Designing Mobile Phone Interfaces for Collaborative Learning in Everyday Life

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Abstract. Literature points out new perspectives for collaborative learning through the use of mobile devices. This subject has being widely discussed by education and computer science researchers, showing as one of the strands for the future of (in)formal education. By using mobile devices, learning could be developed through collaborative interactions at any time or location. This represents a new possibility for people “learning while doing” their everyday activities. Moreover, the advent of mobile phones has created new opportunities that go beyond simple communication acts; their software interfaces have a primary role in enabling the collaboration among the evolved parties. We propose a novel approach which uses mobile collaborative learning for supporting everyday life tasks in general. In order to enrich the mobile collaborative learning, software applications should better explore the interfaces and multimedia resources available in current mobile devices. The mobile interfaces could support and boost situations that lead to learning, however it is essential to minimize the interaction difficulties, and maximize the learning activities itself. To achieve that, this work presents a design proposal and prototype of mobile phone interfaces for supporting mobile collaborative discussion, illustrating the ideas and the design decisions. This new approach aims to the enrichment of mobile interfaces, employing different medias and forms of interaction for the purpose of to constitute “wireless” communities of knowledge sharing about any issue or topic; thus stimulating and promoting the constitution of “communities of practice” through interaction, in which members can share common problems and/or work domain. In the proposed design, the resources of the interfaces are essentials to enable users to explain better their ideas; for that the paper presents multimedia interfaces to share images, sounds, and videos during the discussions. We also present a discussion about the impacts of this approach for informal education, and preliminary results from a qualitative analysis with real users.

Keywords: Mobile Collaborative Learning, Communities of Practice, Informal Education.

1 Introduction

Nowadays, mobile devices are present in a large range of human activities. The fast evolution of the technology, social network services and mobile platforms transformed the traditional notions of community and intercultural communication. Some researchers claim that a new connected and mobile society is emerging, with a variety of information sources and means of communication at home, at work, at schools and in the community [1]. These devices can help us to perform educational and leisure activities in a collaborative way, sharing knowledge of how to perform or perform them better. In this work, the informal education is understood as the lifelong education in which people learn from everyday experience, focusing in aspects related to our lives [2]. In the real world, most of the time we do not have lessons plans to follow, instead we respond to situations and experiences, as well as we learn from them.

In this scenario, mobility can be used for supporting education. Keegan [3] points out that the recent evolution in supporting technology for education can be seen firstly in distance education (d-Learning), then in electronic learning (e-Learning) and finally in mobile learning (m-Learning), called the "mobile revolution of the XXI century". Mobile learning can be developed by mobile devices such as: Personal Digital Assistant (PDA), Handhelds, Smartphones and Mobile phones. These devices can be exploited in the development of daily learning anywhere and/or anytime. According to Sharples [4], these mobile learning devices allow learners to learn wherever they are located and in their personal context then the learning is meaningful.

The mobile computing represents a new possibility for the people “learning while doing” their everyday activities. The advent of mobile devices has created new opportunities that go beyond the simple communication between people. There are new learning scenarios that can be supported by mobile devices, given that these devices can be present at anytime and anywhere. Therefore, by using mobile devices, it is possible to increase the educational development “out of school” by sharing knowledge and experiences about the situation that someone is living at the same time. However, subjects related to this type of education normally are diverse and comprehensive, consequently are necessary technological solutions that allow the involved people interact and act in a collaborative way.

There is a growing need to make m-Learning more interactive, stimulating the sharing of knowledge in a way that is not restricted to certain issues, place or time constraints. In order to achieve this objective, it is necessary to create situations that lead to the social and cultural impact on the use of mobile technologies, contributing in a practical way with the education and socialization of the citizens. At this context, interfaces have a primary role in enabling communication and collaboration among the evolved parties. In a learning environment for informal education, it is essential to design interfaces that minimize the interaction difficulties and maximize the learning activities itself. One big challenge is to deal with the devices restrictions, such as: screen size, performance, and data input difficulties. Another challenge is to provide appropriated interfaces to be used at different places, situations and contexts.

There are several relevant related works which have contributed with the mobile collaborative learning in the field of Mobile Computer Supported Collaborative
Learning (MCSCL), (e.g. [5], [6], [7] and [8]). However, the approach adopted in these works focus mainly on classroom activities inside the school environment. Thus, it is also necessary to think and develop new appropriate methodologies and techniques for the use of mobile devices in learning processes outside the classroom. These methodologies and techniques can focus more than just in formal education, given their peculiar characteristics and capabilities that could support alternative forms of lifelong learning and informal education. Additionally, it is also necessary to have new technological solutions for mobile interfaces that allow the involved people to act in a collaborative way taking into account the self organization of the learning groups.

