Ramasundaram et al., 2005), and they may also increase students' motivation (Heermann & Fuhrmann, 2000). In a study targeting the implementation of a virtual science laboratory to investigate the effect on different learning styles, Sun, Lin and Yu (2008) analysed 132 students from four fifth-grade classes. The participants were divided into an experimental group using virtual lab teaching, and a control group, where traditional classroom teaching took place. The results showed that the students in the experimental group performed better than the students in the control group. In line with the results of Sun et al. (2008), Gibbons et al. (2004) tested whether using virtual labs within the area of learning chromosome analysis and bioinformatics could improve students' learning. The students in this study were divided into two groups, where one of the groups received traditional teaching, while the other group worked with virtual labs. The results showed that the virtual labs were much less time consuming than traditional teaching, and that the decrease in time did not influence students' performance.

As added advantages of instructional significance, virtual labs offer possibilities for students to perform experiments that would need to run over a long time, or that would be dangerous or impossible to perform in schools for practical reasons (Dalgarno et al., 2009; Zacharia, 2008; van Joolingen et al., 2007). Virtual labs are also time and cost effective, and they are relatively easy to integrate into regular teaching activities. Students can work with them independently and at their own pace. Since the experiment may be paused, students can continue next week in class. It is reasonable to assume that such affordances will contribute to making virtual labs popular in education.

As mentioned above, most research has focused on the design of virtual tools and, to some extent, on the consequences for learning outcomes. Pedagogical traditions and social practices of schooling, though, are complex and have to be taken into account; the lesson learned over time is that technologies per se do not necessarily change instructional patterns (Cuban 1986). Now there already are many virtual labs available on the Internet and elsewhere, but very few seem to be integrated into schooling on a regular basis. Furthermore, studies that analyse students' reasoning and discussion in such activities point out that virtual labs may convey a simplified picture of scientific work. Such a simplified picture will hinder rather than support students' development of knowledge of the practices of research and science (cf. Chen, 2010; Karlsson & Ivarsson, 2008).

Virtual labs as sites of learning in environmental science

The background of this study is an interest in analysing how instructional work is organized in the context of a virtual lab. Thus, we see this as an empirical question where the engagement of students and teachers must be explored in situ. To describe and analyse the instructional practices, a socio-cultural-historical perspective on learning has been adopted (Vygotsky, 1978; Wells, 1999; Wertsch, 1998). This means that we regard instruction and learning as embedded in institutional traditions of communication and as mediated through the use of artifacts. This analytic agenda implies that people, institutional contexts, tools, and cultural constructions of tools, are constitutive and inseparable elements of an activity. As has been pointed out above and by Arnseth and Ludvigsen (2006), it is not enough to study how the tool is designed, since tools do not, as we have pointed out, determine instructional practices in a linear fashion. On the other hand, tools are not neutral; they invite and facilitate certain activities while making others less likely or even irrelevant. An interesting element of virtual labs is that they, through their design, 'blackbox' (Latour, 1999) many features of how they function. Blackboxing refers to

> *the way scientific and technical work is made invisible by its own success. When a machine runs efficiently, when a matter of fact is settled, one need focus only on its inputs and outputs and*

> *not on its internal complexity. Thus, paradoxically, the more science and technology succeed, the more opaque and obscure they become* (p. 304).

The blackboxed nature of digital tools, such as virtual labs, thus will have consequences for students' engagement, the obstacles encountered, and the insights made. The analysis that follows has been guided by the following question:

> What kinds of activities evolve when students engage in virtual lab work in environmental science?

Empirical study

A case study has been chosen to illustrate features of student engagement and teacher contributions to learning in the context of the virtual lab. The empirical material has been analysed using interaction analysis (Jordan & Henderson, 1995) with a focus on how the students communicate with each other, and how they interact with the virtual lab. In both cases, attention is also given to nonverbal elements. With its roots in ethnography, sociolinguistics, ethnomethodology, conversation analysis, and other traditions, the aim of Interaction Analysis is to identify how the participants make use of resources in the complex social context in which they act (cf. e.g., Crook, 1994; Stahl, Koschmann, & Suthers, 2006). By regarding interaction as activities that participants perform in order to accomplish something, the focus is on how participants make meaning and coordinate in practices.

Setting and participants

The study has been carried out as part of a binational collaboration between schools in the USA and Sweden on issues of climate change in a research project called Inquiry-to-Insight[14] (I2I). In this specific case study, we have only used empirical material from a school in Sweden. The school was engaged in networking activities using various media, and students had access to digital tools such as virtual labs and other digital media (e.g., carbon dioxide footprint calculators). The curricular context of the use of the virtual lab is marine biology, a subject of choice of the students included.

The virtual environment used is the Acid Ocean Virtual Lab (AOVL), which is briefly described below. The teacher in the current study had been introduced to the AOVL, developed within the project I2I, through collaboration with marine scientists. However, the teacher used the virtual lab on his own and as part of the regular teaching.

The empirical material presented in this article is part of a longer study including approximately 21 hours of video recording following a class of students in a Swedish upper secondary school. In this study we have analysed approximately five hours of video documentation, focusing on actions and interactions between students, and between students and the AOVL. The cameras were positioned on tripods behind the students in order to capture nonverbal activities. Additionally, the computer screens were recorded with the purpose of capturing students' activities in the virtual lab (for a screenshot of video data, see figure 1). The teacher's introduction of the lesson was also video recorded and analysed.

In the study, a class of 19 students worked with the AOVL during one period lasting three hours. The pedagogical goal for the activity was for the students to test the AOVL in order to learn about ocean acidification. The teacher started the lesson by giving an introduction to ocean acidification and its consequences (20 minutes). For example, the teacher wrote the chemical formula for ocean acidification on the whiteboard,

14 The Inquiry-to-Insight (I2I) project started in November 2008, and is a collaboration between Stanford University, California, USA, and Gothenburg University, Sweden, and their respective marine stations; Hopkins Marine Station and Sven Lovén Center for Marine Sciences-Kristineberg. I2I offers an educational program combining ICT, social networking, and pedagogy directed at environmental issues. The I2I idea is to pair classes from different countries within a social network. The students compare views, attitudes, and life styles around three environmental issues (climate change, environmental pollution, and habitat preservation) and will increase their understanding of those issues with different educational tools mainly based on ICT. http://i2i.stanford.edu/

described the acidification of the ocean, mentioned research results, and talked about the effects of ocean acidification on organisms in the oceans. After this introduction, the students worked with the AOVL during the next 60 to 80 minutes. The students worked in groups of three to four, and they used a portable computer. The computer was placed in front of the student who sat in the middle. In general, the student placed in front of the computer also navigated the computer mouse. The teacher interacted directly with the students mostly when called upon.

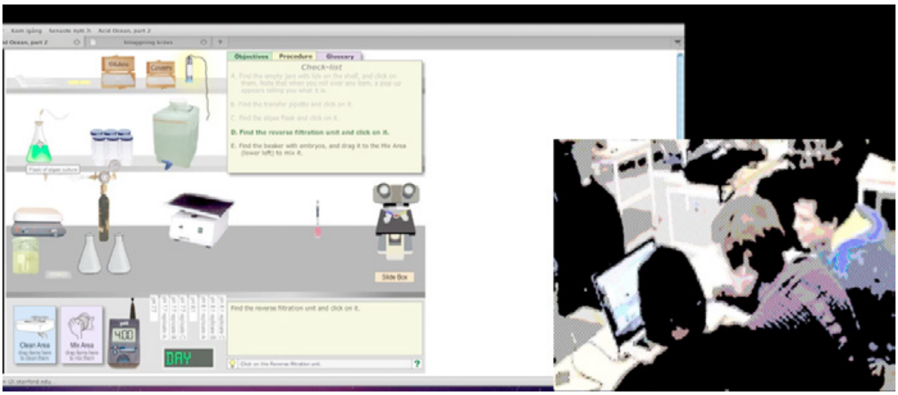

Fig. 1. Screenshot of the video data where the film of the students and the screen recording of the virtual lab have been synchronized into one film.

Acid Ocean Virtual Lab

In order to understand the logic of the study, a brief presentation of the AOVL will be given. The AOVL is a digital tool where students get an opportunity to study acidification of the ocean and its impact on the growth of sea urchin larvae. It consists of three elements that the students attend to and use: 1) information regarding basic facts about ocean acidification; 2) lab sessions; and 3) measurement exercises and information about the consequences of ocean acidification. When entering the virtual lab, students are provided with some information about acidification of the ocean. This first part includes discussion questions and exercises. In the second part, students are given the opportunity to act as scientists by experimenting in a virtual lab session. The lab session is designed to mimic a ‘real’ lab environment with equipment such as beakers, pipettes, a microscope, etc. (fig. 2). During the lab session, students get information about various scientific principles through ‘pop-up’ boxes, for example, regarding the importance of sample size and number of replicates in empirical studies. While experimenting, students also answer ‘pop-up questions’, which concern the specific activity in which they are currently engaged. For example, if a student adds carbon dioxide to the water, the pop-up question could ask the student about the motive for doing so. In other words, these questions are designed to make students justify actions and decisions, and to help them see the consequences of what they do.

In the virtual lab, students perform activities such as setting up replicate cultures and feeding the sea urchin larvae; they make water changes and observe changes in growth of the larvae over time under different experimental conditions. Every step (task) in the lab session is clearly described in two text boxes, and the equipment students are expected to use is highlighted in yellow. The students set up replicate cultures in water with regular pH level (8.1) and in water with a lower pH level (7.7). In the third part, the students measure samples of sea urchin larvae from both water types and make comparisons. The outcome is then related to statistical data from authentic scientific research. This measurement exercise is followed by information about the consequences of a decreased pH level that will occur through ocean acidification.

Results

The analyses below are based on students’ work in all three parts of the AOVL: information section, lab session, and measurement exercises. The excerpts have been chosen so as to illustrate shifting patterns of engagement that evolve when students are working with the different parts of AOVL. Thus, there are tensions in students’ activities where they continuously shift focus while working.

The excerpts are sorted in the same order as the three parts of the virtual lab, which means that Excerpt 1 illustrates how the students work in the introduction part of the lab, Excerpt 2 shows how the students orient themselves in the lab session, and Excerpt 3 is an example of how the students work in the final part of the lab, the measuring exercise.

Fig. 2. Screenshot of the lab session in Acid Ocean Virtual Lab.

Student engagement as contingent on scientific content

The teacher organizes his introduction of the class activity in line with the academic content presented in the first part of the AOVL. To this rather abstract academic information, the teacher adds concrete examples. For instance, the teacher talks about consequences on marine larval organisms of acidification using clownfish as an illustration.

> *[Uhm] recently one has found out that certain fish, for example, lose their sense of smell, and that certain clownfish, which normally recognize the smell of predatory fish and go hiding in the corals, do the opposite. When the ph is seven point six they swim towards the smell of predatory fish instead (.) That's not very good cause then they will be eaten.*

Fig. 3. Illustration of students working with the Acid Ocean Virtual Lab.

Following the teacher's introduction, the groups of students started to work with the first part of the AOVL with information and basic facts about ocean acidification. They read pages with a graph showing carbon dioxide emissions in the air, with information about pH levels in the ocean over time, and chemical formulae and concepts. In Excerpt 1, Amanda, Elsa, and Cecilia are to answer one final question in the first part of the AOVL before entering the lab session. The question is formulated as follows: Can you think of any other possible acidification impacts on marine organisms other than calcification (which is a major serious consequence)? Having read the question on the screen, the students show some uncertainty about how to interpret it and how to go on.

Excerpt 1: Part one of the AOVL - information about ocean acidification

01. Amanda:	yeah that it will be warmer (.) or I don't get it or aha (pause)
02. Cecilia:	ye:ah yeah
03. Amanda:	ohoh David [the teacher] said that thing about the predatory animal
04. Cecilia:	what animal?
05. Amanda:	the predatory animal (.) so when it was like a fish that felt [the smell from a predatory animal so instead of hiding [it sort of went towards it
06. Cecilia:	[THAT'S RIGHT
07. Cecilia:	[yea::h they were like eh (.) mentally
08. Amanda:	the sense of smell and stuff (pause)
09. Cecilia:	yea::h that could also happen

After a few seconds of hesitation, Amanda, in utterance 1, suggests that *it will be warmer*. However, almost immediately after her suggestion, Amanda stresses that she does not really understand what kind of answer would be relevant, and she indicates that the rise in temperature might not be what the question is about. After yet another pause, Amanda, in utterance 3, remembers what the teacher mentioned in his introduction and relates this to the question asked. In her explanation to the rest of the group, Amanda provides an answer by reusing the teacher's example regarding the effects of ocean acidification on clownfish: *the predatory animal (.) so when it was like a fish that felt [the smell from a predatory animal so instead of hiding] it sort of went towards it* (utterance 5). Halfway into Amanda's explanation, Cecilia also seems to remember the teacher's example about the clownfish as she agrees with what Amanda explains.

Cecilia, in utterance 6, adds to Amanda's explanation: *they were like eh (.) mentally*, pointing to that the changed behaviour of the fish has something to do with their mental state. Amanda concludes this utterance by summing up that something happens with the fish's sense of smell. The results show that the students easily understand the teacher's explanation of how the clownfish changes its behaviour as a consequence of ocean acidification. The point of the example of illustrating that the clownfish swims towards the predatory fish instead of away from it has made an impression on the students, and they obviously are able to connect this to ocean acidification.

In this first part of the AOVL activity, Amanda and Cecilia engage with the content of ocean acidification and the impact on the marine organisms. The excerpt above illustrates knowledge-sharing among the students and the teacher in the sense that students pick up arguments and insights provided by the teacher as the work proceeds. As mentioned earlier in this section, the teacher organizes his introduction of the lesson in line with the first part of the AOVL, which includes information about ocean acidification. However, in his introduction, the teacher also adds examples that are not provided by the AOVL, where he uses insights from research, specific examples, and chemical formulae. Several instances in the empirical material show how these types of substantive contributions from the teacher are reused by students working in the lab environment. Through this extended introduction, the teacher provides some of the premises that enable the students to understand the content of ocean acidification in a more concrete way.

Student engagement as contingent on features of the tool

The lab session and the measurement exercise are parts of the AOVL where the students get an opportunity to practice experimentation and study its outcome. In the lab session the students perform an experiment with sea urchin larvae and, later in the measurement exercise, they study the outcome of the experiment by measuring samples of larvae.

In the excerpt below the members of a group of students are involved in an activity of changing the pH value of the water in one of two flasks on the laboratory bench. The students have measured the pH level in the flasks containing seawater. The digital tool indicates that the task of measuring the pH level in each flask is completed in a correct manner, and instructions for a new task are to be found in text box 2 (fig. 2). The task for the students to solve is to place a stir bar in one of the two flasks in order to change the pH level from 8.1 to 7.7 (7.7 is what researchers predict the pH level in the ocean will be in future), and then to place the flask on a stir plate. In the excerpt we follow Elias', Philip's, and Tom's attempts to solve the task of finding the stir bar in order to proceed in the lab session. The students do not recognize the stir bar appearing in yellow on the top of the shelf in the laboratory environment (fig. 2) but instead randomly point at and pull the tools available on the lab bench.

Excerpt 2: Part two of the AOVL – lab session

01. Philip:	stir bar what's a stir bar (.) maybe one should move that one ((places the mouse pointer on the co^2 tank. Clicks on the empty jars))
02. Elias:	that one ((points at the screen)) (pause)
03. Tom:	stir bar is the one you just used
04. Philip:	((pulls the electrode to the stir plate)) that one?
05. Tom:	the one that's in it yeah
06. Philip:	but this isn't working at all (pause)
07. Philip:	((pulls the electrode to the stir plate)) what the hell's a stir bar? ((looks at Tom))
08. Tom:	but it's the one that's in the FLASK
09. Philip:	no it's not that one at all ((pulls the electrode to the stir plate))
10. Tom:	sure it is
11. Elias:	no that's a probe

The conversation displays an uncertainty about what kind of tool a stir bar is, and the students test different alternatives. Philip, in utterance 1, places the mouse pointer on the CO_2 tank and suggests that they might move the tank. Elias continues by pointing at the electrode saying: *that one*. Tom, in utterance 3, also takes the electrode as the stir bar saying: *stir bar is the one you just used*. However, when Philip tries to move the electrode from the flask, it does not work. The AOVL gives an indication when the students' suggestions are incorrect (the tools move back to their original position), but there is no explanatory function telling the user why a certain tool is not relevant. Consequently, the boys try all sorts of actions over and over again, and this leads to some irritation: *what the hell's a stir bar?* (utterance 7). This sense of irritation appears as a result of students' lack of understanding about why their actions fail, and the fact that they do not have any indication that they are on the way to a correct solution or not. Thus, the tool is in some sense not sensitive to their attempts to get ahead. In the excerpt above, Philip, Elias, and Tom do not realize that they need to put the stir bar in the flask before they can place it on the stir plate.

As the excerpt above shows, the interaction among Elias, Philip, and Tom is characterized by confusion about how to interpret the equipment in the virtual lab. There are several deictic expressions such as *move that one* (utterance 1) and *the one that's in it* (utterance 5), and they are accompanied by gestures and pointing as the students try to make sense of the equipment. This conversation goes on without using the experimentally or scientifically relevant terms. This manner of engaging with the lab is frequent in the empirical material. The students move ahead by clicking on the mouse to see what happens but without coordinating these actions with any scientific terminology, and there are no indications that they are involved in doing an experiment. The progress, instead, is guided by guesses rooted in trying to come to grips with the functionalities of the software. As mentioned in the previous section, the teacher's introduction consisted of information related to the content of ocean acidification. The introduction did not include information regarding procedures about how to carry out experiments by formulating hypotheses, setting up experiments, and measuring effects of the manipulations introduced. Thus, in terms of the principles of experimentation, the students are not scaffolded by the teacher's introduction, and their work with the lab in instances such as this seems to be more related to the contingencies introduced by the functionalities of the software than by any consideration of how to do experiments or learn about acidification.

Excerpt 2 thus illustrates an alternative manner in which students orient themselves when in doubt. The step-by-step instructions offered in the lab session aim at facilitating the practical elements of the laboratory. What we see here is a momentary shift in how the students orient themselves while completing the task. The activity of conducting an experiment and measuring sea urchin larvae is somehow rivalled by the focus on the lab as a programmed environment to be mastered. Since the students do not identify the tools through the correct terminology in the lab session in Swedish but rather use the English terms, with which they obviously are not familiar, it is not clear whether they actually understand what tool they are using and what its function is. For example, Philip and Elias use the English terms *stir bar* and *probe*. On quite a number of occasions, the students do not even use the proper English terms but convert them into some kind of Swedish (*stirring platen*). These observations testify to the fact that the environment is very dense as a mediating tool, and the students have to grapple with both terminological and conceptual issues as they try to solve the problems assigned. There are many premises for using the tools that are blackboxed and that may or may not be understood by the users. These are also instances where they would need situated support from the teacher in order to maintain a focus on the substance of their work.

When the students have finished their work in the lab session part in the AOVL, they enter the third part, the measurement exercise. Here the students measure a total number of six replicates using a virtual ruler (three replicates with water with a pH of 8.1 and three with a pH of 7.7). In the excerpt below, we meet another group of students who has just measured the length of replicates using the virtual ruler, and the students are about to type the length of the last replicate into the appropriate box.

Excerpt 3: Part three of the AOVL – measurement exercise

01.	Peter:	((clicks on the sixth replicate in water with pH 8.1. No replicate appears on the computer screen))
02.	Jim:	yeah I think the last one is five hundred
03.	Peter:	((Problems with the programme. Goes back to the previous page and then enters the measurement exercise once again))
04.	Jim:	no but (.) no wait what are you doing what are you doing
05.	Peter:	((clicks on the sixth replicate. No replicate appears on the computer screen)) hehe
06.	Jim:	click there click there (.) we gamble a little
07.	Albin:	four hundred ninety
08.	Jim:	((Without seeing the replicate Jim types 500. Wrong answer. Types 505. Incorrect answer. Types 510. Correct answer.))

In the activity of measuring the replicates, Peter navigates the virtual ruler using the computer mouse. He places the mouse pointer on the sixth replicate in order to measure it, but the replicate does not appear on the screen. Though there is no replicate to measure, Jim, in utterance 2, suggests: *yeah I think the last one is five hundred*. After Jim's suggestion in utterance 2, Peter returns to the previous page, enters the measurement exercise, and once again clicks on the sixth replicate. However, the replicate still does not appear on the screen. Jim, in utterance 4, proposes that they could *gamble a little*. As a response to Jim's proposal, Albin suggests that the length of the replicate could be 490 micrometres. Jim, who sits in front of the keyboard, does not pick up on Albin's suggestion. Instead Jim types the number 500, which he himself suggested in utterance 2. The AOVL indicates that 500 is incorrect, and, in response to this, Jim immediately types a new number (505), which also turns out to be incorrect. The third suggestion (510) is the correct length, and the students enter the next page in the AOVL. This measurement exercise illustrates the students' engagement as a trial-and-error activity focused on entering numbers close to the expected correct answer. The students continue testing numbers until the AOVL finally indicates that their answer is correct.

The knowledge that Jim uses when suggesting the length of the sixth replicate, even though it has not appeared on the screen, is grounded in his insight into how the virtual lab operates as a technology. For example, when entering the measurement exercise the students used the virtual ruler for carefully measuring the replicate. The students' first answer turned out to be incorrect and in response to this, they started their guesswork. There may be different reasons for this. For instance, it might have been difficult to assess where to place the ruler and to read the result. This way of engaging with the lab in the context of measuring was apparent in several instances in the empirical material, i.e., the students typed the various answers rather than measuring their replicates in a more precise sense. The excerpt above illustrates how an instructional activity of measuring the outcome of an experiment is transformed into an activity of typing different values into a given slot. In this example, a shift of focus in the activity appears between, on the one hand, an activity that is triggered by an understanding of the content (measuring larvae), and, on the other hand, an activity that is grounded in understanding the logic of the technology. It is thus not clear if the students construe the activity of typing values as an element of the laboratory work of measuring, or if they are guided by a focus on the functionalities of the technology that tells them approximately what the value should be.

The excerpt may also be seen as illustrating gaps in the students' activities that open up for teacher guidance in order for them to achieve an understanding of what experimenting with ocean acidification is about. For teachers to be able to exploit such instances, it is necessary to understand what kinds of problems the students are facing. Thus, teachers could bridge the gaps that occur by ascertaining whether the students' problems are related to performing laboratory work, to an understanding of issues concerning acidification of the ocean, or to coping with the functionalities of the software.

Discussion

The analyses show that the design of the tool codetermines student engagement, but perhaps not in the intended manner. In the first part of the AOVL, which mainly presents information with few interactive elements, the students frequently engage with the content and their discussion concerns scientific issues. This way of approaching the virtual lab is supported by the teacher's introduction. The students are using the teacher's introduction as a structuring resource for understanding the concepts by reusing his formulations in their reasoning. Thus, they appropriate certain elements of his reasoning for their own use. In the lab session part and the measurement exercise, on the other hand, where the student-controlled interactive elements play a more prominent role, the students, when running into problems, orient towards the functionalities of the design features of the lab, i. e., their actions are contingent on features of the tool itself. Thus, when encountering difficulties, the students seem to let the scientific content move out of focus, and instead they turn to exploring features of the tool itself.

The analyses illustrate the complexities of meaning making and learning while interacting with a tool that blackboxes knowledge and conceptual premises at the same time as it provides 'access points' to rather sophisticated analyses of water quality and its impact on living organisms. When using tools in many contexts, we vacillate between attending to the information mediated and the tool itself; when using a new smartphone, for instance, we frequently have to attend to the tool when writing messages or surfing on the net. Later, the tool itself becomes largely transparent. From an educational point of view, and with an interest in microgenesis (Wertsch 1998), it is interesting to explore what such shifts in attention, provoked when engaging with complex virtual tools, imply for learning. On the one hand, it is obvious that one has to know something about the tool and its affordances; otherwise it is not possible to learn or perform virtual experiments. On the other hand, when the students encounter difficulties and resort to clicking on the mouse in order to get on with their work and without attending to scientific substance, they enter another universe of discourse where their actions are no longer immediately contingent on scientific substance.

The students seem to need support for their activities along several, parallel lines. To learn in the context of the virtual lab, the students have to understand how to navigate in the environment, how to solve different tasks in order to proceed in the environment *and* what all this means in relation to the underlying conception of ocean acidification. In a nonvirtual laboratory lesson, the teacher's role traditionally has been to demonstrate the experiment and then interact with the students during lab work and with the equipment as a shared focus of attention. In the virtual setting the situation is different, and students may engage in activities that will not be visible to the teacher. It is evident from our study and others (cf., e.g., Jahreie et. al., 2010; Krange & Ludvigsen, 2008; Laurillard, 2009; Stahl, 2009) that when engaging in virtual laboratory work, the students need instructional support in order to understand what the different tools and procedures correspond to in a nonvirtual lab world. In a classical school lab, the shortcuts offered by the virtual environment when testing the functionalities of the tool are not present to the same extent.

Also, the scaffolds introduced to compensate for the highly black-boxed nature of the virtual lab create their own problems. The highlighting design becomes a resource for the students' ways of moving forward in the virtual lab by clicking on symbols on the screen, and they may do so without considering the function of the different tools on the lab bench or their role in knowledge-seeking practices (c.f. Manlove et al., 2006). The built-in design, thus, may support an approach where the students do not have to make relevant distinctions in the virtual lab environment; they only need to react if an object is highlighted or not (c.f. Linderoth, 2012). Such scaffolds will 'take the focus away from the content of the knowledge domain that they were meant to make sense of' (Krange & Ludvigsen, 2008, p. 41).

This dilemma of operating in such dense environments, and shifting between attending to the tool and the contents, has been observed in studies of gaming as well (Juul, 2005; Linderoth, 2012). Using Goffman's (1986) framework theory and the distinction between 'rule systems' and 'theme', the gamer focuses primarily on the rules that structure the game, while the theme is something beyond the game itself (e.g., Role Playing Game in fantasy worlds, killing dragons, hunting, etc.) that is mostly secondary for the player, if attended to at all (Linderoth, 2012). That is, the users' attention is on how to go further in the game and reach new levels, and their focus is generally not on what the game is about: the theme. This may be seen as an indication of why gaming is not so efficient in instruction, since in the teacher's case the theme is normally the most interesting component.

An important finding is that several instructional opportunities for the teacher unfold in relation to the students' work in the action oriented parts of the AOVL. The virtual lab should not be perceived as a standalone device, and students need support for their activities along several, parallel lines. To learn in the context of the virtual lab, students have to understand both how to navigate in the environment, how to solve different tasks in order to proceed in the environment, *and* what that means in relation to the underlying conception of ocean acidification. For teachers, to demonstrate an experiment and then interact with the students' lab work in relation to a virtual lab is a new educational practice. Returning to Latour's concept of 'blackboxing', our study illustrates the complexity in relation to the digital tools that are used in schools. Here the virtual lab includes complex information and offers the students the possibility of performing sophisticated experiments way beyond their current scientific background knowledge. However, there are processes and concepts in the technique, which the learner needs to unpack in order to understand the activities they perform, and here a competent partner, a teacher, becomes central.

However, to unpack all information built into such tools is neither possible nor necessary. We have to accept that the tools we use are not totally transparent. For example, we do not need to understand how a computer works in all aspects to be able to use it in a productive way. Nevertheless, the results from our study imply that in instructional contexts certain representations need to be unpacked in order for the students to be able to reflect upon their performed activities, the concepts they use, and what these represent in a nonvirtual world. At such points, instructional opportunities open up for the teacher to support the students to develop an understanding of experimentation as a process of creating knowledge. The teacher's role in such instances would be to challenge the students in their reasoning and give them tools for reflecting on their activities and what these activities represent, i.e., to guide them through the academic substance and the concrete virtual activities. Accordingly, the practical work in the lab session needs to be related to the academic level so as to link what one does on the screen with what one should learn something about.

Conclusion

Virtual labs offer promising opportunities for inquiry learning, and for the learning of scientifically relevant modes of reasoning and working, for instance, about how to organize and evaluate experiments about sophisticated topics. The virtual lab brings students into issues for which they do not have a sufficient background. This is both its strength and its weakness from the learning point of view. Virtual labs, thus, have educationally relevant potentials but as no other technology will they determine student activities. The virtual lab is in itself not a guarantee that the students have learned either what it means to do experiments or about ocean acidification. To learn such skills is to learn highly sophisticated modes of engaging with the world that need to be unpacked and reassembled. The teacher has an important role in finding windows of instructional opportunities to support the students' practical work with virtual labs. The fact that virtual labs sometimes mediate a simplification of scientific studies and problem solving is, however, not in itself something that makes virtual experimentations less promising. A traditional experiment in school (or in a science lab!) is also a simplification of reality and is likewise based on reductions of complexity and refinements of investigated factors. It is, thus, important to become familiar with the meaning of these simplifications when working in virtual labs and realize that we always have to struggle with questions regarding how our results relate to the surrounding world, which we are modelling and which we want to know something about.

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FUTURES FOR LANGUAGE LEARNING AND TEACHING PRACTICES

Linda Bradley & Sylvi Vigmo

Introduction

Teaching and learning practices have been argued to be in need of transformation for some decades, specifically since moving into the continually changing landscape caused by the Network Society (Castells, 2000). The traditional borders between learning sites are becoming blurred due to the rapid development of technology, creating affordances for multilingual interaction networks and language learning. Polarities often referred to between learning within the classroom and beyond, informal and formal, or institutional and everyday are being challenged. The recurrent use of these dichotomies fails to include aspects of learners' uses of digital media in virtual learning places, as self-directed practices (Drotner, 2008) and hybrid digital media places (Buckingham, 2007), in which learners are increasingly in command. A perspective based on dichotomies such as formal and informal may even cause a restricted and delimiting understanding of emergent practices (Sefton-Green, 2008). Given that agency and authorship in virtual learning places are open to learner activities other than those commonly organised from and acknowledged by an educational perspective indicates that the point of departure for the learning and teaching practices is not the same.

Pedagogical concerns in education are based on curricula and policies, and learners are assessed on their individual skills and competences, according to predefined learning outcomes, while Web 2.0 environments are characterised by participation in shared places open for collaboration, changed conditions that require pedagogical design (Lund & Rasmussen, 2010). The conditions for using language in these two places are framed by different genres for participation and contribution, as participants become coproducers (McLoughlin et al., 2008). Cowriting and coediting in Web 2.0 places invites an extended authorship and changed audience (Warschauer & Grimes, 2007).

This raises some issues of particular interest from a pedagogical perspective. Not only are the conditions for participation and contribution changed; it also points to some crucial pedagogical dilemmas due to the shared and distributed authorship. Writing, publishing, and coediting in collaborative virtual places are activities that are increasingly characterised as ongoing, and not necessarily aimed at reaching a final goal. Anyone can be invited to participate, and texts can be transformed and transferred to other virtual places and thus serve other purposes and interests. Who has contributed with what content is of less interest in these virtual places (Bonderup Dohn, 2009; Lankshear & Knobel, 2007). In other words, the contexts and condition for acting, interacting and communicating in so-called Web 2.0 environments differ from the more structured organised learning and teaching practices.

The changed conditions also bring to the fore what is more seldom addressed, i.e., the critical questions about what is the focus for learning, and what content become relevant to learn? When the teaching practices still take as their point of departure the same content, and the same learning objectives as previously, and thus fail to rethink their own practices, the use of media resources and their potential affordances in the virtual learning places does not per se lead to development. The changed directions, aims, and perspectives on learning activities relevant for learning indicates rethinking from a pedagogical point of view to address the pedagogical dilemmas education is facing.

In the following, we will first discuss the changed virtual places for language learning and language teaching that the Web 2.0 developments offer, in particular with relation to language learning and teaching practices. We will then deal with some conceptions of language learning and teaching in the light of the current transformations of our everyday life and the tensions and challenges these may trigger for current practices of language learning and language teaching. Finally, we discuss some heuristic approaches to bridge the gap between educational practices and other virtual learning practices, as well as for strengthening the learners' agency in virtual learning places.

Web 2.0 – new arenas

The web is a topical area that is currently explored in learning at large as well as within a language-learning context. Since social networking and participating in web-based activities are increasing exponentially with Web 2.0, this is a virtual place that encourages reflective productive skills such as writing, speaking, sharing multimedia resources, but also reading and seeking information. Conditions for learning are being transformed as activities distinguished by a 'performative nature' (Säljö, 2009). The new arenas in virtual learning places such as, e.g., Facebook, Twitter, and blogs, afford linguistic activities and uses of language other than those commonly focused on in education. Content can be shared and distributed in various virtual learning places; digital media texts can be manipulated, edited, and combined into new texts, and reaching a final linguistic product may be secondary. What is of importance is that interaction and participation in these virtual learning places are grounded in a bottom-up perspective, and take the collective contribution as a quality in itself (Bonderup Dohn, 2009), while educational approaches are more commonly based on a top-down perspective; teaching practices design for language learner activities, and have certain objectives and learning outcomes to reach. To this image can be added notions of competence and linguistic skills, which are distinguished by having the individual learner in focus.

That new practises for language learning and teaching practices are at stake can also be seen in how other notions are applied to form a broader perspective on the use of languages in virtual learning places. The concept of ecology has been argued to contribute to teaching practices to rethink and reconsider notions of what language use, skills, and competences are in virtual learning places, i.e., in contexts that do not depart from separating and assessing either linguistics competences or the use of language as such (Kramsch, 2008).

This does not only have an impact on everyday practices of language learning and language teaching, but also, on a broader scale, on how linguistic skills and competencies are seen. From a pedagogical perspective it is crucial to consider carefully what these shifts in perspective mean from the point of view of education, and of specific interest for this paper is teacher education. Web 2.0 puts people together in new ways. What seems clear already is the need to explore some daily networked practices such as collaborative problem solving, the collective creation and sharing of texts and their potential role in the educational contexts, and reflect on what this implies for language teaching practices.

New media ecologies exemplified by Web 2.0 enable us to take other perspectives on the uses of English, in particular, uses that are not commonly defined in terms of linguistic skills and competences. An ecological perspective on language in a virtual learning environment enhances rethinking about language education, as it aims to embrace the whole situation and environment in which English is being used (Kramsch, 2008). Taking an ecological perspective implies acknowledging language learning as 'a messy field of study about a complex and messy reality' (Van Lier, 2002, p. 144). Language education has a long academic tradition of breaking language learning 'down into bits and pieces, and lining these up in some sort of order' (2002, p. 159), an assumption Van Lier seriously questions. Canagarajah (2006) argues that we can think of language as *context-transforming*, and that a focus on language learning and language use today would benefit from taking the following notions into account as parts of the language parcel: language as hybrid, language/discourse as changing, and language as representational.

By adopting a holistic approach (Conole, 2008), the investigation of other dimensions of language use and language learning activities can appear as relevant. Going beyond the common framing of linguistic skills and competences also raises some concerns of importance for language learners' use of English in digital media in their daily practices. To address this gap, Conole (2010) points to potential and actual use, and argues that designing for learning is a necessary step towards understanding from a pedagogical perspective and, if possible, bridging the gap.

Of particular interest are if and how the language teacher students' daily practices merge with the educational structures and designs for learning and using English, and how these activities are interrelated and linked to each other.

According to Conole (2010), we face educational dilemmas in education, which deserve time dedicated to pedagogical design. Results from previous studies have referred to the lack of teacher training as one contributing factor to the low rate of acceptance of digital media in education. The image drawn, however, also displays other aspects of concern, e.g., the diversity among the students themselves. In more specific words, we cannot assume that the language teacher student[15] group is homogenous, which in itself represents an educational and instructional dilemma.

