Collaborative Educational Experience with Smartphone Support: An Exploratory Analysis

Javier Organista Sandoval[a], Arturo Serrano Santoyo[b]

[a] *IIDE, Universidad Autónoma de Baja California.*
Carr. Tijuana-Ensenada, Km. 103, Ensenada, B.C., México, 22830.
javor@uabc.edu.mx
[b] *Centro de Investigacin Científica y Educación Superior de Ensenada*
Carr. Ensenada-Tijuana 3918, Zona Playitas, Ensenada, B.C., México, 22860.
serrano@cicese.edu.mx

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Abstract

The educational context has become fertile ground for exploring the potential application of mobile handheld devices to support learning. The aim of this paper is to present the results of the implementation of a collaborative educational activity (m.Activity) using smartphones. This paper identifies the key elements that support ubiquitous communication and interaction of groups of university students in a context that requires an intense level of interactivity and communication for the delivery of short-term assignments.

Keywords: Educational technology, Human-computer interaction, M-learning

1. Introduction

The convergence of global wireless communications and mobile devices with Internet access capabilities [1] and the technological development of wireless networks and their explosive penetration in practically all regions of the world have created opportunities, not previously available, for exploring applications of mobile devices in social, cultural, economic and educational contexts. The deployment of 3G and 4G (third and fourth generation technologies) is advancing and fueled by converging applications that include multifunctional features which enable the user to take advantage of services such as MMS (Multimedia Messaging), mobile video and more importantly, mobile Internet, that allow access to social networking applications and other related services. With the emergence of 3G and its evolution to 4G, the mobile device is seen more as a platform rather than just a telephone, creating challenges for its usability and adoption by ordinary users. Nevertheless, service providers and device manufacturers are seeking strategies to facilitate the adoption of mobile telephones as universal terminals for communication and access to the Internet.

Interaction and collaboration, crucial elements in educational environments, can be supported with powerful

handheld devices such as smartphones. The purpose of our paper is to identify key factors in the implementation of a collaborative educational activity using smartphones from an exploratory perspective. The advanced technological capabilities embedded in smartphones and the development of content for educational emphasis have become key elements in the discipline known as m-learning, a discipline that has recently caught the attention of scholars and educators to look on the one hand, strategies for increasing the coverage, quality and efficiency of educational services and on the other alternative learning opportunities outside the classroom [2]-[3]. In view of the authors, m-learning is considered as the set of processes and technologies to support learning through mobile devices. Not only is the concept of exploring ways to support learning in a ubiquitous or nomadic fashion. Aspects of interaction, interactivity, immediacy, intention of use and other ergonomic, usability and adoption factors are part of such an approach, which aims to comprehensively address the deployment and implementation of smartphones in the educational context [4].

Our approach in this paper focuses on describing the experience of conducting a group activity designed for educational purposes (*m.Activity*) with the support of a Mobile Collaboration Space (MCS) hosted on a web server, where each of the participants in the research experience could be accessed from a handheld device (see Figure 1). The paper is organized as follows: In section 2 we describe the development of the MCS, the functional characteristics of smartphones and the description and procedure to perform the *m.Activity*. In section 3 we describe the *m.Activity* and in sections 4, 5 and 6 we present respectively the results of the interactive experience, a final discussion highlighting the most significant findings of our contribution and the conclusions. The participants in this experience were graduate students with computer science, engineering and psychology backgrounds.

2. Development of the MCS around the m.Activity: Purpose and structure of the MCS

The MCS is a collaboration tool hosted on a webserver (`http://m.educa.ens.uabc.mx/`). For the MCS design, we consider sociocultural elements involved in the application of mobile devices in educational contexts around the framework of convergence of mobile and ubiquitous computing. We started from the premise that college students show a natural tendency and willingness to use technology in their learning process, ie digital natives, from the perspective of Prensky in [5].

Figure 1. Components of the collaborative experience with smartphone support.