This work seeks for a solution that minimizes the mobile phone interaction limitations, and that can assist the development of people’s daily informal education in a collaborative way. For that, we present a reflection on how the mobile collaborative learning could contribute to the development of informal education. Based on it a proposal is presented for a prototype of a mobile computing environment, illustrating the design proposal of a mobile phone interface for mobile collaborative discussion. A new approach aims to the enrichment of this interface, employing different medias and forms of interaction. The objective is to stimulate the constitution of “communities of practice” in which members interact and share common problems and work in the same domain in order to constitute “wireless” communities of knowledge sharing about any issue or topic. Using multimedia interfaces is possible to practitioners share images, sounds, and videos during the discussions. In the proposed design, the resources of these interfaces are essentials to enable the practitioners to explain better their ideas. The proposed software application organizes the users’ interaction, thus they can develop ideas and discussions collaboratively to solve problems in their daily lives. Therefore it is expected to create a technological solution that allows educational development in a mobile and collaborative way outside the school environment.

This work is organized as follows: Section 2 presents the theoretical referential; Section 3 presents a reflection on a new perspective for the development of informal education, explaining the approach and the design requirements, conception, principles and decisions; Section 4 presents the mobile software through the prototype and examples; Section 5 discusses the impact of the interface design decisions for the constitution of the communities and for the promotion of informal education; and Section 6 concludes and presents the future works.

2 Theoretical Referential

This section presents the main theoretical background related to this proposal, discussing the informal education (section 2.1), mobile collaborative learning (section 2.2), and communities of practice (section 2.3).
2.1 Informal Education

According to Jeffs & Smith [9] the informal education brings back elements of an education dated to more than 2500 years ago. In ancient Greece, education was generally made on the streets at events in which people learned from each other through dialogues and discussions. Some of these educational characteristics and procedures are present in today’s informal education. Fisher et al. [10] points out that informal education can be seen as the knowledge of the common sense, personal or practical knowledge, largely developed through experiences. For Smith [2] informal education does not have lessons or plans to follow. The informal is done through situations and experiences, and this can occur at any place, different from formal education, which is strongly linked to institutions and classrooms.

Besides, by not setting the time and location for the occurrence of activities, informal education is flexible for adapting the content of learning for each group in particular. Furthermore, Jeffs & Smith [9] clarify that one cannot say that informal education is better than formal education; it depends on the educational objectives, situations and of the context involved. It is also important to notice that according to Smith [2] the purpose of informal education is not different from any other form of education, it differs only in its scope and focus on aspects related to the common and everyday life. In addition to that, Glória [1] explains that informal education can be understood by multiple dimensions such as: (1) the learning and practice of exercises that enable individuals to organize into community goals, towards the solution of collective daily problems; (2) Learning the content of formal education in different forms and spaces with informal methodologies and (3) training of individuals to work through learning of skills and / or development of potential.

Informal education is related to a process of continuous learning, since we can learn all the time, every day and anywhere about a wide range of issues. In this sense, considering that this educational practice takes into account the learning that occurs on interactions and occupations emerged in the everyday life, it is possible to establish a relationship between informal education and mobile collaborative learning. This issue is explored in the next section.

2.2 Mobile Collaborative Learning

Learning can be seen like something socially built as the collaborative construction of knowledge. According to Dillenbourg [12], we cannot set a precise or exhaustive definition for collaborative learning. To sum up, it is a situation in which two or more people learn or attempt to learn something together interacting in a collaborative way. It describes a situation in which particular forms of interaction among people are expected to occur, which would trigger learning mechanisms. Hence, a general concern is to develop ways to increase the probability in which some types of interaction occur. Furthermore, collaborative learning must include situations, interactions, processes and effects.

Stahl et al. [13] point out that the collaborative learning involves individuals as group members, but also involves phenomena like the negotiation and sharing of meanings, including the construction and maintenance of shared conceptions of tasks,
that are accomplished interactively in group processes. The basis of collaborative learning is in the interaction and exchange of information. Therefore technological mediums (hardware and software) that allow this interaction in an easier, simpler and more effective way can contribute to make this process more dynamic and effective. Collaborative learning through mobile devices has been investigated mainly because of the agility and mobility offered by these devices. Mobility has changed the contexts of learning and modes of collaboration, requiring different design approaches from those used in the traditional system developed to support teaching and learning. The major conclusion is that the learners’ creations, actions, sharing of experiences and reflections are key factors to be considered when one is designing mobile collaborative activities for learning [14].