For language learning this implies an increased focus on language use and the shift in mindset that participation is part of learning as well as acquisition, two metaphors both contributing to our understanding of learning (Sfard, 1998). A simplification of mindsets when being active in virtual places can be illustrated by ways of framing epistemology and learner participation. The first of two mindsets is characterised by notions of knowledge and knowing present in a hierarchical view of the world (Lankshear & Knobel, 2007). What we think of as expertise, competences, and authority are spread among individuals and institutions. The second mindset takes place on the web, and is characterised by being decentralised. What in this virtual place are considered as competence, expertise, and authority, have become collective and shared. Authority is distributed among participants and social aspects are given value. What is communicated and created here is under constant change and development (Lankshear & Knobel, 2007). While education commonly takes mindset one as point of departure, virtual places in Web 2.0 invite to mindset two. Learning implies becoming a participant, belonging in a context and in a constant flux of doing, rather than acquiring something, having, and possessing. Learning is conceived as a process of becoming a member of a certain environment and part of sharing joint activity.

Research questions

That there is a shared concern for education from a governmental perspective can be seen in recurrent national and international reports, which take various approaches to focal points on] dimensions of teaching

15 With language teacher students we mean students participating in language teacher education.

and learning, such as innovative implementation of ICT in European education.[16] One critical dimension of addressing what is being argued as challenges for education points out that teacher education is vital. Today's teacher training students will impact several generations to come. To target what are considered to be teacher digital media competences, UNESCO (2011) describes close to twenty competences – and the interrelations among them -- argued to be necessary. A recurrent theme pointed out as being critical from an international as well as European perspective is that language education does not reflect the use of language among students in schools (Eurydice, 2011; Skolverket, 2011). The conclusion drawn is that schools, i.e., teachers, have to develop their pedagogical approach to digital media and use technologies to bridge learner activities mediated in various virtual spaces and with diverse digital media with activities at school.

The image outlined above is similar to that of Swedish language teacher students; there is a great discrepancy between what takes place in teacher education compared to out-of-school practices. Even though digital media and technologies are increasingly ubiquitous in almost every students' daily life, digital media is leading an obscure life in language education. In their examination of controversies over e-learning in the university, Davidson and Widdowson (2010) discuss the 'incoherence between the e-learning technologies currently adopted in the university and the ways in which our students actually use various technologies' (p. 2). This discrepancy between students' everyday online experiences and participation in various virtual places and what takes place in education is an area worth investigating further. Thus, the case study presented in this paper was guided by the following explorative research questions:

> What are the language teacher students' reflections on digital media and technologies adopted in their daily practices?
>
> How do the language teacher students account for acting,

16 Eurydice, European Commission (2011). Key data on learning and innovation through ICT at school in Europe 2011.

> interacting, and communicating with digital media in educational practices in general and, specifically, in virtual learning places?

Analytical framing

The focus in this study was to examine relations between digital media and technologies used by English language teacher students in and outside the university context. When investigating the students' participation in virtual places, the two concepts of *bridging activities* and *shuttling* (Thorne & Reinhardt, 2008; Thorne, 2009) were used as analytic tools applied in order to frame the possible shifts in interactions between daily practices as a language teacher student and as language teacher students in the educational university practice. Drawing on these two concepts, bridging activities and shuttling, implied finding a way of scrutinizing the interface between the in- and out-of-university practices.

According to Thorne (2009), bridging activities can be used to investigate 'students' digital vernacular interests' in collaboration with educators with the shared aim of exploring 'living language use'. Furthermore, this way of exploring communicative practices includes digital media and print literacies and departs from an ecological perspective on everyday language use, irrespective of place. In this approach, Thorne also points to future practices yet unknown.

This conceptual framework is grounded in the notion of multiliteracies, New London Group, 1996. It concerns the shifting social practices and emerging literacies associated with digital media, focusing on teacher exploration of student-created digital texts originating in digital media. Regarding the concept of multiliteracies, Thorne (2009) raises some critical concerns in claiming that:

> *new media literacies remain largely unacknowledged within instructed L2 contexts and curricula, or worse, are treated as stigmatized varieties that have no place in the classroom (p. 91)* .

Furthermore, Thorne points to another problem in education, which is the lack of explicit and systematic goals to address the 'mastery of high frequency and high stakes mediated genres of communication' (p. 91). What is being argued here in explicit terms is that language use, and linguistic skills 'other' than those education acknowledges, comprise a serious problem that has to be recognized and addressed.

The other analytical tool, *shuttling* (Thorne, 2009), is a concept that illustrates when individuals move between 'defined social-textual conventions and make strategic use of semiotic and narrative resources, sometimes across and sometimes within specific language genres (p. 87). In this, Thorne refers to Canagarajah (2006), and elaborates further on his concept of shuttling to argue that 'writing is not merely constitutive; it is also performative, context-transforming, and acts as an affordance for the ongoing negotiation of voice and presentation of self' (p. 87). Thus, communicative participation in online virtual places is not a trivial activity.

In the analysis of the language teacher student activities in this paper, the concepts were applied as analytical tools to explore the students' move between social media practices at university in virtual learning places, and language use in their everyday use of social media.

Tensions and challenges

Implementing emergent web-based technologies into institutional contexts is not unproblematic (cf. Bonderup Dohn, 2009; Lund; 2008), with examples such as open access and sustainability of content over time on the one hand, and assessment and assignments on the virtual learning places on the other hand. In fact, it is the 'ego-less, time-less and never finished' (Lamb, 2004) business of user interaction that is problematic and that fits existing institutional frames quite poorly. These are challenges in need of debate and targeting in teaching and learning practices. Thus collective online ownership causes both possibilities and problems for learners. As Erstad (2008; 2010) puts it, classroom media production, for example, may be seen as trajectories of remixing as students may bring with them their existing experience and abilities and are often motivated to take the lead on instruction. The affordances of technology may, in other words, change the power structures of the learning situations. Thorne (2010) suggests that learners may be immersed in intercultural communication 'in the wild' while teachers are educated to keep track of what is going on in the classroom. This points to a tension regarding control of linguistic activities, language production and an educational agenda based on development, assessment, and the grading of results. Furthermore, this addresses issues regarding who is in control of information for learning as reproduction and what content is to be focused. Being immersed in a noncontrolled linguistic virtual environment, open for actors and contributors to set the agenda, indicates that agency and distributed collective authorship are framed by other conditions. The linguistic genres for using English in virtual environments take other ontological positions as their point of departure rather than educational practice.

Empirical data, participants and design of study

The data for this case study were based on the voice of future language teacher students. The participants were Swedish teacher students of English. They were in their first year of teacher training, even though some of them had been working a few years as teachers before they started their education. The reason for this focus on language teacher students was to catch the interface between their use of technology and digital media in their daily lives and the accounts of use given concerning what they had encountered at university and in schools. In their teacher education there was limited instruction as far as digital media was concerned. However, since studies show that students tend to use digital media in their everyday lives (Conole, 2008), our study set out to investigate the language teacher students' view of this discrepancy.

The language teacher students were mailed five questions to which they would reply with their views about using new digital media, technologies, and computers in learning situations. There were also two specific questions about the use of virtual learning places. All in all, there were eleven responses, five males and six females. Two students answered in Swedish, the rest in English. The two answers in Swedish have been translated into English. The data were analysed from the student perspective, investigating language teacher student activities and their accounts of engagement, both in private when it comes to digital media, but also in their teacher education and from what they had experienced in schools.

The analysis of the answers was based on the outcomes of the language teacher student accounts. The first area concerns how the students described ways that they use digital media in everyday life, how and if this was applied in their language teacher education. The second area presents students' views about how digital media technologies can be useful for language learning. The third area concerns what potential the language teacher students see for the future of language learning in relation to digital media.

Results

In this section, the results of the case study are based on the language teacher students' accounts of their use of digital media. At the outset of the analysis it was clear that all students were used to digital media in their everyday life. Some language teacher students have been defined as advanced students in this study, i.e., students using more than one social media place as well as being online for several purposes throughout the day. The analysis of this section draws on the two concepts: bridging activities, i.e., the shifting social practices and emerging literacies associated with digital media, and shuttling, i.e., moving between textual conventions in digital media.

Everyday use of technology and how it can be applied in education

The language teacher students are quite used to technology in their everyday life. Eight out of the eleven students are advanced users of digital media. These students stay online most of the day both through their smartphones and computers for a range of purposes, such as using various social media, Internet services and programmes. The eight students mention a range of programmes and social media that they are using. The following four quotes from three advanced users display this familiarity in usage:

> *I use technology for everything I do, Facebook, twitter, blogging, I think I could sit by the computer a whole day without knowing the time actually passes. My iphone is full of technology, using spotify, Facebook, texting, phoning and when I got nothing else to do I play games on my phone, and also on the computer. I very seldom turn my computer or my smartphone off.*

I'm generally "connected" 24/7. Considering smartphones have the ability to push messages and notify you through applications, people have become easily accessible.

I privately own and operate a low-budget server, which I've used to set up a private network amongst friends, with no purpose other than to allow myself to learn from the experience of creating websites with various features.

Most frequently used: self-hosted Wordpress for my websites. Fb and Twitter both for my company and myself, Google documents for writing, information sharing and storing, perfect for group work StumbleUpon, We Heart It, Tumblr and Reddit for sharing links, flickr and Instagram for photo sharing, Skype for talking when gaming or studying Statcounter and Google Analytics for statistics. Linked In for showcasing my accomplishments professionally, Several affiliate and advertising services iPhone apps.[17]

The common feature of the four quotes is that they display advanced users of technology. The language teacher students name a number of virtual places, resources, and activities that they engage in during the day. Though the teacher students participating in the case study are few, their accounts can serve to indicate some of the changes deserving further in-depth research to make more informed pedagogical designs for development of language learning and teaching practices. In the accounts given above, the students refer to social media places in which they participate throughout a regular day. Messages are sent, people are easily connected in networks, private as well as for the marketing of company sites. A variety of websites, virtual places, are named in concrete terms, and respondents specify what kind of activities they afford such as, e.g., sharing information and documents for writing, collaborating, creating, and gaming.

The accounts of activities above imply that the language teacher stu-

17 In quoting the students, the students' spelling of the words has been followed.

dents are engaged in activities that bridge aspects of and interest in their own practices, but that no accounts of activities are given that bridge their 'vernacular use' with educational practice. Similarly, the students' accounts of how they act, interact, and communicate in the virtual places referred to exemplify shuttling; activities go back and forth according to their aims and interests.

Another item that also emphasizes the fact that the language teacher students are advanced users of digital media is the discourse, i.e., how they talk about their use. The following quote shows that the students apply a certain terminology to describe this usage of email, Twitter, Facebook and Skype:

> *Computer based programs are generally more flexible than mobile apps. Regardless, the core focus remains communication.*

Another example of one of the advanced users is:

> *I use my smartphone and tablet very, very much for they simplify things. Everything I need is just a finger touch away.*

The three language teacher students who were not classified as advanced users were still using the Internet and emailing in their daily lives, even though they were not referring to any use of social media. Concerning the use of technologies in education, the students claim that teachers generally do not use it enough. The primary usage area is information passing and emailing. One of the respondents claims that:

> *I do not think that most of the teachers are willing to change their ways of educating the students, and that is a shame!*

This quote shows that use of media literacies is unacknowledged within the curriculum for language teacher students, which is also suggested by Thorne (2009). Another comment that displays this gap is the next quote, which raises this same argument one level higher, from teachers' use of computers to computer usage in schools:

> *Swedish schools have not developed as quickly as the society and there is a big gap between the two of them.*

When the virtual learning place within their education did not offer what the language teacher students thought to be a suitable work area, they arranged such an environment themselves, which they claimed boosted their productivity as a group:

> *We had a Facebook group in our class, which was greatly beneficial since we would share information to the whole group very fast.*

The language teacher students make use of their everyday use of technology for educational purposes, since there is a lack of tools to use, according to the students, moving them out of school digital media into their education. Thus we see that shuttling is part of the student practices but not referred to at all in their references to the educational practice. The advanced users in the study presented here seem to live with virtual places close at hand. Another dimension of the references made by the language teacher students is the focus on generic educational technology; the use of language serves the students' own personal purposes, i.e., their own practices.

Uses for learning languages

Concerning the matter of how to use digital media for language learning, the students had a number of ideas of how they could be implemented, such as setting up social media groups where pupils would be participating with others online. The fact that digital forms of communication allow users to be active is stressed:

> *Never mind if you use a book, audiotape, videotape if the user is an active participant in the process instead of a passive one.*

The students are pointing at suggested ways of implementing technologies in education. This is related to a *bridging activity* where the problem in education is how to address mastery of digital media and technologies for learning purposes and treat this as a shared problem that could be developed together with teacher educators (Thorne, 2009). Also noteworthy is that there are few student references made to domain-specific educational technologies, which again indicates that language is used as a mediating tool for diverse activities and interests, rather than a language being learned.

Future uses of technology and digital media for learning languages

The respondents had a number of suggestions for future uses of digital media and technology. There are already a variety of resources online. Some of the ideas reflect a new generation of language teachers, as, for example, the following statement:

> *I hope textbooks will be something for the past, my students will have everything on their computer, that way they cannot lose any paper or book or anything because everything is in their computer.*

The domain-specific educational technology, i.e., the textbook, is here discussed as an element in language education that is considered outdated. The language teacher student's envisages that his/her own students will not use textbooks since they will be replaced by the computer. The openness of the Internet is brought up as something that is expressed as having a potential. As far as virtual learning places are concerned, the language teacher students claim that they seem to have more potential than what is actually used. On the other hand, there were some sharp comments against virtual learning environments regarding the fact that they are restrictive and lack affordances the students are used to having. The following is one such comment in relation to the university virtual learning place, i.e., a virtual platform:

> *[there are] Numerous examples of expensive sites that are outdated and hard to use, like for example GUL. Big challenge is to get tech that is adjusted to the specific needs of learning and not to some idea of what should be used.*

When education is organized according to academics for language learning and teaching practices, the language teacher students make references to checking, practicing, training and exploring, support, and that they are encouraged to use the Internet for authentic purposes. However, what we see from the results in the case presented and discussed here, when the use of technology is student driven, there is a shift in focus from technologies characterised more by domain-specific dimensions to educational technologies characterised by more generic dimensions

Conclusion

It has been argued here that, although the case study presented here is limited, the language teacher students' accounts raise issues of major relevance to the futures of language teacher practices. There are students, future language teachers, who can be argued to be what we here call advanced users of digital media in various virtual places. They are engaged in activities throughout a regular day in their own practices, while the educational practice to which they refer seems characterised by a more traditional educational practice. The concept of bridging activities and shuttling were used as analytical tools for an increased understanding of how the future of language learning and teaching could be understood and addressed. Though the student group of future teachers is not a homogenous one, this does not make the problem less crucial to target from a pedagogical perspective. The voice given to the advanced language teacher students in this study, and the problems they raise in their accounts, point to shared problems that could be further developed with educational practitioners engaged in teacher education and in collaboration with teacher students. The concepts of bridging activities and shuttling can serve as mind tools, together with the arguments regarding changed audience and authorship in collaborative virtual places and the participatory and performative nature of learning.

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SOCIAL BOOKMARKING AND TAGGING IN A BIOLOGY CLASS

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Introduction

Social media pose challenges as well as opportunities for networked learning. In particular, outside information sources may be seamlessly brought into education, and students may share and discuss those sources in novel and unfamiliar ways. These changes are not merely technological additions to traditional ways of learning and teaching, but transform learning activities, as any technology used for learning will (see, e.g., Säljö, 2010). There are of course several facets of such transformation. On the one hand, students are provided with tools for co-construction of knowledge, coupled with knowledgeable external sources. On the other hand, students and teachers must also gain an understanding of how to use the new tools for educational purposes. Technological tools must not only support the specific learning goals of a course, but also serve to bridge educational goals with students' previous knowledge and experiences. In other words, the adoption of a tool into an educational context will put demands on teachers and students to bridge their previous understandings of the tool (or similar tools) with an educational use. The case we present here concerns social bookmarking and tagging, adapted by an upper secondary school teacher for use in a biology class.

We will approach social media in education from two related theoretical concepts: the sociocultural construct boundary object and digital literacy. The first will be used in terms of the particular understandings that students are intended to gain, and the second to describe how students move between everyday and scientific understandings of a subject area as treated within a social media environment.

Boundary objects are tools that bridge different social worlds (see Star, 1989). These are shared entities that serve as means of translation between intersecting communities. They have different meanings in each community, but also have a common identity. One example in academia is scientific publications. These have a common identity in being repositories of knowledge, but are used in quite different ways by diverse groups such as scholars, funding agencies, media, and policy makers.

Boundary objects and tagging

Star and Griesemer (1989) defined the term boundary object as 'objects which both inhabit several intersecting social worlds ... and satisfy the informational requirements of each of them' (p. 393). Boundary objects have been subject of much discussion and more elaborate definitions. They are entities that can satisfy the needs of different groups of people simultaneously, and thereby aid coordination and alignment of work. Each different community that uses a boundary object attaches its own meaning to the object because people in the community have a need for the boundary object to work as an informational entity for that community. But the meanings of a boundary object also have shared components, so that they may work as means of translation across intersecting communities. In other words, they work as a common point of reference between communities, but have different meanings for each community (Bowker and Star, 1999; Wenger, 1999). Wenger (1999) lists four characteristics of boundary objects: 1) They are *modular*, so that each community may use specific parts of the artefact. 2) They are *abstract* so that there are central aspects that are common across communities. 3) They are plastic so that they *accommodate* themselves to different communities. 4) They are *standardized* so that each community has set criteria for what constitutes the object and how to use it.

Digital artefacts often have attributes that may turn them into boundary objects. For example, Bowker and Star (1999) discuss how we categorize our desktops. This is done in an individual and fairly ad hoc manner, but there are also tools to aid us in arranging them. However, despite these tools we struggle to make things fit into the structures of folders, file names, date stamps, task bars, etc. To complicate matters, we must also pay attention to larger and ever growing standardized systems of formal categories in applications and on the Internet. The use of information systems involves linking experiences gained in different times and places, mediated through technology. Information systems provide persistence across communities, require interpretation by each community, and permit understanding of others' positions (Stahl, 2006). These are all attributes of boundary objects, but the artefacts may in practice work more or less well as boundary objects. According to Christiansen (2005), they should emerge from standardization attempts that allow users to create their own boundary objects.

Standardization is driven by technological development as well as social agreement. If, for instance, tags or relations between links were more strictly specified by the web's programmers, they would probably be too rigid to be able to work as boundary objects. In Wenger's (1999) terms, they would then instead be reifications. On the other hand, if they were less socially agreed on, they would be too unspecified to be understandable within and across communities. Christiansen (2005) argues that environments for computer-supported collaborative work (CSCW) would ideally be boundary objects because they should serve as common ground for different communities of users in the workplace. These environments should neither be constructed as boundary objects nor be left entirely open for user interpretation. Rather, they should emerge from standardization attempts that allow users to create their own boundary objects.

One type of Web 2.0 tools that could provide opportunities as boundary objects is the tagging of media such as images, videos, and web links and bookmarks. Websites for images and video (e.g., Flickr and YouTube) encourage users to tag their submissions with their own words in order to aid searching and grouping similar content. There are also tools where users collect and organize links and bookmarks, share these with each other, discuss, and tag them. These tools could be used in line with Christiansen's (2005) suggestions, because they could be used for user-driven standardization. Tags and bookmark collections could be *modular* because one would use areas and definitions corresponding to one's own interests; *abstract* in terms of referring to concepts, and of being generic pointers to other information; *plastic* in terms of being interpreted differently by different communities; and *standardized* so that each community would know how to tag and bookmark within that community. Ultimately, tags and social bookmarks would form taxonomies, which are more traditionally used as boundary objects.

In the educational context we have studied, tags could be conceived of by the students as they collected popular scientific articles on the Web. Since tags are collaboratively constructed, the collection of tags would represent a standardization attempt by the students. Hypothetically, the tagging activity could then create an intermediate boundary object because it would connect students to the scientific taxonomy (or scientific repository, known by their teacher) while also allowing a place for their everyday understandings. We call it an intermediate boundary object because it is in development. In particular, standardization, and sharing with other communities cannot be expected to be fully realized even if the potential exists. The more traditional boundary object for which one would strive would be biological taxonomy. Pedagogically, the tagging activity was motivated by its similarity to the creation of concept maps, which also would function as an intermediate boundary object.

The question, then, is whether students and teachers who use a social bookmarking tool in class really do make their collaborative tagging into an intermediate boundary object, reminiscent of a taxonomy, and if so, how? In order to gain some insight into that, we conducted a case study where the social bookmarking site Diigo (http://www.diigo.com) was used in an upper secondary biology class, and evaluated its use in terms of how students bookmarked and how they tagged their bookmarks.

Social bookmarking in Diigo

The social bookmarking tool Diigo was chosen as the technical platform on which to conduct our study. A basic feature of the social bookmarking tool Diigo is the ability to share web bookmarks with one another, and also to share description, tags, highlighted and annotated text, and discussion around the bookmarked page. Also, one may create and join groups that center on a common interest (for instance a subject or a class), these groups can be private or public.

Participants may also annotate bookmarked items and view discussions in a graphical layer on top of the bookmarked content rather than only as ordinary discussion threads. Figure 1 below shows a view of Diigo where students are involved in discussion. The view is a layer on top of a web page about Charles Darwin on the website of The Swedish Museum of Natural History (2011). Highlights and comments are only visible to the members in the Diigo group. This view is seen by the members in the group when they are logged on to Diigo; the 'Diigo Web Highlighter' shows the possible ways to highlight, bookmark, make sticky notes, and share the item. Some of the students and/or teachers have bookmarked and highlighted text, and others have commented in sticky notes on top of the page. In figure 1, nine different items are highlighted. The first highlighted sentence, 'Allt levande på jorden...', has five comments (shown by the small grey boxes). The fourth highlighted sentence, 'De individer...', is marked and the yellow box shows two of five comments to these sentences.

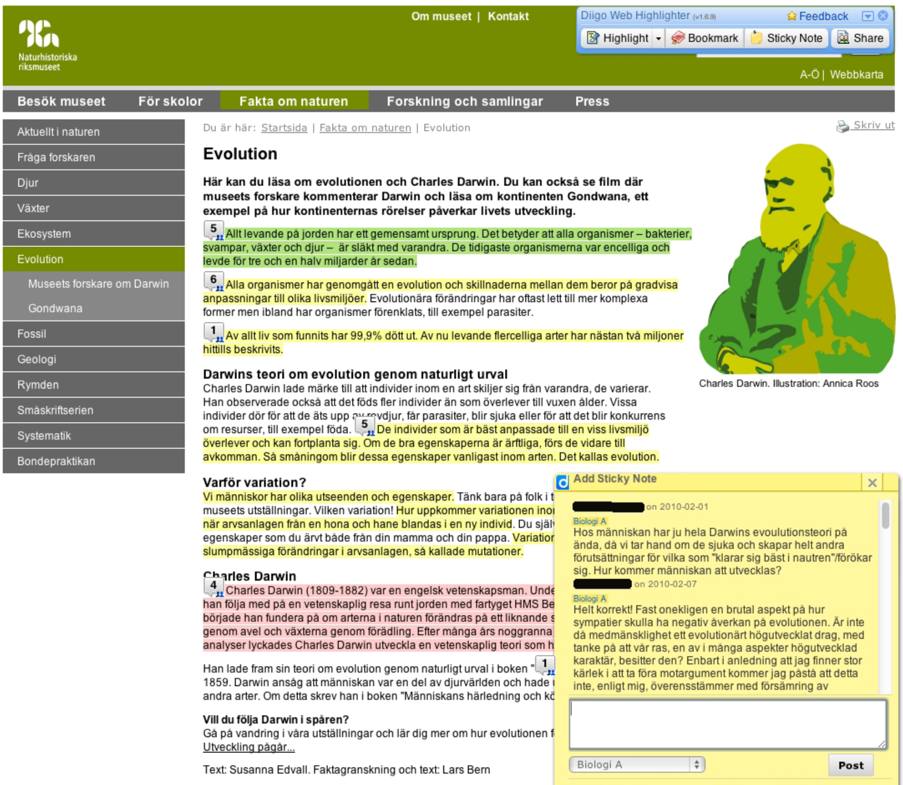

Fig. 1. A discussion on the topic of Darwin and evolution.

When bookmarking, participants have the option of creating tags for the bookmarked item. This may be done by the user who provides the bookmark, or by any other user who participates in the discussion regarding that bookmark. Figure 2 below shows discussion in Diigo around a linked bookmark ('I skuggan av Darwin', 'In Darwin's Shadow'). Participants have labelled the link with four tags: 'evolution', 'naturligt urval' ('natural selection'), 'Darwin', and 'Lamarkism'. The group members have highlighted sentences and also initiated a discussion by posting a comment on the link. Below that, there are replies and discussion concerning the article, its highlighted parts, etc. In this case, all items that are linked to the tags 'naturligt urval' and 'evolution' have been selected as search criteria ('selected tags' at the top). The related tags below have been dynamically generated because they appear in posts where the two first ones also appear.

Fig. 2. A discussion and tags in Diigo.

Categorization and concepts in science education

Very few students in upper secondary school will pursue a career in biological science later in their lives. One may view primary and secondary education as being served a smorgasbord of opportunities; only a few will be taken but all should (ideally) be open for everyone. On the other hand, one stated purpose of primary and secondary education is to provide general knowledge in specific subject areas including science. The Periodic Table and biological taxonomy are examples of categorized scientific knowledge that only a few students will actively use in their careers, but is important general knowledge for all. The instrumental reason for being important general knowledge is that these concepts may in some situations appear as boundary objects. That is to say that students should retain enough knowledge about them to 1) *ideally* have some knowledge about the existing universe and life in it, and 2) *instrumentally* be able to use this knowledge as a boundary object in order to function in their future communities, including general communities such as public opinion and media.

Categorization is of fundamental importance in natural science and particularly in biology, but not only in science. It is intrinsic human traits that exist and have existed in all cultures (see e.g., Bowker & Star, 1999, p. 131). To learn how to categorize is an important part of the students' education. Early teaching involves children in learning activities where they categorize figures, and later, words and scientific concepts. New technology provides more possibilities to work with categorization on all levels. But at the foundation of information technology for learning categorization lies another important technological artefact, namely concept maps, which are commonly used for categorization of scientific concepts. Of recent interest is a study by Hay, Kinchin, and Lygo-Baker (2008), where it is argued that linking new concepts to old ones is central to learning, and that this linking could occur by constructing concept maps in the beginning of a course and then modifying them as the course moves on.

Students' work with the relationship between everyday and scientific concepts is fundamental in educational activities. This relationship is central to concept formation. Being able to understand and participate in specialized language is one of the main goals of school (Ludvigsen, 2011). Scientific concepts are developed through institutional practices and science, and these differ from everyday concepts that we appropriate through social interaction in everyday life (Ludvigsen, 2011). Similarly, Macken-Horarik (1996) makes a strong connection between knowledge in a subject area and the ability to express oneself in that area. She identifies three different domain-specific literacies: everyday, specialized, and reflexive. Scientific concepts belong to specialized literacy, which has a subject specific discourse that has to be learned. The term ‘literacy’ is of course historically as well as currently problematic because of the strongly negative connotations of being labelled as illiterate. Nevertheless, the term is useful when discussing strong connections between the ability to express oneself in a subject area and knowledge in that subject area. Literacy, in this sense, is the manifestation of knowledge that may be shared with others. Knowing how to write in, e.g., scientific domains is an essential part of belonging to that domain.

There are overlaps between scientific and everyday domains, and students must not only learn how to write in the new domain, but also how to switch between different ones. Moving between everyday and specialized domains furthermore has strong connections to the Vygotskyan concept of the Zone of Proximal Development. It concerns filling the gap between what the student knows and does not yet know. Moving between these literacies has bearing on the discussion on boundary objects. In order to use a concept or category within a boundary object, one must know at least one use of the term, but preferably two or more. If two uses are known, one may understand different boundary objects from different perspectives. For example, if one knows the scientific meaning of the concept ‘experiment’, one is enabled to understand boundary objects such as data concerning environmental issues from a scientific perspective, and also boundary objects such as descriptions of systemic (‘experimental’) changes in schooling from an everyday perspective. The key lies in knowing when to apply which sense of the word, and one may only know that if both senses have been incorporated.

Categorization is central to students who learn how to take part in scientific communities (see, e.g., Ludvigsen, 2011; Novak, 2006; Hay et al., 2008; Macken-Horarik, 1996). Categories can make students aware of how a systematic orientation to knowledge can appear. The relationship between a more general concept and simple facts therefore becomes easier to identify. When this identification is part of institutional practice in a complex society, students will benefit if they become socialised to take a critical stand towards any kind of information. The capacity to both differentiate and integrate information is crucial in specialised discourse in both schools and society (Ludvigsen, 2011).

Social bookmarking tools provide opportunities for working with categorization. In line with the above, we focus on the students' categorisation of information that is valuable to them in the context of the course. This reflects students' and teachers' own work with making the scientific practice transparent. The scientific practice will not be transparent to students if they are only exposed to advanced scientific discourse, vocabulary, and categories. It is the students' own work with the categories that makes the area transparent to them (Ludvigsen 2011).

Context of the study

Our study took place during the first biology course in an upper secondary school in Sweden. There were 28 students in class. Of these, 27 used the tool and 18 agreed to participate in the study, and signed consent forms. Data were collected from one sequence of the course where Diigo was used. The sequence took place during one and one-half months in the middle of a course that had a duration of one year. Students were already accustomed to using web-based tools such as wikis, collaborative word processing applications, and blogs. They were also used to being involved in the process of testing and validating web-based tools in learning activities. Students were under no circumstances obliged to use Diigo.

Setting

The class's teacher designed the task where students were presented with opportunities to collaboratively learn the selected parts of a national course syllabus (see below), which included scientific concepts in biology. The task had two phases:

Phase 1 - concepts

Before Diigo was introduced, students worked with sorting and finding patterns in the concepts that were included in the national course syllabus (Skolverket, 2001). Phase 1 started with students in groups of four answering the question, 'What is biology for you?' Then the students wrote all concepts they could think of concerning that question. Concepts that were related to the course syllabus were collected. By systemizing and finding patterns among these concepts, the students worked with generalisation and categorisation of the concepts.

Phase 2 - Diigo

Marking up data with tags in the tool Diigo was intended as a continuation to 'sorting concepts' in the beginning of the course (Phase 1). From the teacher's point of view, the idea of using Diigo was that students and the teacher collaboratively create a content collection with useful sites for the course and a 'conceptual cloud' - a folksonomy that contained and structured the key concepts of the course. The idea was also that the students should discuss the content in Diigo.

The teacher's intention was that the students should find information about evolutionary theory, question and comment on it. Thereby, they should reach at least two politically decided goals of Swedish upper secondary education: 1) 'have knowledge of the theories of natural science concerning the origins and development of life' (Skolverket, 2001, p. 16), and 2) to develop 'their ability to search for biological knowledge from different sources and critically examine this' (p. 12).

The task started with an introduction of evolution theory, which included a practical exercise, a comprehensive lecture, and jointly listening to two podcasts from Swedish Radio. Students were introduced to Diigo, acquired accounts, and tested the tool. When the students had familiarized themselves with Diigo,[18] they joined the Diigo group.

The next step was to formulate their own questions about evolution, search for relevant information, and save that information in the group. The students were told to write a brief critical evaluation of the source, tag it with the most important concepts in the text, and highlight and comment on central parts of the content. They were told to write overall comments it in a 'description box'. The students worked with the task during four lessons and between those lessons. It ended with a lesson where students discussed a visual representation of the concepts that they had formed (a tag-cloud), sorted the concepts, and compared them with concept maps that they had made in the beginning of the course (Phase 1, above).

Method

We analysed the tags used by the students and categorized them according to whether they were scientific or everyday concepts or belonged to

18 http://www.diigo.com/tools

other categories (table 1, below). The everyday categories were further split into whether they belonged to the course or not, or the utility categories 'classification of source', 'synonym', and 'misspelling'. All tags were classified in only one of the categories, but some did not fit and were marked with 'No Category'. We also noted tags that were removed or added to an item when other members reshared items with the group.

Analytic category	**Definition**	**Examples**
Relevant scientific concept	The concept belongs to the scientific taxonomy of biology. Broad concepts such as *växt* (plants), *fisk* (fish), and *rovdjur* (predator) were also included, although the teacher expected that everyone know these concepts. Scientific concepts that were not part of the course syllabus or the task (e.g., gravitation) were not classified as 'relevant scientific concept'.	*ekologi* (ecology) *epigenetik* (epigenetik) *evolution* (evolution) *fisk* (fish) *mutation* (mutation) *människa* (human) *sexuellt urval* (sexual selection) *systematik* (systematics)
Everyday concept within the course	All concepts that were not classified as 'relevant scientific concept' and which concerned the content of the task were analysed as 'everyday concept within the course'. Even broad concepts with multiple meanings such as *egenskaper* (character), *sexuell* (sexual) were placed in this category if the concepts were related to the subject.	*byggstenar* (bricks) *den första cellen* (the first cell) *livets uppkomst* (the origin of life) *variation* (variation)

Everyday concept outside the course	Concepts such as *gud* (God), *kristendom* (Christianity) that were discussed but not related to biology were classified as 'Everyday concept outside the course'.	*bedrägeri* (fraud) *Gud* (God) *historia* (history) *skapelse* (creation)
Classification of sources	The category was used whenever a source such as blog, film, or Wikipedia was specified.	*blo*gg (blog) film (film) radio (radio) Wikipedia YouTube
No category	Tags that do not belong to any of the four categories above.	- kring (round) om (about) översätt (translate) skola (school)
Synonym	Words with similar meanings including linguistic form variants	*Männ*iska (human) Männ*iskan* (the human)
Misspelling	Spelling errors	Lamark instead of Lamarck naturligturval instead of the two words naturligt urval (natural selection)

Table 1. Analytical Definitions of Tags.

These distinctions were highly influenced by Wells' (1994) elaboration on scientific and everyday concepts. Scientific concepts are those that belong to biology as a science, i.e., they are general and systemically organized within that area. The judgment of which tags belonged to which area demands expert knowledge, and was therefore conducted by the teacher (who is also an author of this chapter). In other words, tags that we deemed as 'scientific' were those that the teacher judged as part of the scientific learning goals of the course.

The analytical definitions with examples are presented in table 1.

We kept tallies of straightforward data such as the frequency of tags, how many bookmarks had tags, and how many times each student used a tag. We compared all tags in the tag cloud with the tags displayed on the group page in order to find out which tags were removed, added, or modified when the members reshared bookmarked objects. This was done in order to find out how the members tagged same item, and if they used same or similar tags. When a member tags and reshares an item, the latest version is displayed on the group page, but removed tags remains in the tag-cloud and link back to the item. The relations to other tags also remain and are viewed when a tag is selected in the tag cloud. Here we only have the 'negative' resharing; it is not visible if a student added tags to previous tags. A similar methodological concern is that when a group member tags and shares an already shared item, only this last version of tags are displayed on the group page (see figure 2). Tags that are removed from the item when it is reshared with other tags will remain in the tag cloud, but are not displayed in the group pages (figure 2).

Results and analysis

As one would expect when trying novel technology in class, results were mixed. Students tagged their bookmarked objects in very different ways and some students did not tag at all. A tally of tagging data revealed that, in total, there were 107 objects, 75 unique web pages, shared with the group by 18 students and the teacher. Of the shared items, 23 were unique web pages shared more than once, and four of these were reshared with the same tags. Of the remaining 19 items where the tags were replaced by other tags, 9 of these were the previous tags replaced with 'no tag' and on 10 items the tags were modified.

Sixty-eight of 75 objects were tagged, with 3.5 tags per item in average. In total 134 different tags were used 262 times and each tag was used two times on average. One hundred two tags were used only once and the most frequently used tags are presented in figure 3, together with which student used the tag. In this graph, it becomes apparent that some students tagged more than others, and it shows which tags were reused more than others. The number of tags per student is available in figure 3.

