

# Understanding, Reflecting and Designing Learning Spaces of Tomorrow

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## ABSTRACT

This conceptual paper describes challenges in the field of Interactive Media and Learning (IML), striving towards a research and teaching field for mobile learning. The theoretical background is provided and arguments are listed, specifically what challenges researchers, practitioners (e.g., teachers, employers, employees) and designers face today on the way to mobile learning. This will be done from an educational perspective, in particular from Educational Technology from a Scandinavian community. The leading issue is how to educate the Homo Interneticus? Is learning supported by mobile devices one option? Is there a need to rethink the learning spaces of today? The paper provides answers by illustrating challenges in research and teaching with regard to mobile learning.

## KEYWORDS

Mobile Learning \* Flexible Learning \* Formal Education \* Informal Learning \* Work-based Learning

## 1. EDUCATING THE HOMO INTERNETICUS

With regard to new technologies and social media, universities are responsible for fostering competence development and skills in order to reflect different concepts of new technologies for both students and teachers. In this paper we argue that research and teaching needs a deeper understanding of social media, including the use of media such as technical skills, reflection and the design of cutting-edge technologies, as well as the awareness of advantages, for example fostering networking, collaboration, knowledge exchange, and disadvantages such as the misuse of personal data, bullying, and plagiarism/copyright. However, the question is why should we redesign our formal education, and is there an obvious need? With regard to information and communication technology (ICT), media and learning, the following problems occurred:

1. There is an increasing number of online bullying/mobbing, where children and teenagers at schools spread information about other kids, lie and blame other people, and repeatedly harass others (Cyberbullying Research Center, 2012).
2. People use information (images, files, etc.) from other people without understanding copyright issues; information is used without correctly citing sources; duplication & plagiarism is increasing (Derby, 2008).
3. We have perceived that some directors and teachers at schools do not know how to handle and adopt ICT in their classrooms. Some other teachers have the technical skills but do not know how to use iPads for educational purposes. Sometimes the result is that the use of such devices is prohibited, expressed in 'It is not allowed in my classrooms.' Sweeping the problem under the rug is probably not an appropriate solution because children use the Internet and their mobile devices after class and at home, and they bring their social problems back to the classroom.
4. A fourth example specifies the assessment of information; to understand its different quality (critical thinking). Within the same topic, different information online is available written by competitive firms, people at different ages, from different generations & cultures; diverse designers as well as researchers

from different disciplines. They all have information but from their own perspectives. How can we teach our children to handle this huge difference in information? How do we teach critical thinking?

These above mentioned examples illustrate our point:

- Yes, we need to educate the Homo Interneticus, but how?

Some people say we have to understand how informal learning in online settings takes place because it seems that there is a great success story of informal learning (e.g., Collins & Halverson, 2009; Thomas & Brown, 2011). What does this mean for formal schooling? Instead of learning through textbooks, to what extent can we transform *characteristics* of informal learning *into* formal teaching?

When we choose the option to implement new technology in learning environments, new questions come up: how can a teacher use these new technologies in their learning settings? Do we need new methods and tools, or is there a need to develop new educational methods, or both? Certainly, there are also questions such as, what problems will occur when teachers use new technology? What is a useful design to support interactions among learners when using new technologies (co-located, distance, blended learning)? To what extent, and for which learning scenarios, are different kinds of new technologies helpful, or not?

In order to provide answers to those questions, a research and teaching group called Interactive Media and Learning (IML) has started creating a research and teaching center for mobile learning. Developing mobile learning may be one step in establishing a creative learning place where students, teachers and researchers meet. The idea is simple. We design learning spaces of tomorrow, put them into practice and learn from them. We describe mobile learning as a place where *learning is constructed, designed and reflected* (instead of *being there*). The terms “learning spaces” and “classroom of the future” are not reduced to a physical space or to formal schooling. It is a metaphor for designing different forms of learning, and embraces formal learning and learning out of institutions.

