E-CLUB: A UBIQUITOUS LEARNING MODEL

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Abstract: With new wireless technologies, mobile devices with small displays (handhelds, PDAs, mobile phones…) are present in many environments such as offices, meeting rooms, classrooms, etc. We are interested in the effective use of such ubiquitous computing devices and traditional PCs for collaborative learning. In this chapter we present a platform (called e-CLUB) which integrates such technologies. We also show its application to a case study, the teaching of foreign languages by means of compositions. We identify the main problems of this approach to language education, describe the architecture and main applications of a prototype (called AULA) for language education, and show how it is used to overcome such problems.

Key words: Ubiquitous computing, CSCL, PDA, pervasive computing.

1. INTRODUCTION

The most recent works in ubiquitous and nomadic computing are focused on the integration of different devices (both in size and form), especially when the users are highly mobile [1]. These works assume that the PC disappears and is substituted by devices like Personal Digital Assistants (PDAs). We think that a heterogeneous computing environment, combining PCs and PDAs, would be a more effective and realistic approach. In effect, it
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could take advantage of the features of every kind of computer (the PDAs mobility and the PCs computing power).

In a ubiquitous computing environment, the user can interact with multiple devices by means of different user interfaces. Some works have given different solutions to multimachine user interfaces (called MMUI) [1-3]. In our proposal, the user interacts with one single interface on the mobile device in a collaborative learning environment. In this area, ubiquitous computing has a number of advantages [4,5]. The existent ubiquitous applications or systems [6-11] satisfy some of our domain needs, but not others (especially the discussion process).

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In this work we describe a platform that improves the classical classroom environment thanks to the ubiquitous computing paradigm: e-CLUB (electronic UBiquitous CLassroom). In particular, we have implemented AULA (A Ubiquitous Learning Appliance), a prototype environment for language learning, in particular English like a Foreign Language (EFL). In this chapter we present the tools for the teacher and students. In section 2 we describe the traditional scenario of teaching by means of compositions, and identify its main problems. In section 3 we present the e-CLUB platform, its infrastructure and the AULA prototype. In fourth section we study one composition experience writing a text. To end up, we summarize the conclusions drawn and the work in progress.

2. LANGUAGE TEACHING THROUGH COMPOSITION

In this section we describe the stages of composition writing in foreign language learning, and we identify difficulties. We also show how AULA may contribute to provide solutions. In a traditional class, the teacher and the students make use of a whiteboard, notebooks, dictionaries and books as learning/teaching aids. When the class starts, the teacher gives instructions to the students (the subject to write about and the style to use, the final document title, the schedule for its accomplishment, the document type…). Afterwards, the teacher assigns tasks to the students, indicating the role of each student for the composition project. This is not an easy task for the teacher because he/she often does not have much information about the students.

At this moment, the students start to work collaboratively on the document elaboration. Every student writes individual notes about the suggested subject in his/her notebook. Once these ideas have been matured individually, the student shares them with the rest of the group. Therefore, the student has to write them again in the whiteboard. Later, a brainstorming process begins. Students discuss about the validity of their respective ideas,
thus some are accepted and others are rejected. This procedure of setting individual ideas in common is a boring and tedious method because of the need of rewriting again.

In the following phase, the students complete the ideas they agreed upon by adding some language components. Now, the student needs to access to dictionaries or other information sources. These elements are typically sparse in the classroom; therefore the student has to stand up to the shelf, to fetch it, etc. As a consequence, the student stops paying attention to the composition. Once the students have finished the written composition, the teacher again plays an active role by evaluating the delivered works. This task is hard for the teacher because it is difficult to evaluate the individual effort within a group.

AULA facilitates the accomplishment of some of these tasks. Firstly, it supports work of the student out of the classroom (e.g. at home). When the student is out of the classroom, his work is persistently stored in the PDA’s database. When the student enters to the classroom, automatically the system sends his work to the teacher’s computer and to the student’s device. Secondly, AULA assists the student in the procedure of setting individual ideas in common: the student writes down his/her ideas on the PDA and automatically the system sends them to his/her classmates’ PDAs and projects them on the whiteboard. Thirdly, the system facilitates the process of discussing proposals through synchronous and asynchronous collaborative tools. Fourthly, AULA provides all the tools necessary for composition (e.g. a dictionary) in the student’s PDA. In this way the student is fostered to maintain his concentration. Finally, AULA helps the teacher by recording the traces of the actions developed by the students. Thus, the teacher can consult these traces and assess the actions of students.