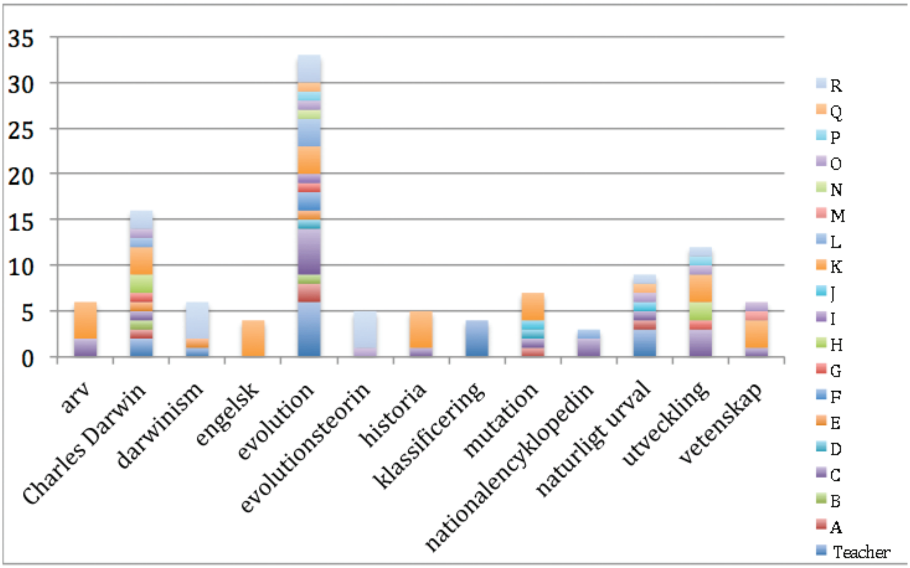

Fig. 3. The most frequent tags. Each letter corresponds to one student, and the y-axis represents how many times a tag was used.

The tag cloud that represented the result of all students' tagging had a flat structure, i.e., only a handful of items stood out as more significant than others (figure 4 below).

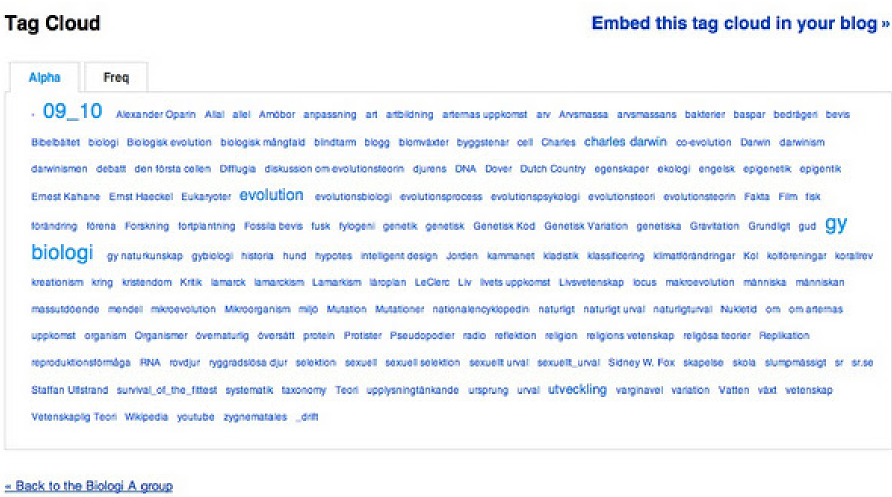

Fig. 4. The tag cloud based on the students' tagging in the course.

The participants used 14 tags on average, but four members (Students C, K, R, and the teacher) accounted for almost 65 percent of the tags. These members stand out in the compilation of the categorized tags (figure 5, below). Our categorization of the unique tags resulted in the following tally.

'Relevant scientific concepts'	63
'Everyday concept within the course'	33
'Everyday concept outside the course'	26
'Classification of source'	8
No category	5
Duplicates / Synonyms	9
Misspellings	5

Table 2. Categorization of the unique tags

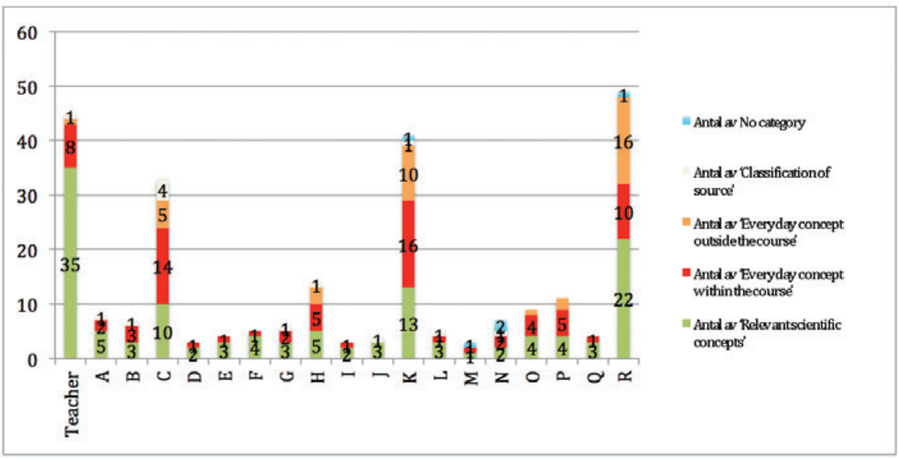

Fig. 5. Teacher and students tagging, categorized.

All students that tagged used tags categorized as 'relevant scientific concepts' and 'everyday concepts within course', but with a wide number of tags. Only six students used 'everyday concepts outside the course', and those six were also the six most frequent taggers. Three students (C, K, and R) stand out as much more frequent taggers than the others. It is also notable that all but one of the students used everyday as well as scientific concepts.

In general, the students did tag according to course contents, but also used their own familiar everyday concepts as well as some concepts outside the course. We will now discuss in more detail what the tagging activity meant in terms of working towards a boundary object in biology. There are two issues that will be highlighted: 1) The flat structure of the tag cloud and the reasons behind that, and 2) the relationship between the different types of tags.

Changed tags – an intermediate boundary object

Diigo clustered tags were based on the same URLs and this created a web of related tags, but no concepts were sorted out in the tag-cloud. The data shows that 102 tags were used only once and that 3.5 tags were used per bookmarked object; this caused a flat structure of the clustered tags.

The data also show that some concepts were used more frequently; this indicates that the members started to adopt a similar 'tagging vocabulary' and the members thereby started to develop their own sorting. On the other hand, the same analysis shows that students more often used different tags. On 10 of the reshared pages, the tags were modified, i.e., the students tagged the same URL with different tags than previous members.

Of particular interest are instances when tags were replaced by another member's tags. This occurred when the pages were reshared. In one of the reshared bookmarked objects, the tags 'charles darwin', 'evolution theory', 'Lamark' (*charles darwin, evolutionsteorin, Lamark*) were replaced by 'evolution', 'natural selection', 'Darwin', and 'Lamarckism' (*evolution, naturligt urval, Darwin, Lamarkism*). Concepts with a similar meaning were changed and replaced, as was the case with 'Everyday concepts within course'; 'Lamark' was replaced with 'relevant scientific concepts'; 'Lamarkism', with the 'relevant scientific concept'. 'Evolution theory' was replaced by another student with the concept 'evolution'. This shows how the members used their own vocabulary when they tagged and labelled things differently.

In summary, the data show that no tags were emphasized and that the structure of the clustered tags and URLs was flat (as visualized in the tag-cloud). But the data also show that the students on some occasions used their own vocabulary and that the members at the same time started to adopt a similar vocabulary, albeit riddled with synonyms, misspellings, etc. An intermediary boundary object began to emerge, but did not reach a common standard for the group.

Spelling and semantics

One reason for the flat structure of the tag cloud was the use of several synonyms/duplicates such as Charles – Charles Darwin – charles darwin – Darwin. A few tags were misspelled, such as 'Lamark', which should be 'Lamarck'. Synonyms and misspellings are problematic in folksonomies, because the software does not recognize these as similar tags.

In tools such as Diigo, tags can be presented according to how they are related to each other. In figure 2, the two tags 'naturligt urval' (natural selection) and 'evolution' (evolution) are related to 18 other tags. The similar tags 'darwin' and 'charles darwin' constitute an example of where students used different tags for similar concepts. This might be of major importance due to the small amount of tags and shared items in the group, which have a huge impact on the folksonomy.

The relationship between tags is only an account of with which other tags occur, with no regard to their semantic content. However, these tags are semantically related to the two selected tags, and are also scientific and related to the course.

In order for a tagging activity to work as an intermediary boundary object that should direct students towards scientific understanding, it is important that the tags' semantic relationships are clear to the students. The kinds of misspellings and mislabelling we saw here counteracted the making of a boundary object because the participants must be able to know that they are discussing the same thing. Also, the tag cloud as a potential visual support for the boundary object will not work if there is no consensus on how to spell the concepts.

Tags

Almost half of the tags were interpreted as 'relevant scientific concepts' and these were mixed with everyday concepts, both outside and within course. The data shows that most students tagged and shared items with 'relevant scientific concepts' and 'everyday concepts within the course'. The members added different tags to the same bookmarked object. One example is when the teacher's tags 'evolution biology', 'climate change', 'invertebrates', and 'radio' were replaced with the tags 'protein', 'fish', 'sr. se', and 'development'. The teacher had tagged 'relevant scientific concepts', which were complemented by other tags that were relevant for the student. These concepts were linked to the same URL and clustered.

Tagging – student activity

The students used the tagging function in different ways. In summary, the activity described above tells us that there were some problems with tagging, namely that there were misspellings and use of synonyms that counteracted the construction of a common concepts.

In other words, it seems that students did not fully understand how to tag so that their tags became keywords and concepts that were collaboratively accepted in the class. But on the other hand, a coherent picture of scientifically relevant concepts emerged regardless of that. Students did seem to notice which scientific concepts were related to the current one. We argue that this is the case because scientific concepts were tagged together.

Discussion

The bookmarking tools provides means for tagging texts with concepts, but not all students tagged the bookmarked texts, and tagging was done more or less successfully. We contend that tagging is a difficult task, and when using social media in education more effort has to be spent on skills such as tagging. These skills are of course developed frequently outside of particular subject matters, in our case biology.

This raises question about which new media literacies are relevant in second upper school in order to prepare the students for life in an information society. We discuss these issues and suggest how to avoid some pitfalls and how to take opportunities when using social bookmarking in class. Some issues (e.g., semantic relationships, replacing tags) are technological design issues. We will demonstrate how features of the tools structure the learning activity, and propose how to design those features.

Tags

Our data were limited to tags, i.e., text in the social bookmarking tool after the course was finished and the teacher's design of the learning activity. Therefore, we can give an account of how students tagged, but we make no claims on anything definitive about the students' appropriation or understanding of scientific concepts. That kind of result would involve other types of methods, e.g., classroom studies or experimental tests.

The learning activity that was organized here could be seen as an attempt to connect students' everyday information (digital) practices and culture with learning biological scientific concepts, in other words, an attempt to achieve 'bridging practices by means of which the relationship between everyday concepts and cultural resources can be connected to scientific concepts' (Ludvigsen, 2011). It is striking that the students and the teacher tagged most of the bookmarked items with concepts that were relevant for the course.

Intermediate boundary object

One-third of the members in the group mixed the vocabulary of scientific discourse with everyday concepts in their tagging, and the folksonomy that began to emerge is the students' version of the taxonomy – the intermediate boundary object. The students used their own vocabulary, and when they were tagging 'provide[d] their meaning in their own understanding' (Wal, 2005). In other words, they used concepts that suited their social world. But this intermediate boundary object only partly bridges different social worlds. The teacher was the only representative of a scientific community and there was no external participant. The intermediate boundary object could serve as a teaching tool for the teacher to illuminate the students' social world (in the context of a class), by discussing the tags that they provided. Further, this could be clustered differently by using theoretical foundation and software from the tradition of working with concept mapping to collaboratively build a taxonomy.

On the other hand, by working more with digital literacies and tagging, the intermediate boundary object could be developed. Concepts are sorted out and a 'common vocabulary' is constructed. Here we have an interesting dilemma: a folksonomy is generated by individuals applying tags to serve their own needs, while taxonomies are defined by experts. It would be interesting to see whether a more developed tagging activity in school, where the students learn to take part in scientific discourses, would generate a folksonomy closer to a boundary object in biological taxonomy.

Another way to develop the tagging activity would be to use social bookmarking tools to connect students to scientists, who are tagging with scientific vocabulary (taxonomy), while also allowing a place for their everyday understandings.

Students' and teacher's literacies

Subject specific concepts

The students created a resource of multimodal texts and in doing this also categorized the texts. However, the students did not get explicit instructions on how to tag the texts, and there were several problems when tagging. Nevertheless, the students used scientific concepts, and with the help of the tool they linked scientific concepts to each other.

They also used everyday concepts. The students were exposed to all kinds of texts, which they bookmarked and shared with the group. The students were not experts in the subject matter and did not have scientific knowledge; they picked texts and other media that they thought were relevant and tagged with, for them, relevant tags. As in everyday Internet/media activities, the students are exposed here to a mixture of scientific concepts and everyday concepts. A further pedagogical step would therefore be to aid students to find ways to connect everyday concepts and other cultural resources to scientific concepts.

It is demanding for the teachers (and the students) to maintain a balance between teaching subject specific knowledge and introducing new cognitive artefacts, where the need is, at the same time, to teach digital literacy. It is still a question whether students and teacher understood all the possibilities and functionalities of the tool and if the teacher understood how to use the tagging possibilities in the learning activity. The study presented here has only analysed textual data saved in Diigo. In this case the teacher did not teach about digital literacy (how to tag) and it is also clear that it was challenging for many students to use the tool. Working with social bookmarking tools needs education in digital literacy.

For the students to appropriate scientific knowledge, simply classifying and tagging multimodal text is not enough. One suggestion based on the case here is to combine the tagging possibilities in a tool such as Diigo with concept mapping (tools). Students could work with the tags, for example, to classify everyday and scientific concepts, to find patterns in the scientific concepts, and from there, reconstruct the tag cloud.

Tagging using Diigo

Social bookmarking provides features for co-constructing knowledge in class through linking tags and abstract concepts of the shared information. But it is a demanding activity for the students and teacher to both understand/learn the scientific concepts and learn how to tag information in a tool that requires specialized kinds of digital literacy.

The way in which a social bookmarking tool mediates between concept and students should also be brought into question. Design changes to the tool could alter its meditational properties to be more in line with students' learning activity. One suggestion would be to visualize co-occurrence between tags. This would show where conceptual links exist, thus making the tags more into concepts. Also, one could use techniques from computational linguistics to find synonyms and misspellings. These two features would aid students in creating a collaborative and hierarchical taxonomy.

Tagging is a difficult task, and when using social media in education more effort has to be spent on skills such as tagging. Digital literacies cannot in a learning activity be separated from other literacies such as categorization, and these skills are not easily separated from subject-specific knowledge and the social and collaborative functions of tools (Knutsson et al., 2012). These skills are of course frequently developed outside of particular subject matter such as, in our case, biology. This raises questions about which new literacies are relevant in school to prepare students for reality in the information society and how this is combined within the subject and organization of collaborative learning activities.

Some of these issues may be resolved in design. But it is important that design of technological educational environments involve interaction design as well as design for learning. In line with Christiansen (2005), environments should stay open ended so that students and teachers may create boundary objects, but also provide tools that assist students' standardization attempts when incorporating new contributions or outside information into the collaborative effort.

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TEACHING PBL WITH WEB 2.0 – A CASE STUDY OF POSSIBILITIES AND CONFLICTS

Nina Bonderup Dohn & Lillian Buus

Vignette

Peter, the teacher of the BA-level problem-based learning course, sighed as he read through the Facebook postings entered by his students during the last 10 hours. Where were the theoretical questions and methodological issues he had been expecting? Once again, the students had posted links to YouTube videos with short comments along the lines of 'Check this out – highly relevant for our course'. But no elaborations were supplied on how the videos were relevant much less how they could be analysed and discussed through the theoretical lenses of the course. Obvious rejoinders from some of the course readings seemed to be completely overlooked by the students. Even worse, a lot of the postings never got beyond practicalities such as length requirements or meeting schedules. Why didn't the students make use of this opportunity to build knowledge together, and to reflect and discuss with each other and with him in this safe and familiar setting? He had even promised them unlimited supervision as long as they interacted with each other, too. How come they weren't all wild at the keys asking all the questions they had never had answered before?? Where were their academic ambitions?

Introduction

The vignette is an adapted narrative version of the experience of one of the teachers in the cases to be presented in this article. We shall argue that the experience is typical for the tensions and frustrations in which one may become caught up when one introduces Web 2.0 activities into educational settings. The tensions arise, we argue, because the informal practices of the former, with internal goals of participation, communication, and knowledge- sharing for their own sake, are subsumed under the external goals and expectations of education concerning the acquisition of knowledge and competence. This assumption leads to a clash in practice between, on the one side, the norms and logic of Web 2.0 activities, and on the other hand, the educational logic of the course in which he is participating (N. Dohn, 2009; N. B. Dohn & Johnsen, 2009). In the vignette, this clash is actualized as the conflict between knowledge sharing 'in the way of Facebook' and knowledge building 'in the way of the educational system'. 'The way of Facebook' is here characterized by the sharing of links and information, the making of everyday comments, and sense making through patchworking of resources. 'The way of the educational system', on the other hand, is characterized by theoretical analysis, methodological reflections, and critical discussion of cases and perspectives. The vignette thus illustrates that teachers who employ Web 2.0 activities in their teaching may face unexpected challenges due to the inherent tensions between the educational and the Web 2.0 practice logics. The structure of the article is as follows: First, we identify a number of pedagogical design issues for Web 2.0-mediated PBL activities. Then we present the method and design of the study and report our findings. In the final section we discuss to what extent the project was a success as concerns the development of viable ways of making use of Web 2.0-mediated activities in support of a PBL approach and explain the difficulties experienced by the teachers theoretically.

Pedagogical design issues in Web 2.0-mediated PBL activities

We understand 'Web 2.0' from a practice perspective as a set of *activities or practices* characterized by

» a high degree of interactive multiway communication between users;

» 'bottom-up' production and transformation of content;

» renunciation of copyright and distributive authorship; and

» continuous use and reuse of material across contexts (Dohn, 2009).

There are obvious learning potentials in activities centred on the users' generation and use of content in and across learning contexts. The work of Scardamalia and Bereiter on knowledge building communities shows this conclusively (Scardamalia & Bereiter, 1994, 2006). In a broader perspective, the potentials involved in student-centred context-crossing have also been documented by other pedagogical approaches, including PBL and POP[19] pedagogy based in face-to-face learning settings (Boud & Feletti, 1997; Dirckinck-Holmfeld, 2002; Fogarty, 1998; Gijselaers & Wilkerson, 1996; Illeris, 2004)there are many possible forms that a curriculum and process for teaching and learning might take and still be compatible with this definition. This book explores these forms in six parts with 33 chapters, beginning with an introductory chapter, \"Changing Problem-Based Learning. Introduction to the Second Edition\" (D. Boud and G.I. Feletti and portfolio pedagogy (Dysthe & Engelsen, 2004; Klenowski, 2002). Context-crossing is not a defining characteristic of these approaches as it is of Web 2.0 practices. However, POP pedagogy has a central focus on 'problems' as opposed to curricula. As students pursue their problems, they are led across different subject domains and working/learning contexts, often traversing borders between school and other life practices on the way. Thus, context-crossing in practice becomes an important feature of many of the students' projects and tasks in POP. Similarly, portfolio pedagogy focuses on a multitude of diverse tasks and on the development of corresponding competencies. The range of tasks also often leads students to a high degree of context-crossing.

19 Problem-oriented project pedagogy

The significance that context-crossi teaching and learning within PBL settings. Conversely, the bottom-up, many-to-many communicative practices of Web 2.0, focused on production and use of content rather than reproduction and acquisition of it (Dohn 2009), concur with the defining characteristics of PBL, i.e., that students are active in producing knowledge through a collaborative engagement with problems (Glud, Buus, Ryberg, Georgsen, & Davidsen, 2010; Ryberg, Glud, Buus, & Georgsen, 2010). More specifically, Web 2.0 activities provide potentials for PBL through making possible

» the organization of flexible learning across formal and informal settings;

» the development of competences necessary for participating in contemporary society;

» specific pedagogical advantages connected to learners' formulation and discussion of content issues; and

» motivational benefits of learner involvement (Dohn, 2010).

However, though these potentials are clear from a theoretical point of view, there exists only a limited amount of research into viable ways of realizing them in practice. Such research is necessary, because the concrete implementation of Web 2.0 activities in PBL settings raises a number of pedagogical design issues, the investigation of which is paramount to the question of success versus failure of Web 2.0-mediated PBL activities in general. These design issues relate to the tension between the student initiative and control of the bottom-up approach of Web 2.0 and the teacher initiative and control of educational settings (Ryberg et al., 2010, cf. below). Among these design issues, the following are central:

» Which role should Web 2.0 activities have in the overall PBL framework? Should they, e.g., be used to generate ideas for problems to work on, for establishing reflective spaces for students, for dialogue with relevant parties outside the educational setting, for contact between students and teacher, or something else?

» How does the teacher act as a facilitator at different stages in the Web 2.0-mediated PBL activities? How does she balance her authoritative and participative roles, e.g., leading, scaffolding, and commenting on a par with the students?

» How are off-task Web 2.0 communications handled in the PBL setting (e.g., as part of or as interruptive to the problem-centred learning activities?) and what are adequate teacher roles and responses in this context?

» How can teacher competences be developed to support teachers in designing and initiating adequate Web 2.0-mediated PBL activities?

The current article provides a contribution to the discussion of these issues by presenting three concrete examples of dealing with them in practice.

The methodological approach

In order to investigate these issues, an action research project was initiated with teachers at the Faculty of Social Sciences, Aalborg University (AAU). The action research project followed the approach of Interactive Research (Svensson, Brulin, Ellström, & Widegren, 2002; Svensson & Aagaard Nielsen, 2006), where a researcher and practitioners collaborate in a joint learning process to initiate interventions in practice with the double goal of producing new theoretical knowledge and of qualifying practice.

In this article we report on three interventions, each involving the researcher (the second author) and a practitioner. The practitioners each taught a course on their own. Two of the interventions took place in the same course and thus involved the same practitioner.

The degree to which the researcher and practitioners realized the Interactive Research approach was very different for the two courses. In the first one (Case 1), the researcher participated very actively in the pedagogical and technological facilitation of the Web 2.0-mediated activities. She also attended all the lectures held by the teacher and had conversational interviews with her about the progress of the activities. Thus, the teacher and researcher developed the project by means of co-research and co-participation to a high degree. In the other course, involving two cases (Case 2 and 3), the researcher had many discussions with the teacher prior to the course, but participated only in the first and last lecture. She did not attend any of the many face-to-face learning activities in between these lectures. She partook in the initiation of the Web 2.0-mediated activities in both cases, but not in the facilitation of them as they unfolded. The differences were due partly to differences between the teachers as to the degree of technological and pedagogical facilitation they wanted and partly to differences in the concrete activities undertaken.

The project was initiated by a kick-off workshop in Spring 2011, followed by the development of the three case interventions. The workshop was held utilizing the Collaborative E-learning Design (CoED) method (see Ryberg, this volume).

On its own, the CoED method does not test the design and sustainability of the results gained in the workshop, nor does it facilitate the implementation process. From other projects using the method it has become increasingly clear that the method needs to be supplemented on these points in order for it to support the development of viable course/learning designs. Thus, quite generally, an extension of the CoED method is called for (Buus, 2012). Therefore, the teachers were scaffolded in further developing their ideas from the CoED workshop and transforming them to actual learning practice.

The study further comprises data conducted by individual interviews with the teachers in order to get a more formal documentation of their perspective on initiating and participating in Web 2.0-mediated educational activities. Finally, surveys have been administered to students in the second and third cases. Students in the first case were invited to a focus group interview, but no one signed up for it.

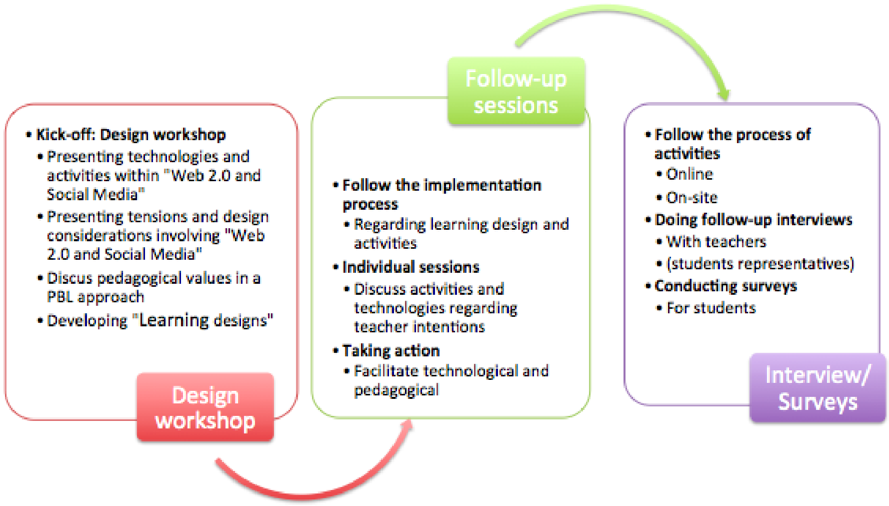

Fig. 1. The steps in the action research project

Course of events

The setting: PBL at Aalborg University

Educational programmes at Aalborg University all conform to a general PBL model, where 50 percent of the work students are expected to perform during a semester (counted in ECTS) is assigned course work and 50 percent is project work undertaken in groups. In the project work, students exert a high degree of control: they define the problem on which they work, explore, negotiate, and draw up a solution to it. In contrast, the teachers are the prime locus of control in the courses. The notion of control is understood with reference to Ryberg's model that specifies three dimensions regarding PBL, namely *the problem*, *the work process*, and *the solution* in the continuum between teacher control and learner/participant control (Ryberg et al., 2010; Ryberg, Koottatep, Pengchai, & Dirckinck-Holmfeld, 2006).

However, many teachers try to engage students and facilitate their learning through implementing more traditional and restricted (in terms of time and student work) PBL activities (Boud & Feletti, 1997; Gijselaers & Wilkerson, 1996)there are many possible forms that a curriculum and process for teaching and learning might take and still be compatible with this definition. This book explores these forms in six parts with 33 chapters, beginning with an introductory chapter, \"Changing Problem-Based Learning. Introduction to the Second Edition\" (D. Boud and G.I. Feletti as well as Active Learning activities (Bonwell & Eison, 1991; Chickering, Gamson, Poulsen, & Johnson Foundation, Racine, 1987) *within* their course settings. Thus, educational programmes at Aalborg University may be said to have PBL activities at two different levels, nested within each other. The top level is the overall structure of the educational programmes where the courses are intended to supply thematic overviews, theoretical input, and inspiration for topics for the group projects. The lower level is then comprised of PBL activities within the courses.

The primary focus of the study was PBL and Active Learning activities at the lower level, i.e., in relation to the courses. The aim thus was to investigate how Web 2.0-mediated activities might be implemented to enhance such course-related learning activities.

The CoED workshop

In keeping with the primary focus of the project, the overall aim of the CoED workshop was to further teacher awareness of Web 2.0-mediated activities and to let the teachers collaboratively develop ideas for how Web 2.0-mediated learning activities can be integrated into course-related PBL settings. Approximately all the 160 teachers at the Faculty of Social Sciences were invited to participate in the workshop and made aware of the possibility of collaborating with the second author on implementing Web 2.0-mediated learning activities in their courses after the workshop. It was stressed that participation in the workshop did not involve a commitment to activities afterward.

Twelve out of the 160 teachers signed up for the workshop, but only seven actually attended it. Two course designs were developed at the workshop. The designs concerned an existing course, taught by two of the participating teachers. However, these two teachers decided not to proceed with implementing the designs in collaboration with the second author. Instead, three other teachers volunteered to participate in the next steps of the project. Together with the second author they developed (in all) four cases, with inspiration from the workshop. However, only three of these four cases made use of Web 2.0-mediated activities to support PBL. In the fourth case Web 2.0 tools were used in a course design, which integrated Active Learning activities but was not problem based. Since the focus of this article is on Web 2.0-mediated learning activities to support PBL, we restrict ourselves to discussing the other three cases.

The three cases

The three cases all took place in a blended learning environment where web-based tools and e-learning platforms are used to complement lectures. Two of them involve applying PBL in course work by integrating narrative 'real-world' or 'real-world-like' problems as vital aspects of the courses. The students were required to collaborate in groups, discuss, negotiate, and explore to find solutions to problems.

The first case (Case 1) was implemented in a course involving approximately 140 students divided into two teams for lectures. The course ended with a two-day workshop where all the students were present in a joint session. Here, they worked in groups on the same case to which they had to apply different theories. The case consisted of integrating a blog into the lectures to support the students in collaborating and sharing work connected to the lecture content. Before each lecture, the teacher inserted into the blog questions concerning theoretical perspectives to be presented at the lecture. During the lecture, she then presented a case for the students to discuss. The students discussed in small groups and posted their comments in the blog. Afterwards, they were supposed to comment on or question the postings of all the other groups. With this activity, the teacher intended to help the students in tying the theoretical perspectives of the course to concrete cases and to promote reflections and discussions. This was done to practice a collaborative approach and support the students in developing an understanding of the potentials of knowledge sharing with an eye to the final two-day workshop. Here, the students had to contribute their different case analyses to a collaborative platform. In doing so, the differences between the theoretical approaches (and their practical implications) become perspicuous. Therefore, the collaboration in the case was potentially beneficial for all students.

The other two cases were both implemented in the same five-week long, intensive master class course, finalised with a group report based on analysis of collected data from a questionnaire. The students came with many different cultural and educational backgrounds: the group numbered 76 students and two-thirds of them were international students from approximately 20 different countries. Their knowledge of how to work with PBL at AAU was therefore very limited.

In the first of the cases implemented in this course (Case 2), unlimited supervision in relation to the group project within the course was offered to the students, provided that the supervision took place in the form of writing a blog/forum/group feature. A class vote was held to decide which tool to use and the outcome was that a Facebook group was established for supervision. Prerequisites for getting supervision from the teacher were: 1) the students could only get supervision in the Facebook group; and 2) at least one fellow student should try to answer or give good ideas before the supervisor gave his feedback.

The teacher's intention for the activity was to make students aware that collaborating allows one to learn more than one can learn alone and makes one contribute to delivering a better 'product'.[20] Furthermore, the teacher intended the students to experience the presence of the supervisor to a higher degree than in traditional supervision settings. In their final project, the students were required to indicate how many contributions they had made to the Facebook group, specified as new postings and comments to others. Their degree of participation did not count toward their final grade, though, since there was no foundation for this in the study regulations.

Case 3 consisted in introducing the students to two Web 2.0 tools for sharing and collaboration, which would support their collaborative work both in relation to the group project within the course and to their semester project work (cf. the section on PBL at Aalborg University, above). The second author gave a short presentation on Web 2.0 tools and illustrated how they could be used by students in educational settings. The tools presented were Diigo (a social bookmarking tool) and

20 Product' here refers to the group project.

Zotero (a social reference tool). By introducing these tools, the teacher's intent was to make students aware of their practical potentials, individually in relation to their project as well as collaboratively in relation to sharing and networking as a group.

Findings from the study

In all of the three cases, the overall intention was to make students share knowledge and collaborate more while becoming aware of the benefits for them in doing so. At the same time, the teachers wanted to support students in developing the practice of using each other to scaffold learning.

Concerning the first case, the teacher reports that the blog activities made the students more willing to present to each other and to share among each other. This is illustrated by the fact that they, at the end of the final two-day workshop, suggested that each group should place its case reflections in the common blog for the teacher to comment on. The aim was to share their understandings of the case and get comments with an eye to the exam later on. The teacher agreed, though she had not initially planned such a follow-up activity, and set a deadline for the end of the week. In the end, all groups posted their material and the teacher commented.

Further, the teacher emphasizes that it is generally important for her during class to strike a balance between lecturing and student activity. She found that integrating the blog and the activities around the blog to some extent made teaching 'easier' because the students became very engaged and because the blog activities resulted in an appropriate balance between her lectures and the students' collaboration and knowledge sharing. However, she found it difficult to find a good way to evaluate the students' work on the blog. Any evaluation had to be done within the timeframe of the lecture, as there were no course activities planned between lectures. Given such time restrictions, she was unsure whether to comment on all of the blog posts in full or to take out essential statements (adequate and inadequate) from some of them and discuss these statements in greater depth. She does not find that 'a really good method' was established, and so considers the evaluation method an issue to be worked on in the next iteration.

In addition to the time restrictions, the teacher mentions the technology setup as a barrier for implementing the activity. She was very pleased to have a more technically competent person (the second author) to scaffold her in this respect. In the course of the study, she acquired some skill in setting up the blog for the lectures, but she was for instance not able to set up the divided access for the two groups of students. In a reflective talk with the second author, she mentioned the possibility that the secretary (who is a super user) might in the future set up the divided access. This suggestion is not unproblematic since it would mean an extra workload for the given secretary, assigned to her not on the basis of her formal duties, but solely on the basis of her competences.

As regards the second case, the teacher reports that the students used the Facebook group in a somewhat more private matter than he had expected. They made hardly any use of the opportunity to be reflective, critical, or ask methodological or theoretical questions related to their course project. They primarily shared links and videos related to course topics, but without reflections on the significance of the links and videos, i.e., on *why* and *how* they were related to the topics. Students did not themselves manage to attain the sufficient academic level in their questions and dialogue. However, the teacher stresses in the interview that he nonetheless thinks he succeeded in being closer and more visible to the students in the Facebook supervision than under normal supervisory circumstances. Following this, he elaborates on how he thinks Web 2.0-mediated activities might be developed to support supervision. He reports that in the next iteration of the case he plans to supplement student input with some methodological and theoretical questions posted by himself as teacher in order to kickstart a more appropriate learning dialogue. In a sense, of course, one should be able to evaluate the value of offering unlimited supervision through the quality of the students' project reports. Here, the teacher did not experience any noticeable difference as compared to reports produced by students in the past, i.e., no conspicuous improvement or degradation.

As a side effect of the case, the teacher reports having envisaged that students would become aware of the benefits they might draw from collaboration, especially considering their diverse educational and cultural backgrounds. This side effect seems to have continued for a while, at least to some extent, since the students kept their Facebook group going after the course ended and used it for sharing for some time afterwards. One student suggested changing the name of the group from the current one, which refers to the course, to one that denoted this specific group of students who could then use the group for the full length of their studies. No one reacted to this, however, and the activity in the group subsided after a couple of months. The students never got beyond posting about practical issues and relevant links; no critical reflections or dialogue developed.

The teacher mentions that he considers making participation in knowledge sharing in an activity such as Case 2 a formal requirement in the study regulation in order to let participation count towards the students' grades. This, he points out, would motivate students more towards participating and thus increase their possibilities of experiencing the benefits of collaboration.

Finally, the teacher reflects on how he thinks Case 2 fits into and supports PBL at AAU. He says that the course in question is based on a 'PBL back to basics' approach because students deal with a real-world company case in which real world issues have to be solved. The students therefore have a chance of actually influencing the company. More specifically, they may supply the company with a business analysis that may be integrated in the company. In this context, Facebook's (social) network dimension is especially interesting because it enables the students to share and collaborate not only in small groups of 4-5 people but across the whole group of students.

As concerns the parallel activity, Case 3, which was kicked off in the first lecture, the student survey revealed that only one student had adopted Zotero (the recommended reference tool). He had done so because of the benefits the tool held for him individually, with regard to time saved in making reference lists and footnotes and the possibility of avoiding spelling mistakes. No one adopted Diigo. Among the reasons listed for not adopting the Web 2.0 tools, the following were the most salient:

» the need to balance the time involved in adopting new systems vs. the time required for project and group work;

» user friendliness; and

» limited notion of the benefits in using the tool.