Thus the design of our MCS focuses on harnessing the familiarity and inclination of students to the use of social networks in their social interaction and extrapolates those experiences to an educational context. The MCS objective is to support university student groups to perform tasks that require interaction and communication among all the group members. The design provides a virtual space for collaboration and communication for 3G/4G access through mobile devices (smartphones).

We designed the MCS with the objective of hosting the collaborative activities of various student groups simultaneously. The *m.Activity* was limited to a maximum of six participants per group, this to facilitate the flow and display of visual information with smartphones. Groups are created in classroom sessions for the initial organization of the task goals and scope. The course facilitator defines the core issues and delivery date of the assignment. In turn, each group appoints its respective project leader, whose job is to coordinate and monitor the progress of the group. At the start of activities, all group members access the MCS to register their profiles, usernames and passwords. Based on this record, the dynamics of mobile and ubiquitous interaction of the participants is enabled. The development of collaborative activities to fulfill the goals is highly dependent on sociocultural, technological and usability factors regarding the use of mobile devices, as well as on the participants' interrelations and quality of interactions [6].

The MCS comprises seven modules (see Figure 2). The first, called *Progress*, provides information about the task or project to be developed. The next module, *Notices*, shows information regarding the development of the activity to be undertaken. These notices must be short messages for adequate display on small screen

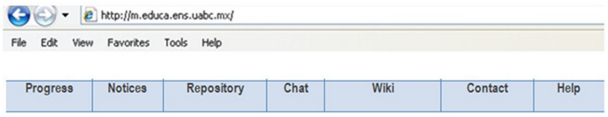

Figure 2. MCS main menu

devices such as smartphones. The third module called *Repository* contains supporting information (text, images, multimedia) to develop the *m.Activity*. Each group sets its repository independently and for their exclusive use. The next module, called *Chat*, allows real-time communication. The fifth module is a *Wiki* to facilitate document edition. This encourages the collaborative construction of documents and agreements between the participants. The next module, called *Contact*, contains profiles and key information necessary to locate the members of each group. The last module, *Help*, contains the MCS user manual and some answers to frequent questions.

To structure the MCS, three key aspects were considered. The first was to allow interaction and communication of students through a smartphone device regardless of type or model, operating system and browser. The second aspect was to use the Internet connectivity offered by cellular technology. The third key aspect of the MCS is the webserver architecture that integrates services for content storage and their associated databases to support learning and to accomplish the tasks. This architecture enables operation and access to MCS without having to develop specific applications for each type and model of smartphone.

To achieve a good user experience in the collaborative activity, the capabilities and limitations of smartphones must be considered. It is essential to develop applications that consider the limitation of screen size, storage capacity and processing of mobile devices. The design of the screens and the definition of content are crucial for successful collaborative interaction. Another element to consider is to contract the lowest cost rate plans and payment schemes of cellular phone providers in order to create a cost-effective learning experience in a real environment.

3. Description of the *m.Activity*

As a starting point, we identified the main features, aspects of connectivity, applications and functionality of the six smartphones used. From the selected dimensions and variables, we developed a questionnaire for assessing the functionality of such smartphones. To do this, we considered 24 items with five response options: not applicable, bad, fair, good and excellent (Consolidation 0-4). Regarding the operating system of the six smartphones, two of them use the operating system Windows Mobile 6.0 Professional, two operate under Symbian S60 and the other two work with I-phone OS.

The objective of the *m.Activity* was to develop an essay in digital format that included the definition of smartphone devices, their characteristics and pedagogical potential. The development of this essay required the collaborative participation of the team to elaborate on the educational potential of mobile technology. As originally planned, we configured the MCS to enabling smartphone access from each team member.

