BLENDED PEER-ASSISTED LEARNING PLATFORM: IMPROVING LEARNING OUTCOMES WITH A COLLABORATIVE ENVIRONMENT

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ABSTRACT

The methodologies applied in classroom and consequently the successful learning is a constant concern and a focus of attention for the scientific community. This concern leads to the exhaustive search for more and better means to strengthen these two elements: methodology and successful learning. Therefore, different methodologies, paradigms, and tools have been proposed to provide an insight on the student's academic and professional development and to consolidate the content taught in classroom, such as e-Portfolios, Blended Learning and Peer-Assisted Learning (PAL). Based on the integration of these different approaches, this article introduces a Blended Peer-Assisted Learning platform based on Moodle which provides the implementation of an adaptive, synchronous, and collaborative learning environment able to adapt the students' learning experience according to their learning needs.

1. INTRODUCTION

Currently high-level education is facing different issues related to the diversity of incoming students and to their increasing degree of mobility. As discussed in [1],

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these issues are mostly related to the students' different cultural and educational background, isolation, to the need for more engaging learning experiences, lack of sense of belonging, lack of collaboration among students, among others. Therefore, there is a growing need of new methodologies, approaches and tools, in order to foster students' socialization and to improve their learning outcomes. In this context, methodologies, techniques and innovating tools, supported by Information and Communication Technologies (ICTs) have been developed to promote better educational experiences. Among these solutions we can find e-Portfolios, Blended Learning and Peer-Assistant Learning (PAL).

e-Portfolios are educational tools that provide students with an insight about their academic and professional development. An e-Portfolio can be considered as a repository for exposing the student's work, allowing him through a self and peer-assessment process, to determine his pedagogic needs in order to obtain a progressive learning development [2]. When e-Portfolios are integrated with e-learning platforms it is possible to provide further dynamic and adaptive learning environments. Dynamic learning environments can also be achieved with the utilization of Blended Learning. Blended Learning describe different alternatives for the incorporation of pedagogic techniques, where with the help of different communication media and learning strategies, learning can be carried out from a face-to-face to a distributed and remote learning environment.

Different studies have already discussed the benefits of Peer-Assisted Learning (PAL) [3-5] and as it is useful to overcome the previously addressed issues related to the first year transition at the university [1]. PAL can also be useful to implement adaptive learning environments since different learning strategies can be applied according to the students' needs. Peer-Assisted Learning is an approach that aims to improve the process of knowledge acquisition through the interaction between individuals that share the same level of apprenticeship (for example, that are attending the same year of school), under the supervision of one or more individuals with a higher level of apprenticeship [6]. Currently, there are different PAL strategies, although we have considered the most generic and relevant strategies: Roleplaying (simulation of real situations), Reciprocal Teaching (among peers), Peer Tutoring (Tutor/Tutees) and Cooperative Learning (cooperative groups of students).

This article reviews the main features of these former learning approaches and introduces a generic platform for the implementation of Blended Peer-Assisted Learning (ePAL) environments. This platform provides users with a set of ICTs in order to foster communication and collaboration among students. According to the students' academic and professional background the ePAL platform allows the customization of the tools and learning strategies to the students' learning needs.

The article is organized as follows: In the second section, the adopted e-Learning approaches are discussed; in the third section, the implementation and main functionalities of the proposed Blended PAL environment are discussed; in the fourth section a case study is presented with the validation of the platform

developed; In the fifth section, we present some related contributions, and; finally a conclusion of this work is presented in section sixth.

2. FROM E-LEARNING TO PAL (E-PORTFOLIOS, BLENDED LEARNING, AND PAL)

E-Learning comprises all forms of electronically supported learning and teaching. Information and Communication Technologies (ICTs), whether networked or not, serve as specific media to implement the learning process. The ICTs applied to education gained high interest due the need to (i) share information and knowledge under different modalities taking advantage of multimedia content available; (ii) explore the existing technological resources (networking, bandwidth, etc.); and (iii) optimize the learning process through the proposal of new methodologies and tools.

Lipponen summarized how ICTs can enhance learning by: (1) allowing students to represent their own and others' ideas and share their expertise in text; (2) eliminating time and space constraints; (3) sharing discourse spaces and distributed interaction that offer multiple perspectives for students with varying knowledge and competencies, which can offer greater opportunities to share and solicit knowledge; (4) allowing time for participants to reflect through asynchronous communication; and (5) providing the data-base, which allows the knowledge to be shared and revisited [7].

E-Learning is a very broad paradigm, and can be applied in different perspectives. In this work we are interested in the integration of e-Portfolio, Blended Learning and Peer-Assisted Learning, in order to propose more rich and customizable e-Learning environments.

2.1. E-Portfolios

An e-Portfolio is an electronic portfolio of acquired learning—knowledge, skills, and abilities acquired through formal, non-formal, informal, accidental, and incidental learning [8]. An e-Portfolio can be considered as a pedagogic tool, composed by an online repository of works, organized and structured throughout a certain period of time. One of the outcomes of an e-Portfolio is to provide a wider and more detailed view of students learning process, and also the different aspects of his cognitive, meta-cognitive and affective development [9].

