Experiencing Mobile Learning: the MouLe project

M.ARRIGO, M.GENTILE, D.TAIBI, G.FULANTELLI, O. DI GIUSEPPE, L.SETA, G.NOVARA
ITD - Institute for Educational Technology
CNR- Italian National Research Council
Via Ugo La Malfa, 153 - Palermo
ITALY
http://www.itd.cnr.it

Abstract: - In this paper we present an experience of mobile learning based on collaborative knowledge construction processes. The experience is based on the use of a learning platform, called the MoULe environment, designed and developed at the Italian National Research Council. Amongst the many functionalities provided by the MoULe environment, we highlight those that permit users to create and share multimedia notes, wiki pages and conceptual maps using desktop computers and smartphones equipped with GPS. All the resources created by the students are geographically associated to specific "points of interest", that is, places visited by the students during their on site learning experiences; in addition, students are tracked throughout their visit to the city. In this way the student activities create an augmented space consisting of physical objects as well as the educational objects they produce. The augmented space, which is represented through a geo-conceptual map, enables the transformation of a city tour into a real educational experience.

Key-Words: - Mobile Learning, Collaborative mLearning Environments, Online Learning Community, Situated Learning

1 Introduction

The study of the impact of mobile technologies on learning activities has a long story [15,14,12,8,10]. These studies highlighted the potential of handheld computers for developing new learning practices and transforming interactions between students, study materials and reality.

In the last few years the availability of cheap and portable GPS devices, embedded or wireless connected with handheld computers, has stimulated new educational experiences in which the location sensitivity of this apparatus can improve learning activities, allowing learners to access supplementary data on the positions of their colleagues and of physical objects of educational interested [4]. These opportunities open up new learning scenarios [7] based on a mix of social learning theories (constructivism, communities of practice, practice fields, distributed cognition, etc.), learning methodologies (situated learning, computer-supported collaborative learning, lifelong learning, and so on), and hardware devices (smartphones, cell phones, PDA, GPS, wireless technologies, etc.) [16].

The effective evaluation of these scenarios appears to be a very complex task, in fact a lot of factors are intertwined when you decide to intervene in a social environment, like the seminal work of Ann L. Brown [2] highlighted even in classroom settings.

Taking into consideration these aspects, in this paper a learning project based on the use of handheld devices will be presented. This project was conducted over a period of four months and involved about 80 students and 12 teachers from four classes in two high schools in Palermo (Italy).

The aim of this project was to analyze the connections between social relationships, knowledge construction and the use of mobile devices in a context of on site educational activities. To carry out these activities a specific mobile learning platform was designed, the Mobile Ubiquitous Learning environment (MoULe), to support ubiquitous collaborative activities, synchronous and asynchronous interactions, searching and gathering of information, where all these operations were related to the geographic location of the students.

This paper presents a brief description of the principal features of the MoULe environment, and then analyses the different phases of the learning project. In the first phase teachers worked to design the learning activities; in the second phase the students carried out activities on site and in the school laboratory. Finally, we discuss some qualitative results to illustrated positive outcomes and some difficulties encountered in this mobile learning experience.