Based on 12 years of experience in eLearning, including four years of experience in conducting workshops (each 1-2 days, 13 workshops so far, titled ‘Web 2.0, Social Media, eLearning and Co. in Higher Education’ for university teachers from different disciplines, for example math, social sciences, architecture, and languages at different universities), this paper illustrates the case of a Scandinavian group, reflects on the challenges of mobile learning, and develops scenarios.

## 2. THEORETICAL BACKGROUND

In order to describe social media and its dynamics in a broader framework, there is a need to reflect on the underlying theoretical approaches. In particular, these are Mediatization (e.g., Krotz, 2008), media-constructed social awareness (Medialitätsbewusstsein, e.g., Groeben & Hurrelmann, 2002), and the socio-technical approach (e.g., dePaula & Fischer, 2005; Mørch & Skaanes, 2010). The approaches stress the duality of social processes and their interwoven structures (“A wicked problem”, Conklin, 2005). New media affects society, and “media is integrated into the operations of social institutions” (Hjarvard, 2008), but on the other hand society *designs* new forms of communication. Media is formed *by* society but also became an *active agent* that influences human interactions (Giddens, 1984, “Duality of structure”).

The media-constructed social awareness approach underlines that people live in a media-constructed world with a difference between a social-constructed “reality” and “reality *given* by different media”. For example, when new technologies transform into an “old *already there* object” (e.g., school system), we call this “objective facticity” (adapted by Berger & Luckmann 1966), that is people do not have influences or enough resources to change this *object* although it is constructed by the society. Our school systems serve as an objective institution; however, these social structures are changeable (regardless what it takes to affect some changes). To know (a) the differences of given realities by social media and to act meaningful, and (b) that social media serves as an objective facticity, but for others as a designable item, and to handle this in the *classroom*—in different learning spaces—is one aspect of teaching media competencies and one central objective of designing educational technology, that is technology for educational purposes.

### 2.1 A complex design problem

When developing learning and its environments, the complexity theory (e.g., Pavard & Dugdale, 2000)—a contribution to a deeper understanding of the sociotechnical approach—must also be considered.

From this point of view, technical, social and didactical developments are required simultaneously, but this is not easy to solve. For example, from a pedagogical point of view, we need to cultivate a Portfolio system for students to support reflections in learning; however, years ago there was no specific technology that provided this method, as we lacked technology (now we have PebblePad or Mahara). As a second example, we have technology like mobile devices but do not know how to use it for educational purposes, as useful applications for mobile teaching have not been developed until now. Technological design (UT) and didactical approaches (DA) in different disciplines (TLC) (e.g., physics, math, social sciences, and computer sciences) means designing interdependencies among these elements (DA, UT, TLC).

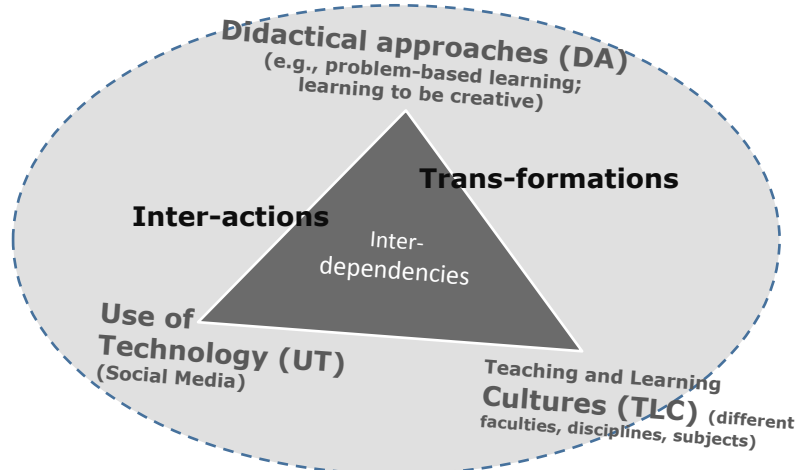


Figure 1. Designing the interdependencies among technical and didactical design in different teaching cultures.