E-Portfolios are currently used in different contexts from recruitment to assessment. When referring to assessment, this kind of e-Portfolio can be grouped in: student e-Portfolios, teacher e-Portfolios, and institutional e-Portfolios. e-Portfolios can be organized by groups or by types [2]:

- Developmental e-Portfolios—Collection of all of the students work, over a period of time. They are used in order to provide communication between students and teachers, to allow self-assessment and reflection. They are also known as personal portfolios;

• Assessment e-Portfolios—Demonstrate student abilities and skills for well-defined areas. They are usually used to evaluate students' work, according to their learning outcomes. They are also known as learning portfolios; and
• Showcase e-Portfolios—Used to exhibit the students best work. They are a way of demonstrating qualities, capabilities, and knowledge. They are usually shown to eventual employers. They are also known as professional portfolios.

Nowadays, most e-Portfolios are hybrid. Users usually don't create a portfolio strictly for assessment, development or showcase purposes, but instead try to combine them. As a result, richer e-Portfolios are developed.

2.2. Blended Learning

Blended Learning can be seen as a merge of different learning methodologies and technologies, combining these with different online educational environments, thus developing a more efficient learning process. Blended Learning is very useful, especially when applied to lessons that address complex or dull concepts, since the combination of face-to-face and on-line training (e-Learning) with different didactic resources allows the students to improve their learning outcomes. For instance, a lesson with a complex theme would use face-to-face sessions in order to introduce the theme, while e-Learning sessions could be applied to present complementary information, thus giving additional information about the concepts addressed in the lesson. In general, Blended Learning can be adopted due to practical constraints in the organization of a course (e.g., physical facilities, schedule, budget, etc.), according to the preferences and differences of students, and depending upon the objectives and type of the educational content to be applied in the course.

When determining what can be combined in Blended Learning, we should consider different aspects such as learning infra-structure and organizational issues (e.g., classroom availability, web-based access, teleconference, tutoring sessions, etc.), educational media to be applied as communication channel (e.g., face-to-face, stand-alone/CD-ROM, Internet, video-recorded/broadcast, book, blackboard, etc.) and the educational strategy to be adopted (e.g., reading, simulation, group discussion, tutoring, coaching, problem-solving/case study, etc.).

Blended Learning increases the options for greater quality and quantity of human interaction in a learning environment. This paradigm provides realistic practical opportunities for learners and teachers to make learning independent, useful and sustainable.

2.3. Peer Assisted Learning (PAL)

Peer-Assisted Learning (PAL) is a learning approach which aims to facilitate the process of knowledge acquisition, through the interaction among individuals of the same academic level (for instance, those attending the same year at school),

under the supervision of one or more individuals with a higher academic level [6, 10]. This approach is extremely useful, because each individual has the possibility of calling upon someone, in case he is experiencing difficulties to accomplish certain tasks or to understand the subject being studied.

PAL is a student-to-student support scheme for both academic and personal development. For instance, volunteer students who have just completed a conceptually difficult course are trained to facilitate the learning of students on the same course in the following year. These trained student "PAL Leaders" meet regularly with small groups of students in the year below to help them to improve their understanding of the subject matter of their course and to develop their study and learning strategies. When PAL is run on first-year courses, it can also help the students attending to integrate into their department during the first few difficult months of being at university [11]. Cooperation and involvement among teachers, students and administrative personnel are imperative to the successful implementation of a PAL approach. They will perform subjacent PAL tasks that include:

Course Staff—Responsible for the implementation of PAL sessions. They are in charge of the execution of certain tasks, such as:

- Encourage and motivate students toward PAL sessions;
- Suggest themes to be discussed by students during their PAL sessions; and
- Indicate to PAL Leaders, through PAL Contacts, specific tips or advice so that these can be transmitted to students.

PAL Leaders:

- Weekly plan and organize PAL sessions, including exercises aiming at reviewing the content of the course;
- Maintain a continuous formation with PAL Coordinators in order to consolidate knowledge with the objective of sharing them with students; and
- Encourage students to collaborate with each other by discussing and sharing ideas, installing by this, a spirit of mutual help.

PAL Co-ordinators:

- Examines the PAL program;
- Cooperate with the PAL team in order to recruit potential PAL Leaders;
- Supervise at least a session of one PAL Leader in order to alert them if anything is going wrong, guiding them in order to conduct a better session; and
- Provide an analysis of the annual impact to the PAL team.

PAL Contacts:

- Maintain contact with PAL Leaders in order to keep up with the PAL evolution;
- Act as a link between the pedagogic team and the PAL Leaders;

- Ensure that PAL Leaders know exactly what their students are studying;
- Help PAL Leaders to prepare their PAL sessions.

2.3.1. Advantages

Some of the advantages of the utilization of PAL can be related to distinct target audiences [11]:

I. Courses:

- Fosters the cohesion among students;
- Encourages students to participate;
- PAL Leaders provide good feedback to the course team, relatively to levels of knowledge demonstrated by students;
- Helps to prepare students for classes, and also aids them throughout the classes; and
- Potentiates competences that students acquire in team works.

II. Students:

- Students feel more comfortable to make mistakes and to admit that they do not understand. This is extremely useful, since many students have knowledge about a notion, but do not demonstrate that knowledge because they feel afraid of making a mistake;
- Students have the opportunity to contact senior students, so that they can tell them what to expect, and give them feedback about their previous experiences; and
- Students can always depend on PAL Leaders to guide them.

