Mobile Collaborative Concept Mapping – Combining Classroom Activity with Simultaneous Field Exploration

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Abstract

Mobile technologies like mobile phones allow a learning community to combine classroom activities with simultaneous field explorations in an authentic environment. The collaboration between the two groups can be enhanced by a technique called Collaborative Concept Maps, based on SMSs (Short Message Service). This means that mobile technology is used not just as a mediator (of learning activity/collaboration) but as a trigger and platform that includes guidance and support for learning methods and the learning process. A formative evaluation indicates that it is possible to construct collaborative concept maps by mobile phones (using SMSs) and combine simultaneous classroom learning activity with mobile learning. In the conducted case study, the students in the forest sent their observations, represented as concept maps, as structured SMSs to the students in the classroom. Our experience shows that even light and easy techniques can make a difference in a learning setting, if they are carefully designed to fit the real users' context.

1. Introduction

Mobile devices like cellular phones bring new dimensions to learning and education. They extend a learning environment and integrate it with a real environment, where learning can occur in an authentic situation and context. Communication, observation and collaborative knowledge building describe students' activity in a learning environment based on mobile educational technologies.

There are emergent needs for advanced applications and *virtual learning environments* (VLE) that concern the characteristics of mobile devices, including the benefits and limitations of their use in communication and collaborative learning. This far, the use of mobile technologies for learning has reduced to mainly regular or conventional uses of standard PDA or WAP equipment, or even sending informal SMSs. In this regard, our approach to have students communicate with structured SMSs is a new innovation. *MoCoCoMa*, an application for *mobile collaborative concept mapping using the SMS* property of mobile phones, is a novel step in this direction. It provides a framework to facilitate collaborative learning in authentic environments and a basis for simultaneous activity in a classroom and in a real environment.

Our main goal was to build a pedagogically meaningful application for mobile learning based on the technology that is available for everyday use. Therefore, the SMS-based mobile learning environment is a good starting point for the implementation of mobile and wireless learning with relatively low cost outside the classroom. The telecommunication infrastructures for transmitting SMS-messages are available in most countries including the developing countries. Any special wireless networks (like WLAN) extending learning out of the classroom are not needed. The cellular phones are also widely spread and SMS-messaging is quite globally a common activity among students [5].

On the other hand, PDAs and other computer-like handheld devices would naturally offer graphical and more sophisticated environments for constructing collaborative concept maps. Working with mobile phones, concept maps can be constructed only by using text without explicit visual maps. This may be seen as both an advantage and a disadvantage. When using only SMS there is no visual presentation of the concept map that may work as a learner's tool for physically distributed cognition [2]. On the other hand, the lack of visual presentation may get a student to use more cognitive effort to create his/her own mental data structures ("mental concept maps") and to collaborate with other students.

Our aims at exploring the possibilities and challenges of MLE with SMS messaging were:

- To provide a Mobile Learning Environment that enables collaborative knowledge building in authentic environments by using SMS;

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- To use concept mapping as a framework and foundation for learners' knowledge building in MLE; and
- To combine the learners' activity in the classroom with learners' activity in the real environment, for example in a forest.

Our objective is not to study the mobile technology (like SMS) just as a mediator of communication, but rather as methods and triggers provided by an application that can be used in order to facilitate learning process.

2. Pedagogical Background for Learning with Collaborative Concept Maps

2.1. Collaborative Knowledge Building

In this context learning is seen as a collaborative knowledge building activity as in for example the process of progressive inquiry [6] that heavily relies on socio-cultural learning theories [15]. More exactly, knowledge building is used as a metaphor for learning activity [1].

Although concept mapping can be a tool used during the whole knowledge building process, this study focuses on examining critical elements of learning in the early phases of the knowledge building process. The early phases of knowledge building, like setting up own problems and questions, context creation and externalization of prior knowledge are heavily emphasized in various pedagogical models and methods (e.g. Progressive inquiry [6] Activating instruction [10] and Problem Based Learning (PBL)).

2.2. Collaborative Concept Maps

Concept maps [12,13] are widely used in teaching and learning. Concept maps are also tools for distributed cognition [8]; they visibly describe concepts and relations between the concepts during the construction process. Concept mapping may be seen also as a technique to regulate learner's cognitive processes [9].

Collaboratively constructed concept maps are tools for collaborative knowledge building [3]. They enable learners to create shared (common) representations and distribute cognition, both physically and socially with each other [14]. When using mobile devices, the concept maps are able to be constructed collaboratively in a real, authentic situation e.g. in a forest or in a work place.

There are various PC software packages for concept mapping [7] as well as on hand held devices for creating individual maps [11,2] and tools for co-operative and collaborative concept mapping, like Pocket PicoMap [4]. These tools are based on the idea to construct a concept map by creating new concepts and links between them while software provides the visual representation of a concept map for the learner. However, similar tools have not been available before on mobile phones based on SMS communication.