According to Roschelle et al. [15], MCSCL is a rapidly growing field with its intellectual activity focused on discovering, describing, and documenting the effectiveness of specific designs of use of mobile devices for learning in a collaborative way. These technologies provide new opportunities to promote and enhance collaboration by engaging learners in a variety of activities across different places and contexts. A main challenge is to identify how to design and deploy mobile tools and services that could be used to support collaboration in different kinds of settings. These different settings provide innovative ways for people and devices to interact by enabling learning to take place beyond the walls of the classroom and the screen of a computer [14]. Finally, Zurita & Nussbaum [7] clarify that the MCSCL activities support transparently the collaborative work by strengthening the: (a) organization of the managed material; (b) social negotiation space of group members; (c) enabling students to collaborate in groups by communication among the group members through the wireless network, that supports the social face-to-face network; (d) coordination between the activity states; (e) possibility to mediate the interactivity; (f) encouraging the mobility of members. Also, mobile collaborative learning activities manage and encourage tasks that include: monitoring real-time progress with respect to learning objectives and controlling interaction, negotiation, coordination and communication of the involved people.

The related works in the literature, which focus on design of mobile collaborative learning activities, (e.g., [7], [15], [8] and [14]) include: the proposition of methods and solutions that aims to solve questions for formal education environments inside the classroom; the investigation on how to design these applications with an interaction-based design [16]; the analysis of user’s interaction [17]; and the approaches focused on specifics field and topics (e.g., [18] and [19]). The work of Breuer et al. [20] shows an approach to seamlessly integrate formal and informal learning, but the activities and the informal learning are still connected to the formal education inside the classroom. Other related works and approaches can be seen in [21], [22] and [23]. Nevertheless, none of these works have explicitly pointed out a particular solution to design a mobile application for the development of informal education outside the school environment. Therefore, this subject should be investigated in a deeper way, so it could create new educational paradigms not yet explored in the literature, and the proposal presented in this work is part of this scope of research.
2.3 Communities of Practice

Since the beginning of the history, human beings have formed communities that share cultural practices reflecting their collective learning: from a tribe around a cave fire to a group of nurses in a ward, to a street gang, or to a community of engineers interested in some issue. Participating in these “communities of practice” (CoP) is essential to the learning process. It is the core of what makes human beings capable of meaningful knowing [24].

The communities of practice are based in the social theory of learning. According to Wenger [25] this theory integrates the components: practice, meaning, identity and community as necessary to characterize social participation as a process of learning and of knowing. The main idea of the CoP is the individual as an active participant in the practices of social communities with common interest in some subject or problem, and that s/he can collaborate and share ideas. These communities are in everywhere and people belong to a number of them: at work, at school, at home, and even in hobbies. “We are core members of some and we belong to others more peripherally. For example, you may be a member of a band, or you may just come to rehearsals to hang around with the group” [26].

Wenger [26] explains that members of a community are “informally bound by what they do together — from engaging in lunchtime discussions to solving difficult problems — and by what they have learned through their mutual engagement in these activities. A CoP is thus different from a community of interest or a geographical community, neither of which implies a shared practice.” According to Wenger [26] a CoP defines itself along three dimensions: what it is about, how it functions and what capability it has produced. In the next section a reflection will be presented about a new perspective for the development of informal education through the use of mobile collaborative learning by CoPs.

3 Mobility and Collaboration using Multimedia: A New Perspective for Developing Informal Education

Some studies try to answer where the education actually happens. Bentley [27] addresses the “lifelong education and for life” arguing that educational development can occur at any location or time during a lifetime; in this sense, the educational process is related to a process of continuous learning. The use of mobile devices with appropriate software applications could support and intensify opportunities for learning since it can enable interaction anywhere and anytime; therefore it can be an option for the development of informal education.