Finally, it should be noted that both teachers expressed satisfaction with having a second person with a technical and pedagogical background to scaffold, share, explore, and elaborate on their implementation of the Web 2.0-mediated activities in collaboration with them. They felt that this gave them the possibility of expressing and discussing their thoughts and reflections.

Discussion and Conclusion

In this section we discuss the findings in relation to two questions: 1) Were the cases successful in developing viable ways of making use of Web 2.0-mediated activities in support of a PBL approach? 2) How can we explain the difficulties which the teachers experienced in establishing an adequate learning dialogue within the Web 2.0-mediated activities?

Starting with question 1), the study has succeeded in producing viable, though not tension-free, new designs for learning that utilize Web 2.0 as pedagogical tools within the framework of PBL. Both Case 1 and Case 2 thus are successful with regard to the facilitation of student activity in and/or between lectures and – as evaluated by the teachers in the interviews – with regard to the initialization of practices where students share knowledge and collaborate with each other, at least to some degree. More specifically, the first case shows that it is possible within a concrete course setting to strike a balance between the formal requirements of the educational context and the informal communicative practices of Web 2.0. The teacher reports that she feels she succeeded in delegating much of the responsibility for learning and communicating about course content to the students. The blog constituted a space for reflections among students, supported to some extent by the teacher's evaluative comments in the lectures (during the course) and in writing (after the final two-day workshop). The activity established a space for knowledge sharing and collaboration, which the students appreciated to the degree that they took the initiative to continue the knowledge sharing beyond the final workshop. Likewise, Case 2 was successful in establishing a beginning practice of information sharing between the students, even if it primarily concerned practical issues and links.

For both cases, however, the interaction was more distributive than collaborative in character. None of the students collaborated about educational matters as much as the teachers wanted them to. The role of the teacher is important here. Within the existing PBL settings, teachers have a more authoritative and dialogue initiating role than students and this has implications for student expectations and actions. They expect teachers to supply comments and evaluations rather than their fellow students. Conversely, they are hesitant about supplying comments themselves. To change this, the teacher has to be more explicit about what s/he expects from the students and facilitate their collaboration to a greater degree.

The necessity of teacher facilitation of student activities if participation is to be ensured is also indicated by the outcome of the third case. Here, the teacher had decided beforehand that the Web 2.0 tools should be presented during class, but that he would not facilitate their adoption by the students. Case 3 was therefore intended as a purely student-based activity, and the students could choose not to adopt any of the tools. This was indeed what happened for nearly all students, even though they report that they could see the advantages of the tools.

A further result concerns the role of the second author in providing the technical support needed to realize the Web 2.0-mediated learning activities. On the one hand, the current study clearly indicates that technical issues may be a significant barrier to the development of teacher competences within the design of Web 2.0-mediated learning activities. As discussed above, the teacher in Case 1 was dependent on the technical support of the second author for carrying out the blog activity and it would most probably have been aborted had it not been for this support. On the other hand, the study also shows by example that it is possible to go quite a long way towards empowering teachers within the technological-pedagogical realm if this is done through close collaboration between the teacher and a technical-pedagogical facilitator. If institutions wish to upgrade teacher competences within Web 2.0-mediated learning (and in general, by analogy, within ICT-mediated learning), indications are that such collaboration projects might be a worthwhile way to go, even if they are somewhat demanding in terms of resources. If anything, the study shows that teachers need even more scaffolding than was supplied here.

Moving on to question 2), the data from the study reveal several instances of tensions in relation to the facilitation of what the teachers deem an adequate learning dialogue within the Web 2.0-mediated activities. One such instance (Case 2), instance A, is the teacher's frustration over the lack of academic level of the posts and over the fact that students communicated in a more informal and private manner than he found appropriate in a course context. A second instance, instance B, is displayed in the difficulties (Case 1) which the teacher experienced in finding an evaluation format for the blog postings. A third instance (Case 2), instance C, also concerned with evaluation, shows up in relation to the teacher's considerations of changing the study regulations so that student participation in Web 2.0-mediated learning activities would count towards the students' grades. These instances can be explained theoretically by drawing on earlier work by the first author (Dohn 2009; Dohn & Johnsen, 2009). Here, the general claim is made that utilizing Web 2.0 activities for educational purposes leads to a) inherent theoretical tensions in implicit views of knowledge and learning, and b) practical challenges regarding a number of pedagogical issues, including collaboration, evaluation, and the general aim and status of the material produced by students.

Briefly, the argument is that inherent in Web 2.0 activities there is a view of learning as participation and of knowledge as situated doing and/or as a distributed trait of a system (dependent on whether one takes a process or product perspective on Web 2.0). On the other hand, educational practices implicitly build on a view of knowledge as a 'something' (an entity, state, disposition, ability, or the like) and of learning as the acquisition by the individual of this 'something'. *In practice* Web 2.0 and education, respectively, incorporate the competing metaphors of learning and knowledge, which has been identified previously as at play in divergent *theoretical* views on learning (Sfard, 1998). The point is here basically the Bourdieuan one: the practice logic of the practices in which we participate is incorporated into our habitus (Bourdieu, 1977, 1990, 2000). As Bourdieu has shown, incorporation into the habitus involves developing a sense of what are right and wrong ways of behaving – a sense which is very often not explicitly articulated, but which shows up as a bodily 'gut feel' of how to proceed and as an emotional response when implicit expectations are violated.

In the narrative of the vignette, which elaborates on instance A, this point is illustrated by the teacher reacting to the violation of educational norms almost as if it were an offence. The teacher's attempt to design an innovative learning activity centred on student contributions in a familiar environment is made on the basis of the expectations of the educational system concerning which types and modes of communications are deemed appropriate. However, he has not fully acknowledged this foundation for his attempt and therefore he is not aware of the constraints and interpretation frames these expectations entail. He implicitly expects the students to take the educational norms for granted, too, and therefore interprets their Facebook postings as a lack of academic focus and ambition within the self-evident norms of educational practice. For this reason, his feelings are also somewhat hurt. In our experience, this is a very common response.

Actually, however, when one considers the informal nature of communication on Facebook in general, it is not surprising that students tend to carry over this tone of voice to a course group established within this overall setting. A similar tendency is reported in Odell, Nevin, Roberts, Willimas, and Remenyi (2008)"page":"231-239","abstract":"This paper describes the initial stage of a one-year research project on the potential value of Facebook as a social networking tool within Higher Education. The project is being run within the School of Architecture and the Visual Arts (AVA. Here, the collision between the informal, equality-based tone of friendship common on Facebook and the asymmetrical relationship between instructor and students resulted in student behaviour that, from the perspective of the instructor (incorporating the educational norms), was highly inappropriate in terms of its degree of intimacy.

It is interesting to note that the teacher decided to remedy the alleged lack of academic decorum level in future iterations by introducing more formal teacher-led discussions into the informal settings. This remedy, as argued by Hemmi, Bayne, and Land (2009), amounts to a scholarly 'reining in' and 'taming' of 'risky' practices in contradiction to the inherent values of the Web 2.0 practices. Hemmi et al. report analogue ways of 'reigning in' 'risky' blog practices. Their studies showed a strong inclination on the part of both teachers and students to utilize blogs as a relatively conventional learning tool to engage in critical and reflective dialogue. At the same time, they provide illustrative interview comments which indicate that both parties found that this was not really a 'Web 2.0 type of use of blogs' (teacher comment, p. 24). Some students quite explicitly reported being conscious that their blog posts had to conform to what the teachers would expect of a 'learner' in the given context (p. 25), thus articulating the inherent tensions between the Web 2.0 'bottom-up' production of meaning and the formal educational requirements.

Further tensions are exhibited in instance B where the teacher finds it difficult to establish an adequate evaluation format for the blog postings. We interpret her worry here as a result of the practice logic of the educational system which posits 1) student inputs as documentation of the degree to which they have acquired an understanding, viewed as an object, and 2) her as the authority who has to endorse or reject student inputs. In contrast, within the practice logic of Web 2.0, student input is posited, not as documentation, but as participation in the ongoing process of knowledge creation. Endorsement consists of the use of blog postings by the involved participants (not just the teacher). It should be pointed out that if she in future iterations succeeds in finding an evaluation format that fits the Web 2.0 ideals (e.g., by involving fellow students more in the endorsement/rejection of input), she has to carefully think through the alignment between this evaluation format and the learning objectives and learning activities of the course. Otherwise the risk is great that she – and the students – will feel that her teaching is out of balance and the evaluation format of the blog activity misaligned with the learning objectives of the course and with the final course exam.

Instance B has complements in several examples in the literature. Thus, Lund and Smørdal (2006) discuss the role of the teacher in a wiki and more specifically show how difficult it is for the teacher to find her place as provider of feedback and evaluation in the bottom-up environment of a wiki. Somewhat inadvertently, as analysed in Dohn (2009), the articles by Farmer, Yue, and Brooks (2008) and Ducate and Lomicka (2008) make conflicts apparent between evaluations of blog posts made from a Web 2.0 participative position and from a course-content focused one. In a similar vein, Bruns and Humphreys (2005) point to tensions concerning quality criteria by noting that student entries in a course wiki, accepted within the course, were in need of instructor correction before being made publicly available. Conversely, Hemmi et al. document a common concern among students about how to attribute authorship to wiki contributions in order to be 'visible' as participants for assessment purposes (Hemmi et al., 2009). Naismith et al. correspondingly point out that true collaboration in the spirit of Web 2.0 is at cross-purposes with educational practices that require individual assessment and that, therefore, one as teacher and as institution sends 'mixed messages about what is valued' (Naismith, Lee, & Pilkington, 2011, p. 241).

Instance C involves a clear risk of sending precisely such a 'mixed message' about the value of student postings if the study regulations are changed in accordance with the teacher's suggestion so that student participation would count towards the students' grades. From a Web 2.0 point of view, participation should be bottom-up, motivated by the experienced value of the contributions and the process of producing them, and evaluated from within the activity itself in accordance with this experienced value. The teacher's wish to use the force of the educational system to 'instantiate' a Web 2.0 activity is therefore at cross-purposes with the activity itself. The risk is great that students in consequence will contribute with postings, not because they see the value of them, but because they have to, and that their experience of compulsion will actually diminish the likelihood for them of having positive experiences of collaboration and knowledge sharing (Ryan & Deci, 2000).

Summing up, the answer to question 2 is that the difficulties experienced by the teachers may be explained as examples of the concrete practical challenges, which may result when one introduces Web 2.0 activities into educational settings and thus implements the practice logic of the former within the incompatible practice logic of the latter. It is, however, very clear from the data that the teachers do not themselves think of these issues as practical realizations of theoretical tensions inherent in Web 2.0-mediated educational activities. Instead, they see them as the result of failures on the part of the agents involved in the activities, either failures on their part as teachers to find 'a really good method' for the activities, or failures on the part of the students to take up the activities in adequate ways. This is an indication that an important focus area of future research into educational development with Web 2.0 should be the empowerment of teachers to deal with the inherent tensions and challenges, not least by raising teacher awareness of their existence. The current study points out the following key questions for such research:

» Develop teacher awareness of the theoretical tensions involved in Web 2.0-mediated educational activities and their implications in practice;

» Develop learning objectives that accommodate both educational requirements and the view of knowledge and learning inherent in Web 2.0 activities;

» Create alignment among learning objectives, learning activities, and evaluation formats;

» Develop teacher roles and participation forms adequate for these learning objectives and activities; and

» Develop teacher competences so that teachers can themselves design pedagogical Web 2.0-mediated activities and can handle them technologically, pedagogically, and communicatively.

In conclusion, the current study has documented the development of viable ways of making use of Web 2.0-mediated activities in support of a PBL approach (question 1). Thus, the two cases provide existence proof that Web 2.0 activities may contribute constructively and productively to learning within a PBL perspective. More specifically, they provide examples of how to deal with the abovementioned pedagogical design issues facing Web 2.0-mediated PBL activities. However, the study also documented several difficulties that arose in the process, not least for the teachers whose expectations concerning the Web 2.0-mediated learning activities were disappointed on certain points. These disappointments have been analysed as the result of the inherent theoretical tensions that are implemented when Web 2.0 activities are utilized within educational settings (question 2).

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GUIDING TOWARDS GENUINE PARTICIPATION – LANGUAGE LEARNING AND NEW TECHNOLOGIES

Leena Kuure, Tiina Keisanen & Maritta Riekki

Introduction

In August 2010, a multifunction centre was opened in a residential area of a city in Northern Finland joining under the same roof a school, a kindergarten, youth services and a library. The opening had been preceded by a lengthy planning and construction process, accompanied by decision making and discussions on various forums. As the major user group of the building had been envisioned to be school children, an important theme in the discussion concerned pedagogic innovations, especially in relation to new technologies. The design of the building, the facilities, and the technological solutions were supposed to contribute to the users' active citizenship, community participation, and collaborative learning. The centre, thus, constituted a fruitful case environment for a multidisciplinary research group, which examined 'everyday life in technology-rich neo-communities' in a longitudinal research project[21] focusing on the topic from children's and young people's perspective.

Previous research and results from the first stages of the project had suggested that 'genuine participation' was still a far distant goal (see Hart, 1992, 1997; Chawla, 2002; Chawla & Heft, 2002). Genuine participation is here understood as opportunities or means that children have for active agency in daily decision making concerning the activities that their

21 CHILDeLINE - The potential of a technology-rich environment in enabling children's genuine participation

lives involve. Such participation may be used in assisting and advancing positive change in the current state of affairs (Hart, 1997; Middleton, 1998). Even if children have been treated as participants in research and design projects for some time, according to the recommendations of various strategies and guidelines, research has shown that the criteria for genuine participation have seldom been met (Halkola et al., 2012). Likewise, in the tradition of language teaching, even in the modern one, children are typically positioned as 'learners', and not as people who, actually, may already have strong linguistic and communicative resources due to their free-time interests and contacts with foreign languages (see Benson & Reinders, 2011). Thus, our aim here is to give value to children's own agency and to promote a view where school-driven learning is but one way in which learning may take place.

This chapter presents the first intervention by the research group in the spring of 2011, focusing on children's genuine participation at the multifunction centre. The participants were Finnish school children (11–13 years of age), and the organizing team including researchers, teachers, and language students. The study examines how the students were guided in planning and implementing a problem-based, participatory process and what the outcome of the process was. The special challenges in the intervention were instigating genuine participation and supporting the language students, i.e., prospective teachers, in acquiring new practices as guides in such projects.

Research Context, Methodological Choices and Data

The intervention that took place in the spring of 2011 was tied to a university course called *Language Learning and New Technologies* (LLNT). The course is organized every year with different foci and themes. As such, the course functions as a boundary object (Star & Griesemer, 1989) in a multilayered process, joining together the worlds of school children, their teachers, language students at the university (some of whom are prospective language teachers), as well as university teachers and researchers.[22] This time the approach was problem based in creating a language learn-

22 The multilayered pedagogic model for the course has been discussed in more detail in Koivistoinen & Kuure (2010).

ing project during which the students were engaged in designing and carrying out different types of participatory workshops for children.

According to Crabtree (2003, p. 132), participatory design can be seen as an approach to systems design that emerged from Scandinavia from the early 1970s. Its primary strategy consists of a commitment to workplace democracy, which translates into the direct and active participation of workers in the design process in the effort to enhance rather than destroy their skills and quality of life. Schuler and Namioka (1993, p. 73) suggest that participatory design is a learning process in which designers and users learn from each other. We are drawing upon a broad notion of problem-based learning as an evolving, collaborative process among participants with varying amounts of expertise in a variety of fields, in relation to technology, languages, literacy practices, and a range of interest fields among others (e.g., Brown, Collins & Duguid, 1989; Brown & Duguid, 2002; Engeström, 1987, 1999, 2001; Engeström & Middleton, 1998; Hakkarainen, Lipponen, & Järvelä, 2001; Lave & Wenger, 1991; Wenger, 1998).

Language and literacy learning are here seen as a social-interactive process (e.g., Mondada & Pekarek Doehler, 2004), taking place in a nexus of practice of a variety of situated actions (e.g., play, reading, writing, and design as in Wohlwend, 2008). Technologies are an integral part of our everyday life and increasingly utilized in education (e.g., Luukka et al., 2008; Blin, 2004; Dooly, 2009; Kukulska-Hulme, 2009). Video and Internet games, for example, may provide authentic learning environments for learning efficient team work, language, interactional practices, and even routines that require persistent and tedious repetition (see, e.g., Arnseth, 2006; Gee, 2003, 2008; Kuure & McCambridge, 2007; Piirainen-Marsh & Tainio, 2009). Multimodal media bring their own challenges for developing literacies. They offer a channel for participating in multilingual and multicultural communities, and negotiating different identities, roles and relationships with the cultures involved (Lankshear & Knobel, 2006). These are issues of central concern in the LLNT course: Potential language teachers of tomorrow are encouraged to challenge their concepts of language learning and envision possible directions for language teaching in a technology-rich world (see Schön, 1987).

On the organising team, there were a total of 19 members: 13 students (advanced level, English Philology, 6 male and 7 female), the teacher of the LLNT course, and five other members of the multidisciplinary research group (two from languages and three from information processing science). Additionally, there were two researchers participating certain phases of the work related to the use of near-field communication (NFC) technology in mobile devices. Before the course started, issues of research ethics had been clarified (see, e.g., Ackerman et al., 2003; Thomas & O'Kane, 1998) and contacts with the school established.

At the beginning of the course, the students were first introduced to the principles of participatory design and the project goals. After a period of preparation and project planning, the students started the activities with children during a 'theme week' at the school with four participatory workshops with children (*Photoscreen*, *Translate a Song*, *Write a Story*, and *Touch and Learn*). After the theme week, the students used some time creating concepts for the future, arising from the work done (their own brainstorming on future technologies of language learning and the experiences at the school with children). They also prepared toolkits for future use (guidance materials for reuse of the workshop activities) and wrote their final reports, including an evaluation of the results.

In its long-term project, the multidisciplinary research group follows the strategic phases of nexus analysis, i.e., engaging, navigating, and changing the nexus of practice, a network of linked practices (Scollon, 2001, p. 147). This involves advancing from one project to another as a participatory venture, interacting with various participants, collecting multiple types of data, and conducting analyses through different approaches (Scollon, 2001; Scollon & Scollon, 2004; see also Hine, 2000). In doing nexus analysis, the researcher's first task after identifying the social issue and the relevant community for study is to enter into a zone of identification with its members, i.e., to become acknowledged as a legitimate member in the community as a researcher. After this engaging phase, the researcher may then proceed to navigating for answers through different kinds of methods and data (e.g., discourse and interaction analysis). Although triggering change is a conscious step in nexus analysis, the researcher contributes to change in the community being studied when entering it and participating in its practices. The current study is located in the navigation phase, at the point when the researchers have already stepped into the community being researched.

In this approach, social action is viewed as mediated (Scollon, 2001; Wertsch, 1991, 1998; Vygotsky, 1978), as an intersection of historical body (Nishida, 1958), interaction order (Goffman, 1963, 1971), and discourses in place. Historical body refers to personal experience and culture. Interaction order refers to the possible arrangements by which we form relationships in social interactions. All social action is situated in real time (Scollon & Scollon, 2003), and language is thus interpretable in its actual context of use (discourses in place). This perspective on social action allows an analysis of complex phenomena both on micro and macro levels.

The focus of the study is on the efforts by the teacher and the researchers to contribute to the university students' thinking and practices in relation to the project goals. The study aims to answer the following question: How did the teachers and the research group guide the university students in the participatory design process, the aim of which was to design language learning workshops for the future, instigating genuine participation? Data were gathered throughout the preliminary phases, the school project, and the student project (course) in various ways: video recordings of in situ action, pictures, observation notes, interviews, various digital information, and artefacts. Informed consent was asked from every participant for the use of data.

The research process advanced through different stages. In the analysis, the notions of interaction order, historical body, and discourses in place (Scollon, 2001; Scollon & Scollon, 2004; Scollon & Scollon, 2003) were used as heuristic tools to examine the nature of social action at focus, here, the guidance of the university students. After identifying the scope of the study, we arranged workshops delving into the data. We made notes and discussed our initial observations, bearing in mind the three intersecting aspects of social action. Mediated discourse analysis (Scollon & Scollon, 2004), combined with the multimodal analysis of social interaction (Streeck, Goodwin, & LeBaron, 2011), forms the methodological foundation for the study. In the following, the main methods for facilitation during the LLNT course will be presented in more detail and discussed in terms of their relationship with the trajectory of the project process.

Guiding towards Genuine Participation

The LLNT course drew upon the idea of problem-based learning, where the course participants engage in complex project work in times within the whole course community and in times in small groups or teams. During the project the participants were exposed to real-life experiences in authentic settings, in this case in designing and carrying out different types of participatory workshops for school children. Collaborative learning and learning by doing, also mediated by the use of educational technology, were central pedagogical principles in the course. An important agenda to advance on the course has been to give the students an opportunity to consider current technological change and its impact on education in general, and on language teaching in particular in the coming years. Such perspectivetaking is usually quite difficult for the student teachers, for example, while coping with their ongoing pedagogic studies and teaching practice in the classroom. Figure 1 below provides a rough illustration of the phases of the LLNT course and the built in affordances for guidance.

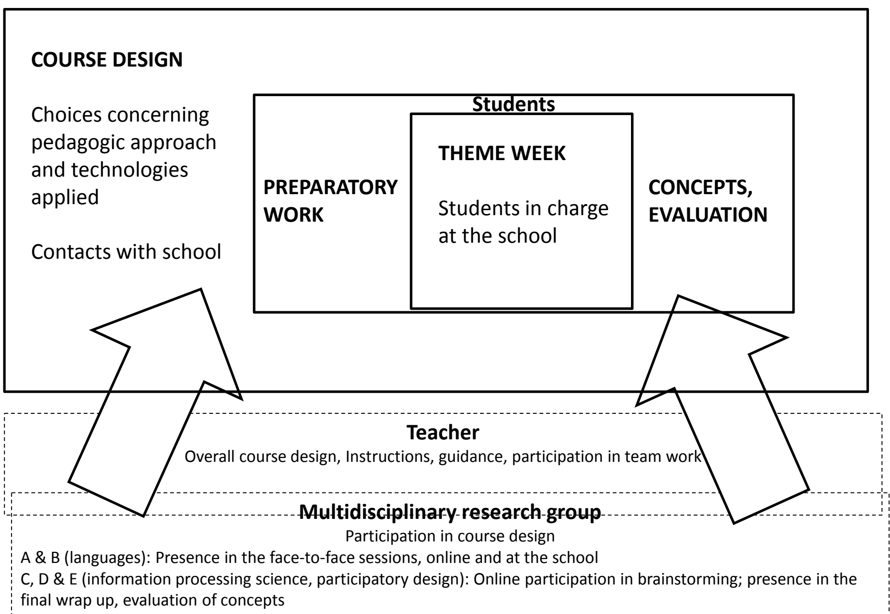

Fig. 4. The LLNT course – the main phases and affordances for guidance

As for the historical body of the teacher and the course, the multilayered approach joining student teachers and schools (pupils and teachers) had been developed and applied for several years already. The main objective of the course had been designed to provide the students an opportunity to meet real-life challenges in language teaching and use technology in its service, especially through learning projects that took into account the children's perspectives and interests and enhanced active language use in collaborative interaction. The learning projects always involved work at the participating schools and in the shared VLE. The courses always started with a preparatory phase (orientation to what is coming and designing the overall approach of the school project as well as preparing the VLE for the purpose), proceeded to the implementation phase with the schools (theme week in this case), and ended in a reflective course wrap-up with project reports and evaluation (lessons learned).

During the course examined in this chapter, a further step was made to enhance children's genuine participation in the practices and decision making in their daily lives, especially in relation to language learning. In developing the course further with respect to this particular aim, the teacher was able to draw upon the expertise of the multidisciplinary research group. In the following, we will discuss various affordances in facilitating the developing understanding concerning the objectives of the course, and how this understanding is observable in the way in which the workshops are ultimately carried out.

Guidance through Course Design

Different types of support were given to the students in different stages of the planning and implementation of the theme week workshops. An essential method provided by the teacher to facilitate the problem-based process among the students was course design with its technological and pedagogical choices. The learning platform (Discendum Optima), on which the virtual learning environment (VLE) was built, allowed the teacher to assign to the participants user profiles that involved extensive access rights and a wide range of tools for participant-driven collaboration. Such technical choices aimed at breaking the traditional IRF pattern (teacher-initiation, student response, teacher follow-up or feedback) for the benefit of more varied collaborative interaction in co-construction of knowledge, which has been shown to have an effect on the actual learning of students (e.g., Van Lier, 1996). In Scollonian (2001) terms, these choices would potentially broaden the interaction among the participants.

In the beginning, the course workspace consisted of the basic structures and guideline documents only and the contents developed in the course of the working process as a joint effort of the participants. The pedagogic approach was based on the following phases during the course.

Preparatory phase

» ORIENTATION (week 11) Introduction, Future workshop, Case examples, Brainstorming, Basic research in the field

» DEVELOPING IDEAS (week 12) Presentations on project fields, Brainstorming activities for the workshops, Deciding on the theme week process and responsibilities for teams

» GETTING PREPARED (week 13) Finalizing the process, Agreeing upon responsibilities

Theme week

» WORKSHOPS AT THE SCHOOL (week 14) Languages and language learning tomorrow

Concepts, evaluation

» WRAP-UP (week 15) Lessons learned, Concepts, Toolkit

The phases above were launched in the face-to-face meetings during the course, then continued as a collaborative process in the course VLE and elaborated further within topic- or task-specific teams, which worked to combine working modes according to their needs and possibilities (e.g., face-to-face meetings and/or work in the VLE, and distribution of labour within the team). As was mentioned above, the course solution had been developed for several years already, but this time the multidisciplinary research group was there to give its support in trying to fine-tune the course in a direction that would enhance genuine participation involving all the participants more systematically than before. Prior to the beginning of the course, contacts had also been made with the teachers in the school. Furthermore, one of the researchers had visited the school and interviewed the children about their opinions on language learning, technology, and what is fun at school. These ideas were introduced to the university students in the initial phases of the project, in order to facilitate the design process. This also provided one, though rather indirect, means for the pupils to participate in the design of their own language learning (see Druin & Solomon, 1996).

Guidance through Interaction

During the actual course, when the students entered the process, the seminar meetings and the VLE provided the important sites for support in reaching the project goals. The preparatory phase involved various activities that aimed at facilitating the students' thinking regarding teaching and learning in technology-rich everyday life. For example, they were invited to envision (ubiquitous) technologies for interaction and communication that might be there in the next few years' time, providing opportunities for teaching and learning languages. This brainstorming was initiated in a face-to-face seminar and continued online. The students also collected resources and gave presentations on some thematic areas relevant to the course.

In the VLE, the discussion lists and the teacher's *Process Log* were channels for mediating course aims as well as, for example, the principles and practices of team work. The extract below illustrates how the teacher communicates to the group her encouragement with regard the chosen pedagogic approach.

Example 1. Process Log in the course VLE 15.3.2011 (Teacher)

> *I also said that people shouldn't worry even if things sound vague – everything will become clearer little by little. I've had projects like this within the LLNT course many years and the students are usually quite happy after the course – they say it was a bit confusing to start with but in the course of the work they saw that it was interesting and there was no trouble.*

The teacher used the log for making the nature of the evolving project clearer to the students. She wrote entries after each meeting summarizing the issues raised, what had been agreed upon, and what kind of information had been gained from different participants, e.g., from the school. If we check the VLE statistics for the document, it appears, nevertheless, that some of the students had only read the first entries in the log. Still, there were various routes via which information flowed from participant to participant, such as small group meetings among students. The knowledge that the teacher conveyed about the history of the course included the issue of so called `vague instructions´. This topic had been raised for discussion repeatedly in the years of LLNT and a lot of negotiation and explanation had been necessary to explain the philosophy of the course: to give the students an opportunity to study topics of technology-mediated language learning and teaching through real-life problems as well as practical experience in solving them in the context of learning projects with school children. It seems that over the years the atmosphere for problem-based approaches has become more open, however. It is also likely that students who have taken the course earlier have shared their experiences, encouraging the new participants to trust that the course will not be too demanding. It seems that the historical body of the students was in the process of change in this respect: Deviance from teacher-led task-definition toward team-based, self-directed co-construction of the task did not cause confusion and resistance any more.

From the point of view of planning and implementing the workshops as participatory projects, it seemed to be very difficult to trigger great changes in the prevalent traditional practices of teaching. The historical body of the students as of the teacher guides the pedagogic design to the direction where pupils are pupils and it is the teachers who bring the activities into the classroom. In the following example, a student teacher (Robert) gives the pupils instructions on an activity in the *Photoscreen* workshop.

Example 2. Photoscreen <T:00:00:02–00:00:34>

```
01 ROBERT:  Okay,
02          (0.6)
03 ROBERT:  So,
04          (1.5)
05 ROBERT:  *What we are going to do today, (0.4) is,
06          *grabs a sheet of paper
07          (1.0)
08 ROBERT:  You take one piece of paper, (that we use &to make now)
09                                                    &grabs a pen
10          (take one times off)
11          (1.0)
12 ROBERT:  You write your name in the middle, %okay like this,
13                                             %starts writing on the paper
14          (2.6)
15 ROBERT:  And then, at the top here you write (.) I like (2.0) something,
16          And, *around the name (.) you have to draw
17               *draws a circle on top of the paper with his finger
18          &the thing that you like,
19          &draws another circle
20          and then under the drawing (.) you write the word in English.
21          (0.6)
22 ROBERT:  Okay?
```

The example is from the beginning of the workshop for this group of pupils. As the data show, Robert straightforwardly proceeds to give instructions on a task where the pupils will draw on a piece of paper a picture of something that they like. The task description is detailed and progresses through the task step by step, for example, *You take one piece of paper* (line 8), and *You write your name in the middle* (line 12). The spoken description of the task is accompanied by a visual demonstration (lines 6, 9, 13, 17) on where to place the required items on the paper. The pupils are expected to follow the instructions without much chance to influence the design or the progress of the task. This initial task description is also partial in that it does not describe what the group will do with the drawings once the pupils have produced them. This description will follow later on during the workshop. Similar task descriptions are prevalent in the other workshops as well.

The situation illustrated in the example above, however, also shows the complex nature of guidance from the point of view of social action in peer groups. It seems that the participants still engage in multimodal and collaborative negotiation of the task throughout. A great deal of the guidance in the *Photoscreen* workshop and in the other workshops took place silently, as children glanced at others working (e.g., looking at the work of the person who was instructed by the student teacher). The *Photoscreen* workshop took place in a small recreational area of the school, where pupils sat close to each other on bean bag chairs or on the floor. The physical distance between the children was thus very small, which made it easier to construct one's understanding of the task at hand by quickly glancing at one's peers working. This special spatial seating arrangement seemed to destabilise the traditional pedagogic practice and enhance pupils' participation in the workshop activities.

Guidance in Retrospect

At first glance, it seemed that during the course, the teacher's goal for students to generate a school project of genuinely participatory nature was not accomplished. However, in the final evaluation session where the other participants of the research team were also present, it became evident how the design process had actually made progress, even if in a different form than anticipated by the teacher. The students had been asked to create concepts as described by the teacher in the process log below.

Example 3. Process Log in the course VLE 11.4.2011 (Teacher)

> *For the Monday session, < the multidisciplinary research group> comes to see when the different groups present their 'Concepts', i.e., suggestions for an application/solution that involves future technology (and, hence, new affordances for interaction, literacy practices and learning). The concepts should be presented as short videos done with Windows Moviemaker or similar (i.e., picture, video, audio, text combined).*

If we consider the activities that the students designed for the school project, there were several aspects that contributed to the success of the project as such, even if the goal of genuine participation was not achieved in the expected form. These contributing factors create the basis for considering what kind of guidance is necessary. It seems that when the students instructed the children to get started in their workshops, the pupils were flexible, ready to do anything, and took on the tasks smoothly. This might be due to their historical role of following the socio-culturally informed practice prevailing in the modern schools, emphasizing interaction, the learners' active role in the classroom, and the teacher's role as a facilitator in knowledge-building rather than a distributor of knowledge. The teachers at the school were also ready to provide their pupils to the workshops, and they presented no requirements for their participation (e.g., requests to follow the 'curriculum' as sometimes is the case with more traditionally oriented project participants). The language students were also open to whatever they were going to face in the LLNT course. Their historical body did not necessarily have much experience from previous problem-based courses: in student reflections after the course, the participants usually state that despite their experience from small group teaching they do not have experience of actual teamwork. As for teaching, some of the language students had previous experience in the classroom and from working with children while others had none. The idea of genuine participation was certainly new to them and they were also ready to take part in envisioning the future in the orientation phase of the course. However, when starting planning, the students seemed to return back to basics, i.e., what so-called `normal´ language teaching would encompass.

In the wrap-up session, the multidisciplinary research group followed the students presenting their concepts and the results of the school project were discussed. While the teacher felt that not much had happened that could be considered genuine participation or a participatory approach, the members of the group who had their background in information processing science and acquaintance with participatory research interpreted the results differently. They explained how the original ideas presented in the workshops actually did take on new forms throughout the working process.

Conclusion

The aim of this chapter was to offer theoretical and practical insights into the study of participatory projects from the point of view of children, language students, and researchers. Special attention was paid to the challenges faced in promoting genuine participation and supporting the language students, i.e., prospective teachers, in acquiring new practices as guides in such projects.

The study promotes a nexus-analytic (Scollon & Scollon, 2004) research approach that combines both the analysis of in-situ (inter)action and the analysis of long-term developments. This entails emphasizing the complex and multifaceted nature of learning, which encompasses not only school-learning but also a multitude of activities which children participate during off-school time. Such a perspective portrays a special challenge to student teachers who in their teacher education programmes gain most of their teaching experience in the classroom environment where the work largely follows the structure of the textbook series, with new technologies an additional resource rather than an integral part of the everyday language learning environment. Such a historical body (Scollon & Scollon, 2004), i.e., accumulated long-term experience and internalized practices connected to the traditional classroom environment, even if socioculturally based (e.g., teacher as a facilitator), does not necessarily provide a sufficient basis for students or even teachers in the field to step away from the textbook-led curriculum towards problem-based approaches, for example, which would give room for stronger agency among the pupils in relation to their own learning. Such a step would require rethinking the nature of language learning more broadly than as an accomplishment in the classroom and, hence, the construction and flow of language lessons as part of our language learning environment as a whole.

Despite the challenge, many of the workshops designed and implemented by the students during the LLNT course attempted to open up and break away from the textbook learning of foreign languages in order to promote an approach where language is essentially viewed as a tool for communication and as something whose home is in its use for social action. Music, storytelling, and using video cameras for recording plays that were produced during the workshops were examples of such means. Obviously, thinking about modern language in teaching these would, indeed, belong to the historical body of the language classroom already, but not necessarily as integrated into a problem-based pedagogic design. What was challenging was to consider how to provide the language students guidance in creating for the children a learning environment allowing their genuine participation during the theme week.

If we consider the guidance that the university students were provided with in their work towards the course objectives in the participatory design process, the analysis of our multiple data suggest that the support drew upon much more than the teacher's verbally or textually expressed interactional contributions. The organization of the virtual learning environment, for example, offered many indications of the nature of participation encouraged. It was possible to adjust the user profile for the students in the course VLE in a way that allowed them to operate with the objects quite freely (e.g., creating, naming, and assigning access rights for folders, documents, and discussion lists). This afforded widening the possible interaction order (e.g., people involved and their roles) in the course environment (Scollon & Scollon, 2004). The problem-based pedagogic approach of the course was identifiable in the VLE as well in the progressive course design. In other words, the course environment only consisted of the basic elements (e.g., some guidelines, a discussion list for the orientation phase, and folders for the main phases of the project) to start with. While the project made progress, more contents were added by the students and some changes made in the structure and elements as also the project itself evolved phase by phase.