Introducing mobile devices into teaching also means facing the challenges of software administration. In contrast to laptops, an iPad is a personal device that makes it difficult to administer because the user decides what app to install via the iTunes store, as central administration is currently not possible.

Each implementation of technology needs a creative design environment where teachers, researchers, designers, and administrators plan the introduction of IT together; therefore, the support of knowledge integration of different stakeholders is a plausible consequence (Herrmann, Loser, Jahnke, 2007).

## 2.2 A new understanding of learning

In the past few years, new forms of learning have emerged. John S. Brown writes (2009): “*Whatever your particular interest is, there is some niche community, already formed on the network you can join. (...) These resources not only provide facts. They are also tools you can use to build things to tinker with, to play with, to reflect on, and to share with others. And most importantly, you will learn from other people’s comments and from what they do with your creations.*” (p. X). Because complex societies need teams of workers, collaboration is one important aspect in learning today (Stahl, 2006). It is not possible anymore to collaborate efficiently without having social media (e.g., think about how easy it is to share information online).

Collins and Halverson (2009), both are professors of education, write, “*Technological innovation is breaking out in administrative office with data systems and among students with gaming, leaving the teachers behind to maintain their traditional classroom practices. The pressure to change the classroom with computing is coming from outside the classroom, in different forms from children and families and central offices.*” (p. 127). We currently do not know if formal schooling will be replaced or not, but new forms of both formal and informal learning will emerge around the edge of formal schooling (Brown, 2009). For example, see the case of InPUD: this informal online learning community is part of a formal computer science study at a European university. Research showed a change in communication, distributions of information and shared knowledge, which together supported the formal study better than without it (read Jahnke, 2010 in detail). Social media affects the relationship between formal schooling, informal learning out of the school (Jahnke, 2010) and collaborative learning at the workplace (e.g., Goggins, Jahnke & Wulf,

2012). These studies illustrate a transformation in education and learning through innovation in mobile computing (read also Tuomi-Gröhn & Engeström, 2003). Fischer (2011) stresses such new forms of lifelong learning as “cultures of participation”. New research questions emerge, for example to what extent do teachers in formal schooling reflect on their understanding of learning towards a culture of participation?

A new understanding of learning is provided by George Siemens. In his concept about “connectivism”, he illustrates how existing knowledge and information in the world can be connected via a network and its nodes; his central metaphor for learning. The idea is that any node (e.g., textual information, data, images, videos, figures) can be connected to another node. Learning in this approach is defined as “*the process of creating connections and developing a network*” (Siemens, 2005), where decision-making is the central part of the learning. “*Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision*”. With his Massive Open Online Courses (MOOC), Siemens provides new ideas about an open model of education that is supported by new technologies.

Laurillard (2007) specifically discusses different pedagogical forms of mobile learning; Kolb’s “learning cycle”, wherein learning includes a concrete experience, reflective observation, abstract conceptualization, and active experimentation by learners. According to this cycle, designers and teachers have to ask if the “design of mobile learning” **motivates and enables students to** (Laurillard, 2007, pp.163-164):

- a) Access the theory, ideas or concepts?
- b) Ask questions of (a) the teacher or (b) their peers?
- c) Offer their own ideas to (a) the teacher or (b) their peers?
- d) Use their understanding to achieve the task goal by adapting their actions?
- e) Repeat the practice using feedback that enables them to improve performance?
- f) Share their practice outputs with peers for comparison and comment?
- g) Reflect on the experience of the goal-action-feedback cycle?
- h) Debate their ideas with other learners?
- i) Reflect on their experience by presenting their own ideas, report designs (productions) to peers and to teachers?

