

Developing new mobile services for the Universities -University students' conceptions of their needs for mobile tools for scaffolding learning activities

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Abstract: The benefit of computers in collaborative learning has been broadly researched, but it is still unknown what kind of possibilities the pedagogical use of mobile tools and wireless devices can bring to learning. In this paper we will present some results of two evaluation studies of students' conceptions of mobile devices in learning. The aim of the first study (n=715) was to explore university students' conceptions of their needs for mobile tools for scaffolding their learning activities. The aim of the second study (n=147) was to reveal what kind of features students would appreciate in a mobile learning environment for scaffolding their learning activities. The data of these studies were gathered with on-line web questionnaire. Data analysis has been conducted by using the quantitative analyzing methods. The results of these studies will be used for developing and implementing new mobile learning tools, for students and workers in the University of Oulu.

Introduction

Increasing amount of researchers are interested in experimenting mobile devices in education (Zurita & Nussbaum, 2004; Roschelle, 2003; Crawford & Vahey, 2003; Hoppe, Joiner, Milrad, & Sharples, 2003). It is, however, obvious that the utilisation of wireless technology for human activity requires increased multidisciplinary co-operation in which not only issues related to the functioning of wireless networks are discussed, but also mobile applications are developed for terminal devices, and designs are made for their pedagogical utilisation in the contexts of learning, studying and work.

As a result of multidisciplinary co-operation, the University of Oulu has started the VirtualCampus project aiming to promote applications of wireless technology in university studies and work. The development of mobile services at the University of Oulu will be done in three parts (figure 1.): 1) creation of the infrastructure 2) modification of existing network services for mobile use and 3) creation of the real new mobile services. (Liukkunen, Riikonen & Järvelä, 2004) First stage of the development has been partly done since wireless network connection is available at main areas of the university campus. There are also projects in progress at the University of Oulu that represent a shift towards (the) true mobile services. For example, SmartLibrary is a mobile service in the library of university, which guides users' mobile search for a book. (Aittola, Ryhänen, & Ojala, 2003; Laru & Järvelä, 2004).

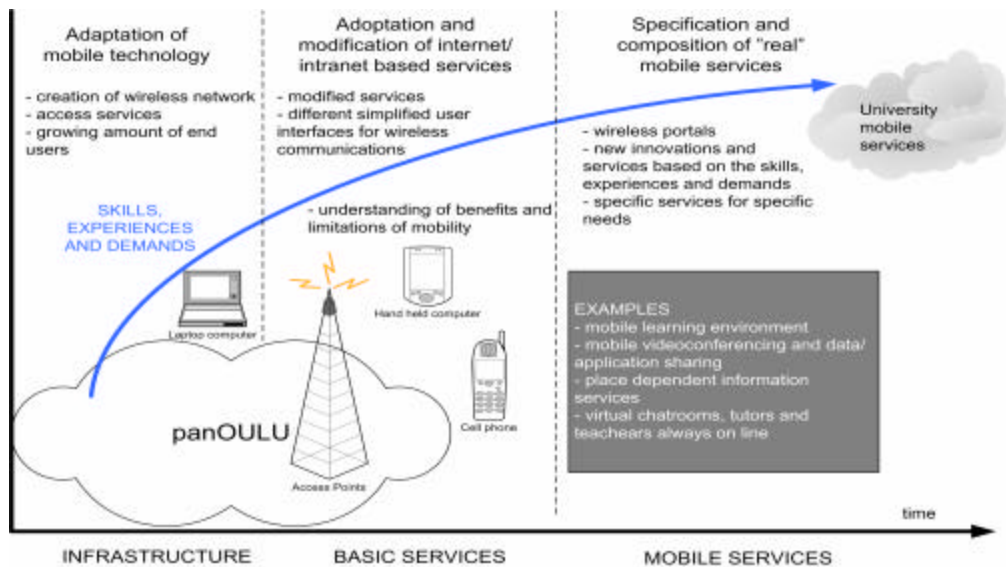


Figure 1. A roadmap to mobile services at the University of Oulu. (Liukkunen, Riikonen & Järvelä, 2004)

In this connection, the creation of an infrastructure means the construction of a wireless network and the offering of wireless internet services (access services) to university students and staff. A functional wireless network provides the basis for a gradual generalisation of the use of wireless terminal devices. At the same time, the users' skills and experiences – as well as their requirements – reach such a level that it becomes possible to build, introduce and evaluate mobile services. In the second phase of the roadmap, the goal is to determine the essential network services that can be reasonably modified for application by mobile users. At this stage it is also important to accumulate experiences about mobility. The overall objective is to understand the limitations of mobile services and to establish the benefits that may be gained from them. The third stage aims at determining the contents of mobile services and creating services that are targeted specifically for mobile users.