People live in a process of continuous learning all the time and not only connected to certain places and/or institutions. This process is collective and involves mainly action, meaning, identity and social participation through communication, dialogue and collaboration. In this one, each individual must develop himself/herself by their contributions, with an active, engaged and practice participation, collaborating and sharing ideas about something through communities. Mobile technological mediums seem like an interesting way to develop this process, contributing to turn it more dynamic and effective through agility and mobility.
This work uses the informal education as focus, since in this form of education any issue can be discussed and explored by users. It also considers the mobile phone interfaces for the constitution of communities of practice aiming to promote the informal education. The use of mobile learning can intensify the chances of learning due to time and place flexibility, creating in this matter, novel possibilities for the development of the informal education. In this context, the mobile learning can boost the development of the informal education since it opens new possibilities for action and relationship of the individual with the world, and therefore allows interventions through interactions and collaboration. Moreover, individuals in face of a new situation or problem are supposed to act in a more agile and flexible way if they share knowledge with others. The joining of these two forms of learning (mobile and collaborative) can provide a special condition for the occurrence of informal education, since they bring peculiar characteristics that can be best exploited through a properly designed mobile computational environment.

In this context, users can take advantage of the environment through the free exploration of these ideas and doubts in the interaction with each other, allowing the generation of new knowledge, and contributing to their education and development as citizens. Thus, the computational proposal presented in this work foresees that the participants must have more possibilities and freedom to interact and propose collaborative discussions on topics related to the interests and practices of the groups.

3.1 Multimedia in the Collaborative Learning

The multimedia technology has transformed the ways that students communicate, learn and socialize themselves, improving their skills for presentation and exploitation of the knowledge. The use of multimedia must be more and better explored in educational contexts, especially in the informal ones, since it can contribute to a better and diversified formation of the individuals [28].

The multimedia instructional messages can be strongly used in the learning environments, since they are characterized by the exploitation of new knowledge and feelings. For Mayer [29] multimedia instructional messages is the communication using words, images (in movement or not) which intends to promote a learning. According to this principle, students learn better with words and pictures than with words alone. His studies indicate that when words and images are presented on a joint, students can build verbal and pictorial mental models, and also build relationships between these models. When words are presented alone, students just are able to develop verbal mental models, but they are less susceptible to develop a pictorial mental model and make connections between them.

Thus, various media should be available for the individual in order to provide different resources to express and make his/her reasoning understandable for the group. Collaboration between learners can be benefited from representations such as images and animations, as they may have the role of referential anchors in the building of a shared understanding. With the use of multimedia, users can employ some artifice like image, video or sound to explain their point of view quickly and easily in a context of collaborative learning [30].
The use of multimedia in a collaborative learning environment leads the user to ratiocinate about how to explain his/her thinking, (e.g. through an image); thereby creating means for the development of his reasoning. Furthermore, other users of the environment can use their imagination to understand the correlation of the image, video or sound along with text and the context under study, reaching conclusions on the explanation of the ideas from the involved. In this perspective, the approach to the exploration of multimedia in a mobile application to support the collaborative learning is plausible, since all necessary resources to capture and storage the audio-visual resources is already found in the mobile devices. The next section presents a mobile prototype interface designed based on the approach discussed in this section.

4 Designing a Mobile Software Application for supporting everyday learning: Prototype and Examples

Due to the informal education heterogeneity, a simple and trivial computational solution (i.e. based only on exchange of asynchronous messages by instant text messages) is not able to support efficiently the collaborative situations. In order to build the prototype was necessary to develop and organize interfaces and different forms of interaction, with multiplies forms of collaboration that must be available in the environment. It was also necessary to provide the minimum of information that must be contained on these interfaces in a simple way. Several requirements was considered such as the flexibility of the application components to fit the different contexts of collaborative use (which are numerous when it deals with informal education); additionally, the application should provide many ways of expression. With this objective the prototype adopted various media as a form to develop a richer and fruitful collaboration.

Thus, the prototype designed in this work shows an organized set of design interfaces capable of supporting collaboration in synchronous and asynchronous ways. Additionally, we proposed a mechanism to consolidate (highlight) the messages in a synchronous collaborative process, and to vote the situations (states) of the developed collaborations. Figure 1 shows a general view of the proposed environment.
According to the scheme presented in Figure 1, collaborations occur in the environment by sending synchronous (chat) and asynchronous messages (commentaries). The users collaborate to consolidate the collaboration, which gives emphasis to specific messages, and to provide the status of the collaborations. The computational proposal foresees that the participants must have more possibilities and freedom to interact and propose collaboratively discussions on topics related to the interests and practices of the groups through the software. The goal is to provide a virtual mobile environment that can support the constitution of CoP, in this way, individuals with similar interests and practices can constitute group of collaborators. These ones can discuss an existing topic and/or open new topics of discussion according to their interests of practice.