III. PAL Leaders:

- Consolidate knowledge, always having in mind that teaching is the best way to learn;
- Develop professional and personal abilities, such as leadership, team work, organization, time management, etc.;
- Significant gain of trust, especially in situations where team work is essential to achieve a certain goal;
- Increase the level of expertise, providing a richer curriculum vital; and
- By reviewing concepts, a deeper knowledge of these will be acquired.

2.3.2. Types of PAL

According to the literature, different PAL strategies can be implemented depending on type of intervenients and how they can interact with each other. After the analysis of these strategies, we are able to generalize them into the following groups:

- Roleplaying—Strategy where students have to simulate (perform) real or imaginary situations;
- Reciprocal Teaching—In this strategy students of the same class interact with each other to learn new forms of comprehension, such as to formulate questions, summarize, make predictions, anticipate, and clarify problems;
- Peer Tutoring—Strategy where one of the intervenients assumes the role of tutor, while the other intervenients assume the role of tutees. In this case, the tutor is a senior student with remarkable learning outcomes; and
- Cooperative Learning—Strategy where students having different knowledge levels study/work in cooperative groups aiming to provide the same level to all the students of a group through the execution of group dynamics.

PAL sessions are in general cooperative and collaborative learning activities. They are usually timetabled weekly into the curriculum, and centered around an hour of discussion and interaction. It is made explicit from the start that the PAL Leaders are not there to teach, and the students attending should not expect them to. They are there to encourage discussion amongst the group, and to enhance comprehension of lectures already attended, not to impart any new knowledge. Although PAL is largely student-driven it works best where the particular course on which it runs is supportive, both in terms of moral support and resourcing, such as by enabling timetabling or provision of activities for PAL sessions [11].

3. BLENDED PEER-ASSISTED LEARNING PLATFORM

The proposed Blended Peer-Assisted Learning (ePAL) platform consists basically on the integration of different existing e-Learning tools and platforms in a coordinated way in order to provide the implementation of PAL strategies. In the Blended ePAL platform two main applications have been developed having a key role in order to convey a customizable improvement of one student´s learning outcomes, the e-Portfolio and the Blended PAL platform, as illustrated in Figure 1.

These two applications are integrated in the ePAL platform as follows: Based on the analysis of the students' academic and professional background, the e-Portfolio is able to determine which PAL strategy (ies) is (are) appropriate to improve the students' learning experience. This analysis is based on the assessment of each entry in the e-Portfolio where skills assets and weaknesses (e.g., Communication, Teamwork, Leadership, Adaptability, Organization, Self-Discipline, and Problem-Solving) are graded. The global average level for each skill analyzed in the whole e-Portfolio will determine the essential skills one student has to possess in order to fulfill the requirements of a certain PAL strategy. This diagnostic indicates the PAL strategies that will facilitate the student´s learning experience. For instance, based on one student's e-Portfolio assessment it
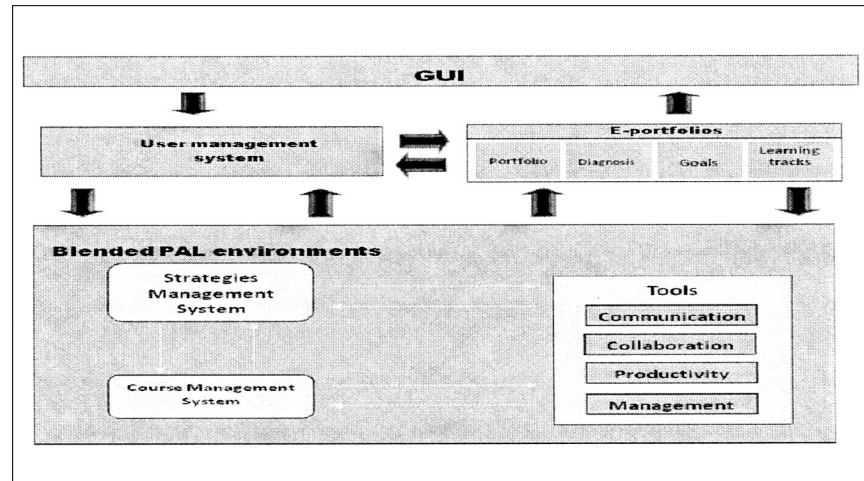
Figure 1. Architecture of the Blended Peer-Assisted
Learning Platform.

was verified that he has strong communication and problem-solving skills. Therefore, the system concludes that Reciprocal Teaching is the most appropriate PAL strategy in order to optimize his learning outcomes. This diagnostic was achieved based on an in-depth study of learning outcomes assessment and on several inquiries carried out in order to validate the analysis method proposed in Gouveia [12].

According to the output of the e-Portfolio application, the professor can implement in the ePAL platform, for instance, Reciprocal Teaching activities to his student who is supposed to learn better with this strategy. It is important to note that the e-Portfolio application is a tool proposed to support learning and the professor's decision, and should not impose the implementation of a particular PAL strategy in a course. As we emphasized before, blending technologies and learning methodologies depend upon different criteria in a course. Nevertheless, the e-Portfolio application still is a useful tool for allowing professors to adapt their courses to the learning needs of his students (intentional learning). In this article we do not address the development aspects of the ePortfolio, in order to further explore the main features of the Blended ePAL platform.

Therefore, in the Blended PAL Platform the professor is able to configure the PAL strategies indicating all the activities that should be carried out by the students in a PAL session and assign the ICTs (e.g., videoconference, whiteboard, etc.) that can be applied to carry out these activities. This process of selecting

strategies/tools will be important in the future of PAL sessions, contributing to a more effective and customizable learning process.