This approach is a good starting point to reflect on teaching and learning. However, mobile learning today is a huge field and different understandings of mobile learning are available. Some people conceptualize mobile learning in terms of devices and technologies, while others focus on the mobility of learners and the mobility of learning. Further, others stress the learners’ experience with mobile devices (Traxler, 2007). Sharples et al. (2005), Sharples (2006), Traxler (2007), and Pachler (2007) stress the importance of a theory of “mLearning” and a research agenda. “Such a base would provide the starting point for evaluation methodologies grounded in the unique attributes of mobile learning” (Traxler, 2007). Several challenges go along with a new understanding of learning enabled by new media like mobile devices. One of the most important challenges, however, is how can we design *learning how to learn*?

### 3. REFLECTIONS ON MOBILE DEVICES IN PRACTICE

For more than 15 years, mobile devices have been part of the daily work practice of a research and teaching group called Interactive Media and Learning (IML). The first mobile devices (Palm Pilot PDAs) allowed the group to take notes and synchronize a personal calendar with a system called FirstClass. IML discovered that these devices were successful as a personal tool but had shortcomings as a collaborative tool: it was not successful in teaching due to the limited functionality for communication and knowledge sharing. A new category of mobile phones called smartphones generation 1 started to emerge in the late 1990s. These devices offered additional features such as applications for calendar scheduling, e-mail messaging, audio/video recording, and web browsing. Two of the smartphones we evaluated at the time were the Nokia Communicator and the Sony Ericsson P900. In the Uninet project, the Sony Ericsson P900 was used as a mobile learning device for streaming lectures across the GSM Telenet, but it was very expensive. Students could not afford the extra cost for data traffic over GSM.

In 2006, IML introduced portable media players—iPod’s—into courses. Funded by the Faculty of Teacher Education and in collaboration with the Department of Creative Studies, IML conducted a one-year project called Podcasting in Teacher Education (Vinnervik & Lindwall, 2006). The project studied how portable media players and course content could be used to support distance learning in the Sloyd subject. With the iPod, media content on the web was supported by a new technology called RSS. It made it possible

to subscribe to content that could easily be transferred to portable media players. iPod's were also tested in the eLene-TT project about podcasting and blogs (Bergström & Lindwall, 2008). Podcasting was also studied in mathematics "Podcasting i skolan" (PIS), reported by Bergqvist, Hudson, Lithner, & Lindwall (2008). With the introduction of the iPod Touch, the graphical interface was also improved, and wireless Internet access (WiFi) became standardized in the device. Web 2.0 became integrated into more learning environments. The collegial discussions and use of these devices were the starting point for further projects like the P@rable project that involved the iPod Touch for teaching and learning.

The iPod Touch was followed by the iPhone in 2008 and a new category of smartphones were introduced to the market. These devices were identified as useful for the entire IML staff, which solved issues related to communication, collaboration and knowledge sharing in teaching, learning and research. In 2009, the department decided to equip each staff member with an iPhone 3GS. The amount of devices is one of the critical challenges since collaboration and sharing is strongly supported by the iPhone 3GS. Additionally, different applications needed to be tested during the everyday life of the staff involved in teacher education and research on ICT, interactive media and learning. Finally, in 2010, the first iPads were bought.

In summary, the IML group learned that not only did the teaching concepts need to be adjusted but also concepts for work-based learning needed to be considered. A critical mass of people is required who has the device for gaining insights into different educational applications. The informal collegial discussions at coffee breaks became a professional development. This professional development has involved all staff, no matter the position. The borders between formal and informal professional development is blurred.

## 4. CHALLENGES TOWARDS MOBILE LEARNING

From the IML experience, the sociotechnical-didactical design of mobile learning is one of the most important challenges in formal schooling over the next years. The guiding questions for us are: (a) For what educational purposes is a specific technology (e.g., mobile devices) a good choice; when do we need other media (could we combine them, creating new technology), when to use what kind of learning environment?; (b) What is the look of a future classroom—what equipment, devices, software, for example, is needed?; (c) To what extent can teachers use mobile devices to support students in becoming a reflective community?