The communities are represented by groups in the software. They are created by users in order to organize topics related to the main group proposes. Furthermore, due to the large range of topics that can be discussed, it was created a way to organize the information in hierarchical levels: (1) Groups (communities), first division of themes; Topics, within a group there are several topics, and (3) Collaborations, numerous collaborations can be associated to one topic.

The process of developing collaboration can start by inserting a new group, or choosing a group that already exists. The groups represent the CoP and they have a vital role within the environment, since they organize the various themes that can be related to informal education into specific areas. Users of a same group are people with common interests and practices in which the objective is to discuss problems and find out solutions in a collaborative way. It means that a group is a specific area of
formal or informal knowledge where users can be grouped, and topics and collaborations are organized. Users are able to join the existing groups, or create new ones, as they want. In the next section, the developed prototype will be presented through examples.

4.1 Prototype and Examples

The main principle behind the proposed design is the self organization of the groups without any formal moderation. These groups perform discussions through collaboration sessions. In the prototype, the collaboration occurs through synchronous and asynchronous multimedia messages. A specific group of collaborators, in a discussion, can consolidate (highlight) messages that could be important to someone that may want to know a synthesis of it. The users can decide which state (situation) each collaboration is, for example any collaborator could vote if they find out the solution of a problem or not. The users can also search discussions by topic in order to know more about some problem, and give opinions (commentaries) using asynchronous messages even after the end of a synchronous session.

![Figure 2. Prototype’s interfaces about groups](image)

The development of the collaboration can start in the insertion of a new group (see Figure 2a and 2b). Within the groups can be added various topics (see Figure 3a and 3b) and within the topics is possible to add new collaborations. Figure 3b shows the list of topics for a group called Bikes, in this interface users can choose a topic to add a new collaboration to interact through synchronous and asynchronous messages.
During the collaborations participants can send synchronous messages as in an instant chat (Figure 4a illustrates this situation). All the messages are sent with a specific "objective" and have a label as: ‘doubt’, ‘question’, ‘conclusion’, ‘answer’, among others that may be defined by the own users following their needs of expression. After sending the message, it is displayed in an interface that centralizes the messages from all involved collaborators in the discussion, as shown in Figure 4b. This illustrates the interface with an example of synchronous message exchange in which users establish a communication (chat) from a defined theme – in this case "Nature and Profits" - and specify his "speech" as the type: question, answer, solution, questions, etc.

The participants can also select which synchronous messages should be "consolidated" during the chat (Figure 4c). These consolidated messages have an important role because they will describe a summary of all the synchronous interaction with the most important messages selected by users in a specific issue. At the consolidation interface, the messages are organized by their types (labels), for example, ‘doubt’, ‘question’, and ‘conclusion’. Figure 4c shows an example of consolidated messages of the collaboration developed in Figure 4b. Other users of the environment can also see this summary (Figure 4c illustrates this interface).

Figure 3. Prototype’s interfaces about topics
The occurrence of communication via asynchronous messages - as shown in Figure 5a - is a way to add new information to synchronous collaboration developed or under development. This type of communication will be especially useful in two situations:

1) When the theme of collaboration takes several days to be resolved, in which there is a need for several rounds of synchronous interaction (online chat). In this case, the commentaries (asynchronous messages) can be a way to divulge possible solutions at any time between the online conversations. These commentaries can be discussed in a new round of synchronous collaboration, thus the discussions of the chat (synchronous messages) are articulated with the commentaries (asynchronous messages).

2) In case of a relevant idea of a user who was not involved in the collaboration after it has finished, the commentaries are a way for the users to register their idea so that other people can see.
As illustrated in Figure 5b, another proposed way for supporting the collaborative environment is to define possible "states" for the developed collaborations. Collaborators can vote on the basis of information from the collaboration (synchronous and asynchronous messages) to classify the status of the collaboration; e.g.: ‘resolved’, ‘pending’, ‘not conclusive’, among others that may be defined by users. This is an important functionality because this interface takes into account the opinions from users.

This state or situation refers to what has been discussed in a collaboration session (determined subject proposed by one person), so a situation would be, for example, the impossibility of conclusion or resolution. That is, the participants of the collaboration interacted with each other and exchanged messages, but they did not reach a definitive conclusion about the problem in question. Different final situations to a collaboration session can be defined in the prototype. The objective is to have a number of situations selected by the users of the application, presenting in this matter different points of view from the same collaboration, enabling users to check if that collaboration has generated interesting results or not (see Figure 5c).