The overall aim of this study is to enhance the pedagogically meaningful use of mobile devices in higher education. This paper provides an introduction to the theoretical framework of pedagogical use of mobile devices in a higher education context. In order to design the mobile tools for learning, two studies were conducted to evaluate students' needs. The first study (n=715) was conducted to explore university students' conceptions of their needs for mobile tools for scaffolding their learning activities. That study was used also to determine the essential network services that will be modified into mobile format. The second study (n=147) was conducted to explore student conceptions of what kind of features the users of the mobile web based learning environment would appreciate to be useful for scaffolding their learning activities. The results of these studies will be used for implementing the mobile learning environment for higher education courses.

Theoretical framework

Mobile devices, such as mobile telephones, personal digital assistants and laptops, can be viewed as a cognitive tool for supporting learning. They offer new opportunities to learn anytime, anywhere, enabling a transition from occasional, supplemental use to a frequent, integral use (Soloway et al., 2001). Mobile devices enable people to access Internet resources and run experiments in the field, store and manage information, images and sounds, and communicate and share the material with others (Sharples, 2002). In the broadest view, cognitive tools can help learners transcend limitations of their memory and share the cognitive burden of carrying out the tasks (Pea, 1993; Salomon, 1993).

Computer Supported Collaborative Learning (CSCL) is an approach, which is based on an idea to organize collaborative learning with educational technology. The benefit of technology for collaboration and knowledge building comes from the advantage of effective thinking tools (Bereiter & Scardmalia, 1989) and shared knowledge resource as computer database. Knowledge building environment can support building, articulating, exploring, and structuring knowledge. The collaborating partners can use the environment for writing notes, creating charts, and reading and commenting on each other's productions in a communal database (Hakkarainen, Lipponen, & Järvelä,

2002). The new potential, which mobile technology gives for teaching and learning, is based, in part, on the unique characteristics and capabilities of the technology. But technology is only a facilitator; the important thing is how technology is being used in educational setting, its pedagogical implementation (Roschelle & Patton, 2002).

Roschelle and Pea (2002) suggest that future classrooms are likely to be organised around Wireless Internet Learning Devices (WILD) that resemble graphing calculators or Palm handhelds, connected by short-range wireless networking. WILD learning will have physical affordance which is different from today's computer lab, and different from classrooms with many students per computer. These differing affordances may lead to learning activities that deviate significantly from today's images of computer and technology-based learning activities. Roschelle (2004) explains that change in his article: "mobile devices will participate in a network that is overlaid in the same physical space in which students and teachers participate socially in teaching and learning, so two distinct kinds of participation are occurring at the same time and in the same space: the normal social participation in classroom discussion (for example) and the new informatic participation among connected devices". Roschelle & Pea (2002) have identified that the nature of coupling between these two layers (informatic & social) is important issue for further research. Luchini, Quintana & Soloway (2004) has contributed in this field by defining principles learning centered design (LCD) that focuses on developing tools that help people learn. LCD is effort to understand and address the broader design challenges of building handheld software to support learners. (Luchini, Quintana, & Soloway, 2004)

Aim and methods

The aim of the first study is to explore university students' conceptions of their needs for mobile tools. The subjects (n=715) were higher education students and voluntarily participated in the research. The total amount of students in University of Oulu is 14500.

The aim of the second study is to explore what kind of features possible end-users of mobile learning environment would appreciate to scaffold their learning and working. The subjects (n=147) were also higher education students and voluntarily participated in the research. These students belong to a group of students who are active users of Oulu University virtual learning environment "Optima" (M:2,85, SD:1,510, $p < 0,001$; where 1: many times per day and 7: less frequently than once in a month)

The data of both studies were collected by an online questionnaire in a web. In the first study the questions were implemented on five-point Likert -scale. The questionnaire contained questions of the use of mobile technology and questions dealing with learning practices and strategies. This section of the questionnaire was divided into three categories: 1) learning context, 2) learning strategies and 3) learning tools. In this study the main focus is on the use of learning tools.

In the second study the questions were divided into two main categories: 1) present features of the "Optima" and 2) possible new future features for "mobileOptima" learning environment. The aim of these questions was to explore users' conceptions of what kind of features could be useful in a mobile learning environment. Subjects' conceptions of the possible new features were also gathered with open ended questions.