For a better comprehension of the main modules of the architecture presented in Figure 1, these modules are described:

- Graphical User Interface (GUI)—Interface responsible for the interaction with the user. It represents the graphic component of the PAL environment;
- E-portfolios—This module has as main goal not only the exhibition of portfolios, but it is also responsible for their generation and assessment, based on the student´s professional and academic experience;
- User Management—Responsible for managing the entire application, ensuring who can/cannot access a certain resource. It has an important role in the coordination and use of the different modules;
- Course Management—Manages the courses that are lectured in the e-Learning context. Some of its features are: storing information about the students involved in the courses; creation/edition/removal of courses; definition of user profiles (teachers and students), etc.;
- Strategies Management—The purpose of this module is to coordinate the utilization of the ICTs in order to implement the PAL strategy suggested by the student's e-portfolio; and
- Tools (ICTs)—Applied for providing students feasible ways to carry out the activities proposed in a PAL session. These tools can be synchronous and asynchronous and are combined in order to provide a richer and flexible work environment.

In the next section we illustrate the implementation of the Blended Peer-Assisted Learning's main functionalities.

3.1. Implementation of PAL Strategies

The Blended Peer-Assisted Learning platform has been implemented so that it can be easily integrated to existing e-Learning platforms and tools. As such, we decided to adopt Moodle [13] since it is an open-source platform which provides different management functionalities concerning users, content, course organization, assessment, among others. In this case, when the person responsible for a course is creating, structuring, and making available content and activities in his respective course, he will also be able to propose ePAL sessions as some of these activities, as depicted in Figure 2.

In order to present the implementation of the architecture depicted in Figure 1, we illustrate some of the users' steps for the creation and utilization of a Peer-Tutoring strategy through the proposed platform. The remaining strategies were also implemented, but for sake of illustration we present only the implementation for Peer Tutoring.
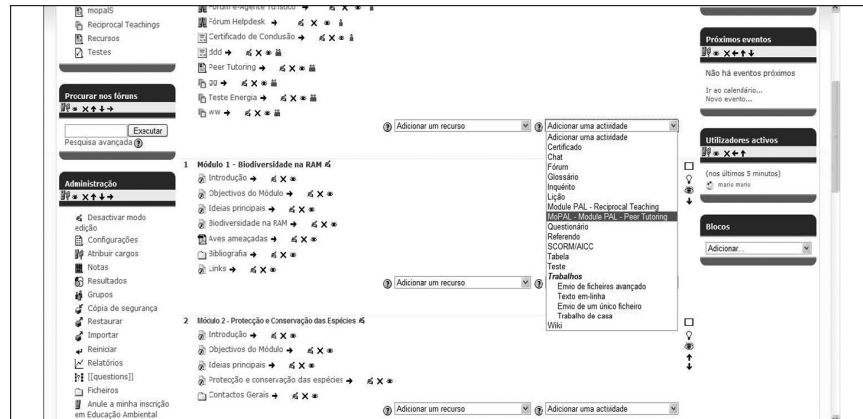
Figure 2. Addition of a new ePAL activity.

For the implementation of this strategy three main different types/roles of users are considered:

- Teacher—person that will prepare the Peer Tutoring Session and coordinate all the sessions between tutors and tutees. Among the main roles of the teacher, he should be able to perform:
  - Configuration of the session;
  - Management of the group of users—add or remove element in a group;
  - Content management—association of didactic content with the ePAL session;
  - Session guide management—add and remove tasks that will have to be carried out by the students in a particular session;
  - Work groups' Follow-up—the professor should be able to follow the work of each group, being able to visualize all the concluded and ongoing tasks, as well as being able to access the common interaction space (ICTs) reserved to each group; and
  - Selection of the ICTs to make available in a particular session.

- Tutor—senior students who will interact with tutees, assisting them throughout the session in order to understand concepts, solve problems, etc. Some of the tasks carried out by the Tutor are:
  - Access to all the information provided by the professor for the session (course, session, goals, and session guide);
  - Access to all the content provided by the professor for the respective session;
  - Work group management;
  - Tasks management—where the tutor is able to change the status of the tasks as they are concluded;

- Assessment according to the types of evaluation provided by the professor; and
- Access to the interaction space for the execution of different exercises/tasks defined by the professor in the session guide.

• Tutee—student who is going to be assisted in a session. The Tutees are able to:
  - Access to all the information provided by the professor for the session (course, session, goals, and session guide);
  - Access to all the content provided by the professor to carried out the tasks of the session;
  - Work group management;
  - Tasks management—being able to change the status of the tasks as they are concluded;
  - Assessment according to the types of evaluation provided by the professor; and
  - Access to the interaction space for the execution of different exercises/tasks defined by the professor in the session guide.

Each module of the Blended Peer-Assisted Learning is presented according to the role or type of user, as presented previously.

3.1.1. Teacher Modules

In order to create a Peer-Tutoring strategy, the teacher (responsible) of a course has to define all the main features of the Peer-Tutoring session. For this purpose, the following modules are available to the teacher: *Session Configuration, Workgroup Manager, Content Manager, Session Guide Manager, Groups Follow-up,* and *Assessment Manager*

Session Configuration (main module)

In this module, the teacher will configure the main features of the Peer Tutoring session (Figure 3). The features of this module are the course name, session description, objectives of this session, and ICTs to be applied in the session. Starting from this module, the teacher can also be guided intuitively to configure all the other components of the session (e.g., *Workgroup Manager, Content Manager, Session Guide Manager,* and *Assessment Manager*).