Figure 4b illustrates the interface with an example of synchronous message exchange in which users establish a communication (chat) from a defined issue – in this case "Nature and Profits" - and specify his/her "speech" as being of the type: ‘question’, ‘answer’, ‘solution’, ‘doubt’, etc. Figure 4c shows an example of consolidated messages from the collaboration developed in Figure 4b. Figure 5a illustrates an interface of commentaries, in which users sent asynchronous messages to a collaboration named "Problems with Java". Finally Figure 5b shows the vote results made by users for the collaboration entitled "Problems with Java".

Besides these aspects, the environment encourages autonomy by providing resources for the self-organization through the collaboration sessions. Users can launch themes for discussion; they can be involved in the resolution of a problem, choosing the relevant solutions, and they can point out the status of the collaborations. Thus, the environment does not foresee the existence of a group’s mediator, hence mechanisms have been developed in order to enable all users to organize the proposed subjects by the creation of groups, topics and collaborations necessary for the organization of the information at the mobile software.

4.2 Using Multimedia in the Mobile Collaborative Learning

The prototype developed use multimedia resources to explain ideas, facts or concepts using the media (audio, image and video) as a way for explanation and expression of ideas. Therefore the proposal is not to provide functionalities in a software environment to produce video or sound collaboratively, but to use these resources. There would have proposed means to make the explanation of the exact through the abstract, the art through images, audio and videos helping in a process of collaborative learning between users through mobile devices.

Consequently is discussed how the multimedia was introduced in the collaborative learning through the interfaces of the prototype. We should clarify that was assumed that the media archives were already recorded in the respective mobile devices, and the software interfaces only use the media that is already available.
In the prototype, besides other interfaces for the management of the collaborative environment, from the specific interface for sending messages, we developed an interface mechanism for the inclusion of multimedia; which provides means to include medias of the following types: image, audio and video. Thus, when users are interacting in the collaboration, they may attach media in their messages. Figure 6(a) shows an example of interaction (sending the message) using multimedia; for that, the user will need to click on the menu "Add media" in order to add a media in the message using the interface of messages.

![Figure 6](image)

**Figure 6.** Prototype’s Interface of message showing the option “Add Media” at the menu (a); Interface of Multimedia (b).

In sequence as shown by Figure 6(b), the multimedia interface appears to the user. In this interface users can see the name of the collaboration, the text message and what type of collaboration (chat or commentary) media will be attached to this message. At this moment, the user has the option to list the three types of media available to be manipulated in the environment, as shown the right side menu of Figure 6(b). People can choose a media file, as illustrated in Figure 7(a). This interface displays the list of all media available in the device, given the type chosen in the menu. After that users can visualize it, as shown in Figure 7(b) (the example shows an audio) that presents the media after the selection. In this way, users can attach the media in the message through an option from the menu in the interface shown in Figure 7(b).
After sending a new message to the collaboration, the media attached to the message will be available to other users. The sent message will have an icon on the interface of the collaboration that will indicate whether a media has been attached and what type of media. Figure 8 illustrates the types of icons that will appear in the interface indicating the media added.

The icon in Figure 8(a) indicates that a picture was attached to that message; the icon in Figure 8(b) indicates that an audio was added to the message, and the icon in Figure 8(c) indicates that a video was attached to that message. Figure 9(a) illustrates the collaborative interface (chat) with the messages and the media attached to them. This resource in the interface indicates if there is media attached to a message or not. In order to view the content of this media, users must select the message, access at the right side the menu option "See media". Then the media will be displayed as illustrated in Figure 9(b) (interface that shows the media attached to a message). Note that with the media, users will see the text message related to that media; he can select the option "Back" at the left side menu to return to the interface with the collaborative messages (Figure 9a). Every message of the collaborative context (synchronous or asynchronous) sent by a user in the environment may have attached to an image, an audio or a video together with or without text. Figure 9(c) illustrates the interface of commentaries about a collaboration, presenting messages with attached media, as also happens in the chat (Figure 9a).
It is important to note that an interesting way to introduce the multimedia in the collaboration is through the attachment of the media in the mobile collaboration messages. Given that the volume of messages that may arise during the collaboration sessions can be big, and also considering the screen size of mobile devices would be impracticable put all these information together in a single interface for manipulating media. Finally, after having presented a proposal on how the multimedia resources could be added to messages in an environment for supporting of mobile collaborative learning it is important to make a discussion about what this approach can educationally provide for users. Thus, the next section discusses this use and explains on some potential educational advantages that this environment can bring for people.