The course teacher's actions online, providing support for the participants towards the shared goal of designing and implementing the theme week at school, included log entries, discussion entries, and different actions that reflected the evolving project trajectory in the course VLE (e.g., creating discussion lists when they were needed, checking log statistics, updating the schedule, and informing the students about the contacts with school teachers among others). Class meetings were also central sites for checking the situation, making sure that teams worked well and that the commitment to implement the theme week workshops at the school was going to be fulfilled. The working methods for broadening the students' understanding of language learning, the rapid development of technologies and consequent pedagogic change were future workshops, presentations of the students' mini projects on orientation topics. On these occasions, some members of the research group were also present. The teacher also gave consultation to individual students and teams.

The students also drew upon their mutual expertise as many had already taken units of pedagogic studies, including practice at the training school, or were otherwise familiar with language teaching (e.g., having been substitute teachers).

The school children and their teachers were very pleased with the theme week and thought that the workshops had presented them with language learning opportunities that were different from the everyday school practice. The children had been able to use English as a medium for communication and not as a target of learning only, for example. Dealing with situations where the instructors (the students and the teacher) had only used English (some students were not Finnish speakers at all) had also provided experiences of success in the use of foreign language interaction and learning. In the workshops, the leaders and supporters of the activities had been able to adapt according to the needs arising from the interaction and work with the children.

Despite the abundant affordances for guidance on the course, the research group and the course teacher felt, however, that the ultimate goal of supporting genuine participation had not been fully achieved. The ethnographic observations and video recordings of the execution of the workshops suggest that the guidance was not strong enough to trigger great changes in the students' historical body concerning the way they view future language teaching and the role of new technologies in it. The final project reports and the reflection papers show that the students felt they had been able to successfully cope with the challenging situations throughout the problem-based and, hence, evolving theme week, when only the overall picture of the project is known in advance. In some final reflections, views were expressed on the positive aspects encouraging the students to apply new technologies in their future work, but the examples of possible use indicated that no particular move from the traditional textbook-led approach had taken place in student thinking.

In conclusion, it seems that there are numerous challenges in trying to contribute to change in terms of pedagogic thinking and practice among the students even during a problem-based university course such as LLNT. Even if an abundance of guidance were offered in the form of course design, guidelines, descriptions of objectives, and interaction among the participants through classroom sessions, collaborative work online, and teamwork, the participants come to the course with varying backgrounds, life situations, and motivations. There may be various 'powers' affecting their views on learning, language teaching, related technology-use, and on the teacher's professional profile, too. For example, even if teacher education as such promotes modern views of learning, if the practice period at the teacher training school is primarily based on the textbook-led approach, it may provide the students a strong model of language teaching in their future careers as well. This growing historical body is, obviously, strengthened by the students' experiences from their own language learning histories. It is also of interest that social (inter) action is situated and tied closely to place (Scollon & Scollon, 2004). In the workshops it was seen how an exceptional place such as an open, still confined resting space in the main corridor area as a site for learning put certain aspects of interaction order into foreground. In other words, it was possible to see through video data how guidance took place multimodally, without much verbal contribution, the teacher offering help to one pupil, and the others then observing through delicate gazing what this pupil was doing.

As for the opportunities to contribute to change during the LLNT course, it must be observed that LLNT still is 'only' a course for students. They have to cope with all their other commitments simultaneously. Therefore, even if they wish to participate actively and fulfil the course requirements, the schedule should be flexible enough to allow the organisatory work demanded by problem-based study involving team work, for example (e.g., agreeing on responsibilities, meeting with technical challenges, making decisions, etc.). In the case of LLNT, the timeframe for the whole course seemed to be too tight for building bridges between theory and practice, for example. Actually, a major challenge in conducting the LLNT course and project is its multilayered structure. We are, therefore, dealing with guidance aiming at change in the understanding and practice of language learning for many participants, e.g., the children, the students (some of whom are future teachers and others not), the teacher, and the multidisciplinary research group. There are also teachers at the school with their own expectations and other actors indirectly affecting the molding of the project (e.g., authors of curricula and strategy papers). These issues could be taken into account in the future implementations of the course.

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PART III

EXTENDING THE LEARNING ENVIRONMENT

BRIDGING MODES OF LEARNING IN A VIRTUAL LEARNING ENVIRONMENT – PROBLEM MEDIATION AND USER-DRIVEN INNOVATION IN THE DANISH VOCATIONAL TRAINING SYSTEM

Kevin Mogensen, Janne Gleerup, Simon B. Heilesen, and Anders Siig Andersen

Introduction

The catchphrase 'From Sage on the Stage to Guide on the Side' (King, 1993), originally a plea for a constructivist approach to teaching and learning, is often used when discussing how new technologies may support the transformation of education. Although it proposes a new role for the teacher, the relocation from centre stage to the wings does not fundamentally challenge the notion that the knowledge institution runs the theatre and that the teacher creates the set. In the information society, however, the brick-and-mortar 'theatre' is being augmented or replaced by formal and informal virtual learning spaces, and actors from the outside are making inroads into the once-autonomous knowledge institutions. As to the 'set', new technologies are challenging conventional teaching formats; being digital immigrants (Prensky, 2001), teachers are not necessarily well qualified to head off innovation by themselves.

This chapter discusses methods for bringing the teacher back on-stage as one of several (inter)actors collaborating in designing new teaching formats that exploit the potentials of digital media. The term 'design' will be understood both as the process of planning, constructing, and testing an artefact, and as the actual artefact (a didactic design combined with an IT prototype) that is the outcome of the process. As we shall see,

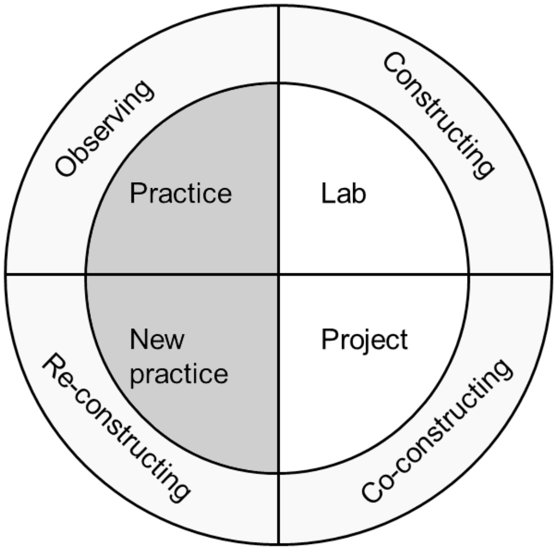

Fig. 1. The Quadrant Model.

the evolving artefact is an indispensable boundary object between the knowledge systems of the various groups of actors participating in a process of user-driven innovation. At the end of the process, adoption in the learning environment of the artefact as a suitable solution is facilitated by the fact that the process has proven the product to be functional and usable as well as being compatible with the users and providing a relative advantage (Rogers, 2003).

The case to be discussed in this chapter involves the training of electrician apprentices at a Danish vocational school. As is common in vocational training, the curriculum consists of alternating periods of attending school and working as an apprentice in a company. As has been established in earlier research (Jørgensen, 2004), a major challenge consists of helping the apprentices realize how the two modes of learning, taking place in different contexts (formal instruction at school, and informal learning at the workplace), add up to a meaningful whole. The design arrived at attempts to bridge the contexts by means of a virtual learning environment, extending the reach of the teacher beyond the school and encouraging the apprentices to engage in learning on the basis of problems encountered in their work.

The research has been carried out as a contribution to the Danish ELYK project (2009-2012; http://www.elyk.dk) which has been funded by the European Regional Development Fund and the Danish Enterprise and Construction Authority. Overall, the ELYK project has addressed the problem of developing and retaining competencies in outlying areas – on the premise that net-based learning may help provide the competences needed for the development and growth of small- and medium-sized enterprises (SME).

Designing for user-driven innovation

Exploring new ways of introducing user-driven innovation into educational design has been the methodological pivotal point of the ELYK project, of which the case discussed in this chapter forms a part (Mogensen, Gleerup, & Heilesen, 2012). Our particular approach to user-driven innovation has been inspired partly by *participatory design*, particularly as it has been practiced within the so-called Scandinavian School of Design (Ehn & Kyng, 1987) according to which the creation of software artifacts involves integrating them into a context of changing practice. This is done partly in the tradition of *user innovation* represented by Eric von Hippel (2005), combining 'voice of the consumer' soliciting of end-user needs with coinvention by 'lead users', and partly by the experimental approach characteristic of *design-based research* in education, involving users as codesigners (Barab & Squire, 2004; Amiel & Reeves, 2008).

In the ELYK project perspective, the term 'user' is understood neither as consumer nor as an individual or group of individuals with particular professional functions. Rather, the user is a construction defined by situation, aims, and relations to other actors (Helms & Heilesen, 2011). Consider the case of the electrician apprentices to be discussed below. When at school, the apprentice is a student; when in practice, he or she is an employee. As a student, the apprentice is a client of the official authorities (e.g., local government); as an employee he is a net contributor to society. In the company, the master electrician is an employer, but he and his journeymen are also teachers. The teachers at school may also be professional electricians, and official authorities both enable and control their work. No role is absolute.

Designing for and with users requires all actors to become involved in the process – apprentices, teachers, masters and journeymen, government (at least in terms of legal framework), and, as we shall see, also the researchers themselves. Effectively, the design process thus also becomes a collaborative learning process to which all participants, acting as equals, contribute in an effort to understand a practice (or a problem) and to devise ways for improving upon it or changing it.

Combining elements from the theoretical approaches mentioned above, and taking into account our understanding of 'user as construction', the ELYK project has developed a four- stage model (the Quadrant Model, fig. 1) that provides a framework for managing processes of user-driven innovation (Helms & Heilesen, 2011). Each quadrant, or 'stage', represents a work phase, and from one stage to the next there is a progression in time and substance. But the model is not entirely linear – as suggested by the term 'quadrant' -- and iterations may occur both within and across stages.

The first quadrant (upper left) deals with *observation* of existing practices (context, actual setting, objectives, and regulations relevant to the learning situation, the tools currently in use, and the goals, attitudes, and general work situation of the users). Users include students, teachers, representatives from business and official authorities, all of them acting in a particular role in a particular situation. Observation is performed by the researchers, and it may involve ethnographical observation, interviews, questionnaires, and analyses of documents. Initial observation is necessary for the researchers to gain domain knowledge, and for the users to focus on their practices and needs. It is also essential for developing some initial ideas of how existing practices can be augmented, modified, supplemented, or replaced. The roles of the participants in the process are evolving from one quadrant to the next. At this stage, users act as informants, and researchers act as managers and facilitators.

The second quadrant (upper right) deals with the *construction* of new ideas and artefacts. At this stage, the researchers' observations and assumptions, developed in the first stage, are used to initiate discussions and processes of reflection on practices, drawing the users into actively participating in the design processes. The quadrant provides a framework for iterative processes of creating, evaluating, and modifying drafts, specifying needs and functionalities, and rethinking practices. Workshops are the preferred mode of interaction. At this stage, products are ideas, outlines and drafts that later, and perhaps after additional observation, will be turned into working prototypes. Interaction is the keyword in the second quadrant, as researchers shift from the role of observer to that of developer, and users assume an active role as equals in the development process. The composite nature of the user group helps provide a faceted understanding of the subject on all levels, ranging from simple technical ones of functionality, and to general matters of workplace and relevance of competences.

The third quadrant (lower right) involves *co-constructing* prototypes (based on ideas and drafts developed at the second stage) in a *community of interest* (Fischer, 2001). Like a community of practice (Wenger, 1998), a community of interest is an environment facilitating collaborative learning, but it differs from the community of practice in being temporal and heterogeneous. (It is a community of communities). In a community of interest, boundary objects provide shared references between the knowledge systems of the various communities. In the current case, the boundary objects are the prototypes, to which all participants – apprentices, teachers, masters, journeymen, administrators, and researchers – contribute their competencies and rationalities in processes of developing, testing, and modifying. The participants act as equal partners, constructing and mutually learning in a community where roles are defined by competences and individual contributions, rather than by social and professional status. Again, the preferred work form is the workshop, but testing and evaluating may take place in breakout sessions, small local groups, or in a virtual workspace.

Finally, the fourth quadrant is one of *reconstructing*, as artefacts and new practices are implemented on the basis of the prototypes created in the third quadrant, and are integrated in the organization, eventually to become routine. As the project terminates, and the community breaks up, original roles are reestablished, and a new iteration of the innovation process may begin.

In the next section, we will discuss a design project trying out the Quadrant Model in practice.

Designing the 'learning bridge'

The aim of the ELYK project has been to develop innovative designs for IT-supported learning. The designs have been developed in collaboration with companies and learning institutions, but the project has not been involved in developing curricula and actually implementing the designs in professional programs. This task has been left to the learning institution partners, in the current case, the Center for Vocational Education in Lolland and Falster (CELF). The case involves the training of electricians.

Lolland and Falster, neighbouring islands in southern Denmark, geographically and social-economically are located at the periphery of the country. Managers and faculty at CELF have been motivated to take part in the project because they see it as an important mission to attract more young people to a vocational training that is oriented both toward the local and the national labour market. Located in an area with a fairly low level of education, motivation presents challenges in terms of recruitment of apprentices, and thus also challenges the fulfilment of the national objective for getting more young people to complete vocational training. Managers and faculty at CELF believe that increased use of Information and Communication Technology- (ICT) based teaching methods may contribute to the recruitment of more apprentices from the peripheral area. The teachers at CELF have been enthusiastic about taking part in the project, probably because electrician apprentices tend to be particularly qualified in the area of ICT.

Some background on Vocational Education in Denmark

Our design process has been inspired by studies of the legal framework of the vocational educational system in Denmark, and by research into this system (see also Juul & Jørgensen, 2001).

The main principle of the Danish vocational educational system is that the apprentices alternate between being pupils at school and apprentices in the workplace. In practice, the coupling between practical education and teaching at school is supported by educational contracts, guiding rules of practice, and 'practice forms'. The practice forms specify what skills must be acquired during periods of practice, and they document that the requirements have been met.

The vocational programs in Denmark have goals for qualifications within specific work areas as well as goals for more general qualifications.

It is an official requirement that the vocational educational system ensures that a large proportion of a youth generation completes vocational training. This has generated some uncertainty as to the fundamental function of the vocational education system: Is the primary function the social integration of diffident youth, or the training of competent craftsmen for the contemporary and future labour market? (Larsen, 2012) Another serious challenge is that there have been great problems in providing the necessary number of training places (Andersen, 2001). The lack of training places means that many young people entering vocational training never get an opportunity to complete it.

Increasingly, these problems have overshadowed questions of how to plan the best possible vocational education. Research indicates that the major pedagogical challenge to vocational training is findings ways of creating the best possible interplay between practical education at the workplace and teaching at school (Jørgensen, 2010; Wahlgren, 2002; Andersen & Iversen, 1995). The reasons are twofold: 1) there has been too little interest and too few experiments in systematically using and developing the apprentices' school learning outcomes in the context of the workplace; and 2) only a few sustainable practices have been developed for supporting learning at school with the learning experiences and learning outcomes accumulated through practice at the workplace.

The prototype developed in the project addresses this key problem of coupling contexts.

Observing practice

On the basis of the problems and challenges outlined above, the first stage in the design process consisted in carrying out a pilot study to elicit how the interplay between school and practice at CELF is conceived by apprentices and teachers engaged in the vocational training of electricians. Also, we wanted to establish empirically the qualifications of the teachers and the apprentices with respect to the use of ICT in supporting teaching and learning. The study has been based on three, two-day observations of classes, a questionnaire distributed to a class of apprentices, individual interviews with three teachers and the head of studies, and a group interview with six apprentices.

The pilot study indicates that the apprentices take a highly positive view of the interplay between theory learned at school and the assignments that they are meant to carry out at the workplace. This is somewhat in contradiction to what is normally concluded in the research literature within the area. A likely explanation is that it is essential for an electrician to gain a fundamental understanding of theory in order to carry out his or her work in a safe and technically efficient way. The apprentices, however, do not experience that their work situation and their work tasks at the companies are reflected in the teaching at school. At school, all that teachers do is try to simulate reality, and they do so only to a limited degree. Furthermore, the apprentices indicate that some teachers have a primary interest in theory and only a secondary interest in practice. In part this is due to a lack of experience in the field of practice.

Some apprentices say that they do not have a proper knowledge of the learning objectives for the practice periods, and many apprentices state that practice does not offer the necessary variations with respect to assignments because the companies they work at are small and/or specialized. Teachers emphasize that practice at the workplace is the most important locus of learning, and also that the apprentices are confronted with theoretical requirements at school that are much more advanced than the theory needed to carry out their work tasks. The teachers agree with the apprentices that too few connections are drawn between the curriculum and the practical experiences of the apprentices. The teachers also agree on the fact that the learning objectives of the practice periods are not always met. As one teacher states:

> *Many of the apprentices just draw cables. It varies at different firms. It has always been like that (…) the journeymen that they drive around with – it is they who decide.*

Furthermore, the teachers recognize that many of the masters at the companies never complete and return the practice forms, and that this is contrary to the formal requirements.

By eliciting the experiences of managers, teachers, and apprentices with respect to the use of ICT, the pilot investigation shows that digital media are mostly used at school, and less frequently at the small companies. The manager of the program is quite aware that in many respects the apprentices are masters of digital media. He sees potential in strengthening the digital profile of the school, and he emphasizes that stepping up digital competences may support the supplementary training that the school offers. This often is structured as 'blended learning'. The apprentices experience that the teachers use digital media when teaching, but to varying degrees. The study suggests that the apprentices value teachers who use digital teaching materials and technologies, e.g., by mastering a great repertoire of smartboard features. Logically, they do not appreciate teachers who are not able to demonstrate the same IT pedagogical competences. However, technology is not all that matters. High value is also assigned to other competences and not least to the personal qualities of the teacher, such as attentiveness and engagement.

The apprentices use digital media only to a very limited degree in their mutual communication. They explain that the group of apprentices is very heterogeneous and that the alternation between school and practice imply that the enrolment in any particular class will have changed each time the apprentices return to school. Still, a few examples are offered on the use of e-mail in connection with apprentices working collaboratively on assignments.

The school runs an intranet using Sharepoint 2007™. Mostly, the intranet is used for broadcasting information from the school to the apprentices. Even for faculty, dialogical features are virtually nonexistent. The attitude of the apprentices towards the system is generally negative. One apprentice puts it like this:

> *It has been changed every time you are down here (…) Then you have a new password because you have not been here for three months (…) Then, when you get back home, it is not possible to login and you have to ask IT support – maybe because they have introduced a new system. And it is not possible, when you sit at home, and then you drop it. So I have used my own e-mail address.*

Many apprentices use a smartphone when at work. Sometimes they take pictures because they want to document having done the work properly or because they are going to order new parts for electrical installations and want the agent to supply the right parts. The apprentices also use pictures if they are not sure how to carry out a specific task:

> *I do it if I am in doubt. Then you take a picture and send it to the master or journeyman and ask him – what should I do? Then half an hour passes by, and then he calls me and provides the answer.*

Among the teachers, opinions vary with respect to the question of what advantages might be associated with an increased application of digital media. Some engage actively in experiments with extended use of the media. Others are more hesitant.

Constructing concepts

Moving on to the second stage of the design process, the group of researchers started generating new ideas and concepts on the basis of the observation and analysis of existing practice. First, a number of assumptions with regard to challenges and potentials in the existing educational practice were discussed within the group of researchers. Next, a workshop was arranged. The participants in the workshop were masters and journeymen from local companies and teachers and apprentices from a class at CELF, some twenty participants in all. In the course of the workshop, in discussions and exercises within and across socially defined roles, a variety of problems, needs and wishes were voiced and qualified as new ideas. Many of them pointed towards creating a digital learning platform that should be able to facilitate the interplay between practice and school. The outcomes may be summarized as follows:

» School management and teachers generally experience a need to strengthen the communication between companies, school, and apprentices. An answer to this need might be a digital version of the practice form, acting as a mediating artifact. A supplementary solution might consist in a digital platform for sharing knowledge about what is happening during the educational trajectory of the individual apprentice, and about the content and learning objectives for the practice periods and the education at school.

» The apprentices argue that the teaching at school to a greater extent ought to involve situations and experiences from practice. An answer to this might consist in starting to draw on images and video documentation of situations belonging to the practice. This simple adjustment of teaching practice could exploit the fact that most apprentices are experienced in using smartphones as a tool supporting their learning and work processes in practice.

» The apprentices are apprehensive of the challenges at the workplace with respect to occupational health and safety. It appears that a contradiction exists between practice at the workplace and the formal regulations. The apprentices do not feel that they have the necessary strength in the face of their employers to improve conditions. At the same time, the apprentices want to be able to express themselves more freely regarding technical as well as social problems at work, without the risk of being monitored by employers or school. An answer to this challenge might be to create an option for the apprentices to exchange experiences and opinions in a virtual space excluding all representatives from school and the companies.

» The teachers want better opportunities for maintaining the apprentices' interest in theoretical subjects during their practice at the companies, i.e., by giving assignments. This may also be facilitated by the means of a digital platform.

After the workshop, the group of researchers undertook an analysis of how the many needs and wishes voiced in the discussions might be translated into features in a prototype system. Both practical acceptability and social acceptability in terms of variables facilitating adoption, notably relative advantage and compatibility (Rogers, 2003), were considered.
Apart from the fact that the project would never be allowed to make experimental adjustments to a working production system, the existing school intranet was found to be inadequate for project needs. Nor was it considered essential to develop a system that would fully integrate with

Sharepoint 2007™. But it was deemed important that it should be possible to access the ELYK prototypes from within the school intranet. The new system should be easy to learn, easy to use, the interface should be appealing, and the software system should be cheap to purchase and easy to maintain. Choosing software that is hosted in the cloud and that may be accessed through a web browser will meet some of these requirements. Care has also been taken to find an up-to-date system with the promise of being viable in the foreseeable future. Although guarantees can never be made, choosing a product that has been around for a while that has attracted interest and is marketed by a company that can easily be contacted, makes a system more attractive in this latter respect. Finally, considerations have been made regarding speed, stability and, importantly, security.

Among several net-based collaborative and social software tools available, the project team settled on Podio (https://podio.com/) as a versatile, extremely flexible, and inexpensive tool. Within Podio, organizations (virtual spaces framing all activities within a company or a project) were set up both for CELF – eventually to become the prototype – and for the research group to carry out various experiments and prototyping. Thus, one installation served all needs. Within an organization, spaces define tasks, and apps are created within a space for performing the tasks. A space has an activity stream logging all activities and creating awareness of other users; access to each space can be regulated. A large number of standard apps are available, and they can be modified, and new ones can be created by using an app-builder feature that offers an extremely easy drag-and-drop functionality for compiling a complex app from basic elements.

Co-constructing the product

This third stage of the design process has had three phases. An initial one for testing the first version of the prototype; a second one for running a large-scale test of the prototype, and a final stage for evaluating the prototype and the impact it has had on teaching practices.

The early prototype consisted of three different spaces. In later versions, several adjustments were made and some terminology was changed, but the basic structure was retained:

Learning Objectives in Practice is a space accessible for all registered users where apprentices using text, images, audio, and video may add descriptions of tasks performed at the workplace and relate them to the learning objectives of the practice period. In short, it is a very simple kind of portfolio that may be used to document the skills enumerated in the practice form, and also to provide examples of products and processes that can be drawn upon in the teaching when the apprentices return to school.

Weekly Assignment is a space where teachers can post assignments for the apprentices, and where the teachers and apprentices may communicate on various issues. This is the 'school at the workplace' setting.

Discussion is space for apprentices only, providing facilities for communicating on matters of mutual interest.

The early prototype was discussed at a small workshop involving the developers and two electricians who had recently finished their education. Features as well as usability were reviewed and reflected critically. This process contributed experiences and ideas that were productively brought into play in the construction of the second prototype.

The second prototype, named 'The Digital Learning Bridge', was tested in a class of first- year apprentices and their teachers at CELF (18 participants in all were active in the Podio 9workspace). Testing took place during the first five weeks of practice at the companies. The prototype was introduced in class at CELF to the apprentices and the teachers. They were all trained to use it, and they were provided with three, one-page 'manuals', explaining how to use each of the three spaces.

The teachers were assigned responsibility for testing the *Weekly Assignment* space meant for communication between school and apprentice by means of assignments. Each week, the researchers prompted activity by asking the participants questions in the two other spaces. The researchers also monitored the test through status updates and activity overviews. At one point during the test, the researches contacted the apprentices directly by SMS and telephone in order to motivate them to use the prototype.

All users provided very positive feedback to the testing, but the activity in the different spaces of the Podio application remained rather low. At the end of the period of testing, all apprentices and teachers participating in co-constructing the product were invited to a meeting for collaborative reflection and evaluation of the test. Valuable material for the overall evaluation of the test was gathered through interviews with the teachers and a group discussion with six apprentices.

At the time of writing, the final stage of the design process, that of integrating new practices in the school environment, has not been completed. But feedback suggests that the ELYK design experiment is likely to have some lasting impact.

Evaluating the Learning Bridge

Our point of departure in evaluating the prototype has been the apprentices, since they are the primary user group. They tested the prototype for a five-week period, and their reflections feed this analysis. The experiences of the apprentices are supplemented with and qualified by interpretations from the teacher perspective. The aim of the evaluation has been to solicit shortcomings as well as potentials of the prototype as they have been identified from a user perspective.

Student interpretation of the two learning contexts

In the eyes of the apprentices, the two learning contexts differ substantially. The 'real world' of the workplace is characterized as being more challenging than periods at school. When comparing the two, the apprentices emphasize the 'unpredictable conditions' at the workplace as something exciting, whereas the school environment is described as some kind of 'protected area'. School assignments are safely framed by indisputable theories, far removed from the muddy complexity of the kind of real-world problems that electricians experience in their work life. As one of apprentice explains:

> *At school, you can always solve the problems; the wall [that you work on] is made of cardboard, and you can always get help. Out in the real world: sometimes neither master nor journeymen know what to do. At school, we are simply told. Everything is planned, and we all do what is expected from us.*

Thus, as a learning environment, school may be perceived as being somewhat boring. However, this does not mean that the apprentices regard the theoretical dimensions of their education as being unimportant. Several times the apprentices emphasize that understanding the theoretical background helps to develop their professional identity and self-confidence. But even if they acknowledge the relevance and value of the theoretical elements for their professional work, they still relate theory closely to the school context. In other words, they see the *connection* but they do not experience that theory and practice are *interwoven* in the educational design.

It is the interplay between the two learning environments that the *Weekly Assignment* space is meant to support by helping the teachers reach out to the apprentices during periods of practice. This idea may be developed further by also exploiting the opportunities for bringing examples from the unpredictable and exciting 'real world' workplace back into the school context.

The weekly assignment

During the test period, the teachers uploaded assignments on a weekly basis. According to them, this was an easy and practical way of keeping the apprentices in a flow of continuity, supporting them in processes of reflecting practical work in a theoretical perspective. Even if rather few apprentices actually did this new kind of 'homework', many of them regularly visited the digital platform, checking out what kind of assignments the teachers had posted. The teachers regard this as a fine initial result, pointing out that the experiment as such has increased student awareness of the interplay between theory and practice. However, the teachers also conclude that full implementation of this kind of bridging tool requires more comprehensive pedagogical and didactic reflections.

From a student point of view, the assignment space and its apps are seen as a great tool, provided that the level of difficulty in assignments is kept at a reasonable level. In other words, they prefer that assignments repeat theoretical subjects rather than introduce new ones. As a barrier to adoption they note that doing schoolwork after a long day's work in practice is often too hard. They return home filled with new impressions, and having worked long hours they are physically tired. However, the apprentices propose ways to overcome this barrier.

Doing assignments during breaks and in time slots reserved for theoretical reflection at the workplace

One way of overcoming the challenges in finding time for homework, the apprentices suggest, would be to introduce a model integrating the weekly assignments into the work hours at the workplace. This would allow the apprentices to draw upon theoretical dimensions in their daily work. They explain how the assignments could be discussed with the journeymen responsible for their training. In a legitimate and inspiring way, such discussions could provide the beginnings of a new workplace-based learning environment. A condition, however, is that the masters agree that there are significant learning potentials in allowing time for doing school assignments.

From a teacher's point of view, this broader engagement is considered to be a major improvement to the utility of the prototype. Not only would it strengthen ties between the school context and the companies. Potentially, it would also boost processes of collaborative learning within the workplace communities in innovative ways. Below, this idea is extended also to ways of using the portfolio space.

The discussion space

The apprentices assess the discussion space critically. They see no real need for a student-to-student space, explaining that by and large the need for social contact is met at the workplace or by friendships established before or outside the school environment. The apprentices consider themselves to be a rather heterogeneous group with few shared interests. The fact that they are not in sustainable classes also weakens the motivation for maintaining social contact during practice periods. The apprentices turn to the workplace for social and professional dialogue, and they turn to the journeymen when the have concrete questions of a professional nature. If the apprentices did point out discussion space potentials, they suggest that it should be made chat-based with facilities for near real-time interaction. However, this feature is already available on, e.g., Facebook, which most of the apprentices use in their spare time.

The portfolio space

The *Learning Objectives in Practice* space is meant to bridge learning activities taking place in the workplace context and in the school context. The main app in the Podio space enumerates the training objectives specified by the practice form for the various practice periods. The list helps the apprentices keep track of the training activities that they are supposed to undergo. It also provides them with a tool for documenting and reflecting on their work, and it helps visualize the progression in their individual learning processes.

Documenting the progress of learning

Although the apprentices generally like the idea of a portfolio summarizing the training objectives, they find the app difficult to use. The problem is not of a technical nature; rather it originates in requirements being diffuse and general. How is one to document the learning process in terms of concrete examples? However, the apprentices find that the portfolio could frame a kind of professional diary during the practice periods. They propose considering an opening up of the digital infrastructure so that family and friends may access postings on products and illustrations of best practice.

From a teacher perspective, the portfolio space is considered an interesting innovation, potentially helpful as a pedagogical bridging tool. Often, the teachers experience that the long periods of practice training tend to segregate them from the learning process of the apprentices. They know little about what goes on in the field of practice. Therefore, they have only limited opportunity to grasp and make use of the practical experience accumulated by the apprentices. The portfolio may help overcome the segregation, providing a better flow in the education of new electricians. The potentials in this innovative interplay of contexts are expanded upon by the apprentices, proposing a much more ambitious engagement of the masters and the journeymen in use of the portfolio.

Integrating the workplace into the learning sphere of the prototype

The apprentices suggest that the *Learning Objectives in Practice* space may be a tool for more collaborative and more theoretically reflected, workplace-based processes of learning, and for qualified professional discussions. Furthermore, they point out a potential for increased cooperation among masters of the companies accepting the apprentices. By agreeing to short-term exchanges of apprentices, the masters could help one another ensure that all required training objectives are reached in the periods of practice.

From a teacher's point of view, ICT-mediated improvement to cooperation among masters is considered a smart way to increase the quality of apprentice workplace learning. Moreover, better collaborative workplace learning could support not only apprentice learning, but also cooperation between school and companies. It could lead to stronger focus on how the educational system may inspire and support strategies of workplace-based competence development. As one teacher puts it:

> *If this means that we can get the companies to discuss these issues and create a new understanding that knowledge has to enter the field of practice, then we have achieved a great deal.*

Thus, in many ways apprentices and teachers have shared interests. Bringing their experiences and ideas together may help to improve the quality and utility of the prototype.

Defining responsibilities

The apprentices point out an important and unintended potential consequence of the changes to which a full implementation of the prototype may lead. There is a risk of shifting the responsibility for learning demands in the field of practice. The formal responsibility for facilitating broad and adequate processes of competence development rests with the workplace master. However, when the prototype is adopted, focus slowly shifts to the role of the apprentices, and they do not want to shoulder this responsibility alone. Hence, in an eventual process of universal implementation and integration of the software solution at CELF, it is important that questions of responsibility be negotiated and clearly defined in the institutional contexts framing cooperation between school and companies.

Conclusion

Building the 'Learning Bridge' has provided an illustration of how user-driven innovation may be introduced into educational design. The project has made successful use of the Quadrant Model, proving that in developing new didactic designs there are clear advantages to introducing a participation orientation and to taking a problem-based approach. It has facilitated addressing several important issues concerning learning processes, teaching, and education. Our general conclusions may be summarized in three points.

Firstly, user-driven educational design offers an environment with opportunities for articulating many different perspectives and positions in the course of the design process. Thus, important and critical needs, issues and challenges within the context of learning and practice are brought out.

Consequently, the motivation of the participants for engaging in the process has increased. Not only does the design environment facilitate the development of a common language, it also mediates the interest in and recognition of matters important to the design context.

Specifically, the method provides a distinct framework for the learning process, which reflects the shared and the divergent experiences in the context. The method has the potential to stimulate new and transcend current exchanges of experiences. But it is likely sometimes to clash with ingrained notions of what is 'correct' in terms of educational and institutional practices. As the teachers themselves point out in interviews, successful implementation of the innovations require broad faculty support, and this can be reached only by in-depth discussions on pedagogy and how new digital infrastructures may improve the quality of teaching. Also one has to know how to strike a balance between immediate concerns and long-term objectives and policies. Innovation left solely in the hands of fiery souls has a history of being largely ineffectual.

Secondly, the user-driven innovation approach has the potential to strengthen both the internal and the external communication of the institution. Through the inclusion and informal training of all actors, they are likely to develop a nuanced understanding of how each module, course, and lesson is linked to the organizational and pedagogical ideas and objectives of the program.

Using the design method also is likely to make all actors (apprentices, faculty, and administrators) more visible to one another. This may result in their becoming more attentive to mutual relations and better informed as to when to evaluate and develop professional and educational practices. Providing more individual responsibility leads to an increased sense of ownership and to actual empowerment.

Thirdly, the approach to user-driven innovation outlined in this chapter amounts to a challenge to education as an institution and to the conventional roles associated with it. The 'theatre' no longer is the sole domain of educators. All stakeholders should get involved, and putting them all on an equal footing in processes of educational innovation presents a major challenge to their self-perception, and perhaps also to their competences. Still, the benefits for teachers and 'customers' (whether companies or society in general) should be obvious. By opening up in this way, the educational institution will be better equipped to meet the ever more rapidly changing demands for graduates with up-to-date qualifications. When not left alone on stage or in the wings, but drawn instead into collaborative exercises of exploring the best ways of designing education, the teachers develop new skills and a new understanding not only of the use of technology, but also of their professional field.

To sum it all up, what we have learned is how the use of 'real-world problems' can guide the learning processes in vocational training. The Problem-Based Learning strategy offers a new set of languages rooted in different personal and professional experiences in different communities of practice. The problem at hand can be understood as a 'trigger' that conveys new meanings to the participants, thereby enabling the creation of new reflective personal and professional practices. The problem 'trigger' provides for mediation of both the experience at hand and the theoretical and practical knowledge that is necessary to solve the problem. That is reason we have been using the bridge as a metaphor for the dynamic conjunction of theory and practice, school and workplace, in a technology-mediated and problem-oriented VLE. The bridging – or mediation – of experienced practice affords letting the 'problem' become the pivot for concrete processes of learning, that activate and draw upon the experiences and motivation of the participants for collaborating in developing learning, teaching, and working life. It is a new direction that we would like to suggest may have impact on the future of learning.

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PROBLEM-BASED LEARNING AND MUTUAL DEVELOPMENT IN SOFTWARE PRODUCT DEVELOPMENT

Renate Andersen, Anders I. Mørch

Introduction

Engaging customers in organizational learning, innovation, and knowledge processes heralds the dawn of a new paradigm for product development, where user data and information are not just gathered in databases, but are embedded in dynamic co-creation processes that involve customers as partners with product developers rather than subjects (Rowley et al., 2007). Several authors have written and stated the need for researching how customers are co-creators in product development processes (von Hippel, 2005). A focus on users is one of the most topical issues in the new product development and innovation management literatures (Repo et al., 2007), and users have a greater say than before in how innovations are adopted; it is an unexpected type of user empowerment in the digital age (Repo et al., 2007). This is also supported by Engeström when he underscores the partnership activity between customers and developers in product development processes, which may lead to new forms of learning, referred to as co-configuration work, in an expansive learning framework (Engeström, 2004). In modern product development, the input of the users and their acceptance are of major importance to market success (Maalej and Rashid, 2009). The objective of this study is to look more closely at the interaction and relationship between professional developers and customers in mutual product development and investigate what issues of problem-based learning may derive from this.