3. E-CLUB: AN UBIQUITOUS COMPUTING ENVIRONMENT FOR DOCUMENTS COMPOSITION IN GROUP

3.1 Infrastructure

The ubiquitous classroom is composed of the following devices (see Figure 1): a Projection/Edition WhiteBoard, a server that manages the system database, a Location Manager that provides context-aware, the Session Coordinator that coordinates the classroom’s devices, and the mobile devices (PDAs). Communications are supported by several communications networks: radio frequency wireless network (it connects PDAs and the Session Coordinator), infrared network (it connects PDAs and
other devices such as printers) and a LAN network. The architecture of the classroom is described with more detail elsewhere [12,13].

![Diagram of AULA infrastructure consisting of various networks and devices.]

**Figure 1. AULA infrastructure consisting of various networks and devices.**

### 3.2 The Document Composition System

The *Composition Coordinator* is a subsystem of the Session Coordinator. This subsystem manages the students’ work for the composition writing process (see Figure 2). We can identify three types of student actions during this composition process:

- **Document actions:** they modify the contents of the document, that is, the students’ composition. For example, the student sends a proposal to the group. The result is visualized in the Collaborative Visualisation space.
- **Attributes actions:** they change some attributes of the composition. For example, the user votes a proposal. The result is visualized in the Collaborative Visualisation area.
- **Personal actions:** they modify the personal workspace. For example, the user creates a new aspect. The result is visualized in the Individual Edition space.

The Composition Coordinator subsystem interprets the actions invoked by the user and, depending on the action, performs different tasks. The tasks supported by this subsystem are:

- Packaging and unpacking messages. The messages between the *Composition Coordinator* and the PDAs are encoded to reduce the size of messages. The module Encoder manages packing and unpacking.
Interpreting received messages. The Analyser interprets each message and deduces the type of action that must be executed. Afterwards, the analyser invokes an action to the appropriate module.

Executing actions. Depending on the type of action, the system has to perform different tasks. The module Document Attributes modifies the attributes of the shared object and updates the users’ PDAs. The Collaborative Workspace Manager updates the document and its new version is sent to all of the PDAs. The module Personal Workspace updates the user’s individual work in the database.

Recording traces. The actions invoked by the students are persistently recorded in the system’s database. The data recorded are the following: user identification, actions and its attributes, context-aware information (date and time, inside or outside the classroom, etc.). The Trace Handler accomplishes this task.

We have implemented the system applications by means of Java and Visual C++ Embedded [13]. The architecture of e-CLUB can be supported in a classroom and has been used in other sites like smart homes [14,15].

### 3.3 AULA

The students access AULA tools through their PDAs. There are two tool types: collaborative tools (synchronous and asynchronous) and language tools. The collaborative tools are: a chat channel, a news board and the email facility. These tools are aimed at the communication process among the students and the teacher. The student uses this tool to make on-line requests of information to the teacher or to other colleagues, although the main utility
of this tool is to support the discussion and debate process about the proposals at the brainstorming phase.

The system provides to student with three language tools: dictionaries (monolingual as well as bilingual), an electronic grammar book and a case database.

![Figure 3. The application interface in a mobile device on beginning a composition.](image)

The system structures all the resulting information from the composition process into so-called aspects, which are composed of ideas. Aspects and ideas are the blocks of partial information that constitute the framework that the students have to elaborate. Several aspects form a so-called topic. Figure 3 shows the application user interface of a mobile device when the composition process of a document is going to start. Notice that there are three well-defined working areas: the Individual Edition workspace (where the students write their individual contributions), the Collaborative Visualization workspace (where all the contributions of the group are displayed) and the Final Document Edition workspace (where the accepted proposals, which will be part of the document, are shown).

4. **A COMPOSITION EXPERIENCE**

At this section we introduce a typical session with the e-CLUB platform using the AULA prototype. In this session a small group of students must write a document in English about a given topic. The topic generates the title of the document. The accepted aspects will be the sections of the document and the ideas will be the paragraphs of these sections. We study in detail the students’ work.

When the session begins, the teacher states the type of document that the students have to write. As an example, assume that it is a technical
document: a paper on ubiquitous computing and education. Besides, the
teacher gives the scheduled time and the title of the document. These matters
are verbally explained by the teacher using the Projection/Edition
WhiteBoard. Afterwards, the teacher proposes the following text as the topic
of composition: “Language Learning and Ubiquitous C.”. The topic
proposed by the teacher is visualized in the display of the students’ PDAs at
the Individual Edition area and the Collaborative Visualisation area (see Fig.
3). At this moment, the students play an active role for the session: they
propose his/her ideas and the brainstorming process begins.