### 4.1 Challenge 1 – The shift from *textbook learning* to *learning to be creative*

One challenge is to cultivate cultures of learning that foster collaborative reflection. One question is what learning today means when we see people who use the Internet, get information easily, and learn informally outside of schools and workplaces. Besides the traditional teaching objectives called (a) learning *what* (e.g., textbook knowledge) and (b) learning *how* (e.g., methods, techniques), there is a need to design teaching as (c) "learning to be". This means that to become a school teacher, a researcher or an employee in a specific sector involving different values/norms that includes to learn must take on a new role and develop it (Jahnke, 2010). This is often expressed in notions like "*We want our students to think like a researcher (or etc.)*".

Furthermore, an innovative society needs people who develop skills to find solutions when the answers are unknown. How do teachers teach creativity and enable learning "when the answer to a problem is not known" (Fischer, 2011)? This shows a need to design teaching as (d) "learning to be creative".

When we shift the focus of traditional teaching objectives and student-centered learning from *textbook learning* more in the direction of *learning to be* and *learning to be creative*, we then need a new understanding of learning. New technologies and interactive media (and its deeper understanding) might be useful to foster this shift (Jahnke, 2011; Mårell-Olsson & Hudson, 2008). This leads us to Thesis 1.

- Thesis 1. Mobile learning can support a shift from textbook learning to learning to be creative.

### 4.2 Challenge 2 – Informal learning affects formal education

Mobile technology (iPads, Android, IOS-based smartphones, etc.) can support flexible learning.

The Australian Flexible Learning Framework (2008) defines flexible learning as enabling people to learn anywhere, at anytime with anyone. This learning approach has a strong focus on lifelong learning. The main idea is to support students moving from a reflective practitioner to a reflective community.

The teachers at IML have a flexible work situation, as students study at diverse times (e.g., evenings, weekends). This means that the service to students is not supported between 8am-5pm only. Of course, we know, this is controversial from a work-life-balance viewpoint. However, besides the main time slot for providing services, some teachers and administrators have a flexible approach with our students by answering their questions after the daily work. This could affect avoiding a) drop-out students and b) decreasing the learner's motivation. However, this assumption needs more research. The challenge is to design mobile learning for learners with different needs, and also for teachers and their needs. To what extent is mobile learning able to support flexible learning and also support the teachers? There is a need for research: to what extent does flexible learning need flexible services at universities?

Have you ever asked yourself why you should learn something at school/university? Someone in the past said this is important knowledge and therefore it is part of our curriculum. And for what purpose is it helpful to know this? Knowledge and the attribution of "what knowledge is important" change over time. In informal learning outside of schools the problem is often the trigger for learning. A person wants to know something and starts searching for answers and solutions (for instance, "problems" are improving a swim style, learning a foreign language, checking the existing information of a citation if this is valid, true or wrong). This does not exclude other learning forms like serendipitous learning. What can we learn from informal learning for formal teaching? One answer is textbook learning is not enough, as we need classrooms where the problem is at the center and the students are able to learn and become creative in order to solve this problem, and foster critical thinking and creative practices. Sure, professional knowledge is often necessary to find an appropriate answer to a problem. So, with a problem at the center, people develop various different skills.

- Thesis 2. Mobile learning can bridge informal learning approaches to formal education and new flexible teaching methods, where the problem, and not only the textbook, is at the center of teaching.

### **4.3 Challenge 3 – It is not one or the other; it is not technology or didactics**

The younger generation (e.g., digital natives), as well as people who are more or less online around the clock, (Homo Interneticus, it does not matter what age) already created new forms of communication and knowledge sharing. However, the problem remains that ICT use in schools and universities is behind this social change. Some teachers are happy about the new technologies (group A), but some other teachers are not able to revise their didactical designs supported by the mobile devices in their classrooms; they need support (group B). Some teachers do not want to use mobile devices because of different reasons (group C).