The *Session Configuration* is a flexible procedure since it can be carried out according to the teacher´s needs. Therefore, the teacher can only apply the modules that he will need during the ePAL session. Nevertheless, to implement a Peer Tutoring session, the teacher will need at least to configure the *Workgroup Manager* and the *ICTs selection*. In the following sub-sections we present the remaining ePAL modules.
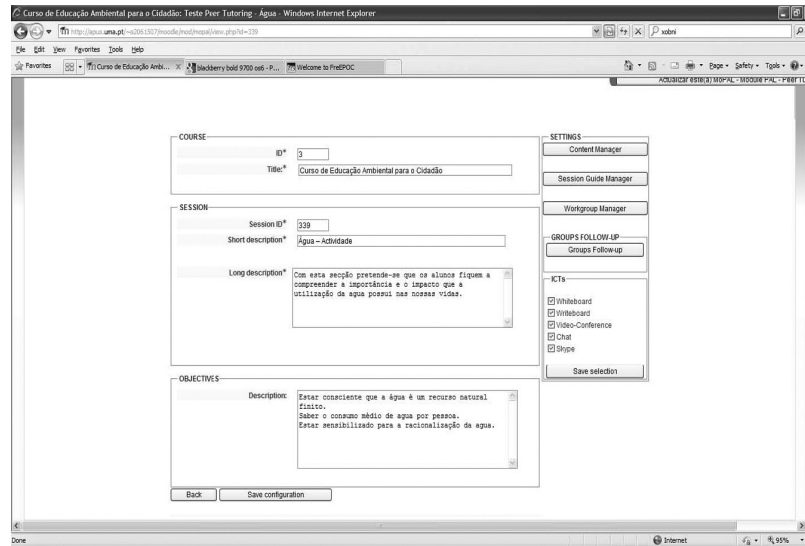
Figure 3. Session Configuration module.

Workgroup Manager

In the *Workgroup Manager* module, the teacher (responsible for a course) is able to create and associate students with a working group, and assign their respective roles for each Peer-Tutoring session (as depicted in Figure 4). After the session is configured by the teacher, the students enrolled on the course can form the groups. Each student performs a specific role in the group: Tutor (only one) or Tutee (one or more).

The *Workgroup Manager* Module depicted in Figure 4 is divided into two main areas:

- Configuration area—In this area the teacher is allowed to configure the workgroups, determining not only the users that will be able to access his own workgroup configuration, but also determining the maximal number of elements per group; and
- List of all the students enrolled on the course, and their respective profile and groups—in this area all the enrolled students are presented. This area allows the professor to determine the workgroups and the profile of each student inside the group (tutor/tutee).

Content Manager

In this module, the teacher is able to add and manage the content associated with his Peer-Tutoring sessions. This content will be applied by tutors and

Figure 4. Workgroup Manager module.

tutees throughout the sessions (Figure 5). For each content provided for the session the teacher has to indicate: *content, file type, role* (with the values tutor, tutee, and all, depending upon who is allowed to access the respective file) and *file* name.

Note that this module represents an extra resource to the teacher to make available content besides the possibility of already doing this on Moodle. This is to make sure that complementary files only related to that particular ePAL activity can be provided to tutors and tutees, and also to provide files that can only be accessed by the tutors for obvious reasons (e.g., exercises resolution).

Session Guide Manager

The *Session Guide Manager* module has a key role on the session description in order to guide students throughout the learning process (Figure 6). This module enables teachers to define the tasks that have to be performed by the students so that they can accomplish the objectives initially defined for the respective Peer Tutoring session. Each task can be related to a specific activity during the session (e.g., reading a paper, solving an exercise sheet, etc.), they can be associated with contents (documents) and possibly allow tutors and tutees to assess it. Each task can also have a limited duration to be carried out which can be defined by the teacher.

The *Session Guide Manager* Module is composed of four different configuration areas: Course, Session, Tasks, and Add New Task. Course and Session, as described previously, present the information concerning respectively the course and ePAL session.
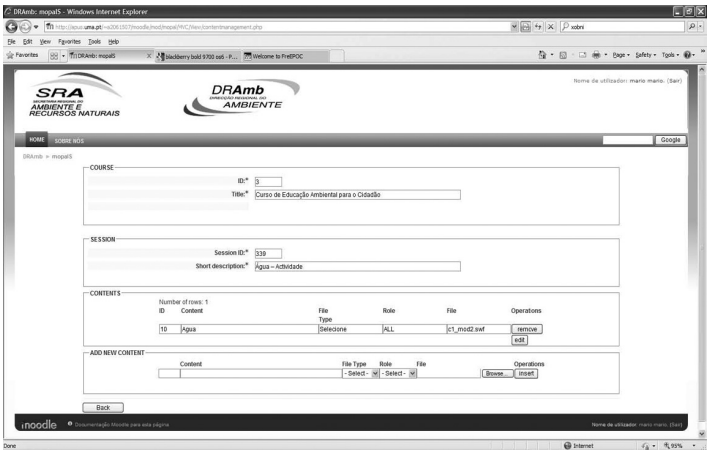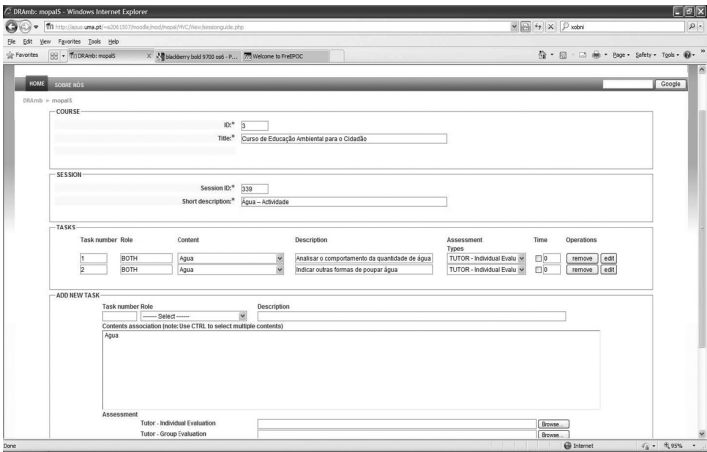
Figure 5. Content Manager module.