![Figure 4. Inserting an aspect in Individual Edition workspace.](image)

The student works by writing small sentences (items of information) in
his/her mobile device (the student thinks that these sentences are important
and they must be a part of the document). The student writes these items in
the Individual Edition area, being each written item one aspect (see Fig. 4).
The student later refines these aspects by writing several ideas for each
aspect (see Fig. 5). In our example, a student thinks that the aspect
Introduction must be composed of three blocks of information: an
introduction to the subject, related works by other authors and a description
of the paper structure. Therefore, the student creates in his/her PDA three
ideas for the aspect Introduction: subject, related work and paper
presentation (see Fig. 6).

When the student has written his/her aspects and ideas in his/her PDA’s
personal workspace, he/she delivers his/her work to the rest of the group. At
this moment, those proposed aspects and ideas are visualized at the
Collaborative Visualization area of all of their mobile devices (as well as any
other proposed items).
This starts a discussion process among the students about the validity of the aspects and ideas proposed. In this way, the student argues and explains his/her ideas to the other students. The students can argue and explain their ideas verbally, using the Edition whiteboard. Besides, system provides some tools to support this process: polling of proposed works (see Figure 7), chat, e-mail and news.

As a consequence of this discussion process, some aspects and ideas are rejected. The student can modify his/her rejected aspects and ideas. Afterwards, these modified proposals may be sent to the group again. The accepted proposes are visualized in the Final Document Edition Workspace. The items in this space are basis for the sentences that will form the final document. The process of discussion finishes when the group of students achieve an agreement, accepting some suggested aspects and ideas and refusing others, through a polling process provided by the system. At this point, the students focus on adding small sentences to deliver the final document.

Notice that the information structure supported by the system (topic, aspect and idea) produces different parts of the document written by the students. In our example, the topic has generated a paper title (“Language Learning & Ubiquitous C.”), the aspect Introduction has generated the
section “Introduction” of the paper and the ideas of this aspect have generated the paragraphs of such a section (see Fig. 8).

When the document has been finished by the students, the teacher begins the evaluation process. In a typical class of English, the teacher evaluates in a postproduction process, where he/she assesses the activity by marking two issues: the resulting document delivered by the group of students and the performance of every student, based on the teacher’s memory and ability to infer it. In general, this evaluation has two phases: firstly, the teacher dialogues with the students and secondly he/she examines their composition. This way of evaluating is very hard to the teacher due to the emotional implication it involves. Obviously, the teacher can make questions about the students’ work (who suggested this particular idea?, did this student take an active role during discussion?, to what extent?...).

We have developed the AULA system considering indicators and analysis strategies of group work [16,17] to assist the teacher in evaluation. During the process of composition writing, the user’s actions are structured as user’s traces. Every action accomplished by a student is recorded by the system in its database as a trace. The teacher may later consult such traces to analyze more easily issues such as: the progress of each student in their language development (globally as well as in particular areas), the student’s reaction to errors made by other members of the group or the participation history of a student in previous activities (see Figure 9).

Finally, the teacher chats with the group about the conclusions and possible corrections of the composition.
5. CONCLUSIONS AND FUTURE WORK

In this chapter we have presented a platform, called e-CLUB, to improve the traditional classroom environment with the collaborative and the ubiquitous computing paradigms. We have implemented a prototype, called AULA, developed for language education (in particular English as a Foreign Language, EFL) by means of composition writing in group.

Recent works on ubiquitous and mobile computing use a variety of different devices, like PDAs or telephones, and are based on wireless communications. In these works, the PC has been substituted by these new devices. The platform described in this chapter combines PC and PDAs, as well as other devices as printer, whiteboard, projector... In this way, we provide the user with two things: mobility (thanks to PDAs and wireless networks) and computing power (thanks to desktop PCs).

In a multimachine environment, the user must operate with several types of devices by means of different user interfaces. In our proposal, he/she interacts by means of one single user interface, that of the PDA. In this way, when the user makes a request to the system, he/she thinks that is using only one machine (his/her PDA). Actually, the requested function is performed by another machine (PC) transparently to the user.
During the composition writing process, a large amount of information is produced which is partly wasted. In particular, many of the student actions are not important at the beginning but they later play a relevant role for the teacher. A system such as ours is of great importance to the teacher because it records all these actions of the student (traces).

In addition, the teacher needs analysis tools to handle the recorded traces. We are researching on mechanisms of analysis of the composition process. We are working on analysis applications that may give conclusions about the working process and the final solution delivered by the students.

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