For example, on September 30, 2011, KVL (anonymous person) posted a question on the POD mailing list. Almost all of the Centers for Excellence in Teaching & Learning in the U.S. subscribe to POD. POD has almost 1,800 members). He asked: "*Anyone out there doing any workshops for faculty on useful iPad apps to support student learning....?*" (September 30, 2011, POD). There were just a couple of answers, which is a surprise because normally the community discusses teaching issues over several days or weeks depending on the issue. After some e-mails, where people just gave a few examples of mobile learning and iPads, a new answer was given: "*I'm not sure that I like the direction of this conversation... My approach has tended to be to look at what I wish to achieve and then find the appropriate means of so doing, rather than start with the latest toy and see what I can do with it*" (answer by BT on October 2, 2011).

The point is, it is not one or the other—it is not technology or didactical approaches. To develop and to improve teaching practices, teachers look for tools but sometimes they do not exist yet, are too expensive, or beyond the skillset and so forth. This is probably clear for researchers in the field of Technology-Enhanced Learning but some teachers have a different understanding.

With the mobile devices, which are almost anywhere, as each student has a smartphone, the pressure to rethink how to handle this omnipresent online presence is increasing. This is different to the laptop age. The mobile devices are small; when the users don't want, nobody can see it; a huge mass of learners use it, you can communicate in seconds, and they do not take much time to reboot. Teachers ask themselves how can I handle the omnipresent online presence when students in my class google my talk and scrutinize what I said? From a didactical point of view, we would say, "Fantastic!" We want to have students, thinking as a

researcher, who are engaged, critical and active. Yet, it seems that some teachers need support. One way is to design mobile learning together with teachers and students.

- Thesis 3. Mobile devices bring innovations from daily life into schools and universities, and are able to *crack* traditional teaching routines.

#### 4.4 Challenge 4 – Creating CSCL@Work for all

Challenge 4 focuses on the creation of a collaborative work-based learning environment for all staff members (teachers, researchers, designers, administration), or in the case of firms for all employees.

With the IML group we did test different applications for supporting teaching, and we also applied those mobile devices for our own daily work. One such approach started with the synchronization between our Google calendar and the iPhone. This supports the daily work for all staff and supports mobile learning at work. In this environment, students, researchers and teachers as well as administrators and people who organize the courses had a mobile device. For instance, in cases where students have questions like, “How do I apply for a course?”, they often go first to the study administration. Based on our experiences, we also saw the need for teachers to implement this type of CSCL@Work friendly environment.

In their edited book, Goggins, Jahnke & Wulf (2012) illustrate that work-based learning is not restricted to learning places *within* an organization (see also Jahnke & Koch, 2009 “Web 2.0 makes a difference”). Instead, the cases show that CSCL@Work—collaborative learning at the workplace—means to enable unexpected and unusual online learning places, and to design technology-embraced collaborative learning *across* established boundaries (social- and technology-constructed boundaries).

- Thesis 4. Mobile learning can bridge informal learning with work practices.

It is important to outline that these four theses (Section 4.1-4.4) above are created with the **assumption** that mobile learning is designed *correctly* and useful with regard to specific teaching objectives and ideas of learning outcomes. However, the question is, of course, what are appropriate, correct and useful designs?

## 5. SCENARIOS FOR MOBILE LEARNING AT FORMAL SCHOOLING

We define mobile learning as a form of learning where mobile devices (e.g., iPads, Androids) are used for educational purposes in particular at formal schooling and in universities. Specially designed mobile content is time- and location-independent. This mobile content can be varied from text to figures to documents, blog entries, pictures, photos, Podcasts, videos, simulation, movies and so forth. Simple examples of learning materials are texts or presentations. Learners have access to the manuscripts, photos or short stories, read them, set bookmarks, and mark specific passages in the text or edited small notes (e.g., Evernote).