Results

The first study - students' conception of their need for mobile tools

According to the data analysis, learning activities of the subjects are quite traditional. The subjects were asked to evaluate the amount of the following activities in their studies: individual learning, learning in a group, learning in guidance of a teacher in a lecture and distance learning. Instead of distance learning, their studies are composed of the lectures, group work and individual work (see table 1). The subjects indicated that a great part of their learning activities (66,8 %) are learning in lecture, 49 % learning in group, 89,1 % individual and self-directing learning and only 19 % learning in distance education. In addition to slight proportion of distance learning in their studies, they didn't use web based learning environment for scaffolding learning. (M: 2,49, SD: 1,365, $p < 0,001$).

The results indicate also that the students like to study in an informal environment whenever possible. When the subjects were asked an open-ended question about the most convenient place to study, 68 % of them preferred studying at home, and 49 % of subjects preferred to study at the library. More informal places, such as cafeterias,

were not in favour among the subjects of this study. There were not many mentions of more formal places such as classroom or lecture, either.

	M	SD
1.1 My studies include a lot of individual work*	4,21	,848
1.2 I prefer individual work	3,77	1,012
2.1 My studies include a lot of group work *	3,15	1,158
2.2 I prefer group work	3,55	1,050
3.1 My studies include a lot of lessons *	3,69	1,092
3.2. I prefer lessons	3,04	1,159
4.1 My studies include a lot of distance learning *	2,25	1,147
4.2 I prefer distance learning	2,91	1,101
*p < 0.01		

NOTE: For these items 1 = strongly disagree and 5 strongly agree

Table 1. Composition of the studies of the subjects

The study reveals that technological readiness of the students is inadequate to use mobile tools in learning. Although main areas in the University of Oulu and the city centre of Oulu are covered with Wireless Local Area Network, only 17,4% of the subjects have used it. Reason for that might be the lack of appropriate hardware: 41% of subjects don't own a laptop computer and 83,5% have never used a handheld device. All of the subjects own a mobile phone, but use it mainly for voice calls and SMS messages.

To clarify what are the subjects' conceptions of their needs for mobile tools and services, they were asked both 1) to select among the existing www-based services that they would like to use via mobile device and 2) to select among the possible future mobile services that they would like to use to scaffold their studies. The results of the study states that 86% of the subjects want to read their emails via mobile device, 57% want to use library services via mobile devices and 30,5% of subjects are interested in using the learning environment in a mobile device. Results reveal also (see Table 2) that the subject would like to use their mobile learning devices to store learning materials in/to mobile portfolio, to get current information about what happens at the university and use device to search additional information from the Internet.

	Mean	SD
1. Announcement service	4,58	,779
2. Information searching tool	4,06	,941
3. Mobile portfolio	4,02	,984
4. Awareness tool	3,70	1,155
5. Lecture handouts with a possibility to do personal marks and share them	3,95	1,106

6. Lecture notes with share/merge function	3,61	1,117
7. Lecture handouts	3,60	1,274
8. Asynchronous discussion tool	3,37	1,114
9. Mind mapping tool	2,88	1,172

NOTE: For these items 1 = strongly disagree and 5 strongly agree

Table 2: Some of the future mobile services presented to the subjects

The second study – Optima learning environment users’ conception of useful features of mobile learning environment

The quantitative data analysis reveals that Optima learning environment users would appreciate mobile learning environment to be used as an additional tool with computer based learning environment. According to the subjects of this study, mobile learning environment could be used mainly for information delivery and discussion. Analysis reveals that the most useful feature of mobile learning environment is the possibility to read current information and messages from the discussion forum (see table 3). Also a possibility to read documents and notes via the mobile learning environment is appropriate from the subjects’ point of view. Mobile learning environment could be used for writing short notes and store ideas when needed. Other activity, for example writing longer documents would take place in a computer based learning environment.

The Subjects were also asked to evaluate the meaning of the new features for scaffolding their learning and working activities (see table 4). According to the study, the majority of the subjects argued that the most useful new feature would be a possibility to receive a message to their mobile device about the new activity conducted in a learning environment. Other meaningful feature would be an opportunity to use visualization to clarify the activity happened in a learning environment’s discussion forum.