5 Interfaces, Communities and Informal Education: Discussing the Proposed Approach

Features designed for the environment must be represented on its interface, and it is necessary that interfaces make sense to users in their context. Furthermore, the design of the features, the interaction model and its relationship with the educational activities must be well designed. At learning in a virtual environment, the interfaces can be as a facilitator or a big problem, since if this interface is bad designed can let the educational activities unviable; however in the other way it can provide great support and really maximize the learning results.

Moreover, to provide the development of the communities, the interface should present specific features for satisfactorily support and management. The interface should provide mechanism for users create, organize and maintain the communities by themselves. The prototype developed in this work shows a possible alternative to stimulate the constitution of the CoP through groups. From these groups, all the organization of the application, the topics and the collaborative discussions are developed.

The themes, topics and collaborations supported by the application’s interface create conditions for users develop the communities in a natural way. The subjects
related to their daily life fits in the thematic of these communities, and the communities are the basis for the organization of themes that are part of the informal education. The design of the interface allows a particular organization which enables the establishment of these communities and therefore also issues from the informal education, which is developed through collaborative discussions.

In the proposed approach agility and mobility are viable through mobile devices which promote opportunities for situated and collaborative learning that occurs throughout life, anytime and anywhere. Learning experiences are encouraged in a process of communication and collaboration permeated by issues or questions related to situations experienced in people’s lives. Besides the prototype allows people to build CoPs which can discuss problems in a little structured way, with the freedom to propose questions and solutions, to interact and express with decisions and solutions built through a collective consensus whatever the issue.

The mobile software was not thought to a specific application or to support a specific theme. A lot of real-world educational applications could be instantiate to any area. As an example, we could think on healthcare professionals that take care of people at home and need fast answer to problem and they do not have access to computer at that time. They could create a ‘community’ using this software to collaborate and to exchange ideas about problems that could appear on time of working and be resolved quickly using mobile collaboration. Other example in another context, users could collaborate to solve problems regarding to how to fix mechanical problem of car engines.

The use of multimedia resources in the interface adds distinct features to the application, providing new forms of expression available to the users during the collaboration. These resources can provide benefits to the exploration of the creativity of those involved, since they can make associations between the messages in the collaboration with the external world, such as by creating a video to illustrate an idea in a message, the user will be exercising his/her reflection and trying to make connections of that media with all the collaborative context under discussion and with the message that will be sent.

Other initiatives has explored how to provide and share media resources in a group of users [31, 8], however they does not explicitly use the audio-visual resources inside the collaboration. In this work, we highlight the importance of exploiting the advantages of combining multiple media in the computing environment. Otherwise, in this work was studied the use of these resources for supporting the explanation of ideas in the collaborative learning, such using it as multiple ways to explain a thought or idea in the collaboration. This approach may generate suitable means for learning be explored in a more incisive way on users’ daily lives. The presented prototype can take advantage of the locations (places) where users are for the collaboration and educational development of the involved group. Including visuals resources in the collaborative mobile application users with mobile device can take advantages of the environment around them looking for explanations that exemplify their ideas in a clear and simple way.

The proposed solution allows the possibility for users to make connections between the collaborations under discussion in the software environment with their everyday life. Users may have difficult situations during the collaboration that only the use of simple words and phrases would not be enough to express an idea or an intention,
thus multimedia resources could be used as alternative methods to solve this problem. Furthermore, the use of multimedia provides a richer learning environment in that users will have an alternative to words to express themselves. It is understood that using multimedia in a propitious environment to capture, to explore and to aggregate to a context or subject can generate many reflections by users, both in the development of the visual or audio "product" and in its relationship with the collaborative context which the media should be inserted. Users should think what media to use, and how to use it in order to their ideas be understood in a practice, clear and dynamic way by other users of the collaborative environment with this form of media (expression).

Concerning the empirical analysis, a brief qualitative evaluation of the proposal and prototype with potential target users has been done. At this moment the goal was not to verify issues of device connectivity and location aware information; however we intended to analyse characteristics and functionalities of the software.