Figure 6. Session Guide Manager module.

The Task area lists all the tasks included which are to be performed by the tutors and tutees. Each entry in this list is defined by the following elements: Task Number, Role (Tutor, Tutee or Both), Associated Content, Description, and Assessment Types (Tutor—individual evaluation, Tutor—Group evaluation, Tutee—Self-evaluation, and Tutee—Tutor evaluation). The Add New Task, as the name indicates allows the addition of new tasks to the list.

Also, the teacher can provide the assessment sheets (as XML files) determining the template to each kind of evaluation to be carried out in the session. At last, the teacher can also determine a time limit for performing each task proposed.

Groups Follow-Up

This module allows the teacher to follow, at any time, the tasks carried out by each group. Each task has three statuses: Pending, Ongoing, and Finished. Teachers can supervise students' work, and eventually provide feedback, in order to guide them throughout their learning sessions. By accessing the Interaction Space, group members can perform videoconference, chat, access whiteboard, and writeboard tools, among others. Teachers can also join the Interaction Space to supervision how each groups' work is getting along.

As illustrated in Figure 7, this module allows the teacher to follow the students´ activities along their workgroup sessions. The teacher carries out the follow-up through a list of the working groups and their respective user members. Each entry on this list is defined by the following elements: Group Id, Users Id, Role (Tutor/Tutee), Current task, status (not started/started/finished), and the respective Interaction Space.

Assessment Manager

This module provides teachers with the ability of creating assessment forms for their Peer Tutoring session (Figure 8). Each assessment is composed of questions (it can be seen as a questionnaire) that will be presented to students, in order to promote individual assessment, group assessment, and even self-assessment.
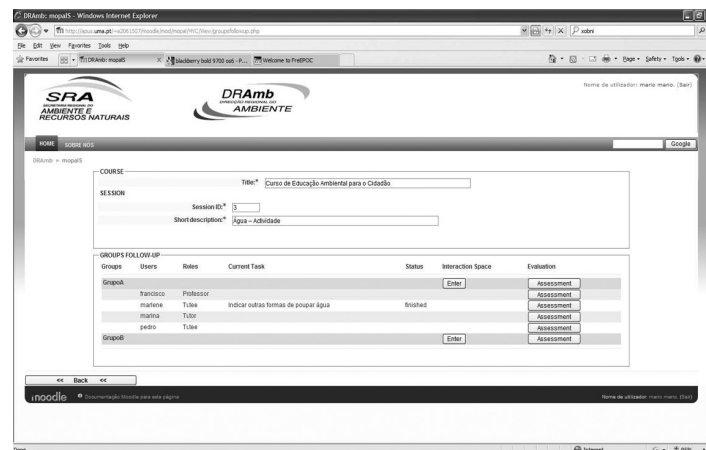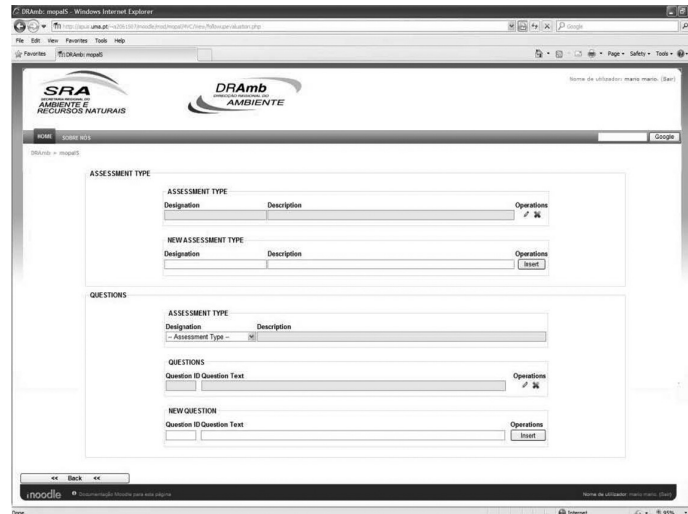

Figure 7. Group Follow-up module.

Figure 8. Assessment Manager module.

Students also have the possibility of assessing the teacher, so that the later can auto-critique the adopted learning strategy, and suit it better to students needs.