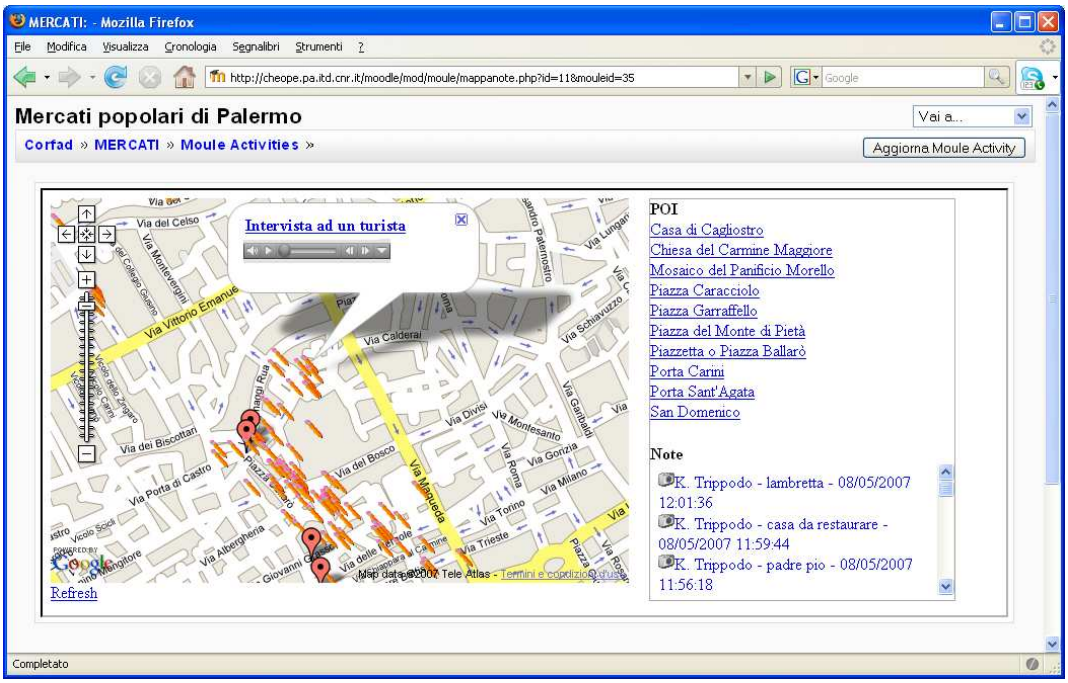

Figure 1 - The geo-conceptual map representing the augmented space

2 The MoULe project

The MoULe project is strongly based on student mobility and on contextualized information; mobility means being in and moving around the places which are the object of study; contextualization is very important because the student's geographical position changes the learning context and consequentially the students' learning experiences.

In the MoULe project we have used smartphones supplied with GPS in order to link all the activities carried out by the students with a specific location inside an area of interest, called Point of Interest (POI). Each POI does not indicate a single geo-referenced position, but a set of spatial coordinates that represents a geographical area, for example cultural heritage sites or archaeological sites related to the learning activity. Students are tracked throughout a collaborative knowledge building process, and the physical exploration of their learning space is reconstructed. In this way the student activities create an augmented space consisting of physical objects as well as the didactic objects/items they produce.

The augmented space, which is represented through a geo-conceptual map, enables the transformation of a city tour into a real educational experience (Fig. 1).

To achieve this we have integrated the functionalities of a traditional Learning Management System, Moodle [6], with the functionalities to implement and manage mobile learning activities. The goal was to create a single system, called the MoULe environment, in which on site learning activities can be alternated with classroom learning activities, so that the knowledge building process is supported in both learning environments. In particular, the MoULe environment is accessible both through desktop computers, used by students in the classroom or at home, and through mobile devices during on-site learning activities. The resources produced during both activities are associated to the points of interest.

In order to promote the learning strategies presented above, in the MoULe project we have foreseen the definition of specific learning environments to support the achievement of the learning goals; the setting up of a learning environment in MoULe means activating specially designed functionalities that can be accessed through mobile devices or desktop computers.

In particular, the MoULe project supports learning mechanisms based on two important processes: firstly, the collaborative knowledge building through representation schema based on concept maps [11,1,13]; secondly, the collaborative creation of hypertextual documents based on the use of wiki [3,9]. Both the construction of the conceptual maps and of the development of the hypertextual documents are always connected to the physical sites represented by POIs.

Access to the MoULe environment from the computer desktop is provided by a specific module of Moodle developed at our Institute. Using this module teachers can design a MoULe activity,

defining the POIs, the learning objectives and the functionalities that students can use during their learning activities. In particular, students can use tools to create and edit wiki pages, build and share conceptual maps, make personal notes, communicate with peers and perform search tasks.
In the following section we illustrate the potentials of using the MoULe environment.

3 Working with MoULe

The testing for the MoULe system was designed in two identical cycles involving different high schools in Palermo and each lasting for a four month period. The first took place from February to May 2007 and the second will be held from October 2007 to February 2008 with other schools. Each cycle of the testing was designed in two phases: firstly we test the prototype with the teachers and then with both students and teachers.
In the first cycle, which we finished last May, the first phase involved fifteen teachers of different subjects from five high schools in Palermo. The group was introduced to the methodology and technology of mobile learning and then instructed in the use of the MoULe environment to build the collaborative knowledge activities. Moreover, the teachers designed the learning activity and the itinerary for the second phase involving students.
Then, in the second phase, with students and teachers, we involved eighty students and twelve teachers from two high schools, one specializing in pedagogical subjects and the other in tourism. Two fourth year classes were selected from each school. The students started learning about the main functionalities of the MoULe system and getting used to the mobile devices. Then the teachers explained the outside learning activity they designed in the first phase, which varied according to the type of school. In fact, the students from the pedagogical school followed a "historical street markets" itinerary, while the students from the tourism school followed a "baroque age" itinerary. Finally, the students carried out the learning task in the classroom and on site. At the end of the testing phase the students worked collaboratively to produce tourist guides in different languages about the sites they had visited.
In the following sections we report the testing activities we performed during the first testing cycle in more detail.