Undoubtedly, the educational potential of mobile technologies is enormous. To mention some examples, students can locate information in various formats, to communicate with experts or with peers, exchange information, among many other activities. However, they also are exposed to distractions such as games, movies and social networks, among others. We observed that in some instances students were unaware of special features, capabilities and potential educational applications of smartphones. Under these circumstances, it was considered pertinent for the *m.Activity* to develop an essay in digital and multimedia format in order to realize the advantages and limitations of smartphones. This essay could in turn serve as a white paper to introduce the student community to the m-learning discipline. The collaborative group was formed with six members (two researchers and four graduate students). The idea was to integrate a group whose participants had equal roles to perform the task (*m.Activity*). By agreement of the group, one student was designated as project leader.

As part of our experience, regarding the m.activity, a focus group was implemented to gather information about: i) technical aspects of the server that housed the mobile collaboration space, ii) development of the MCS, iii) feedback on the smartphone as an access point to the server, iv) opinion about the m.Activity and finally, and v) the advantages and disadvantages of mobile technology. The focus group participants were the six members of the collaborative research group. For the quantitative statistical analysis we used SPSS Ver. 17.0©.

We kept track of the development and progress of the *m.Activity* as well as the quality of the working groups contributions in each of the collaboration spaces of the MCS. As it was mentioned before, at the start of the *m.Activity*, a kick-off meeting is organized to gather information about the activities and arrangements for the preparation of the essay and to coordinate the group members' interactions. A period of ten business days was set for delivery and publication of the essay.

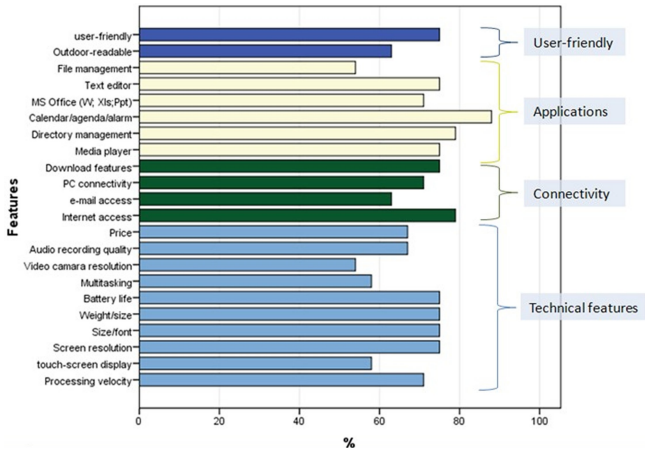

Figure 3. Features of Smartphones used in the research.

4. Results

The questionnaire considered an equivalent percentage of the scale used (0-4). Items were grouped into four categories: characteristics of the device, connectivity, applications and functionality (see Figure 3). For the characteristics of the device, associated items achieved moderate rates ($\sim$ 75%) for attributes such as size and weight, battery life and screen resolution. The attributes most penalized ($\sim$ 55%) were the ability to process multiple tasks, the quality of video camera and touch screen handling. Regarding connectivity, the best evaluated attribute (79%) was the ability to access the Internet, while the worst score is related to email management (63%). With regard to the handling of applications, smartphones had a moderate value ($\sim$ 80%). Of note is the attribute that has to do with the organization of files by their low value (54%). Ease of use was the best aspect evaluated for the functionality of the device (75%), while the ability to read text in outdoor spaces was poorly evaluated (63%).

Upon entering the *MCS PROGRESS* option, a description, main features and specific questions about the task, as well as the deadline of the assignment are displayed (see Figure 4).

For ten days, the research team collaboratively developed a paper outlining the advantages and limitations of smartphones as a teaching tool. As a result, an essay of 11 pages in Word format was produced and incorporated into the MCS repository.

5. Discussion

In this section we present our findings and a brief analysis about the smartphones used as well as the implementation of the *m.Activity*. Finally, some reflections on the pedagogical potential of portable devices are raised.