4.1.2. Tutor and Tutees Modules

The modules of the Blended Peer-Assisted Learning platform accessed by the tutors and tutees are similar to those of the teacher. These modules allow them to access and manage the task performed in a session in order to accomplish the proposed objectives of the PAL session.

Main Module

This module provides students (tutor and tutees) with a list of ordered tasks to be performed in a session with their respective objectives proposed by the teacher. Students can manage the tasks carried out by defining the status of a determined task (not started, started, or finished), checking the pending time for finishing it, and also by providing its assessment. They can also access the "Interaction Space." Figure 9 illustrated the students' main module.

The Tutor/Tutees' Main Module is composed of different areas: Configuration (workgroup management), available Content, Description, and Objectives of the session, Session Guide (which describes the list of activities to be carried out in this session), and Interaction Space. The Interaction Space allows each group to select the desired communication and collaboration tools in order to perform the activities proposed in the ePAL session (Figure 10). Currently, the
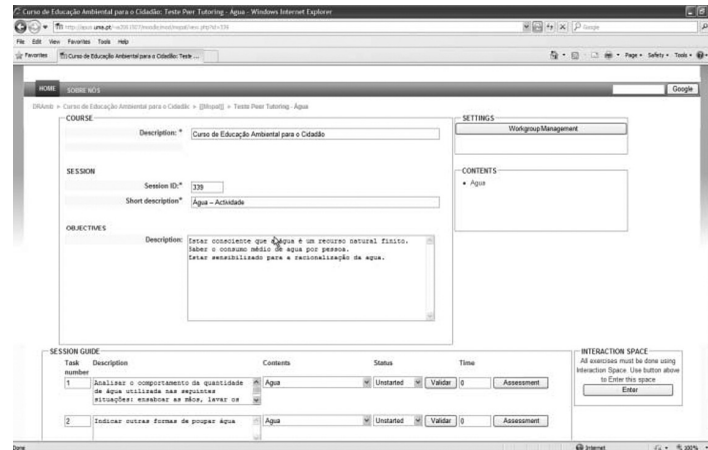
Figure 9. Tutor and tutees main module.

Figure 10. Interaction Space and ICTs.

ICTs supported by the Blended ePAL platform are Skype [14], MSN [15], Whiteboard [16], Writeboard [17], and Videoconference [18].

WorkGroup Management Module

Figure 11 illustrates another Workgroup Manager module which was developed for the tutors and tutees. This module is different from the teacher's since it allows the workgroup management after the session in on-line. This module

Figure 11. Tutor/Tutee Workgroup Management module.

is composed of two distinct areas: Course identification and Workgroup. In particular, the Workgroup area allows the user to manage—add, delete, edit, and order—the members of his group.

Assessment Module

When the tutor/tutee selects the Assessment option next to each task in the Session Guide (Figure 9), he will be able to choose the appropriate assessment form (Tutor—individual evaluation, Tutor—Group evaluation, Tutee—Self-evaluation, and Tutee—Tutor evaluation) which will be presented as an inquiry to be filled out (Figure 12). All the assessment forms will be available afterwards to the teacher so that he is able to evaluate the outputs of the ePAL session.

Following the same principle presented for the implementation of the Peer Tutoring strategy, the remaining PAL strategies were also defined and implemented. The experience with the initial application of the implemented strategy has demonstrated that this enriched synchronous activity in an e-Learning environment such as Moodle can facilitate the learning process, also allowing teachers to improve the quality of their courses, and students to be closely assisted.

4. CASE STUDY

The Environment Regional Direction (DRAmb) [19] in Madeira (Portugal) offers different e-Learning courses on environmental education for providing citizens awareness and sustainability consciousness. Since DRAmb was interested to introduce new ICTs in order to organize, provide, and share information related to their courses, we decided to apply the developed Blended Peer-Assisted Learning platform to validate its functionalities and usability. For

Figure 12. Assessment module.

this case study, some PAL sessions were proposed for the course "Environmental Education for the Citizen," in particular for the modules "The importance of Water" and "Energy."

The first validation of the ePAL platform concerned the configuration of the PAL sessions related to the environmental courses and aimed at providing a first feedback about the platform's usability and configurations issues from the responsible for these courses (administrator). The second validation concerns the utilization of the platform by the students attending the courses in order to also assess its usability.

This case study was carried out with a small group of users in order to facilitate the validation of the developed modules. A group of nine persons (1 tutor and 8 tutees) participated in this case study. After the configuration of the ePAL sessions by the administrator (in DRAmb the administrator/tutor is the same person) and the utilization of the platform by the students (tutees), some inquiries were proposed in order to assess the opinion of the users about each module and its usability. Therefore, two distinct inquiries were applied, one for the tutor and another for the tutees.