3. MoCoCoMa – A Tool for Mobile Collaborative Concept Mapping

We have developed an application for constructing collaborative concept maps by using mobile phones in an authentic environment. A collaborative concept map works as a basis for learning and for further knowledge building. Concept mapping also creates a structure and framework for knowledge building activity. *MoCoCoMa* is a Java- and PHP-based application for constructing collaborative concept maps by using SMSs. It forms an Open Learning Environment (OLE) for mobile devices. The learning environment is open in the sense that students are able to construct the content of learning in the form of the concept map and communicate by using chat.

3.1. Functionalities of MoCoCoMa

SMS Interface: In MoCoCoMa students are able to construct collaborative concept maps by using SMSs and a simple script language that have commands for adding a new concept, creating a relation between concepts, and textually browsing threads of the concept map (see Table 1). A notification message is always sent to the user, e.g. concerning whether the new concept/relation is added to a concept map or the concept/relation already exists. Students can also send an explanation request to the student who originally added a particular concept.

Table 1. Commands that students can use in SMS messages in order to construct concept maps.

luk *concept*	adds a new concept
lyk *concept1 -> concept2*	adds a new relation between concepts
lst *concept*	lists the concepts related to a particular concept

Web Interface: The Web interface visualizes the concept map in real-time when students are gathering and adding new concepts and relations in a real environment by SMS. The Web interface may be used

on an individual computer or it may be projected on the white board for the whole class.

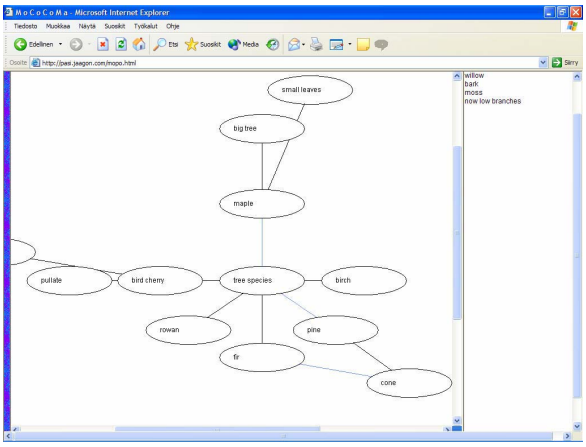

Figure 1. Web interface of MoCoCoMa for real-time viewing of the constructed concept map.

There is a concept space (see Figure 1) that includes the concepts added but not yet linked with other concepts in the concept map. These individual concepts will appear on the concept map after they have been linked to another concept that exists in the map. It is also possible to organize and add new concepts and relations on the Web interface. The whole construction process of a concept map is recorded and thus it may also be reconstructed afterwards even as an animation.

Chat discussion: Chat messages sent from mobile phones are displayed on the Web-based chat window, but they are not transmitted to other students' mobile phones. The chat function offers e.g. a possibility for students working in a real environment to ask questions from the students working in a classroom. The students in a classroom may use Internet and other resources to provide the requested information. Chat messages sent from a classroom by the Web interface are displayed on the chat window and on the mobile phones of selected users. In addition, the system enables SMS group sending via the Web interface. All students working out of the classroom or in a real environment can be easily reached at the same time by this function.

3.2. Technical Implementation

The MoCoCoMa application consists of the *PHP module* and the *Java Applet module* and the database shared with the PHP and Java Applet modules (see Figure 2). Sent SMS messages are transmitted to the IP-based *SMS gateway* by teleoperators. The SMS gateway processes the SMS messages and directs them (based on the command used in the message) to the selected PHP script and executes the script. The PHP module is used to process user commands and to update concepts and relations in the database. In addition, the PHP module handles the sending of notification messages to users' mobile phones via the SMS gateway, as well as sending chat messages i.e. the messages sent from the Web and messages sent from mobile phones. The Java applet is used to construct a graphic representation of a concept map on the computer screen. The Java applet runs locally on the user's computer.

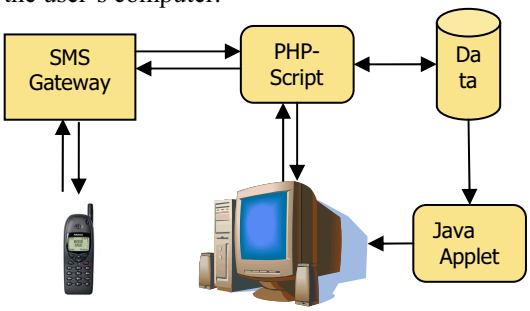

Figure 2. General technical architecture of MoCoCoMa.