Figure 4. MCS: main features of the task

With regard to the benefits of using smartphones for the development of the *m.Activity*, portability, connectivity, personalization and user friendly features were identified. Internet connectivity was available to all members of the group at all times. The group members noted also some specific problems, among which, the reduced visibility of small screen displays in outdoors scenarios and the limited amount of text that can be displayed on the screen at a given time. An important aspect to consider is the limitation for inputting information in the smartphone and the tradeoffs of using haptic or qwerty keyboards. Additionally, programs or applications for smartphones available on the Internet may show unpredictable performance due to compatibility issues arising from the different operating systems available for such devices. The applications more frequently used during the *m.Activity* were electronic agendas, alarm and calendar, contact management and communication.

Our Mobile Collaboration Space was installed in a specially configured webserver for handling and identification of the smartphones employed. For the development of the software applications built on the MCS, we used public domain modules in addition to our own coding. The MCS was accessed in an efficient and stable fashion. The choice of bulletin boards for the NOTICES option was particularly useful to publish short messages

and keep a historical record of messages sent. Thus, any member of the group readily knew the status of the activity and the agreements reached. For its part, the *CHAT* option did not function as expected, mainly for the difficulty of reaching agreements when six participants interacted simultaneously. Added to this, it was difficult to manage historical records of text on the small screen. It is recommended to form smaller groups, perhaps with a maximum of three or four participants and consider some mechanism to moderate the communication and interactions among all participants.

Regarding the *REPOSITORY* option, we highlight the importance of this shared storage space. This option allowed the management and storage of important and useful files for the group. One of the main benefits and design features of the MCS, noted by the participants, was the ability to record the evolution of collaborative activity. We were able to keep records of progress and to implement eventually remedial actions. Nevertheless, the participants felt the need to improve the design of the MCS to optimize its performance and to include applications and features of new generation smartphones and tablets.

In relation to the collaborative activity undertaken with support of the MCS and smartphone Internet connectivity, we highlight the following. The collaborative work required a minimum of knowledge and skills on the part of the participants. Seeing the *m.Activity* as a process, some key steps such as: motivation, socialization, agreements, information flows and synthesis were identified. The participants mentioned the difficulty of constructing the document of the essay using the smartphone, for this reason the members of the working groups used their desktop computer or laptop to accomplish this task. The project leader noted that his work required a great effort to ensure the participation of all working group members in a timely manner. The coordination requires collaborative skills not usually available or taught, so it is suggested to train participants about collaborative work and their roles before or at the inception of the mobile collaborative projects.

6. Conclusions

In closing, we stress the enormous potential of smartphones for educational activities. Undoubtedly this requires the knowledge of its core capabilities and functions, as well as a clear pedagogical strategy. Several studies [7] have pointed out that the frequent contact of students with mobile technology encourages the development of skills to operate these devices, specially regarding the search and query of information from large data banks and digital libraries on the web. According to [8], handheld devices are conducive to students' integration in social networking. The possibility of instant communication gives the owner of such devices, the perception of belonging to a community. Generally, social networks establish a virtual meeting point for students with common academic interests and responsibilities. By the same token, social networks support the functions of information sharing, collaboration and communication among network members. These functions are key to educational applications. One of the biggest challenges we have in our university community is the very conception and realization on the part of our students that smartphones are potential teaching and learning tools. Fortunately, a growing number of educational applications are currently deployed or under development. Though many of such applications are deliberately intended to arouse the recreational interests of students, the communication and entertainment applications are still more pervasive.

The MCS design was conceived to stimulate the collaboration of small groups of students in a ubiquitous fashion. According to our findings and interviews, the students responded expeditiously and enthusiastically to the assignment. Our aim was to design a collaboration space with a simple and user-friendly smartphone interface with the basic components to accomplish successful interaction. The MCS contributed to accomplish the objectives of our educational research. It must be acknowledged that new models of smartphones and new versions of mobile operational systems might have a significant impact on the results shown in section 4, particularly on the quality of the information displayed as well as in the perceptions of the MCS users. This is part of our future research in which we will incorporate some elements of cognitive nature and a more detailed analysis of the quality of the interactions among the participants.

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