Mutual development, first proposed as a process model of customer-developer relations, describes how professional developers and users interact in customer-initiated product development processes (Andersen, 2008; Andersen & Mørch, 2009; Mørch & Andersen, 2010). The model defines different constellations of actors ranging from professional developers to customers and multiple stages of development between use and development. The authors identified five different subprocesses of mutual development, which is initiated and driven forward by problems that customers encounter in their everyday work (in alphabetical order): adaptation, generalization, improvement request, specialization, and tailoring (Andersen, 2008; Andersen and Mørch, 2009).

During the processes of mutual development, opportunities for learning and innovation, such as Problem-Based Learning (PBL) and interorganisational learning, emerge. The aim of this paper is to contribute to the conceptual framework of mutual development by comparing it with PBL in order to shed light on the early stages of the software product development.

It can be fruitful to look at mutual development from a PBL perspective since it can provide a context for the integration of work and learning. PBL is not very often referred to in the work context, e.g., reported in business management journals. Surveying past work, Coombs and Elden found only 39 citations to papers having problem-based learning or PBL in the title. However, there are many occurrences of PBL titles in educational journals (958) and even more in medical journals (1,671) (Coombs and Elden, 2004). Glud and colleagues underline that there is a need for doing research on the use and experience with web-based learning tools (Glud et al., 2010; Conole et al., 2008). This chapter will go more deeply into some aspects of PBL in work-oriented and developmental contexts. We start by surveying the related work according to theoretical perspectives. Then the context of our study is presented, followed by the research questions and methodological considerations. Next, the empirical data are described, followed by a general discussion. Finally some conclusions and directions for further work are presented.

Related work

In mutual development, problems are the starting point for a cooperative problem-solving process between customers and professional developers. It is the problems the customers encounter in their working life when using existing software products, a project-planning tool in our case, that we wish to investigate further. In this context, problem-based learning becomes a natural byproduct of the software development process. Therefore, aspects of PBL are used as a sensitizing concept in our empirical analysis of the early phases of the mutual development of software products. Theoretical perspectives that shed light on different aspects of processes of mutual development will be reviewed in this section, which is organized by first presenting Problem-Based Learning, then users as innovators, followed by a description of users as active contributors, and finally co-configuration.

Problem-based learning (PBL)

There is a large body of literature about problem-based learning, describing it from different perspectives and as part of various processes. We cannot cover all of it here, but focus on the most relevant from our perspective. PBL is well suited to helping students to become active learners because it situates learning in real-world problems and makes students responsible for their own learning (Hmelo-Silver, 2004). There are different perspectives advocated by problem-based learning researchers, which highlight the various aspects of PBL differently. In Europe and Scandinavia in particular, three influential perspectives are the Aalborg model, Linkoping model, and Maastricht model. At the University of Aalborg the students work closely together for an extensive period of time in which they have to formulate and identify the problem and write a project report (Ryberg et al., 2010). The Linköping model was initiated in 1986 at the Faculty of Health Sciences at Linköping University in Sweden and was a groundbreaking effort to organize interprofessional education. The basic idea is that it is favorable for the development of the students' own professional identity to meet other undergraduate students (Wilhelmsson et al., 2009). The Linköping model combines the model of PBL with interprofessional learning, emphasizing PBL in small groups and student-centred learning (Wilhelmsson et al., 2009). At the University of Maastricht students follow a model where they are less dependent on each other as they work individually on cases they have chosen themselves, which are open ended but formulated and suggested by the teachers. The students meet in larger study groups (8-12 persons), which they can use as an inspiration and as a backdrop for their own work (Ryberg et al., 2010). The Maastricht and the Aalborg models of project work share some characteristics, even though they were developed independently as two different educational models, such as the pedagogical idea of problem analysis serving as the basis for the learning process, interdisciplinary features, participation direction, and group work (de Graaf and Kolmos, 2003).

Common to all models of PBL is that *problems are the starting point for the learning process.* Furthermore, the problems with which students work should as much as possible be *real life problems*. It is crucial that the problem serves as the basis for the learning process because this determines the direction of the learning process and places emphasis on students as problem owners (rather than teachers) (Fischer, 1994), and on the formulation of a question rather than an answer (de Graaf and Kolmos, 2003). A problem in PBL is defined as an incentive for students, a challenge to start them off on their own learning process (Graff and Kolmos, 2007). In mutual product development processes it is the problems the customers encounter that serve as the starting point for a learning process, which is a side-effect of using advanced software products such as project-planning tools. Students are attracted to different types of problems on the basis of their own experiences and interests. A problem can be any type of problem, for instance a concrete and realistic problem (my car has a flat battery, the printer stopped working) or a theoretical and abstract problem (e.g., formatting a database table) (de Graaf and Kolmos, 2007). In processes of mutual development the focus is on *realistic problems.* The most characteristic feature of PBL is that it is based on authentic and complex problems (Lehtinen, 2002). In software development this could mean a software product that is difficult to use for supporting work in a user organization (e.g., project planning).

Characteristic for PBL is that students are asked to put their knowledge to use and to be reflective and self-directed learners (Hmelo-Silver, 2004). Hmelo-Silver underlines that the principle of *self-directed learning* emphasizes a distinguishing feature of PBL. In PBL students become responsible for their own learning, which has the potential to make them become more reflective and thinking critically about what is being learned (Bereiter & Scardamalia, 1989; Hmelo-Silver, 2004). Being a self-directed learner involves several subskills. Firstly, learners must have a metacognitive awareness of what they do and do not understand. Secondly, they must be able to set learning goals and identify what they need to learn more about for the task in which they are engaged. Thirdly, they must be able to plan their learning and select appropriate learning strategies, which means they must select an appropriate course of action to reach these goals. Finally, as they implement their plan, learners must be able to monitor and evaluate whether or not their goals have been attained (Hmelo-Silver, 2004). Blumberg further states that students participating in PBL curricula demonstrate self-directed learning skills, such as having the ability to define what is to be learned, to access material, and to actively study the material (Blumberg, 2004).

Users as active contributors and innovators

Researchers in participatory design, human-computer interaction (HCI), and computer- supported cooperative work (CSCW) have studied active user involvement in ICT development (Bjerknes, Bratteteig & Espeseth, 1991; Gantt & Nardi, 1992) and developed design environments (Fischer, 2004) and end-user tailoring toolkits (Mørch, 1998) for user participation. Researchers in management have studied innovation in manufacturing process, in particular a turn from manufacturer-centric innovation to user-centric innovation (Von Hippel, 2005). Lundvall pointed to the usefulness of applying a user-producer perspective to innovation (Lundvall, 1985). He found that user-producer interaction works in different ways in different parts of the economy. Jeppesen and Molin (2003) suggest providing customers with *user toolkits for design* to foster user-driven innovation (Von Hippel, 2005). With the notion of toolkits for design, the HCI & CSCW tradition of user-tailorable systems may one day converge with the management tradition of user-driven innovation.

Nardi and Miller identified a continuum of three kinds of users: end users, local developers, and professional programmers, where local developers where defined as domain experts who have acquired more advanced knowledge of computing (Gantt and Nardi, 1991). However, Nardi and Gantt developed the notion *of local developers* further and point to how the role of the local developer has evolved into the more formal or semiformal role of 'gardener', obviating the need for professional programmers. Local developers supporting mechanical engineers in domain-specific programming tasks are referred to as gardeners, and those in electrical engineering are gurus (Gantt and Nardi, 1992). Gardeners and gurus are distinct from other local developers in that they are given recognition, time, and resources for pursuing local developer activities (Gantt and Nardi, 1992). Åsand and Mørch define *superusers* as regular employees with in-depth knowledge of one or more of the organization's computer applications without being programmers. Superusers have both domain expertise and computer know-how, and they are trained to teach other users. They are not trained as programmers; instead they interact with regular users and with local developers in their daily work (Åsand and Mørch, 2006). Fischer uses the term *power users* when describing users or domain experts that are able to make modifications and customizations on a system, and making needed changes to a system on behalf of the community, or by teaching others to do so (Fischer, 2004). Power users help others to transcend the boundary that exists between using a system as it is and modifying it for new purposes (Fischer, 2004).

Users that innovate are often referred to as *'lead users'* (von Hippel, 2005). Von Hippel defines the term lead user as a member of a user population having two characteristics. First, lead users anticipate relatively high benefits from obtaining a solution to local problems and so, may innovate. Second, they are at the leading edge of important trends in a marketplace under study, and so are currently experiencing needs that will later be experienced by many other users in that marketplace (von Hippel, 2005). It has also been shown that innovations developed by lead users to solve problems they encounter are at the leading edge of the market, and will later also be wanted by others, and therefore will be potentially profitable products for manufacturers (von Hippel, 2005). The innovative ideas the customers submit to the company often are new ideas that the professional developers have not yet thought of developing.

Local developers, gardeners, gurus, superusers, power users and lead users are all different terms for describing active users who take initiative by proposing solutions or idea proposals to improve existing products or services, or otherwise contributing to the community with site-specific knowledge and use experience.

Co-configuration

Co-configuration provides an example of how the work of domain-expert users can be organized in cooperation with professional developers during various stages of product development processes. Co-configuration is defined as an emerging, historically new type of work, which generates new forms for learning (Victor & Boynton, 1998). Characteristic for co-configuration is that it consists of flexible and adaptive products, service combinations, continuous mutual exchange between customers and developers, ongoing customization of product-service relationships over time, multiple collaborating producers, and mutual learning from interactions between the parties involved (Engeström, 2004). Co-configuration originally derives from a model of development of work developed by Victor and Boynton (1998). Whereas Victor and Boynton define co-configuration as a new form of work, Engeström places co-configuration within an organizational learning context. According to Engeström, co-configuration is an approach to product development where the dialectic relationship between the customers and developers is of the utmost importance. There are two clear advantages of co-configuration: the adaptation of products to customers' individual needs and an ongoing value creation for the company, for example, organizational learning (Andersen, 2008). Co-configuration thus can enlighten the collaborative aspect between customers and professional developers in product development processes. During co-configuration work, the customer becomes in a sense a 'partner with the producer' (Engeström 2004; Victor & Boynton, 1998). In spite of this, it is not a simultaneous process of equal participation, but a rather complex process involving several subprocesses and asymmetrical relationships among participants, some of which are closely tied to software professionals' work and others that are tied to organization of local developers (Åsand & Mørch, 2006).

The context of study

Learning, in this chapter, is viewed from a sociocultural perspective, underlining that what people learn in specific settings is dependent on how activities are socially organized and how they have emerged as institutional practices (Ludvigsen et al., 2011). Within the sociocultural perspective it is taken for granted that the context and the world we live in are mediated through different artifacts. We are always situated in a context that has to be taken into consideration. This also applies for product development processes when seen in light of PBL. The problems end users encounter when using software products are often connected to users working life context, meaning that this context needs to be taken into consideration. This opens up for a connection between PBL and mutual product development. From a sociocultural perspective, this means we need to pay attention to how the students' problem- solving activities are situated in their social, cultural, historical, and institutional settings and a main issue is to identify how these differing settings provide contexts and tools for interaction (Krange and Ludvigsen, 2008). ICT as infrastructure, tool, and artifact play a central role in the mediation of communication, collaboration, and learning according to Dirckinck-Holmfeld (2009). She further states that ICT as a tool and as a way of organizing information is one of the most important societal tools of today and PBL approaches should therefore exploit its advantages (Dirckinck-Holmfeld, 2009).

The Company is a software house that develops and sells project management tools to the oil, gas, and building industry in Norway. The Company has a total of 30-35 employees geographically distributed in different offices. The main office is located in Stavanger, one office is in Oslo, and one in the United States. The professional developers told us, 'Our project management tool is being used in nearly 90 percent of all Norwegian oil and gas projects' (informant 1), indicating that this is a tool that is widely used for planning complex projects. In order to handle the rapid growth of customers who forward improvement requests and provide feedback concerning the Company's product planning tools, the Company uses a technological support tool for handling these issues, HelpDesk. HelpDesk is an information repository and distribution system place where customers can issue requests for improvement, such as a wish for new functionality, error messages, usability problems, upgrades, and new versions of the different products, etc.

The customers have a login account and password for HelpDesk and are encouraged to use the HelpDesk for submitting issues towards further development of the products. A screen image of HelpDesk is shown in figure 1.

Fig. 1. HelpDesk:
Issuing an improvement requests to the company and viewing old requests

On the basis of the context description above, we have formulated the following research question:

1. To what extent can PBL be used to characterize aspects of mutual development, in particular:

a) The role of problems as starting points of development;
b) Identifying opportunities for learning in conjunction with development; and
c) Organization of customer-developer relationships over time.

Methods and data collection

The objective of the study is to investigate what forms of PBL may occur in processes of mutual development mediated by technological tools, including a project-planning tool and HelpDesk. Data were collected as part of a research project, KIKK (Kunnskapsforvaltning for Intern Kommunikasjon og Kundebetjening), which was a case in a large EU project, Knowledge Practices (KP) Lab (Moen, Mørch, & Paavola, 2012). We used a *qualitative approach* as part of a *case study,* where the primary goal was to clarify the character or attributes of a phenomenon (Widerberg, 2001). A case study is useful since it allows the researcher to study the phenomenon in detail and to develop as full an understanding as possible (Silverman, 2005). The case study is designed to extend our previous efforts (as described above) by focusing on the mutual development and potential learning situations.

Ethnography was employed as a method in line with the sociocultural perspective adopted in the project. Ethnography is a method that 'seeks to present a portrait of life as seen and understood by those who live and work within the domain concerned' (Hughes et. al., 1994). Techniques used in the data gathering were open-ended interviews, participating observation, and observation. We interviewed both professional developers at the Company and customers in both the oil and building industries. An interview guide was created in advance with some preset topics and used as a guideline during the open-ended interviews. 'An open-ended interview is usually thematised in advance, meaning there exists a set of topics or areas of interest which the researchers want to investigate further' (Fog, 2004, p. 18, my translation). During the interviews, the emphasis was on starting a conversation and then letting the informant lead the interview. What characterizes a qualitative interview, which is not a structured interview, is how it pursues what the informants start to talk about, and which may shed light on the informants' understanding of the actual theme (Widerberg, 2004). In the KIKK project, we collected 22 hours of video and audio recordings.

During analysis of the empirical data, template analysis was used for defining the intermediate terms that emerged (analytic categories). Template analysis is a process where the researcher produces a list of codes (a template) representing themes identified in the textual data (King, 1994). The codes that emerged from the empirical data during the analysis serve as analytic categories to organize the presentation of findings. The top-level categories are: adaptation, generalization, improvement request, and scaffolding. The process of coding means to label a section of text with a code in order to index it as relating to a theme or issue in the data that the researcher has identified as important to his or her interpretation

(King, 1994). In a previous round of analysis, the authors identified improvement request, adaptation, and generalization. They are reused here because the data we report overlap with the previously reported findings pertaining to subprocesses of mutual development (Andersen & Mørch, 2009; Mørch & Andersen, 2010). Our focus in this chapter has been on identifying aspects of PBL and processes of cooperation and collaboration. The term scaffolding refers to the phenomena of guiding novices in unfamiliar settings, helping them to become independent problem solvers; it was first reported in studies of adult-child cooperative problem solving (Wood, Bruner, & Ross, 1976).

Data and analysis

Data were selected on the basis of being representative of the empirical categories in our data set. The selection of excerpts for each category had not been used earlier. The aim of the presentation is to highlight the problem-based learning aspects of mutual development, which served as a sensitizing concept to foreground aspects of learning and (personal) development, as users interact with professional developers in processes of mutual development. The product referred to in the excerpts is a project-planning tool used in the oil, gas, and building industries for managing complex projects. Figure 2 shows a screen image of The Company's Planner tool.

The organization of data analysis is as follows: first, we name the empirical category, give a brief context description of the data extract, then present a sequence of interview data, followed by a brief explanation in 'common sense' terminology before we discuss it with the theoretical perspectives we presented in the Related Work section.

Improvement request

Excerpts 1 and *2* highlight the identification of real-world problems. The excerpts are examples of how a customer has encountered a problem in his daily work when using the project-planning tool and therefore has sent an improvement request to the company.

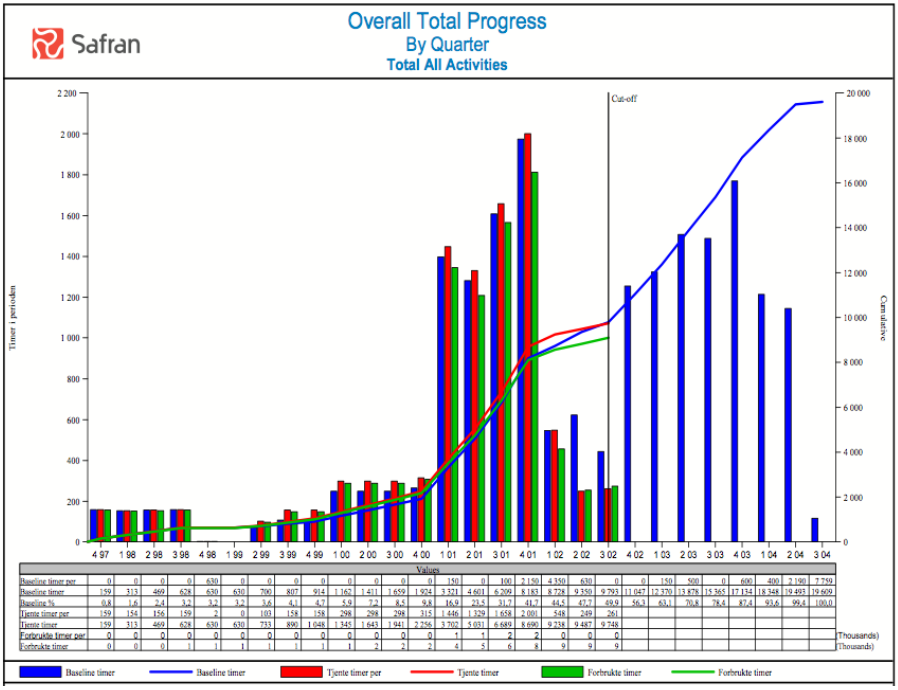

Fig. 2. A screen of the Planner tool: Overall Total Progress of project planning activity

Excerpt 1

Question: Have you suggested any improvements on the product to the Company?

Answer: Yes, there is one thing that annoys me a little bit. But it might be that I am using version 2000 of the product, but I think it is corrected in the newer version [of the product]. But the problem is that when I add hours worked [into the project plan] I add them to task level, however when running the analysis it needs to have the hours worked on resource levels. This means that I have to put it in two times – and on 4,000 activities this is a quite lot of work.

In this excerpt the customer answers that he has suggested some improvement of the project-planning tool to the Company because he experienced problems with the tool, which he thought was troublesome. The customer points to a problem with the project-planning tool when editing the project plan and adding hours worked. He does this on a level of editing named task level; however, this is not the same level as the one on which the analysis is run. Running an analysis of the project is being done on the resource level, meaning that he has to put in hours worked twice.

> *Excerpt 2*
>
> *In this excerpt, which follows from excerpt 1, the customer tells the interviewer that he has sent an improvement request to the company about the problem reported with the project-planning tool.*
>
> *Question: Concerning the issue that you have to put in worked hours in the project-planning tool twice in order to run the analysis, have this been fixed for you? Have you provided feedback to the Company about this?*
>
> *Answer: No, they have not yet found a solution to this problem. I have given my input and sent them an improvement request, but it works in… However, in a couple of years this is a forgotten problem. It is only in Planning Tool 2000 that this is a problem, so I am looking forward to the new version [of the product].*

The customer says that he has given the Company input about a problem with the project-planning tool, but it is not fixed yet. The excerpt shows that it is actual problems the customers encounter that can trigger further development of the product. It is clear from this excerpt that the customer has sent a suggestion to the Company about improving the problem. *Excerpts 1* and *2* illustrate how problems serve as the starting point for providing the company feedback about further development of the products.

Scaffolding
In *Excerpt 3* below, one of the professional developers in the Company explains how knowledgeable their customers are. He says they often answer their own questions due to their domain-expert knowledge in the use of the project-planning tools.

> *Excerpt 3*
>
> *Professional developer: The customers call directly to the developers [when they want to forward improvement requests, ideas, bug fixes etc.]. Very often the case is actual that, many of our customers are really competent and skilled – they even have a lot of [expert] knowledge of the project-planning tools they, [if I tell them to] just repeat their question to me enough times –they very often find an answer to the question themselves. It happens frequently. Often it is like they ask – how was this being done or what did you suggest now – and do this a couple of times and then they have found their solution.*

This excerpt shows how competent and skilled some of the Company's customers are. In this case the professional developer purposively (and it seems this is something he usually does with his customers) encourages the customers to answer their own questions by guiding them in the right direction. This becomes evident when the developer says that he tries to help them to use and develop their own knowledge by asking them leading questions and to repeat the questions. It seems as though it is an underlying goal for the developer to help the customers to help themselves, by directing them to answer their own questions and using the knowledge they already possess.

Adaptation
The excerpt below is from an interview with one of the professional developers at the Company, describing how the customers contact them when they want to develop the product further in order to fit it to their needs. Nils, another professional developer in the Company, is also involved in customer support.

Excerpt 4

Question: If the customers want extra functionality added to their products, do they contact you?

Answer: No, they do not. [The developer works more with the technical part of the products, configurations, installations, etc.]. It is typical that they have talked with Nils for a long time [indicating several communication points over time]. They have explained why things [functions in the project-planning tool] work in certain ways and how they want them to work differently, what does not work and how they want it. They want us to develop the product further, more specifically for them.

The developer states that the typical product development process is characterized by a relationship between customers and some developers assigned the role of customer consultant over time, since several contact points concerning further development of the product is implied. This indicates that there is long-term interaction between some customers and developers that include collaboration (with, e.g., Nils) and cooperation (indirectly with the other developer). This excerpt also shows that some customers are clear about how they want the products to behave, and consequently adapted, according to their needs.

Generalization

Excerpt 5 is from an interview with one of the professional developers in the Company, in which he describes how their customers contact them regarding further development of their products.

Excerpt 5

Question: Does this [the process of handling improvement request or local adaptation of the product] apply to all of your products?

Answer: No, in practice it does not. It is meant to be just for

> *Planning Tool. But if a customer states that he wants to have a product that does this and that [work in a specific way] and if the customer pays for it, then it is okay [to develop the product further in accordance to the customers' request].*
>
> *Question: Is this because Planner [Planning tool and Company's main product] is the tool that is the most adaptable product you have?*
>
> *Answer: Yes, that is what I am telling you. If we see that this is a feature we should have created/thought of a long time ago, like, why did we not make it like that [the product], it may be the case that it will be part of the next main release of the product. If not, the customer has to pay for it. It can be a feature that we see is really useful and think that we absolutely should have it, but it is way too expensive to develop – it can be – that the customer will have to pay for it.*

In this excerpt it is being questioned whether the customers ask for improvement requests on all of their products, implying that the Company produces several types of project-planning tools. The Company provides four different types of project-planning tools (Andersen, 2008). According to the professional developer, the project-planning tool named Planner is the product about which most customers send improvement requests regarding adaptation and further development. This excerpt reveals an underlying philosophy heralded by the Company, being open to ideas to improve its product further and appreciating suggestions from valued customers. Furthermore, the developer says that if one of the customers suggests an innovative feature for one of their products, which is the type of idea the Company would have liked to discover for itself, the Company can choose to integrate the suggested feature in the next release of the product. This means that a single customer's idea for improvement may be 'generalized' and made available to all customers, that is, if it is a good idea. However, if the idea is not so good, the Company can still fulfill the request, but the customer will then have to pay for the cost of the adaptation.

General discussion

In this section the empirical data will be interpreted and discussed at a more general level of discourse. The purpose of this section is to answer the research questions: a) the role of problem as primer; b) opportunities for learning in conjunction with development; and c) organization of customer-developer relationships over time, which are reflected in the organization of this section. We seek to make use of the theoretical perspectives surveyed in the beginning of this chapter in order to compare and contrast our results with the results reported in the literature (PBL; self-directed learning; active users; co-configuration).

Authentic problem as primer

In problem-based learning, as the name implies, the problem serves as the basis for the learning process by giving a direction to the learning process. PBL emphasizes the equal importance of formulating a question and finding the answer (de Graff and Kolmos, 2003). *Excerpts 1* and *2* can be seen as an example of how the customers act as *problem identifiers*, suggesting problems that can serve as the starting point for a product development and learning process. Graaf and Kolmos claim that it is important that problems serve as a starting point in order to give the process direction and meaning (Graaf and Kolmos, 2007). *Excerpts 1* and *2* emphasize how the suggestions for product development derive from problems and issues the customers encounter when using the project-planning tool in their everyday work. Additionally, it is clear from the excerpts that it is the customers who experience problems with the products and take initiative on their own and contact the company regarding further development. This is in line with Lehtinen, who says that the most characteristic feature of PBL is that it is based on authentic and complex problems (Lehtinen, 2002). *Excerpts 1* and *2* also show how the customers act as *problem identifiers.* When the customer calls the professional developer and explains why their project-planning tool does not operate the way they want in order to perform in their daily work tasks, they act as problem identifiers. Coombs and Elden (2004) emphasize PBL's focus on real-world or authentic problems that capture the complexity and ambiguity that learners will face in their careers rather than being structured around separate academic disciplines. When the customer in *Excerpt 4* proposes improvement requests to the Company, it is almost a demand to be part of a collaborative product development process. When the customers in *Excerpts 1, 2,* and *4* suggest ideas for further change to the products, it provides a context for the development and learning process, as well as what is to be further developed on the project-planning tool. This is in line with Coombs and Elden saying that in PBL the problems form the context for learning within which both content knowledge and skills or competencies are developed (Coombs & Elden, 2004).

Opportunities for learning: Self-directed learning

Self-directed learning refers to a situation where students are made responsible for their own learning and involves subskills, such as having a perspective on what the students do and do not understand, identifying learning goals, and planning appropriate learning strategies (Hmelo-Silver, 2004). *Excerpt 3* points to how the customers act as self-directed learners due to the emphasis on customers answering their own questions. It is evident in this excerpt that the customers, through some guidance from the professional developers, are creating solutions and answers to their own problems with their project-planning tools. In self-directed learning, students apply their new knowledge (as the customer uses the new version of the project-planning tool) and evaluate their hypotheses in light of what they have learned (as the customer uses the planning tool to plan a project and reflects upon it). According to Hmelo-Silver (2004), self-directed learning involves several subskills, where one of them is metacognitive awareness, i.e., learners' awareness of what they do and do not understand. When the customers ask questions, reformulate them, and reflect upon what they do and do not understand, and finally find a solution to their problems themselves, this is an example of self-directed learning. In PBL, students become reflective and critically think about what is being learned (Hmelo-Silver, 2004). It seems like this is the case here, when the professional developer in the excerpt says that he repeats the customers' questions several times and thereby guides them towards creating their own solutions. As stated in *Excerpt 3*, the customer calls the developer directly because he has a problem with a current product and wants to have it further developed according to his needs. Doing this is in keeping with self-directed learning according to Blumberg (2004): users have the ability to define what is to be learned, to access material, and to actively study the material. Contacting the developer and explaining in what ways he wants to change the product points at the fact that the customer has an overview of what he wants to be learned and changed. The customer uses the tool in his daily work and thereby has the opportunity to access the product and study what changes are needed.

Opportunities for learning: Active users

All of the excerpts above point at how the users are active contributors in mutual software product development. The users propose improvement requests as in *Excerpt 1* and *2*, in *Excerpt 3* the customer contacts directly the developers with questions and ideas, and in *Excerpt 4* the customers asks for adaptations of the product so that it fit just their needs. Further on, in *Excerpt 5*, the customers are actually active to such great extent that their suggestions for further development actually become part of the general product. This indicates a wide range of different ways the users are active contributors in the mutual development.

The adaptation of products as pointed at in *Excerpt 4* demonstrates to what great extent the customers are active and engaged in the product development processes, due to the fact that they are the ones asking for and suggesting further development of the products. Superusers are regular employees with in depth knowledge of one or more of the organization's computer applications without being programmers (Åsand and Mørch, 2006). In *Excerpt 4* regular employees acting as users of the products have such in depth knowledge about the project-planning tool that they are able to propose software changes to the product. In this manner, in the light of a super user, the customer can be seen as an active user. Further on, in *Excerpt 4,* it is evident that the customers through explaining how the products work and does not work show that they have domain expertise and computer know how, which is in line with the notion of superusers by Åsand and Mørch (Åsand and Mørch 2006). The concept of active users is further supported in *Excerpt 5.* In *Excerpt 5* the developer states how the customers call directly to the professional developers and say in what ways the product should be changed to work in order to fit their needs. As a prolonging of this it is being said that customers sometimes proposes such good ideas that it becomes part of the general product, which indicates great domain expertise and know-how about the project-planning tool. When a customer proposes an improvement request, which is of such good quality that it becomes integrated in the general product, it is an underlying assumption that the customer has to be knowledgeable in order to propose such changes. These types of superusers can be classified as local developers (Gantt and Miller, 1992) or power users (Fischer, 2004). *Excerpt 1* and *2* are examples of how the customers are the driving forces behind the development process, pointing at how the customers are the ones contacting the company and in this manner being active. In lead user innovation (von Hippel, 2005), users are considered as important parts of the product development process, as they bring innovative ideas from outside. However, user participation is not without its problems. Developer issues such as security, ownership rights to ideas and products, can easily lead to big problems for the company. These issues are considered outside the scope of this paper due to space requirements and lack of data. In spite of this, *Excerpt 5* gives a flavour of a complex problem in how the company encourages customers to propose improvements to the products and accepts those that are of good quality. This is in line with lead user innovation, which refers to users who are ahead of the companies' products (von Hippel, 2005). *Excerpt 5* illustrates how a single improvement request from a customer can lead to a generalization that is implemented in the next release of the software and made available to all customers.

Organization of customer-developer relationships

In *Excerpt 3* it is indicated that there exists collaboration between developers and customers in the product development processes, since the customers propose ideas and the developers develop respond to them and sometimes implement them as the data indicates. This is a form of co-configuration. A central aspect in co-configuration work is the close collaboration between developers and customers (Engeström, 2004). Another indication is that a mutual exchange between customers and developers can be seen, meaning that the customers sometimes get their development for free and the company gets good and innovative ideas integrated in the general product. Engeström says that a characteristic of co-configuration is the continuous mutual exchange between customers and developers (Engeström, 2004). *Excerpt 1* and *2* shows how the customer has given the company feedback of how to improve the product even further. These excerpts point to how the customer through his request of modification of the product asks the company for a sort of collaboration in the product development process, which is in keeping with co-configuration processes, where the emphasize is on close collaboration between developers and customers in product development (Engeström, 2004). In our previous work (Andersen, 2008; Andersen & Mørch, 2009; Mørch & Andersen 2010), we have referred to this as outer-loop development; in contrast, the technically driven work organized by the company internally we call inner-loop development. Furthermore, one of the characteristics of co-configuration is that there is an ongoing customization of product-service relationships over time (Engeström, 2004). We can distinguish product-service relationships as a two-stage process: 1) interaction between customers and a developer with the role of customer support to bridge between the product and Helpdesk and 2) interaction between the customer support and the full-time developers, mediated by the product. Moreover, we can distinguish the process in terms of 'collaboration' and 'cooperation:' collaboration between customers and customer support (intensive short-term activity) and cooperation between end-user developers and professional developers as an activity spread over time (i.e., as stated in the beginning of *Excerpt 4*). When the customers contact the company with questions on how to develop the product further or how to adapt it to their specific needs, this is an example of how the customers initiate and invite the company into a special type of collaboration (which can take several months); this may end with a long-term process of cooperation (taking up to several years). In *Excerpt 3*, the professional developer points out that the customers contact Nils (another professional developer in the Company who acts as customer support). He plays a critical role in integrating collaboration (short term, intense) and cooperation (long term, interspersed) activities, which we see as key components of co-configuration work.

Directions for further work

The main findings derived from the empirical data are that the customers act as problem identifiers and problem owners when they co-create a new artifact with the company's developers. An interesting question to be explored is to what extent these findings could apply in educational contexts as well, i.e., to what degree the students identify their own problems and how they are connected to issues of development they experience in their daily lives. Furthermore, a PBL scenario at a school that draws on the concept of mutual development and the students' expertise from outside school settings could be envisioned. One example to illustrate this point is giving a group of students an assignment to initiate or join a campaign for the improvement of some well-known product or service in the community; to achieve success, this may require skills of multiple kinds: research, interest, communication, and persuasion. There have been attempts at this in the public sphere in Norway, in the domains of unhealthy foods and sugary beverages, sports goods, and public services. Often initiated in the popular press or on Internet sites with broad interest (e.g., Facebook). Moreover, Ponti (2013) conducted a interesting study to identify the mechanisms involved in open educational resources and the role of the teacher in this process. In Ponti's study, she identified 'tensions' connected to empowering students to participate in open educational courses and how they appropriate open educational resources that are not fixed a priori by a teacher, but adapted by the students to their own needs (Ponti, 2013). A direction for further work could be to investigate the tensions that arise in situations where students are expected to be active participants and when the quality of the course is directly dependent on their participation. Following from this, directions for further work based on the current study could be to take a closer look at what tensions can be associated with customer initiated development (such as the issue of property rights) and what strengths and weaknesses are associated with problem-based and self-directed learning within mutual development in professional contexts. Further work could start by studying mutual development in another domain, and by employing research methods (other than interview) for data collection and analysis. We are currently pursuing the latter by involving social network analysis and combining qualitative (interview, interaction analysis) and quantitative methods (SNA).

Summary and conclusions

We have described a set of processes of collaborative software product development that involves customers in processes of adaptation, generalization, improvement request, and scaffolding. Improvement request and adaptation involve problems that customers encounter in their daily work and they serve as drivers for further development. During scaffolding, facets of self-directed learning are revealed in the way that developers help the customers to help themselves. Generalization is more elaborated process and involves short-term collaboration (between customers and customer support) embedded within a longer-term cycle of cooperation (between end-user developers and professional developers). Our analysis shows that mutual development provides opportunities for learning in terms of problem-based and self-directed learning. This chapter therefore contributes to the discourse of discussing PBL outside formal educational settings. In addition, this chapter suggests that Problem-Based Learning can be part of product development processes, and that the learning opportunities can enrich the development process for the participants involved. The lessons learned from this study may provide new ideas that can be adopted in educational settings.

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MUSICALLY SKILLED GAMERS' USE AND EXPRESSIONS OF KNOWLEDGE OF MUSIC AND MUSIC MAKING WHEN PLAYING GUITAR HERO

Jens Ideland

Background

A great deal of musical learning often takes place outside traditional music educational environments (Folkestad, 2007). Listening to music while doing other things, or consuming multimedia with background music, contributes to knowledge of music (Ericsson, 2007; Green, 2001; Wingstedt, 2008). It has been suggested that playing the digital music game Guitar Hero (GH) is an activity that 'isn't just like playing a real instrument, but it's nothing at all like just listening to music' (Miller, 2009, p. 424). When introduced in 2005 Guitar Hero rapidly became widespread and very popular, and for some years many youths spent a lot of time mastering this game challenge based on guitar parts of heavy rock songs. Many Swedish pupils refer to Guitar Hero and other digital music games, e.g., Rock Band or Sing Star, when talking about music or what it means to be musically talented (Hellgren, 2011). Nowadays these games also affect what is being done during music lessons in Sweden (Ericsson & Lindgren, 2010).