3.1 The use of the MoULe system by the teachers

In February and March 2007 we organized six meetings with the teachers involved in the testing phase. After introducing the teachers to the methodologies and technologies of mobile learning, we encouraged them to design the learning activity and the itinerary for the second phase involving students. Specifically, we asked them to develop a concept map at each school, in order to formally describe the educational process to be followed by the students.
The teachers reacted very favourably to this proposal, especially those with most expertise; in fact, the teachers highlighted the benefits of using concept maps to better specify and clarify the educational objectives to be achieved by students. In addition, the teachers appreciated the opportunity to have practical and tangible results at the end of the design phase, and to share these results with colleagues and students at the starting point for the rest of the activities. We selected the CmapTool [17] to support this process.
After 2 half-day training sessions carried out at our institute, the concept maps created by teachers were stored in a CmapTool server; in such a way, teachers had the chance to continue elaborating their concept maps on-line, at their own pace and wherever they wanted.
Despite some technical obstacles to the remote and collaborative work on the concept maps using the school computer laboratories, the teachers decided to overcome these difficulties by using their free time and their home connections to develop the concept maps for the project. They were very willing to participate in the MoULe project and they were very enthusiastic about the use of concept map tools to design learning activities.
The teachers from the two schools designed two different learning paths, reflecting their specific school curricula; each learning path was associated with an area of the city that students would visit using their smartphones. In particular, the teachers from the school specializing in tourism chose to produce a tourist guide to the baroque architectural heritage of the city of Palermo, while the teachers from the school specializing in pedagogical subjects chose to conduct a survey of the street markets in the city.
The activities to be performed by the students from the first school would consist in walking around the baroque area of the city and gathering information to be included in a tourist guide. In this case the nodes

of the concept map represented the main points of interest that would be visited by the students: the teachers described the structure of the learning process through the map by using various images indicating the places to be visited by the students, and many links to web-sites containing information about these places.
The teachers from the pedagogical school created a concept map to guide students in carrying out a social investigation of street markets in Palermo. The map is centred on the social processes occurring in a popular district of the city, and reflects the profound interest of the teachers in the social, cultural and historical aspects of the street markets. Unlike the previous map, which was based on the physical places to be visited by the students, this one contained links between social concepts, such as the relationships between people and their environment, between the environment and sounds, and so on.
Although the learning activities designed by the teachers of the two schools concern the same area of the city centre, and in some cases the same physical places (many monuments of the baroque heritage are located in the popular markets), the related concept maps are quite different, reflecting the different educational models adopted by each school, and how the two models influence the design of mobile learning activities [5].
The use of the MoULe environment, both through desktop computers and smartphones, concluded the teachers' training sessions.

3.2 The use of the MoULe system by the students

This testing had two main objectives: the first focussed on testing the functionalities of the MoULe environment, the second was more centred on the methodological aspects of the project and on evaluating the efficacy of the learning models designed in the first phase.
The testing was organized as follows: first for each school we arranged a plenary meeting with the two classes, then each class participated in four testing sessions, two of them carried out in the classroom and two on site. A final plenary meeting was held after the testing sessions.
The aim of the preliminary meeting was to explain the project guidelines and the MoULe functionalities to the students. We asked the students to fill in two questionnaires. The first was to find out about the technical background of the students, while the second was a sociometric test to investigate the relationships between the students in each class, in order to create workgroups for the testing stage.
Next, each class was asked to take part in four test sessions, two in the laboratory and two on site. The class in the laboratory used desktop computers connected to the Internet, while the other class went on site and used handheld devices with wireless connections. In each session the roles of the two classes were inverted.
These sessions were held on different days for each school both for organizational and logistic reasons, and because the schools followed different itineraries.
In particular, the school specializing in pedagogical subjects, alternated a study of the anthropological aspects of Palermo's street markets with a survey of their neighbourhoods with particular analysis of the relationships between people and their environment.
Instead, the school specializing in tourism had a different objective for each session. First, they studied the external aspects of some examples of Baroque architecture in their context, then they analyzed the internal features of the same buildings. In the third session, they focused on the tourist services in the same areas (such as hotels, bars, restaurants), and finally in the last session, they gathered information about other interesting points of interest near the area they visited.

On site activities

In the on site experience we provided students with 12 handheld devices with GPS aerials, used to localize the activities performed by the students. In particular, we used two different hardware models in order to evaluate the system functionality independently of the resources employed. The internet connection was provided by a national provider using GPRS technology.
Students were divided into pairs and each pair member used the PDA alternately to perform learning activities on site. A teacher and/or a CNR researcher accompanied each pair of students.
The on site sessions took place as follows:

1. Students, teachers and CNR researchers met at an agreed place in the historical area of the city.
2. Students were divided into pairs or small groups and teachers assigned the tasks to perform on the itinerary.
3. Students visited the point of interest (POI) according to their learning path. They used the MoULe system to locate the POI, to communicate with the students from the other class who were testing the prototype in the school laboratory, to take multimedia notes and to edit learning contents.
4. Students returned to the initial meeting-point.