From a pedagogical perspective, the design of mobile learning usually starts with certain considerations: “How to use mobile devices and for what purposes?”, for example “What are the teaching objectives?”; “Which teaching problem can be solved by applying mobile learning?”; and “Do any of the learners have a mobile device?” These lead to questions such as: “Is content to be developed (or done by others)?”; and “Are new apps required or are they made by others?” Technical skills are required to fulfill the pedagogical aims, as both go hand in hand.

### 5.1 Mobile learning at schools

In this section, we describe ideas of how to integrate iPads into formal schooling from a didactical viewpoint.

*Scenario.* A biology teacher offers one idea. She explained to her class (10-year-olds) that a mushroom is a special plant, and tasked the students (a group of 3) to use an iPad outdoors and take photos of mushrooms, find photos online and discuss different kinds of these plants online. The scaffolding question was to identify an edible from a toxic plant. In this case, the teaching objective was to support professional knowledge but also to foster collaborative reflections among the pupils. In this setting, formal learning has been connected to learning outside of the school. The teachers brought the *problem* (identify toxic mushrooms) to the center of learning. When the activity is done, the class reflects on the technical device (what was good, how does the iPad help, what was not so good, where were the problems?)

*Advantages.* Pupils seem to integrate mobile devices into their personal learning environment easily. YouTube, for example, is a source often used for learning. The use of mobile devices is part of youth culture outside of schools. When using it at formal schooling, teachers have the chance to critically reflect on the use of media within their classes.

*Possible problems.* In Sweden it is not uncommon for teachers and schools to debate the prohibition of the use of smartphones during class. The debate is often about whether smartphones disrupt teaching and whether students cheat by using these devices. Is the mobile technology revolution only for the teachers that are already interested and not reaching teachers who also would benefit from this technology? How can the design of teaching resources and activities change in order to utilize the features of modern mobile devices?

## 5.2 Mobile learning at universities

In this section, we illustrate a mobile learning scenario with the didactical focus on learning to be creative.

*Scenario A.* In order to understand and apply production processes to new standards in production engineering, students are tasked to develop a new machine (or parts of it). The problems with the existing machines are more or less well known. A solution does not exist yet.

*Scenario B.* Social sciences students are tasked with making social changes in society. The reflection on theoretical approaches and a small survey or interviews are part of the learning assignments.

*What is new?* Creativity can be learned; at least the environment of getting new ideas can be prepared (see Jahnke & Haertel, 2010). The support of creativity is usually done within the following phases:

- Collection of ideas (e.g., using brainstorming, Synectic Technique; de Bono, 2005);
- Condensing ideas, tracking one or several ideas to find a suitable solution; and
- It could be that the first ideas need to be rejected, as a combination with other ideas leads to a better solution.

The generation of new ideas can be supported by using mind-mapping tools like Freemind or Mindmeister, and can be performed synchronously and asynchronously. Those mobile devices tools also include small communication functions where the ideas can be discussed and evaluated. Other communication tools are, for example, Springpad, Evernote and PebblePed. Some face-to-face meetings could be helpful for developing knowledge sharing and learning (“Where are we with our new machine?” and “What have we achieved so far?”). The instructor coaches the creative process at the beginning and pays attention during the process to ensure that all employees have the opportunity to participate.

The cultivation of a *reflective community* (e.g., with Ning.com, Elgg.org) has the advantage that learners get the chance to immediately communicate their ideas. Furthermore, reflections on new ideas can be fostered by the instructor who uses creative techniques (e.g. PMI, Plus Minus Interest).

*Advantages.* Notes can be made quickly, easily and are available for all learners through a shared online folder (flash notes), and developing a community is useful when establishing a culture of “being and becoming creative”.