Since Guitar Hero runs on a game console (e.g., PlayStation, X-box or Wii) and the player sees the game track and hears sounds and music through a television set, it is in one sense a 'traditional' digital game. But unlike most digital games, Guitar Hero has a customised game control (fig. 3). The guitarlike shape, the five colourful buttons, and the strum bar do not make the control a real guitar, but nevertheless it has *some* physical resemblance to an electric guitar. Together with the display of a virtual band, stage, and audience on the game screen, this control frames the game as a kind of simulation of playing the guitar in a rock band, thus urging the gamer to act with *some* resemblance to a guitar player (see Arsenault, 2008). Playing Guitar Hero thereby offers an activity in which the digitally generated game screen, as well as the sounds and actions heard and performed in front of the television set, are important (see Miller, 2008, 2009).

The game-specific notation displayed on the game screen similarly represents *some* aspects of the original guitar part. Since the notation and the guitarlike interface use only five colours/buttons, it is impossible to represent tonal movements and different chords accurately. But, as the former music educator Shultz (2008) argues, the reduction used to create the game track is often quite successful and has many similarities to the reduction used by music theorists when analysing basic structures in compositions. A gamer that succeeds when playing the game thus performs a simplified representation of the guitar part on the plastic GH guitar. When doing so correctly, s/he is rewarded with points, but even more importantly, s/he gets to hear the original guitar part through the speakers. This way the gamer is sometimes offered an illusion of 'playing' the guitar part him/herself.

Arsenault (2008) argues that Guitar Hero is a rather good simulation of what rock guitarists do. This is not because the game accurately simulates any single aspect of playing an electric guitar in detail, but because, through representing many different aspects of playing guitar in a rock band in a fairly good way Guitar Hero simulates 'the idea of playing guitar' (p. 2). Miller (2009) comes to a similar conclusion when arguing that Guitar Hero is a type of rock performance simulation somewhere between listening to music and playing an instrument. Although playing Guitar Hero or Rock Band stands out here as a form of tribute to rock music and rock musicians, Miller's study reveals that many musically interested adults, i.e., music journalists and musicians, are negative about this kind of music games. They often describe playing Guitar Hero as an activity with no meaningful connection to music or musical learning, and one that kills both time and creativity (Miller, 2009).

As a commercial off-the-shelf game made for entertainment (Svingby & Nilsson, 2010), Guitar Hero is not designed primarily to enhance education or the development of musical skills. Nevertheless, it can be argued that some popular entertainment games provide good environments for learning (Becker, 2008; Gee, 2003), offering opportunities for players taking support from smart tools and distributed knowledge to view, perform, and feel a depicted activity in a 'professionalised way' (see Goodwin, 1994; Gee, 2007). Some researchers (e.g., Walker & Shelton, 2008) argue that many digital games for education function as environments for problem-based learning (PBL). Considering that players taking on the seemingly authentic 'problem' offered by Guitar Hero (Arsenault, 2008) often develop knowledge and skills in small groups and/or Internet communities (see Miller, 2009; Väkevä, 2010), this entertainment game, too, stands out as a kind of informal PBL environmnet.

In line with such arguments, some researchers advocate the possibilities of incorporating games like Guitar Hero into music education (Gower & McDowall, 2012). Other researchers problematize high expectations on learning through gaming when arguing that *what* gamers do and learn in digital environments cannot easily be foreseen (Peterson, 2011). Rather than gaining knowledge of a 'reality' depicted by a game, players often learn how to read and handle the visual game screen itself (Linderoth & Bennerstedt, 2007; Linderoth, 2010). Furthermore, many commercial games give an *illusion* of learning rather than pushing gamers to develop new skills (Linderoth, 2008; 2010). In this study, though, playing Guitar Hero is viewed as a practice in its own right, a spare time activity outside the didactic framing and predefined goals of education that offers increasingly demanding challenges to gamers moving on to higher levels.

The challenge that players need to tackle to succeed can in itself be viewed as a skill and drill task, drawing on behaviouristic ideas about learning (Egenfeldt-Nielsen, 2006). On the other hand, Guitar Hero was originally developed to be a sort of rock performance simulator, a kind of microworld (Papert, 1980) in the sense that it offers possibilities of exploring and expressing the showmanship of rock musicians (Miller, 2009, p. 412). Consequently, it is not only managing the game challenge and getting high scores that are important. *How* this is done and expressed as a *musical experience*, using bodily movements, etc., is often as important to many gamers interested in rock music (Miller, 2009). Guitar Hero can thus be viewed as a sociocultural environment and situated practice, rooted in both music making and gaming practices, which offers 'new' ways to experience, act, and express knowledge as well as identity to participating players (Egenfeldt-Nielsen, 2006; Gee, 2003; Nilsson, 2010; see also Dewey, 1938; Säljö, 2010). Rather than learning itself, the scope of this study is to examine how this environment affords performing and expressing knowledge of music and musicianship.

Features of the GH tools and technology at hand thus play an important role since they affect players' abilities to express *who* they are and *what* they are doing in the current situation (Gee, 1999; 2003; Säljö, 2010; Turkle, 1984). A common adult perspective on Guitar Hero is that players have to obey the rules and scoring system, and therefore become 'enslaved' by the game (Miller, 2009; Svec, 2008). But the smart tools and scenic qualities offered also facilitate actions and performances that make GH playing an expressive and creative activity (Säljö, 2010; Turkle, 1984). People 'playing' the GH guitar and who take on the role as a guitar hero are thus often able to express themselves to real or virtual others in new ways (Miller, 2008; 2009; Väkevä, 2010), often feeling like professionals though performing before competence (Gee, 2007; Miller 2009). When doing so, players articulate discourses, knowledge, and understanding of music and gaming in ways that are not always accepted as legitimate or even possible outside the activity of 'playing' the guitarlike GH control (Väkevä, 2010).

This does not mean that all musical knowledge or skills can be used or articulated smoothly when playing Guitar Hero. Entering a new practice or context, offering different resources and tools for communication and meaning-making, causes a *transduction* phenomenon that forces individuals to redesign their ways of articulating knowledge and identity (Kress & van Leeuwen, 2001; Wingstedt, 2008). One way to study what affordances Guitar Hero offers is to examine more closely what young rock musicians do and how they perform musical knowledge when taking on the game. They express a great deal of knowledge of music and musicianship when playing musical instruments in a rock band, but what actions do musically skilled youths perform, what identities do they articulate, and what genre clashes (Hanghøj, 2011) occur when playing Guitar Hero? The game can be viewed as a kind of virtual stage, offering people without musical training opportunities to make and participate in musical performances (Miller, 2009; Väkevä, 2010). But what does this environment mean to young musicians who are used to perform this kind of music on a 'real' stage with 'real' instruments?

Analytical framing

Researchers interested in digital environments have pointed out that research has to study what people do in these practices to visualise how 'knowledge is expressed in our abilities to merge and collaborate with external tools and to integrate them into the flow of our doings, whether these are intellectual, physical or mixed' (Säljö, 2010, p. 62). When people act and engage in a practice, they *show* knowledge, as well as who they are and what they are doing, by using different resources and tools at hand (Gee, 2003; Kress, 2010; Säljö, 2010). GH gaming is communicatively speaking a complex and highly multimodal practice that has to be thoroughly analysed to understand the meaning or point of gamers' actions and utterances (Kress & van Leeuwen, 2001; The New London Group, 2000).

This work draws on a multimodal perspective on communication (Kress & van Leeuwen, 2001; Kress, 2010) based on social semiotic theories (van Leeuwen, 2005) that view practically all human actions and products as communicative. For example, gestures, sounds and music as well as speech and written texts used in the GH context can be seen as important resources for meaning making. An important aspect of this view is that a GH gamer *makes* signs and meaning based on his/her social interest in the current situation (Kress, 2010). These are here understood as representations of discourses or discursive knowledge.

> *We have defined discourse as a knowledge which is 1) a knowledge of practices, of how things are or must be done (at the level of discourse these two merge), together with specific evaluations and legitimations of and purposes for these practices, and 2) a knowledge which is linked to and activated in the context of specific communicative practices. This means that people may at different times draw on different discourses about the same practice or practices, choosing the one they see as most adequate to their own interests in the given context* (Kress & van Leeuwen, 2001, p. 114).

When designing and producing signs, people use social and material resources at hand in the specific sociocultural environment that offers different affordances (Jewitt & Kress, 2003; Kress & van Leeuwen, 2001). This is a kind of work that implies a process of learning because discourses and discursive knowledge are reshaped and worked with (Kress & van Leeuwen, 2001). As individuals get experienced in using resources to produce signs, they also enhance their capacity for making meaning and acting in the world (e.g., Kress, 2010). This means that signs and communicative resources, rather than having a fixed meaning, offer meaning potentials that change over time as people use them for diverging purposes in different contexts (Kress & van Leeuwen, 2001). A multimodal view on *literacy* thus means that individuals using available communicative resources are able to make sense of, and create, signs and products with a meaning potential (Kress & van Leeuwen, 2001; Wingstedt, 2008) accepted in the practice and context at hand (Jewitt & Kress, 2003; Kress, 2010).

The physical and social framing has to be considered in order to understand such actions as part of individuals' communicative work and identity formation in relation to a certain affiliation group or practice (Gee, 2003; Kress, 2010; Säljö, 2010). But a focus on contextual premises is not sufficient to understand why GH players express themselves and their knowledge in certain ways, or why some situations lead to breakdowns (Winograd & Flores, 1987). As in Gibson's original view (1986), affordances are here viewed as a relational matter because previous experiences of handling available tools and resources, as well as different social interests in the particular situation, mean that playing Guitar Hero offers diverging possibilities and constraints to different players (e.g., Kress, 2010).

Based on this perspective, actions performed when playing Guitar Hero can be understood and analysed as signs of the individual's discursive knowledge and capacity to handle communicative resources at hand, i.e., the GH guitar, GH notation, and audible music, as well as whatever social position the individual finds attractive in the current situation. Those actions can also be understood as the young musician's expressions of *who* he is and *what* he is doing when playing Guitar Hero. Through taking a position in this context the player articulates a socially motivated *situated identity* (Gee, 1999) and understanding of how Guitar Hero should be handled in this particular social framing. One way to describe the affordances of playing Guitar Hero is therefore to analyse what *meaningful action space* (fig. 1) the player has, e.g., what possibilities he is offered to make meaningful actions articulating a situated identity in line with the social interest.

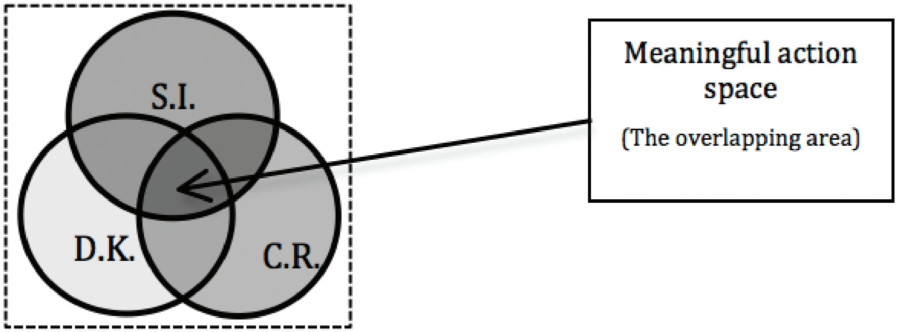

Fig. 1. Model visualising how the meaningful action space relates to the young musician's social interest (S.I.) in, discursive knowledge (D.K.) of, and capacity to handle tools and communicative resources (C.R.) available in this GH context (see also Ideland, 2011).

The aim of this study is to examine what playing the digital music game Guitar Hero means to youths trained in, and used to, making music on 'real' instruments. Through analysing how young musicians perform and express musical knowledge and situated identities, in this borderland of gaming and music making, affordances of handling game-specific tools and resources as well as the social context are made visible. Individual case descriptions are used to answer the following research questions:

» What *situated identity* is the player articulating?

» What knowledge of music, music making, and gaming is the player using and/or expressing?

» What meaningful action space is the player offered in this environment?

In the discussion, these cases are compared and analysed one step further to illuminate what, and how, affordances offered affect musically skilled players' possibilities of using and expressing knowledge of music and music making within a meaningful action space.

Method

Following these theoretical underpinnings, it is important to look at what young musicians do when taking on the game challenge *in* the practice of playing Guitar Hero. To enable a thorough analysis of how GH gamers act and utilise available resources and tools, it is necessary to examine the complex multimodal communication. No device can capture it all (Jewitt, 2006; Rostvall & West, 2005), but an audio/video recorder was used to document the section of the room where important actions analysed in this study took place. An additional display was used to be able to have the currently gaming informant in focus and simultaneously catch what was happening on the game screen.

Fig. 2. Screen shot from the first version of Guitar Hero

The setup used when playing guitar versions of Guitar Hero consists of a game console, a television set and one or two guitarlike game controls. The basic idea of the single player mode used in this study[23] is that the gamer has to read and 'play' according to colourful notes scrolling towards him on the game screen (fig. 2). This game notation is a simplified representation of the guitar part of the typically heavy rock song that the gamer chooses to play. Each of the five colours used has its own lane on the game track, arranged to correspond to the five coloured buttons on the plastic GH guitar (fig. 3). In lower levels (easy and medium), the game specific notation represents a heavily reduced and basic skeleton of the audible guitar part. In higher levels (high and expert), all five colours are used in different combinations in such a way that the game notation more closely represents the rhythmic and tonal movements played by the original guitarist (Shultz, 2008).

Fig. 3. The guitarlike game control used in Guitar Hero World Tour

23 The World Tour edition released in 2008 is used in this study. This version offers new controls (drums and microphone) as well as new gaming modes. However, the single player and quick play mode used here are basically true to the original GH concept.

When a round or stretched GH note reaches a certain position on the lower part of the screen, the gamer must press the corresponding button and hit the strum bar on the GH guitar. Hitting notes in Guitar Hero triggers the game to play the sound of the original guitar part, and the player is also rewarded with points and the sound of an ecstatic audience. If the gamer tilts the guitar, presses the *star power* button or uses the *whammy bar* correctly, s/he gets more points (fig. 3). Missed notes, on the other hand, do not give any points at all. Even worse, the original guitar part stays numb and dull 'clunks' are heard when the gamer fails. Eventually bad gaming makes the virtual audience boo as the song is interrupted.

To reach the goal of this study, a group of six 16-18-year-old male informants attending a specialised music programme in a Swedish upper secondary school was used. These voluntarily participating music students make it possible to illuminate what, and how, knowledge of 'real' music and music making can be performed when playing Guitar Hero. Their previous experiences of playing Guitar Hero and other digital games varied greatly, from novices to experienced gamers. Musically they had much more in common. At the time they were studying different instruments or singing, but they all had the experience of playing the guitar as well as pop and rock music, and in school they were brought together to form a 'traditional' rock band. In this study two of these informants are used as examples because their ways of taking on Guitar Hero illuminate how diverging the affordances offered gamers with different experiences and knowledge of this environment sometimes are.

The main material analysed is a video recording of a gaming session conducted in late 2009. During this session the informants took turns playing the guitar part of Guitar Hero using the guitarlike GH control.[24] The more experienced GH gamers played one song each, while the two newcomers took on two and three songs respectively. In order not to put the informants under unnecessary pressure, the session was conducted in a youth centre, out of reach of the immediate influence of teachers and schoolfellows. As background material, the informants were filmed during one lesson in ensemble playing (the rock band) and one in ear

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24 The informants chose to play the Quick Play mode of the World tour edition.

training and music theory. Additional individual interviews were conducted approximately one month after the gaming session.

Processing and analysing

Early results visualise an important difference between GH gaming and speech-based forms of interaction. Unlike, e.g., verbal conversation, it is not that fruitful to analyse GH gaming as a sequence primarily based on taking turns (Heath, Hindmarsh, & Luff, 2010). Musicians playing in a group make musically synchronized meaningful actions simultaneously (Sawyer, 2005). Typically in pop and rock music, they often act and respond to a known pattern and/or situation, spread out over time, rather than the most recent 'prompt' (Green, 2001; Johansson, 2010). Actions performed by participating GH gamers similarly make more sense when analysed as responses to communicatively consistent sections and/or patterns of the song played.

In keeping with those insights, the video documentation was divided into clips aligned with, and based on, such communicative consistent situations. A scheme was used when transcribing to secure that bodily actions, oral utterances, and the informant's way of handling the GH guitar in relation to the specific game context, e.g., sounding music and game specific notation, were considered and described. Situations, actions, and approaches that reoccurred or stood out as typical or important when looking at the video and reading the transcripts were compiled in matrices, one for each informant. These matrices were analysed in several steps to create individual case descriptions.

A first round of analysis was made to summarise and describe the informant's actions and ways of handling the game and guitar interface in different situations. A special focus was put on how strumming, 'button pressing', tilting and use of the whammy bar (fig. 3), as well as bodily movements and oral utterances, relate to the game context, e.g., the game notation and sounding music. The second step examines what view of Guitar Hero and GH gaming this manner of taking on the game articulates, as well as what relation to knowledge of music this approach implies. The informant's way of approaching the game was then analysed to illuminate what gamer position and situated identity he expresses. This level of analysis also considers how these expressions relate to the informants' articulation of a situated identity when playing a 'real' instrument in a 'real' band. The fourth and final step focuses on what possibilities and constraints on using and expression knowledge of music and musicianship, and also digital gaming, the player faces when approaching the game and articulating a situated identity in this manner.

Results

Two case descriptions are here condensed and briefly summarised. In each case a short description of the informant's previous experiences of digital games and music is presented to visualise the background of analyses made. Since the experienced gamer played one song with a rather consistent approach while the newcomer tried different approaches during his three attempts, the structure of the cases is somewhat different.

Joel, the experienced gamer

Joel is a talented young musician. He plays the guitar and keyboard and he also likes to stand in front of his band and sing. When playing or singing with a band he often emphasises the expressive aspects of being a musician. He is also an experienced gamer, who has been playing various kinds of digital games for a long time. Joel plays Guitar Hero a lot, and he prefers to do so with friends or family. When talking about the game, Joel often points out that Guitar Hero is a game with a primarily visual reading challenge. He argues that Guitar Hero is quite similar to the old computer and arcade game Tetris, but with a good soundtrack.

When taking on Bon Jovi's 'Living on a prayer' on the hard level, Joel usually stamps or marks the pulse bodily. Often he somewhat exaggeratedly moves like a guitarist, i.e., when tilting the GH guitar or using the whammy bar, and/or sings the melody with a playful smile on his face. Occasionally he sings the guitar part, and at one point he also sings an improvised fill, imitating the sound of an electric guitar. At the same time Joel is using an often fluctuating and consequently earlier timing than musically motivated, as well as a gamer efficient 'thumb grip', when strumming the GH guitar. During the solo, and other parts not consisting of reoccurring patterns, Joel is sometimes strumming so early and unsteady that he fails to hit some of the GH notation.

Through 'playing' the GH notation on the plastic guitar without a clear and distinct relation to the pulse or the original guitar part, Joel's early and fluctuating timing makes the GH challenge stand out as primarily visual game task. Guitar Hero seems to be about strumming and pressing buttons when GH notes are at a certain position on the screen. Handling the guitarlike game control this way is distinctly different from the way musicians use timing and strumming techniques when playing guitar in a band. Through expressing GH gaming as different from playing a 'real' guitar, Joel articulates *Guitar Hero as a non-musical game task*. At the same time Joel is articulating *Guitar Hero as playing a game* by using theatrical and playful mimicry and bodily movements when stamping the pulse, moving like a guitarist, and/or singing the melody. Acting like this makes GH gaming stand out as a playful and scenic activity where musician-like actions are expressed as part of a theatrical play.

With this double-layered approach Joel takes a position as a *playing gamer* that stands out as highly valued in this context. This position has a clear connectedness to the situated identity and knowledge Joel expresses when making music in school. Through approaching *Guitar Hero as playing a game* he is drawing on, emphasising, and exaggerating the importance of expressive actions and 'show' as a means of articulating musical knowledge, experience, and commitment when being onstage. Despite the theatrical and playful touch this musician-like approach in itself could be misinterpreted as a position, which means that Joel makes no clear distinction between making music and playing Guitar Hero. The use of early timing and gamer efficient strumming, however, simultaneously underlines that Guitar Hero is a game which Joel handles by using gaming skills. Thus the parallel articulation of *Guitar Hero as a non-musical game task* makes Joel stand out as a skilled gamer with a great love for music instead of a socially problematic 'fake musician'.

Through articulating *Guitar Hero as playing a game* Joel creates an opportunity to use his voice and bodily movements to show and express a great deal of knowledge of music and musicianship, as well as the ability to perceive musical aspects. When taking on 'Living on a prayer', he shows knowledge of, e.g., the melody, form and guitar part of this song as well as knowledge of guitar sounds, fills, improvisation, and how guitarists often move on stage. Furthermore, articulating *Guitar Hero as a* *non-musical game task* when ‘playing’ the GH guitar means that Joel in an efficient way can express gamer specific skills and knowledge through, e.g., using gamer efficient strumming technique, timing, and way of handling the whammy bar. Relating to the game task as a primarily visual and nonmusical challenge is at the same time a constriction. It is not possible for Joel to show or use guitarist-like timing and strumming skills when taking on and articulating the game challenge in this manner.

Pierre, the newcomer

Pierre is a skilled and disciplined young bass player. He often takes on the role of a competent background musician using discreet body language. Also when singing in a band he normally emphasises the musical expression rather than expressive body language. Digital games are not Pierre’s priority and he has practically no previous experience of playing Guitar Hero or Rock Band. His main prior source of knowledge of those games is his classmates’ and friends’ discussions about digital music games and gaming.

> *Scenario 1*: In his first attempt to play Guitar Hero (‘Eye of the tiger’, medium level) Pierre is sitting still, with no musician-like bodily expressions of musical experience. Nor does his strumming on the GH guitar have a recognisable relation to the pulse or musical context. During the easy Intro he misses a large part of the GH notes and he soon chooses to abort the song. This indicates that the newcomer Pierre makes an unsuccessful attempt to take on Guitar Hero without relating to the musical context. It is likely that this approach is based on, and an attempt to act in line with, a discourse articulating *Guitar Hero as different from making music* that the more GH-experienced classmates (like Joel) often articulate when talking about the game. But Pierre cannot yet, as the classmates advocate, read the unfamiliar GH notation or ‘play’ the strange GH guitar without support from the musical context. Consequently this attempt to articulate *Guitar Hero as a non-musical game* leads to a breakdown.

Scenario 2: When retrying ('Eye of the tiger', easy level) Pierre stamps the pulse and discretely moves his body in musician-like ways. When strumming the guitarlike control there is a clear and musician-like timing and relation to the pulse and/or musical context/original. This time he misses rather few GH notes during the whole song. Acting like this indicates that Pierre uses knowledge of, and ability to perceive, the musical context as well as musician-like skills and strategies as supports when reading the game notation and 'playing' the guitarlike game control. In so doing, his way of taking on the game articulates *Guitar Hero as a music-related game.* When using this approach, Pierre has very few problems in managing the game task. But on the other hand, this way of using the communicative tools in a musician-like way means that he cannot articulate the discursive view on Guitar Hero as a nonmusical activity he most probably made an attempted to articulate at first.

Scenario 3: At the end of the second song and during the main part of the third ('Feel the pain', easy level) Pierre is leaning back on the sofa, stretching his legs with a slightly bored expression on his face. Pierre uses a musician-like timing when hitting the GH notation that indicates that he still strums in relation to the musical context and/or pulse. But with the exception of sometimes wiggling his toes he expresses no musical experience or commitment. It seems that Pierre avoids actions that are musician-like and/or express a musical experience. Instead the laidback and slightly bored expression articulates *Guitar Hero as a music related but uninteresting game task.* Handling the game like this stands out as a way of getting closer to the 'standpoint' in *scenario 1*; through using newly acquired abilities to handle tools and resources at hand Pierre is approaching a position as an *uninterested gamer.*

Superficially Pierre's musician-like strategies in *scenario 2* can be analysed as if he were successfully expressing skills and 'everyday' identity as a musician in the GH context. But when he uses his gradually growing experience of, and ability to handle, the game specific tools and resources to articulate *Guitar Hero as a music-related but uninteresting game task*, it indicates that Pierre does not think of the musician-like position in *scenario 2* as desirable. A probable explanation is that the position in *scenario 2* means that Pierre might stand out as a 'fake musician' who tries to make music on the plastic GH guitar. Such a position could easily come in conflict with Pierre's situated identity as a serious and 'real' musician expressed in the school context. Pierre's choice is to maintain a distance from, and articulate, Guitar Hero as both uninteresting and distinctly different from making music. Through approaching and striving towards a position as an *uninterested gamer*, Pierre also shows a growing ability to handle the game challenge. This position simultaneously makes the alternative activity of playing 'real' music in a band stand out as more interesting and valuable.

Discussion

In the cases studied, exemplified here by Joel and Pierre, Guitar Hero stands out as an environment offering varied and sometimes ample, meaningful action spaces to musically skilled gamers. Largely due to the guitarlike interface and scenic space offered (Miller, 2008; 2009) players perform expressions of knowledge and situated identities in many different ways. But it is not self-evident that young gamers with experience of playing the guitar in real life can easily use or express this knowledge when 'playing' the GH guitar. Nor is the ability to play instruments in a rock band in itself sufficient to succeed as a 'guitar hero' in the game. This is most evident in the newcomer Pierre's first attempt that leads to a breakdown (Winograd & Flores, 1987). Without a useful discursive understanding of the Guitar Hero concept and experiences of the game specific tools and resources, he can neither manage the game challenge nor express musical skills or understanding in a way that is accepted as legitimate in this context. The more experienced gamer Joel has already developed a double-layered approach that works well in this environment. To use such early timing and strumming when playing guitar in a real band would, on the other hand, most certainly lead to breakdowns, and he would run the risk of standing out as a lousy musician.

These cases thus illuminate how tools and resources offered in the Guitar Hero environment cause a sometimes problematic transduction phenomenon (Kress & van Leeuwen, 2001) when forcing musically skilled players to redesign and perform new expressions of musical skills and knowledge. In a rock band, where musicians often play by ear, it is common that notation and reading sheet music have a low status and are 'secondary to the aural' (Green, 2001, p. 96; Gullberg, 2002). Playing Guitar Hero, though, is a different activity. Newcomers like Pierre have to develop an ability to read and understand the game notation to be able to take any of the gamer positions standing out as attractive in this study. On the other hand, this environment quite efficiently scaffolds (Bruner, 1986; Gee, 2007) the newcomers' abilities to participate and perform in the game (Gee, 2003). In his second attempted Pierre chooses a lower level (easy) that uses only three out of five colours/buttons and a more reduced rhythm to represent the original guitar part. As this support lowers the learning load (Gee, 2007) he is able to 'crack the code' and make actions necessary to succeed.

Using and expressing knowledge of music

When the original guitarist plays, e.g., a solo or fill, Joel usually uses very early and fluctuating timing. This indicates that he, as other informants with experience of playing Guitar Hero, reads the GH notation in such situations without relating it to the musical context. Typical for those situations is that the guitar part does not represent an easily recognisable and/or reoccurring musical pattern. Often, the relationship between the sounding original and the game notation is also less clear. In line with Linderoth's (2010) argument it is likely that players in those situations have to rely on their ability to read the visual game notation itself. To use or show musical knowledge or experience cannot be easy under such circumstances. On the other hand, these situations offer an opportunity to express visual reading ability and generic gaming skills (Gee, 2007) explicitly.

Situations where the original guitar part plays a recognisable and/or reoccurring pattern or riff are often treated rather differently. These situations often illuminate that young musicians, at least now and then, lean on a musical memory of the original and/or an ability to understand the audible music as a support when handling and acting in the game context. This is most evident when Joel and Pierre, e.g., stamp the pulse, use musically correct or motivated timing, move like a guitarist, and/or sing the melody or guitar part. This shows that young musicians in many different situations and ways can use and express some knowledge of music, e.g., form, riffs, and accompaniment patterns, and musicianship when taking on Guitar Hero.

Additionally, skilled players taking on games where the music is not as central often use and relate to patterns (Turkle, 1984). But in contrast to the cases studied by Linderoth (2008; 2010), and the Pac-Man game in Turkle's (1984) example, patterns standing out as important in this GH context are often not a game-specific construction or representation of a 'real' world. The young musicians 'playing' the GH guitar often relate to known and/or recognisable musical patterns in the audible music or guitar part, e.g., form and riffs, as well as accompaniment and strumming patterns, produced in the 'real' world by musicians (see also Miller, 2009). Their ways of relating to these patterns are sometimes quite similar to what rock or pop musicians do when playing music by ear (Green, 2001; Johansson, 2010). Now and then Joel and Pierre even strike 'chords' or 'notes' played by the original guitarist that are not represented in the game notation. They then make their own representations of the original and audible guitar part using the GH guitar. But not even when 'homemade' signs such as these are produced in coherence with the internal logic and musical reductions used in Guitar Hero (Shultz, 2008) are such creative expressions of musical understanding accepted and awarded by the game.

Strumming like a gamer or a like musician

Despite this connection to the musical context, the experienced gamer Joel is largely using earlier timing than musically motivated. Instead of hitting the *strum bar* (fig. 2) when the original guitarist plays the note/chord represented in the GH notation, the results show that Joel 'plays' this a little bit earlier. This is also true for the other three more experienced GH gamers in this study (Ideland, 2011). Since Joel, like all participants, uses musically motivated timing correctly when playing a 'real' musical instrument in a band, it is not likely that Joel, or the others, lack the actual capacity to perceive the musical context or synchronise strumming when taking on Guitar Hero. The use of early timing must be explained in a different way.

One probable explanation of using early timing is that many GH set ups, when, e.g., using a LCD-TV without adjusting for the lag, often cause a problematic latency[25] (see also Gower & McDowall, 2012). Thus, musically correct timing is often judged as too late by the game, thereby forcing the gamer to 'play ahead'. Hitting the GH notation earlier than motivated by the musical context is essential under such circumstances, if one wants to manage the game and stand out as a skilled gamer. But the GH setup used during the gaming session analysed in this chapter did not cause such a problematic latency. Instead, the few mistakes that Joel and the other experienced gamers make are often caused by timing that is *too* early. Despite this, Joel sticks to approaching *Guitar Hero as a non-musical game task,* and when interviewed about how to handle the game he says (translation by author); 'To manage it I think I put more concentration on looking [than listening], because it is not synchronised'. Thus this approach stands out as a sign of Joel's genuine understanding of how the game must be played.

A look at Pierre and the other newcomer reveals that they lean on musical knowledge and perception to understand and handle the unfamiliar gaming context (Ideland, 2011). Initially both depend on musician-like approaches and a musically correct timing to hit the GH notation in the right position. With the support from the musical context and the simplified game track on lower levels they can perform easy, but in this context important, communicative actions. When doing so they more or less instantly gain a form of local literacy (Gee, 2003; Jewitt & Kress, 2003). An interesting question, though, is what would have happened if the setup used during this GH session had caused a severe latency. Then the newcomers' successful use of musician-like timing would have been rejected, most probably causing breakdowns forcing them to reconsider their ways of tackling the game. It seems that latency, or not,

25 On my private set-up the lag caused by the LCD-TV is approximately 0.15 seconds.

is one of the features of the GH setup that heavily affects what it means to be literate in this context, as well as what discursive knowledge of GH gaming and what ability to handle available communicative tools and resources gamers can utilise.

Expressing Guitar Hero as different from making music

Many situations, as for example large parts of the Joel case, indicate that when the informant has the discursive knowledge and ability to handle the communicative tools and resources needed, then the player is able to articulate a situated identity, expressed as a *gamer position,* accepted as legitimate and valued in this context (Gee, 1999; Kress, 2010). Like Joel, other informants with prior experiences of playing Guitar Hero usually express a gamer position that stands out as attractive in this context, but which is also in line with a situated identity articulated in the musically imprinted school context (Ideland, 2011). The Pierre case, on the other hand, illuminates that newcomers initially might have rather limited meaningful action spaces, e.g., possibilities to express themselves in, or choose to take, such a desirable position. A common characteristic though is that all informants, like Joel and Pierre, avoid expressing their way of 'playing' Guitar Hero as making music. Instead, they all take or strive towards positions meaning that their ability to understand the musical context, as well as their knowledge *of* musical aspects and musicianship, can be articulated *as* gamer actions.

A probable reason for this is that young musicians are under the influence of ideas about rock music as real and authentic. Such discourses are often strong and drawn on by rock musicians and music journalists talking about rock music and digital music games (Miller, 2009) as well as music students in Swedish upper secondary schools (Scheid, 2009). Even though some researchers view Guitar Hero as a fairly good simulation of the idea of playing rock guitar (i.e., Arsenault, 2008), the GH guitar itself is a heavy reduction of the six strings and many frets of an electric guitar. The results indicate that this reduction, and a real or anticipated latency, makes it hard for young musicians to articulate their extensive knowledge of music making and musicianship explicitly enough. It is simply not possible to articulate musical skills and knowledge in a way that makes them stand out as 'real' rock musicians when 'playing' the GH guitar.

The risk of coming out as a socially problematic 'fake musician', thereby risking their position and situated identity as 'real' musicians in school, is thus the most probable reason why all informants strive to articulate GH gaming as distinctly separated from music making. Through articulating and acting in line with a discourse describing *Guitar Hero as different from making music* they tackle genre clashes (Hanghøj, 2011) arising when gaming and musician practices collide.

A complementary explanation of Joel's use of early timing from this perspective is that consistent and successful use of early strumming efficiently makes him stand out as a successful gamer, distinctly separated from the musician who plays in a band. Notably, also, the other three informants with previous experiences of playing Guitar Hero use early timing in a similar way. The player viewed as most skilled and cool by the others even adjusts *how* much earlier than the musically motivated timing he strums, depending on the current gaming situation, i.e., solo, rhythmic pattern or long chords (Ideland, 2011). Early timing, once a way of handling a technical shortcoming of the game, thus stands out in this context as a communicative resource used in combination with other resources by experienced players to articulate a situated identity as a skilled, playful or uninterested *gamer.* Intentionally or not, Guitar Hero itself supports this use of early timing as a sign of being a skilled gamer when asking a player who is about to adjust the lag to get rid of a problematic latency: 'Are you ready to blame your TV?' Adjusting the lag thus stands out as a sort of cheating, which supports the view that a *real* GH gamer can handle latency problems.

Conclusion

On the one hand this study supports the view that Guitar Hero is an environment supporting the possibility for players to participate in a kind of musical performance (Gower & McDowall, 2012; Miller, 2009; Väkevä, 2010), an activity that also musically skilled gamers use, express, and through which they eventually develop *some* knowledge of rock songs and guitar parts. On the other hand, small details and features of communicative tools and resources at hand have a big impact on the practice of playing the GH guitar. A seemingly small and here only imagined latency, not even a feature of the set-up used, accentuates an often problematic transduction phenomenon (Kress & van Leeuwen, 2001). Together with other communicative constraints, e.g., sometimes incoherent or unpredictable relationships between the sounding music and the game notation, this anticipated latency is affecting what and how participating young musicians make use and signs of their music-related skills and knowledge (Kress & van Leeuwen, 2001). Viewing music making through the 'lens' of the game may lend many nonmusicians a context-bound 'professionalised' vision and ability to perform (Gee, 2007; Squire, 2006). But to these young musicians it means that their (semi-) professional vision (Goodwin, 1994), hearing, and capacity to act is often blurred and 'gamerised' (compare Linderoth, 2010).