In the classroom laboratory

While one class was on site, the students from the other class accessed the MoULe system through the desktop computers in the school laboratory. In this way the two classes participated in the same virtual environment. The students on site cooperated with the students in the laboratory sharing information, asking each other questions and working collaboratively in order to create learning contents as defined by the teachers. In particular, students with desktop computers connected to the MoULe through the Moodle Learning Management System, and they used the following tools:

- communication tools to request extra information (in the form of photos and/or multimedia notes) from the students on site, or to provide specific information to the students on site;
- a specialized search engine to search for learning material specifically filtered according to the point of interest;
- a wiki style collaborative document creation tool, to create the learning hypermedia of the learning path;
- a visualization tool to show the geographic positions of the students in order to coordinate their on site activities.

All the test activities on site and in the laboratory were supported and supervised by teachers and CNR researchers.

At the end of the test sessions we organized a final meeting to present the test results and students were asked to fill in two questionnaires, one to evaluate the learning experience and the other was again a sociometric test to evaluate the effects of the MoULe system on the social relationships between the students.

In this second phase, the students produced two hypermedia depending on their school. One was a tourist guide to Baroque in Palermo in Italian, English and French and the other was about the street markets in Palermo. Both are available, with authorized access, at http://cheope.pa.itd.cnr.it/moodle.

3.3 A MoULe scenario

In order to describe a scenario of the MoULe system we refer to the interaction between a teacher and two students called Giuseppe and Maria. The teacher uses CMapTools from his desktop computer to design a learning activity based on conceptual map while the two students use their PDA to access the MoULe system and elaborate the conceptual map in a collaborative way. The teacher defines a conceptual map about a specific topic (for example the study of a Mercato Popolare of Palermo), then the students can expand and improve the map during the learning activity on-situ.

When the students are in different places of the city they can use the chat of the MoULe system to talk each other and with their teacher in order to choice which aspect of the map they should be improve. We suppose that Maria choose to deepen the architectural field of the Mercato, while Giuseppe focus on the linguistic aspects. In this way the two students share the experience of a collaborative construction of the same conceptual map. The students guided by the MoULe navigator go towards the Mercato area. When they arrive in the proximity of the Mercato the system notifies with a visual and audio signal that they are entering the "point of interest" area. Giuseppe starts expanding the nodes of the map, he can create new concepts and can associate at them specific media that he collects in his in situ experience such as video, audio recording and images. Maria that is interested at the architectural aspects of the Mercato, she can use the localized search engine to collect new information on the cultural heritage that she are visiting and she can add them to the map adding new nodes. Moreover, she can create a new concept for the cultural heritage for its style and for its history. At the end of their learning activity the two students can talk using the chat to decide the last editing to do to create the definitive version of the conceptual map they create. Finally they can publish their work in this way the teacher can evaluate their work and other colleagues can use the map in their learning activities.

4 Conclusions

During the MoULe testing sessions, we logged all the users' activities inside MoULe system and carried out both with the desktop computers and the smartphones; for each operation, we also tracked the geographical location related to the operation (e.g the student's position when he sent a chat message or recorded an interview). As of today, the analysis of these data is not complete. Nevertheless, we can provide some preliminary results that provide an indication of the level of success of the experience.

The MoULe environment tools which the students used most were the wiki, the chat and the concept maps. Each of these tools proved particularly useful in carrying out different activities of the test sessions: the concept maps were essential for defining the learning objectives and describing the

whole educational process; chat was used intensively during the learning on-site activities as the communication tool preferred by the students; finally, the wiki was the collaborative tool used effectively to complete the final group task.

The successful outcome of the project is due in large measure to the human input, in association with the right technologies and methodologies. In fact, in order to obtain such good results, both teachers and students overcame some initial logistic and technical problems, and worked hard to achieve their goals. Moreover, we would like to underline the high quality of the concept maps produced by the teachers. These maps were used to explain the learning activities to the students, and were the main support for producing the final detailed and high quality wiki contributions.

Further reflections on the experience highlight how, once again, the human input has proved to be the overriding factor with respect to the technological aspects. In fact, the teachers and students must take the credit for the success of the experience. The teachers succeeded in designing learning activities to exploit the potential of the technology available, and integrated these "innovative" learning strategies into the official curricular ones. The students tackled the project with great enthusiasm and motivation, providing useful feedback and tips throughout the experience, even when technological problems (especially mobile phone connection delays) risked compromising the whole mobile learning experience.

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