*Possible problems.* Rather than establishing a “culture of making failures” and learning from them, which fosters creativity, failures are treated as taboo.

## 5.3 Mobile learning at the workplace

In this section, we illustrate a mobile learning scenario at the workplace.

*Scenario.* New employees are tasked with adopting knowledge that will fulfill their work tasks within a firm or a university. A conventional continuing training is not suitable because of limited time and lack of individual attention, or because the knowledge does not yet exist.

Mobile learning is introduced in a broader knowledge management concept. Employees have access to databases (e.g., via Dropbox) and retrieve knowledge through the use of mobile devices. Through social networking sites (e.g., LinkedIn), learners are able to look for colleagues and read about their work areas. Through communication functions like chatting or text messages (e.g., Skype), they can directly contact their colleagues or other experts. Employees can illustrate the problem through mobile devices (uploading descriptions, photos, videos). Such documentation can be uploaded quickly to the server (for instance via Dropbox). The documentation is based on multimedia such as photos and small videos. Via the iPad and iPhone, photos or videos are easily made and in a second they are uploaded to a Dropbox shared folder or



similar. Sometimes a photo says more than a thousand words, meaning it makes the problem much more visible than a written document. Other employees create comments, annotations and notes easier and directly on the documented problem. Using mobile knowledge management, the employees are able to search already documented files. Searching mechanisms are supported by tagging and crowdsourcing, and integrating new tags is possible each time.

*What is new?* The difference between a normal PC and mobile devices is that mobile devices are more flexible, they do not take much time to reboot, and have an omnipresent online presence. Mobile devices are especially useful for workplaces that do not employ PCs, for example outdoors jobs (timber, biology) or in production plants and long-haul trucking. Mobile knowledge management can be useful for those workplaces (e.g., Herrmann et al., 2005).

*Advantages.* Information can be retrieved directly in the *doing of work* when needed, new experience can be uploaded to the network (e.g., wiki principle), and the small size of the devices increases mobility and supports flexible learning, thus allowing searching already solved problems and communicating with others by sending a photo or video of the problem (e.g., in the foresting, timber sector).

*Possible problems.* Reluctance to link learning and work (employer could invent learning as cultural event, see for example the Ideo company/U.S.); it is too time-consuming to create a comprehensive knowledge base or to conduct quality assurance; updates for mobile devices are required; and often there is more than just one perfect solution, so how does one handle this from a learner's point of view?

## 6. CONCLUSION

We started with the question of how to educate the Homo Interneticus and provided answers creating four theses that illustrate the challenges of rethinking formal education supported by mobile devices.

1. Designing mobile learning fosters the shift from textbook learning to learning to be creative.
2. Implementing mobile learning bridges informal learning approaches with formal education and new flexible *teaching* methods, where the problem and not the textbook is at the center of teaching.
3. Mobile devices bring innovations from daily life into schools and universities, and *crack* traditional teaching routines.
4. Mobile learning bridges informal learning with collaborative work practices (mobileCSCL@work).

The design of learning spaces is a complex design problem that involves technology and didactical approaches in different cultural disciplines. It means to design the interdependencies among these elements (see figure 1). Mobile devices are one option when mobile learning is designed correctly and useful with regard to specific teaching objectives, learning outcomes and competencies. However, the question is, of course, what are appropriate, correct and useful designs? We illustrated several scenarios for formal education (schools and universities) but also for the workplace, where the possible problems have been addressed, for example group dynamics prevent online collaboration, role conflicts occur, and a culture of failure is not allowed.

With this conceptual paper, we wanted to highlight the potentials and challenges of mobile learning today. What already exists in daily life (Twitter and Facebook via smartphones around the clock) will affect the school and formal education of tomorrow. The question is do we respond to this and how? What is an appropriate answer? We need to conduct more research on designing mobile learning together with teachers and students, and study/learn from them in order to find appropriate didactical solutions to enhance learning in forms of "learning to be creative".

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