Feature activity	N	%
1. Public announcements reading	107	72,8
2. Asynchronous discussion reading	104	70,7
3. Private messages reading	97	66,0
4. Workspace viewing	89	60,5
5. Lecture notes reading	80	54,4
6. Asynchronous discussion writing	76	51,7
7. Private messages writing	75	51,0
8. Peers’ personal data viewing	44	29,9
9. Workspace modifying	43	29,3
10. Videotaped lecture viewing	30	20,4
11. Internal search engine searching	20	13,6

Table 3. Features of current virtual learning environment which subject would like to use in mobile version also

Function shared/personal/none	N	%
1. Reminder personal	106	72,1
2. Small notes personal	89	60,5
3. Visualisations of asynchronous discussions shared	72	49,0
4. Small notes shared	61	41,5
5. Activity tracking personal	59	40,1
6. To-Do list personal	57	38,8
7. To-Do list shared	52	35,4
8. Brainstorming personal	51	34,7
9. Activity tracking personal	47	32,0
10. Brainstorming shared	39	26,5

Table 4. Subjects' evaluations of the possible new features in mobile version

Subjects' answers to the open ended questions reveal, for example, that visualization is an important feature because it scaffolds the use of mobile learning environment, especially while traveling when it is important to perceive a lot of information at a glance. Subjects stated that visualization illustrates the overall situation in a learning environment, scaffolds on-line discussion, scaffolds expression of emotions and nonverbal communication. On the other hand, a few subjects noted that visualization is secondary to the textual presentation. Subjects' annotation to this is that the capacities of mobile devices are inadequate for visualization.

The data analysis reveals that the mobile learning environment could be used as an awareness tool (Leinonen, Järvelä & Häkkinen, 2004). The subjects of this study were asked to evaluate the meaning of the "social awareness". Majority of the subjects indicated that the awareness of the presence of other users and their availability is not very important in their learning process, but they agreed that it increases meaningfulness of a virtual learning environment. This is important especially when there is no face-to-face interaction. "Workspace awareness", for example students' awareness of what others are doing in the learning environment, awareness of new messages or documents can also enhance the use of learning environment. The students can check whether there are new activities to be reacted, what have been done and what need to be done next; is there, for example, new messages which need to be answered or new documents which need to be read. This possibility would be useful for scaffolding group work especially when students want to use learning environment, but don't have the possibility to use computer based environment.

Discussion & future work

In this paper we have presented results of two evaluation studies of students' concepts of mobile devices in learning. These studies have been conducted to design computer support collaborative learning and the use of mobile devices in the higher education context. The aim of the first study was to explore university students' conceptions of their needs for mobile tools. The results of the first study indicate that the students would need mobile tools for scaffolding learning processes at the university. There is need for special applications, for example, which encourage in-class participation with mobile devices (Ratto, Shapiro, Truong, & Griswold, 2003; Anderson, Anderson, Vandegrift, Wolfman, & Yasuhara, 2003). Students need also simple tools to scaffold or support learning activities. (Laru & Järvelä, 2004; Laru & Järvelä, 2003). As a result of the first study two software development projects has been started: MobileOptima and University Mobile Services.

The second study was conducted to reveal what kind of features students would appreciate in a mobile learning tool to be developed in Mobile Optima project. Results of the study are currently being used as the raw material for software development process – they represent end users' conceptions for software developers. Prototype version will be tested in a four week field trial during spring 2005. In order to assess the performance of the developed mobile tool, both instructor and students opinions and conceptions will be gathered (interview and questionnaire data) and content of the learning processes stored to databases collected.

The third aim was to explore what kind of aspect need to be noticed for implementing CSCL learning approach and the pedagogical use of mobile learning environment to the higher education context. Because new mobile application is currently under development this aim is very important for forthcoming field trial. Subjects of the field trial will be selected among virtual master education programmes of the University of Oulu. CSCL learning approach makes certain demands for the implementation of mobile tool in forthcoming field trial. An important thing is to enable the shared knowledge building by providing socio-cognitive scaffolding for articulating, exploring and structuring knowledge (Dillenbourg, 1999). Prototype version of a mobile learning tool will be used to scaffold learning activities in field trial, but also a new pedagogical model needs to be developed and implemented to scaffold use of the mobile learning tool in collaborative learning setting.

Information of how to support effective collaboration (Dillenbourg, 2002) is essential when designing mobile tools in order to promote distributed learning and working. Our studies show that the evaluation studies from larger samples of students can be useful for the pedagogical design of the future learning environments – at least they can give authentic information about the students' needs and also reflect the current pedagogical culture of universities.

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