This analysis has been conducted with participation of Information Technology professionals (4 participants), Computer Science students (3 participants), Healthcare professionals (2 participants) and high school students (2 participants). The participants have had contact with the prototype and answered the questions about their impression over the proposal. The questions elaborated were:

- If you face a problem, would you use the proposed application to discuss the solution? If yes, in which situation;
- What topics would you be more inclined to discuss?
- Would you collaborate with other people through the application to solve a problem proposed by someone? If yes, in which situation;
- Would you use multimedia messages during the collaboration?
- What difficulties could you point out in using the application in your daily life?
- How long and how often would you use it in your daily life?
- Do you think that you could improve (learning to develop better) the performance of your tasks with this application?

After analyzing the answers, we can indicate that users mainly would use the application in emergency situations, for example, when (s)he had no access to a computer, and also in working field situations or in occasions of daily life like such as during traffic time. They could discuss about several topics such as news, health, hobbies, technology, or on topics of everyday and professional context, generally in situations that need help. Most of users indicated that they would collaborate with other users on the application, especially in areas that they have knowledge. About the multimedia messages, all participants pointed out that they would use some form of multimedia messages, mainly due to the flexibility offered by these messages. The difficulties that could prevent users to use the application are mainly due to: the small screen of mobile devices, the difficulty of interaction (data entry), operation cost and low speed connection. Additionally, users have indicated that they would use the application especially when they had to solve a problem in unusual places and times, but they would not frequently use the application, as they could use personal computers in normal situations. Most users clarified in a positive way that a proposal
with this approach could improve their performance in development of learning activities related to informal education. Looking to these results, we think that with this approach we can improve both tangible and intangible educational benefits for users, since they will be actively collaborating and learning without time, place and issue constraints.

Finally the use of the collaboration and mobility for the development of the informal education seems like a valid educational approach. It enables users to begin discussions about what they are experiencing in one moment about any issue, and also to participate in existing groups to share ideas and opinions. Then users can collaborate on a joint process of learning, in which the goal is mainly the intellectual evolution of the involved collectivity. To sum up, users could benefit from collaboration and flexibility through the use of mobile devices.

6 Conclusion

Recent studies have investigated how education can be boosted and developed in any place or time. They have investigated mainly how the learning process could occur regardless of subject or any other constraint aiming to maximize the possibilities for learning of the citizens in their daily lives. Mobile collaborative learning environments are frontiers of research in the scientific community of the area and there are several challenges in this context to obtain improvements in the quality of the collaboration. In order to achieve improvements on this aspect and in the users’ experience in learning activities it is essential to study new alternatives to design richer mobile computing environments to improve the capacity and easiness of communication, interaction, and expression. For that, this work presented a technological proposal for the development of the informal education based on mobile and collaborative learning, including a reflection about this new perspective. Based on it, a prototype was implemented aiming to illustrate the proposed approach for the design of mobile software, including the use of multimedia in mobile collaborative learning.

We addressed aspects for designing interfaces of a computational environment to support mobile collaborative learning, which allows the constitution of CoPs. These CoPs are developed from groups and mobile collaborative discussions, which aim to promote and develop the informal education. The developed prototype illustrated the main ideas of the approach. Using this prototype, an analysis about the role and impact of the mobile software interfaces was conducted, and we could observe that the proposal shows propitious scenarios for the development of the informal education constituting communities of practice. Moreover, we intended to perform an investigation on how audio-visual resources could be aggregated in the process. The approach shows as an interesting alternative to deal with the mobile interaction and collaboration restrictions; the prototype presented possibilities for exploiting in this direction. The features designed assist mainly the development of collaborative activities using the multimedia resources already available by the devices. They presented an interesting way to improve the learning through multimedia resources in a mobile application.
Based on the results obtained with potential users, the proposal can be pointed out as a likely starting point for the development of the informal education using mobile collaborative learning. It aims to add educational value for those involved at any place or time in a collaborative session. Moreover, this work emphasizes flexible ways to develop a collaboration session in a mobile phone application exploring the autonomy of the involved users with focus on informal education.

As further work is proposed a better and deeper investigation of the approach presented from a theoretical and practical point of view. Even though the proposal is based on these aspects, research on real case studies should point out improvements and new solutions for the design of the interface in the studied context. Concerning the features of the prototype, improvements in the design should be made; including those issues related to usability and to include new features in the prototype, mainly to sophisticate the establishment of the communities of practice. We propose to study the real educational benefits of the proposed approach in long period of use. Actually the use on a large scale should also provide what the concrete educational results of the proposed approach are.

References


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