4. Case study: Mobile Collaborative Concept Mapping in Environmental Education in a Primary School

Our formative research aims at exploring the possibilities and challenges of using MLE based on SMS messaging were to examine how mobile phones (SMSs) allow a learning community to combine class room activity with a simultaneous learning in an authentic environment and how to use collaborative concept mapping as a framework and as a foundation for learners' knowledge building activity.

4.1. Participants and Procedure

This case study involves 20 students on the 6th grade in a primary school. The average age of the 6th grade students is 13 years. The primary school was an urban, university practice school. All the students were familiar with concept mapping technique done on the paper before participating in this study.

Twelve students were assigned to work in pairs in a forest. Each of the pairs had a mobile phone in order to contribute to the collaborative concept map by SMS messages with MoCoCoMa. The pairs were given one hour time to walk around in a neighboring forest, to make observations and to add new concepts and

relations to the concept map. The students were not able to browse to concept map by SMSs. The rest of the students (8) were working in a classroom with wireless laptop computers. The concept map was projected on the white board in order to present the collaborative constructing process. The chat-discussion was used on laptop computers and students were instructed to keep the chat window open.

Students working in the forest were instructed to construct a concept map on tree species including the description of the properties of trees and the environment surrounding the trees. They were also explicitly guided to use the MoCoCoMa and to use chat in order to ask for more information on trees and to ask help from the students working in the classroom. Students working in the classroom were instructed to write a short essay on some tree based on the concepts that appeared on the collaborative concept map projected on the white board. They worked in teams of two or three students and each team had a laptop computer connected to the Internet in order to have information resources available for the task.

4.2. Methodology

Our findings are based on the following three research methods: analysis of post questionnaires, log file analysis and content analysis of chat messages. MoCoCoMa creates a log file consisting of sent and received SMS messages within the system. In addition the phone number and time stamp were saved in the log file. The content analysis of chat messages were conducted by using qualitative data analysis software ATLAS.ti. The chat messages were classified at the first stage in four categories: 1) subject oriented, 2) not subject oriented, 3) short answers (like yes or no) and 4) meta-level messages, that concerns the organizing the learning activity and teamwork. At the second stage the chat messages were examined more closely in order to investigate what kinds of elements they may bring up to the learning situation where learning in the authentic environment is combined with the classroom activity.

4.3. Results

In our case study altogether 115 SMS messages were sent from the forest. Of these 45% (52) of SMSs were messages for constructing the concept map (see Table 3) and 55% (63) were chat messages displayed on the white board. The students in the classroom sent altogether 58 chat messages.

Table 3. The number of SMS messages sent in the forest during the case study.

SMS messages sent total	115
Chat messages	63
Messages for constructing the concept map:	52
-adding a new relation	29
- adding a new concept	23

As it is shown on Table 4, the most of the chat messages were subject oriented or meta-level comments (77%), and only 17 % of messages were categorized to be not subject oriented (e.g. messages like “What’s up?” or “Hi guys”).

Table 4. The categories and the number of chat comments sent in the forest and in the classroom.

Category	Forest	Classroom	Total
Subject oriented	35	29	64
Meta (organizing etc.)	12	17	29
Short answers	6	1	7
Not subject oriented	10	11	21
Total	63	58	121

In a closer analysis of the messages and based on the content analysis of chat discussion the following findings were found (see Table 5): The most of the subject oriented chat messages sent from the nature were answers that provide information or observations, whereas the subject oriented chat messages sent from the classroom were mostly inquiry questions or information requests.

Table 5. The Category of subject or task oriented chat comments sent in the forest and sent in the classroom.

Category	Forest	classroom	Total
Inquiries / information requests	5	24	29
Answers / provided information	30	5	35
Meta (organizing activity etc).	12	17	29

Based on the post questionnaires, 14 out of 20 students report that it is fun to construct concept map together with other students. 9 of the 12 students who were working with mobile phones found that it is easy to add new concepts to a concept map and 10 students found that it is easy to create relations between the concepts.

5. Conclusions

It is possible to communicate and collaborate with SMS in learning situations and to combine the activity in a classroom with the activity in the authentic environment. SMS messages can be used to create collaborative concept maps when some of the students are in an authentic environment like a forest and others are working in a classroom. Also chat seems to be an effective tool for communication between students working in the classroom and the ones who were making observations in the forest. The chat discussion included (a remarkable amount of) spontaneous questions written by students in the classroom. These questions may be seen as peer-tutoring, inquiries or triggers that guided students' process in the forest. The function of the application in a learning situation is not just to provide observations to the classroom and facilitate and organize observations, but the function is to activate and guide students' learning process in an authentic environment. Evaluation of the use of mobile phones in the case study suggests that students respond to using SMS as a tool of learning and interaction favorably. We did not encounter any serious technical or pragmatic problems, neither the problems related to potentially different nor individual learning styles or cultures. As of scaling up, the system is not particularly vulnerable to larger number of participants, because the communication is based on SMSs.

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