Consequently such constraints also have an impact on communicative actions expressing *who* they are and *what* they are doing (Gee, 1999) when taking on the game. In the long run, the absent latency even seems to have had a crucial effect on what actions and situated identities these young musicians accept as socially legitimate signs (Kress, 2010) of being a successful, skilled and/or cool musician playing Guitar Hero. Thus this study illuminates that occurring constraints, as well as meaningful action spaces offered, are not necessarily the consequences of players' abilities to handle features of available tools or technology per see. Discursive views and meaning potentials of playing the GH guitar have evolved as gamers interplaying with different setups and versions of Guitar Hero have made efforts to perform actions that stand out as meaningful and legitimate (Kress & van Leeuwen, 2001; Säljö, 2010), not only to other gamers but also to, e.g., fellow musicians and classmates interested in music.

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PROBLEM-BASED LEARNING AS A DOUBLE DRIVER FOR LEARNING – FOR STUDENTS AND EXTERNAL PARTNERS

Marianne Lykke & Tom Nyvang

Introduction

This chapter reports from research on the learning process that emerges when students' learning revolves around real-life problems provided by organizations outside the university. Firstly, we research how problems can drive learning within a course module with a fixed curriculum, and secondly, we research how the same problems can drive university-society/industry interaction thus contributing to learning inside as well as outside the university. We thus regard the learning a double-sided process in which students as well as organizations providing problems are offered opportunities to learn.

Prior studies tend to focus on either students or external organizations, but mostly on students' learning. Gavin (2011) is just one example of a study that shows how problems and tasks from industry can be a vehicle for learning among engineering students. When it comes to external organizations learning from academia, most research focuses on industry-researcher collaboration. This is done with reference to specific models for collaboration (Bruneel, D'Este, & Salter, 2010) or with reference to higher-level models such as the triple helix that agues for an approach to innovation that includes industry-university-state collaboration (Leydesdorff, 2009) . It appears to be an unspoken assumption that external partners cannot learn very much from collaboration with students, at least not students in bachelor programmes. Perhaps their knowledge is not regarded as sufficiently advanced for external partners to gain from it. Our starting idea is, however, that student-external organization collaboration with the appropriate scaffold will induce learning in both groups of learners. We assume that bachelor students under the right circumstances offer an innovative potential in the problem-solving process that provides new insights for external partners.

Our examination is a case study with 158 students in the third semester of a bachelor programme at Aalborg University and four external partners who offer problems to provide a direction for student learning. During the course, the students analyse and develop solutions for six design problems related to the design and development of communication systems for internal and/or external communication in the organizations. We study the problem-solving process, designs and reflections developed by the students during the project work, and the companies satisfaction and comments on the students' designs, in order to gain insight into how the students and the external partners learned from the project work.

In our analysis we focus on analysing if and how the students and organizations learned from the project work. We seek to answer whether the project work represents a productive interpretation of PBL (Barge, 2010), the triple helix interaction between state, academia, and industry (Leydesdorff, 2009). Before we turn to more specific research questions, we give a short review of literature in the field of PBL and university-industry collaboration related to PBL.

PBL is not just PBL

Our test case is situated in a learning environment that is familiar with PBL – at least it is familiar with one interpretation of what PBL is – an interpretation that is summarized by Barge (2010). The research literature does, however, show different practices and approaches to PBL. First of all, the understanding of the source and constituents of a problem differ. Some sources stress that the problem originates in the students' experience of the world, that problems are ill structured and that problems do not always fit a traditional fixed curriculum very well (Dirckinck-Holmfeld, 2002; Kjærsdam & Enemark, 1994; Kolmos, Fink, & Krogh, 2004). According to these sources student ownership of the problem and the solution are core motivational factors. Other sources suggest a (somewhat) different source of the problem by stressing the importance of working on real-life problems or, more precisely, real problems from the work domain the students train to enter (Gavin, 2011; Herreid, Schiller, Herreid, & Wright, 2011; Shafi, Quadri, Ahmed, Mahmud, & Iqbal, 2010; Tonts, 2011; Warren, Dondlinger, McLeod, & Bigenho, 2012; Williamson & Gregory, 2010). In that case, it is the teacher or professor that provides or at least approves problems within a relatively narrow professional framework. This interpretation is often found in medicine (Raupach, Munscher, Pukrop, Anders, & Harendza, 2010; Shafi et al., 2010), engineering (Gavin, 2011), or science (Herreid et al., 2011; Overton & Bradley, 2010) but it is also found in the social sciences (Williamson & Gregory, 2010), and more rarely in the humanities.

Few authors suggest that problems could have a third source – namely, in industry (Sas, 2009). Students solving problems with roots in industry and research are then offered a way to convey knowledge back and forth between industry and university. Jarzabek, Pettersson, & Zhang (2011) report from a university-industry collaboration with students involvement, too. In this case students completed tasks that sprung out of the collaboration between industry and researchers. As the collaboration developed, students also used it as a springboard to internships with the industrial partner. There is, however, no mention of problem identification or problem solving as a vehicle for learning on the part of the students.

Gavin (2011) brings us back to the discussion about PBL and curriculum. He discusses an implementation of PBL where students are given open-ended problems to solve in teams (he thus uses the term project-based learning). These students have completed at least three years of traditional university studies before being ‘allowed’ to enter into PBL activities. Aalborg University (among others) chooses a different approach by applying PBL from the very first semester. The underlying assumption about the relationship between a set curriculum and PBL appears to differ. PBL is either something that follows when students have learned most of the curriculum (acquired a solid foundation of knowledge and skills) *or* it is applied from early on to be a continuous part of student learning and motivation, thus being a part of the curriculum. Teacher defined or structured problems appear to fit a traditional set curriculum whereas student defined problems appear to require a more open curriculum. The student-controlled problems influence the curriculum by directing student attention to the subject, theories, and methods that are most relevant to solving the problem. This observation is supported by researchers that report the need for a more integrative thinking about curriculum because students working on problems tend to or perhaps even need to think across what used to be difference subjects (Shafi et al., 2010).

Some of the differences in approaches to PBL stem from different assumptions about learning. Most authors place PBL within a framework of constructivism or social constructivism, exactly as do Tonts (2011) and Warren et al. (2012). The references to constructivism are however often quite subtle with few or no explicit references to constructivist theory. Authors merely refer to the experiences that students learn more or better when they acquire new knowledge through negotiation with peers. Lately we have also begun to see networked learning and connectivist approaches to learning mentioned in relation to PBL (Ryberg, Glud, Buus, & Georgsen, 2010). In either case the reasons for choosing PBL are mainly that it is said to be popular among students and teachers for various reasons.

In the current case we work in a university context where PBL plays a major role in the learning environment. A recent AAU PBL guide tells us that students are the owners of problems and that participation in collaborative processes for the majority of a semester is the way for students to work on the problems they have identified (Barge, 2010). Barge (2010) also distinguishes between core PBL activity in project groups and the more traditional course modules implying that courses support PBL without PBL taking place within courses. Earlier studies grounded in the practice of Aalborg University offer a similar distinction between courses and PBL-based learning (Dirckinck-Holmfeld, 2002; Kjærsdam & Enemark, 1994; Kolmos, Fink, & Krogh, 2004). These sources also link PBL with a collaborative effort on the part of students in solving problems.

To research how the collaboration between students and external organizations induced learning in both students and external partners, we aim to answer the following research questions:

1. How did the students react to the realistic design problems?

    a. Did they understand the problems?
    b. Did they obtain ownership to the problems?
    c. Did they find solutions for the design problems?

The first research question originates in the discussion about different origins of the problems from which students learn. Since the problems in this case (more about that later) came from external partners, student understanding as well as ownership of the problems is questioned, but it is also questioned whether a problem that *is* real to someone else has the power to motivate learning among students.

2. How did the students relate the problems to theories, models, and methods presented during the course?

    a. Did they understand the theories, models, and methods?
    b. Did they use the theories, models, and methods to analyze the problems and develop design?
    c. Did they use other related literature?

The second research question originates in the discussion about the relationship between problem and curriculum. Since the curricula were set by the teachers (more about that later), it can be questioned whether the students learned that curriculum or another curriculum defined by the problem (or if they learned too little due to a bad fit between problem and curriculum, lack of motivation due to lack of problem ownership, or some other problem).

3. How did the students develop solutions and system design for the design problems?

The third research question originates in one of the original assumptions about PBL. Students were expected not only to learn abstract theory and methodology, but also to design solutions to real problems in the organizations of external partners. Therefore, we question how they did that and in what way other parts of the curriculum came into play.

4. How did the organizations gain and learn from the collaboration?

    a. Did they look at and consider design proposals developed by the students in later system design work?

The fourth research question originates in our assumption that second-year university students with sufficient scaffolding can in fact supply external partners with useful insights and/or concrete solutions to actual problems.

These research questions come together in a further developed overall hypothesis that students will find the motivation to learn a set curriculum and shape meaningful design solutions in problems they know are real problems for potential future employers. It is consequently also our hypothesis that external partners will gain from the collaboration with the students. In the following section we will show how we aim to answer the research questions and test our hypothesis.

Overall methodology

We have studied this possible mutual learning concept in a case study with 158 second-year bachelor students, 135 humanistic informatics students, and 23 information technology students. We tried out problem-based learning design as part of the study course 'Design and ICT with organizations as context'. The course forms part of a third-semester module that focuses on strategic communication in and from organizations.

The third semester consists of three individual courses, the project course 'Communication and strategy' (20 ETCS), and two study courses 'Methods for investigation, analysis and intervention' (5 ECTS), and 'Design and ICT with organizations as context' (5 ECTS).

The design and ICT study course looks at how different communication forms and ICT systems are used with strategic purposes in organizations. The course focuses on interaction and usability. The students can choose to focus on internal or external communication. The course is organized into 5 themes. Themes 1, 2, 3, and 5 are taught through

4-hour lectures, and theme 4 through three 4-hour lectures, totalling seven 4-hour lectures in all:

1. **Strategies for knowledge sharing in organisations –** here the concept of knowledge and strategies for knowledge sharing are presented.

2. **Theoretical approaches to interaction design and usability** – here approaches and theories of ICT-mediated interaction and usability are presented.

3. **Communication systems** – here systems, technologies, and functionalities supporting internal and external communication in and from organizations are covered, including studies of practices and challenges in the use of technologies.

4. **Interaction design and information architecture** – here design principles for interface design and information architecture, including methods for user-driven innovation and design, are presented.

5. **Usability evaluation –** here methodologies for the evaluation of usability are discussed, with a focus on user-oriented methods.

The teaching is organized around four realistic case studies describing actual design problems for the design of a communication system for either internal or external communication in an organization. The cases and design problems are provided by organizations outside the university. Case A concerns design of a web-based system that facilitates knowledge sharing and task coordination for the Aalborg Carnival office that organizes the yearly carnival. Case B deals with redesign of the information website for Gigantium, a large cultural and sports center in Aalborg; case C concerns design of a web-based knowledge sharing system facilitating communication and knowledge sharing internally between employees and externally between employees and customers of Bjerg Architecture, an international architect company with branches in Denmark and Poland. Case D concerns design of either functionalities or organizational procedures that motivate and make it easy for local government employees at Hjørring Community to consult the local intranet more frequently.

The teaching is organized so that each lecture has a theme, a design problem, and two student tasks, a design task that students solve in project groups and a reflection task where the students reflect on the project work, learning process, and learning outcome. The students answer the reflection task individually. The design problems are solved in groups of 3-5 students. Figure 1 provides an overview of the design for learning, dividing the design into learning tasks, learning support, learning resources, and assessment. Learning tasks are tasks that learners are required to do, learning resources support learners in conducting the tasks, learning support consists of mechanisms that exist from the teacher to support the learning and task solving, and assessment is the evaluation tools to assess the learning outcome.

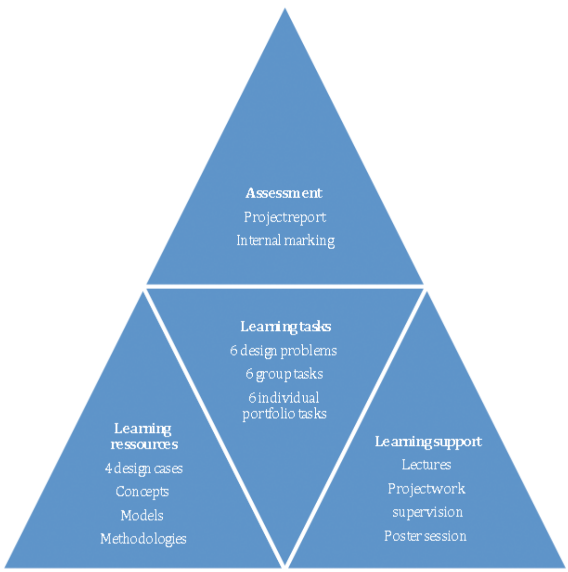

Fig. 1. Learning design.

The lectures are four-hour sessions consisting of a two-hour introductory lecture presenting theories and models relevant for the overall theme, and two hours of group work, in which the students solve the design tasks.

The design tasks are comprised of design problems, e.g., choice of knowledge sharing and communication strategy, development of wireframe and blueprints for the interaction design, or design of usability tests. All problems are related to specific designs of the communication systems outlined in the case studies developed by the external partners. The tasks and problems are defined by the lecturers and *given to* the students. The students are instructed to use concepts, theories, and models presented during the introductory lecture to find solutions for the design problems. The students solve six design problems in all. During the seven, two-hour group work sessions, the lecturer and three student tutors help out and are available for consultation. Table 1 shows examples of design problems as they are formulated in respectively a design and a portfolio task.

Design task (solved in groups)	**Portfolio task (solved individually)**
Describe the concepts, models and technologies introduced in the lecture. Discuss how they can be used to analyse and determine level of interactivity and system functionality of the future knowledge sharing system: – What type of knowledge should be included and communicated by the system? – What knowledge sharing strategies and activities should be supported by the system? – What functions and interactions are needed?	Reflect upon and discuss: – How concepts and models contribute to the understanding of the case problem – How they contribute to analysis and design decisions concerning choice of communication system, knowledge sharing strategy, interaction levels, and communication functions

Table1. Course tasks for Communication system theme

Solutions for the design problems are answered through a poster that the students develop in common. The posters are supposed to report considerations and solutions for the design problems. The posters are presented and discussed with the external partners at a poster seminar at the end of the course. The individual reflection tasks are reported through an e-portfolio, uploaded weekly to the course site at Moodle. In the reflection task the students are expected to discuss and make reflections about the design problems, group work, and the work process. The individual portfolios are later revised to create a project report that constitutes the exam of the study course. The supervisor and an internal censor grade the project report internally. Each project group chooses freely among the four case studies.

Data collection and analysis

We collect a set of different data to study and understand whether and how students and organizations learn from the problem-based project work. Data include the individual portfolio contributions from the 158 students, posters from 31 project groups, observation data generated by the three tutors and the two teachers, the final project reports, and interview data from post-semester interviews with two of the external partners.

Individual portfolio contributions

At each lecture the students were invited to upload portfolio entries for the individual portfolio tasks. Not all 158 students uploaded portfolios during the course work. 120 students uploaded portfolios for portfolio task 1, 111 students for task 2, 95 students for task 380 students for task 4/5, 65 students for task 6, and 52 students for task 7. The portfolios contained descriptions, arguments, and discussions of design solutions for the six design problems. The lecturers provided oral and written feedback for the portfolios at the following lecture. The written feedback was uploaded to Moodle.

Posters

All 31 project groups developed posters. The posters primarily contained descriptions of the design solutions in form of short summaries, screen dumps, wireframes, blueprints, usability test plans, etc. Figure 2 shows a poster example summing up decisions concerning content (indhold) of the proposed knowledge sharing system, design considerations and decisions (design), design of usability evaluation (undersøgelse), strategies for knowledge sharing and implementation (implementering), and a wireframe for the entry page for the system.

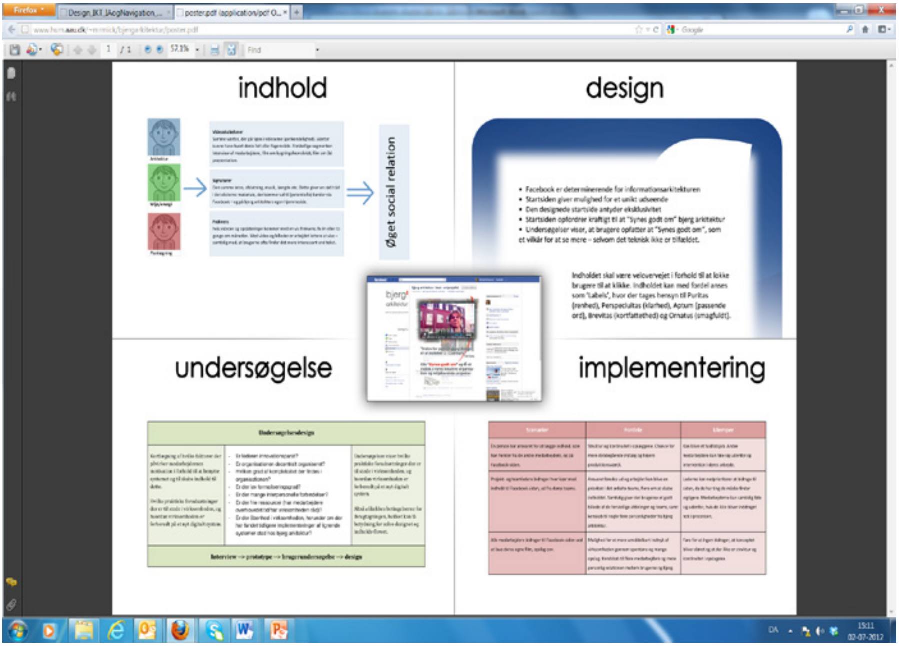

Fig. 2. Poster example.

Observation data

During the six group work sessions, the two teachers and the three tutors made observations about how the students worked with the design problems. They used a structured observation scheme for the observation. They collected about the following variables:

Problem	How do the students react to the problems that have been formulated by the external partners? Are the cases motivating? Do the students consider the problems as their 'own'? How is their understanding of the problems? Do the students concentrate on the problems? Do they stay the full time for group work? Do they quarrel about the problems? What problems have they been working with today? What solutions did they work with today?
Learning	Did the students understand today's lecture, theories, and methods? Are there essential misunderstandings? Is it possible to see a connection between today's lecture and their discussions and problem solving? How? Do the students ask simple, clarifying questions, or very fundamental questions? Are today's theories present in the discussions? Is there a relation to previous lectures? Which? Do the students include material, questions or work from previous lectures? Which?

Table 2. Scheme for structured observation.

Project reports

The project reports are compilations of the six individual portfolios that have been developed during the course work. The portfolios contain analytical and critical reflections to the work process and problems appearing during the project work. The students were instructed to ground reflections on the theoretical course literature. The recommended structure for the reports included:

» Short presentation of the case and its problem (approx. 1 page);

» Summary and discussion of solutions for the 6 design problems (approx. 7 pages);

» Resume of the overall ICT design and solution to the case problem (approx. 1 page); and

» References (approx. 1 page).

Interview data

Approximately a month after the poster session, two of the external partners were interviewed about their experience and benefits of the collaboration. The interviews were semistructured following the interview guide presented in table 3. The interviews were recorded. They were not transcribed, but informants' utterances and viewpoints were condensed to short, precise formulations. Meaning condensation abridges the thoughts expressed by the interviewees into briefer, more concise statements (Kvale & Brinkmann, 2008).

Interview guide for interviews with external partners
1) What motivated your participation as external partner?
2) What were your expectations for the collaboration?
3) Did you have previous experiences with student-external organization collaboration?
4) Did you like the proposed design solutions? Why/why not?
5) How did you gain from the collaboration and design solutions – why/why not?
a) Design:
i) Strategy for knowledge sharing, technologies, and functionalities
ii) Interface design
iii) Wireframe and label
iv) Usability evaluation
b) Methodologies – development process
c) Ideas
6) Have you used any of the design solutions or student ideas?
7) Were your expectations for the collaboration fulfilled?
8) Do you want to participate another time?

Table 3. Interview guide for external organizations.

All data types, portfolios, posters, observation schemes, and meaning condensations were coded and analyzed into themes using the same matrix-based method for ordering and synthesizing empirical data (Bryman, 2008). In the analysis themes and subthemes were developed from a combination of thorough reading and rereading of the data material and reading of literature outlining challenges and problems typically faced in problem-based learning (The Aalborg PBL model, 2004). Table 4 presents and defines the analytical themes.

Analytical theme	**Description**
Problem understanding	Analysis if and how the students understand the design problem, described in the design tasks.
Problem ownership	Analysis if and how the students relate to and take ownership of the design problems.
Theory understanding, use and application	Analysis if and how the students understand the presented theories, models and methods and use them to solve the design problems.
Theory compilation	Analysis if and how the students relate theory from other lectures or semesters.
Learning outcome	Analysis if and how respectively the students and the external partners learn from the project work.

Table 4: Analytical themes. Double-driver learning

All together, the students understood well the design problems, took ownership, and were good at using the presented theories, models, and concepts to analyze, discuss, and develop design solutions. The students also created useful as well as interesting and creative design solutions. The average marks were 7.4 that are above average in a 7-point scale, given for a good report of completed course goals with few failures.

However, it is a characteristic of their project work that they did not reflect upon or criticize the relevance or usefulness of the concepts and models. Only a few students discussed whether and how the theoretical foundation truly contributes to the analysis and understanding of the design problems. Below we will discuss findings in detail. The structure of the discussion follows the analytical themes.

Problem understanding
In general, the students understood well the topics and problems of the design tasks, and were capable of analyzing the problems and finding solutions. The posters and final project reports show this clearly. However, understanding the problem was a learning process. At first when the students were presented with the problems, they were confused and did not know how to approach them. Many groups had to work with the problems before they reached an understanding and took ownership. In many cases they developed their own understanding of the problem. As such the students also gained knowledge and experience in identifying and defining realistic problems for future project work.

> *Throughout the course there was some confusion concerning the organizations' problems, but soon they reached a conclusion and defined some clear problems. The groups had their nuances on the problem, and also some different solutions (Student observer 2).*

The difficulty in defining and constructing a clear understanding of the problem was twofold. The students had problems in understanding the meaning and implication of the design problems, and in determining how to approach it methodologically, what analysis method to use, what tools to apply.

> *Test. They are not sure whether they should make a test or just write about their considerations (Student observer 1).*

Two of the interaction design problems, the prototype problem and the wireframe problem, appeared very similar to the students. This similarity caused confusion regarding the meaning of the problem. It also demotivated the students because they felt that they repeated and found solutions for apparently similar problems.

> *Some groups were confused about making prototype and later a wireframe. Some doubt whether they do it correctly because they think that they do the same again and again. (Student observer 2).*

In addition, the students had problems in understanding the details of the learning design, how to report the project work on, respectively, the posters and in the portfolios. The students especially had difficulties in differentiating what to report in the group task and the individual task, what to present and discuss in the poster and in the portfolio. This two-sided structure of the learning design dividing the project work into group tasks reported in posters and individual tasks, reported in the portfolios, was very confusing for the students, and the students used much effort to figure out the structure.

> *They are not aware what a poster should contain. Practically, only few students know that there is a template for a poster at Moodle. They ask whether they should make it digital or in paper (Student observer 1).*

Problem ownership

The realistic setup with real organizations and real design problems were very motivating for the students. Additionally, the fact that the external partners would attend the poster session and provide feedback was very inspiring for the students. Feedback from external partners was indispensable compared to feedback from the teachers.

> *They take it very seriously that they are going to present the solution, it seems to motivate a lot (Student observer 1).*

> *The students seem quite motivated by the fact that it is a 'real' case' (Student observer 1).*

No students questioned the fact that the cases and problems were defined beforehand by the teachers and external partners. However, the case descriptions lacked information, or at least it was frustrating for the students that they were not allowed to ask questions and communicate directly with the external partners during the problem-solving process.

Many students found technical information in the case descriptions upsetting and worrisome. As a consequence, several project groups chose the Gigantium case with less technical description. Some students commented later that they regretted to have chosen the less technical case instead of choosing the case that they found most interesting.

> *Technological platform and hardware info seem to frighten when they choose case. Annoying (Student observer 3).*

From the posters and project reports it appears that the students that chose the more technically rich case descriptions did very well, also with regard to marks. The conclusion is that technical information is important and necessary, but it should be better explained to the students how to use it in the problem solving process, and by this avert the practice of students with less technical knowledge avoiding more technical cases.

Theory understanding, use and application

In general, the students were rather skillful in using theories, models, and concepts from the literature to analyze the problems and develop design solutions.

> *The theories were well understood by most while others had to fight a bit (Student observer 2).*

We can see this clearly in the project reports, where students in general are very skilled in using the theories to limit and define a scope for the design. The theoretical literature provided overview and helped the students to structure the project work.

> *Knowledge about and learning of theoretical concepts and models are thus essential for the development of such a system, because these are fundamental for the understanding and solution of the problem (Student 5).*

> *The concepts help us to identify the individual elements of the design process, which in the end make it possible to define our whole design task. Furthermore, the concepts show what is relevant in relation to this course – give us something concrete to consider such as the communication function instead of just tak-*

ing a shot in the dark and looking at something that is interesting, but not relevant in relation to interaction and usability, which are keywords in this task (Student 12).

Several students wrote in the reflection reports that the theoretical concepts and models made the analysis more concrete.

The above-mentioned theories have each been helpful in finding a focus, design proposals, and ideas. The design problem has been more structured and thus been made clear for the group (Student 10).

All these models and concepts help to understand what functions the system should contain, to carry out the demands as best as possible. Setting this focus early in the process, one can have some important thoughts how communication should 'flow' in the organization, who can do what, who should have access to what. This early focus on function and knowledge means, too, that one more concretely can start the discussion of what technologies you should use for the system, as different knowledge types put different demands on what technology fits best (Student 2).

The concepts that we found relevant for our case helped to provide overall insight into the problems that the group faced (Student 9).

The students furthermore described how the theoretical literature made it possible to work in a more nuanced way with problem solving and develop innovative ideas.

The theoretical concepts and models that so far have been presented in the Design and ICT course contribute to the understanding of the chosen case, Gigantium, in a way where it is possible to work with the nuances of the case … . The theoretical concepts and models provide a better understanding of the suggestions that the company has described (Student 8).

When we talk about knowledge types, knowledge sharing, knowledge sharing strategies, and type of organizations, all these factors help determine what type of knowledge the organization should share internally and externally, how it should go on, depending the knowledge type and the type of organization (Blackler, 1995) (Student 11).

All in all, it is always a challenge to learn a new field and new concepts. However, in this case it is necessary in order to understand a very difficult problem that is extra difficult for us as new designers. We are in an area very new to us (Student 13).

The students discussed how the theories helped to develop convincing and well-argued solutions.

The theoretical concepts and models mentioned above contribute to the understanding, not only by providing a theoretical approach to the problem, but at the same time to provide a broader perspective and a well-argued solution to the company. In order to develop a solution to such a problem, the answer must and should be well-argued from theoretical and professional concepts that can ensure the company that the work has followed guidelines from the subject area (Student 5).

The theoretical concepts and related controlled terminology became furthermore a means in the communication between students, and provided the students with a common language.

The use of these concepts becomes much clearer, after a long time of monotone and mechanical reading. Suddenly these concepts are useful as a communication means. When you present the term 'internal communication', suddenly all in the group know what you are talking about, and then all concepts show to their best [advantage] (Student 1).

All I talked to had the case open at the computer that they had *chosen so that they could switch back and forth from the theory in the slides, to the task and to the case (Student observer 2).*

However, it also appears from the discussions and argumentation in the project reports that the students use experiences from their personal daily use of websites and online communities, e.g., Facebook. In a similar vein, one student adds that the theories are good for framing, but that they may also limit the creative process of problem solving.

We had the experience that the theories were useful in limiting what forms of knowledge and interaction should be available in the design. We had a feeling that it was easier to create visual thoughts about design possibilities. However, the theories also had a drawback: this limitation could reduce the possibilities for new ideas outside the framework of the theories. In this way, a limitation could appear on innovative and original additions to the design (Student 4).

Some students mentioned that the number of presented theories, models, and concepts was overwhelming, that the large number of presented theories confused more than helped. The finding suggests that it might be useful to scope the choice of theoretical backgrounds. However, at the same time the very same students said that the different perspectives in the literature made the considerations and discussion more detailed, more nuanced, and well considered.

The above-mentioned theories and models have provided a knowledge foundation for the design, but it's clear that they have caused many considerations because we as inexperienced designers do not have previous experience to use. Therefore, we had to work from the different theories, from what we found best in relation to the problem (Student 7).

Several of the knowledge sharing theories that were presented in the lecture overlap a bit. One could discuss whether it is necessary to use so many theories developing a solution, as it may *confuse us more than form an overview. A few theories could have been chosen as most relevant for the project, and then go into detail with these. On the contrary, using many theories provides an understanding of knowledge sharing and communication in an organization from many different perspectives (Student 6).*

ICT/Moodle provided a useful framework for teachers to gain insight into the progress of students.

Theory compilation

The students used literature mostly related to the design problem, and did not transfer literature from one lecture to another. However, the information technology students, especially, did integrate previous course literature from earlier, related courses in the Computer Science department.

They relate to stuff from other lectures, but only from this course (Student observer 1).

Some has included stuff from the previous lecture in the construction and design of labels (Student observer 2).

Learning outcome

In general, the project reports show that the students obtained a good understanding of the theories, models, and concepts as well as how to apply them and relate to realistic design problems. The learning design seems to have encouraged the students to truly explore the theoretical literature and exploit it as analytical tool for real-life problem solving.

To be thrown into this project as we are, without much knowledge and without a language to formulate the task is a big task, but it has at the same time a greater learning potential than if we had known the concepts, terms, and theories beforehand. Here it is up to us to explore and examine (Student 14).

The external partners all were motivated to participate in the collaboration because they wanted to get ideas and new perspectives on the design tasks. The organizations were either in the planning or analysis phase of the system development projects described in the design cases, and they saw the collaboration as a means to get inspiration. One partner found the subject ICT for knowledge sharing was interesting and appealing; they were in the process of dividing the organization into knowledge groups with the purpose both of enhancing the internal knowledge sharing and innovation and strengthening the collaboration and knowledge sharing with customers and other stakeholders. Another motivation was the wish to obtain the knowledge generated at the university, and to generate new knowledge in collaboration with the university. The informant explained that it is as important for peripheral regions as the region around Aalborg University that all regional knowledge resources are exploited and work together. Another external partner expressed that she sees the collaboration as payback. She knows from her university time how fruitful and rewarding it is to work with realistic problems, how motivating and encouraging it is that the solutions will be used.

The primary learning outcome for the external partners is the design proposals, the set of different ideas that were presented during the poster session. They found it especially inspiring that the project groups had interpreted the design tasks differently, and as a consequence approached the problem from slightly different perspectives, e.g., prioritized the goals for the systems differently. They explained how they have used the ideas in later project meetings as points of departure for brainstorming discussions. Both the overall solutions and specific parts, e.g., suggestions on how to encourage dialogue or ensure security, have been used by the external partners. One partner also said that he had gained from learning about the structured system development process, from the division into development phases and specific design problems. Before this, he did not have any particular knowledge about system design, and he obtained a better understanding of the design process by the way that the project work was structured into design problems and design phrases.

The external partners praised the oral as well as written description of the design solutions. They found that the oral presentations, posters, and dialogues around the posters altogether provided an adequate picture of the solutions. They appreciated the short form and short time needed to get an overview and understanding of the ideas. In general, they found the presentations and posters clear and precise, and the talk around the posters a good way to get detailed information and arguments and explanations to the solutions. All four external partners are interested and willing to become partners again in similar collaborations.

Further reflections

It was a drawback that two of the external partners did not attend the poster session and did not give any feedback. Their absence demotivated the students. Students that had worked with these cases left the poster session early. The finding shows that attention and interest from the external partners is essential for the motivation.

> *At the end of the process it would have been an advantage to get feedback from Gigantium. By this we could have gotten some knowledge about whether the design fulfilled the defined wishes and demands, and as such fulfilled the desired image. Furthermore, this feedback could have been a further step to the development of the design (Student 4).*

Summing up the experiences

It is a common understanding in the PBL literature that problems originating from students' own experience of the world are a core factor for learning and motivation. Other research shows that problems based on students' experiences are often ill structured and do not always fit a traditional fixed curriculum well. The starting idea for the current work is that realistic problems originate from external partners and are closely integrated into the learning design; it is possible that this will increase students' motivation and understanding of the problem, provide focus for the project work, and induce learning for students as well as external partners. Thus, in the study we have focused on analyzing whether realistic problems defined by external partners represent a productive interpretation of PBL.

We have investigated this possible mutual learning concept in a case study with 158 second-year, humanistic informatics and information technology bachelor students that are following a third-semester module on strategic communication in and from organizations. The learning design consisted of seven lectures, organized so that each lecture had a theme, a design problem, and two student tasks, a design task that students solve in project groups and a reflection task on the project work, learning process, and learning outcome. The students answered the reflection task individually. The design problems were solved in groups of 3-5 students, and reported on posters.

In order to study the learning outcome, we collected a set of data including individual portfolio contributions, posters, and observation data generated by the teachers and three tutors; final project reports and interview data from post-semester interviews with two of the external partners. We investigated the following variables: problem understanding, problem motivation, theory understanding, use and application, theory compilation, and learning outcome.

Concerning *problem understanding, motivation, and ownership,* the findings show that realistic cases and external collaboration truly motivated the students. In particular, the fact that the external partners participated in the poster session and intended to use the designs was a motivating factor. No students questioned the fact that the cases were defined beforehand by the teachers. The controlled problems provided structure for the project work, and helped the students to focus and concentrate on combining problems, theories, and solutions. The students developed and formed the problems according to their own understanding and interests during the project work, thereby increasing understanding and motivation as well as ownership of the problems. However, several students report that it was frustrating that, due to practical implications, they were not allowed to make direct contact with external partners to ask additional questions and shape the problems. A midway dialogue between students and external partners may be a way to overcome this problem.

As regards *theory understanding and use,* the strong integration between lectures and design problems provided guidance and stimulated the students to apply the theoretical framework in the problem solving. However, the structured learning design and frequent use of PowerPoint slides as a primary teaching tool invited the students primarily to base analysis and problem solving on the teaching material instead of the original literature. As a consequence, there appeared a need to force the students to actually read and use the course literature. Multiple theoretical frameworks were presented for each design problem. This provided, on the one hand, a rich and productive theoretical framework for the students, but on the other hand, appeared to be overwhelming and sometimes confusing for the students. However, at the same time students also pointed out that those different perspectives produced more nuanced discussions and solutions. The close integration between problems and theories eased the communication between students, providing them with a common language. In total, the findings suggest that it might be useful to evaluate the choice of theoretical background literature, and moreover be clearer in instructions that the students should decide on and approach the problem from only one theoretical viewpoint.

Concerning *learning outcome,* the project reports show that the students obtained a good understanding of the presented theories and concepts. The learning design seems to have encouraged the students to truly explore the theoretical literature and exploit the literature as an analytical tool for real-life problem solving. It is clear from the reports that the students truly learned how to apply theories and methods in system design.

For the external partners, the primary learning outcome was the design proposals presented during the poster session. Especially, they found it inspiring that the project groups had interpreted the design tasks differently, and as a consequence approached the problem from different perspectives. They explained how they have used the ideas in later project meetings as points of departure for brainstorm discussions. One partner also expressed that he had gained from the learning design, dividing the system development into phases, each with specific design problems.

The overall conclusion is that motivation can be found in problems given to the students. The findings also confirm that problem-based learning based on realistic design problems and collaboration with external partners may facilitate double-sided learning, even double up. The external partners gain design ideas as well as a better understanding of theoretical frameworks for design. The students learn to apply theories for realistic problem solving and to identify realistic problems for future project work.

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Education has become available to everyone with Internet access and the ability to read and write, and the cultural and personal inclination to do so – anywhere, anytime. Monopolies and control systems will gradually break down while new ones are emerging. Moreover, this is experienced by all teachers on a day-to-day basis in a variety of ways. This book is about the struggle of teachers to keep up with and build new practices and, last but not least, to bring forth actual teacher experience reflected through the lens of problem-based learning.

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