Basically, the questions on the tutor's inquiry aimed at verifying how intuitive (or not) were the tutor's module during the configuration of a session, his opinion about the resources available for the work groups' follow-up (Session Guide, Interaction Space, ICTs, etc.), possible suggestions for enhancements and indication of strong/weak features of the platform. Based on tutor's responses to the inquiry and on some notes remarked during the session, we came to the following results:

• Concerning how intuitive the platform is for the configuration of the sessions, the feedback from the tutor was positive since he considered that as an easy task to perform and he did not report any issues during the process;

- As for the work groups' follow-up, the tutor considered that it is important to be able to assist the tutees to perform the tasks whenever is possible and he claimed that the ICTs available are enough and effective for accomplishing the goals proposed in the session;
- Concerning the suggestions for enhancements, it was proposed the development of a drag-and-drop functionality for adding new content;
- As strong features, the tutor identified the communication among the partners of a group. Considering the tutor/tutees are using synchronous tools, tutees feel more comfortable to acknowledge the tutor's "presence." Another strong feature pointed out by the tutor is that through tutoring he has the opportunity to consolidate the knowledge he already has about a particular subject;
- Nevertheless, as weak features the tutor argued that the he probably would not follow the tutees activities appropriately leading to a miscommunication among the last ones, and consequently to their lack of engagement in order to achieve the goals proposed for the session. In our opinion, a solution to this issue is to foster an appropriate utilization of the platform and the communication and collaboration tools by the tutor enabling him not only to follow the tutees' activities appropriately but also assessing the tutees' performance during the learning process and assisting the tutees motivating them to achieve the goals proposed for the session; and
- Another issue pointed out by the tutor is that he eventually will be overloaded with more work since besides having to follow the tutees' activities, he also will have to attend periodic meetings for coordinating session proposals with the other tutors. In this case, we indeed have to consider that the application of new methodologies and tools for improving the learning quality demand a period of adaptation and training, which is an effort needed so that all the stakeholders achieve a common goal. However, we observed that the tutor rapidly adapted to the utilization of the platform being able to configure correctly the PAL session and to assist the tutees' activities.

After having concluded the tests with the tutor, we also applied the tests and the inquiry to the tutees. The questions in this inquiry were related to how intuitive is the navigation and utilization of the platform, the need for existing another kind of communication/collaboration technology in the application, which were the problems found during the utilization of the platform, suggestion for improvements, which were the most helpful ICTs for acquiring knowledge and achieving the proposed goals of the session, the existence of an ICT that makes more difficult the learning process and general comments on how the adopted strategy represents an advantage during the learning process. Based on tutees' responses to the inquiry, we came to the following results:

- As for the navigation aspects, the comments diverged concerning how intuitive is the user interface. Some users were satisfied with the simple and intuitive application, while others suggested some improvements such as the

utilization of images or icons to facilitate the identification of the Interaction Space access area and modification of some technical terms applied in order to make the interface more accessible and comprehensive;

- As for the adopted ICTs, the tutees thought they were sufficient to carry out the tasks proposed, having a preference for the writeboard and video-conference. Although, they also pointed out that the choice of ICT depends particularly upon the task to be performed. Concerning MSN, two users considered that as a tool that can lead to some distraction during the learning process;
- Most of the ICTs' utilization problems reported were related to the application of writeboard and whiteboard, and on the insertion of new addresses in the application. Nevertheless, we later verified that it occurred due the lack of knowledge and experience in the utilization of these tools. After some time of utilization, the same users understood their correct utilization and this constraint did not represent a problem anymore;
- Concerning the relevance of the adopted strategy to the learning process, the tutees had similar opinions, basically related to existence of a good communication between tutor and tutees due the confidence among the members of the group, considering that they are colleagues from the same course. Therefore, this "comfortable" working environment provided tutees more initiative and a larger collaboration among them for performing the tasks, the possibility of learning with their own mistakes and sharing their doubts with their peers, leading to a major effort from each member of the group and a space for self-development.

Based on the results of this case study, it was possible to obtain in general a positive feedback about the utilization of the Blended Peer-Assisted Learning platform. Nevertheless, we concluded that some improvements should still be carried out in the platform in order to make it more comprehensive and intuitive for users. Therefore, despite the need for some improvements, the core functionalities of the platform developed provide users with an useful learning environment where communication and collaboration among tutor and tutees are the main key to convince us of the potential of the utilization of the Blended Peer-Assisted Learning platform in order to improve learning experience.

5. RELATED WORKS

The benefits of collaborative Peer-Assisted Learning (PAL) have been confirmed by different studies. For instance, children are able to greatly increase their computer proficiency [3]; students can discuss varied issues in greater depth and their critical thinking skills are considerably enhanced in the process [4]; and learners' levels of involvement and incentives to learn have also increased significantly with a wider and more complete understanding of the subject

knowledge [5]. Some other efforts in the literature explore the PAL benefits through the development of mobile-based or web-based solutions for providing synchronous collaborative learning environments.

Lan, Sung, and Chang present a mobile-device-supported Peer-Assisted Learning (MPAL) system which was developed for addressing the weaknesses of collaborative learning in traditional English as a Foreign Language setting. MPAL seemed to reduce anxiety in elementary EFL learners, promote motivation to learn, and enhance oral reading confidence [20]. The use of mobile devices in collaborative EFL reading activities reduces the stress experienced by students and facilitates student collaboration.

Another approach discussed some of the challenges tutors face when engaging with multi-user virtual environments (VEs) specifically addressing Second Life used as a learning environment [21]. In this work the author explored the mentoring practices and interactions tutor/tutees in PAL sessions inside VEs. Some of the conclusions of this work indicates that the key of success for an online course run in Second Life is to identify the educational dynamics (introduced by different learning/teaching contexts) behind the unique affordances the environment itself offers and highlight how they can affect teaching and learning.

Bader-Natal claims that many web-based learning systems connect students asynchronously, while fewer systems focus on facilitating synchronous interactions among learners [22]. As a solution to this issue, his paper presents the main aspects about the development of a web-based learning environment designed to support both synchronous and asynchronous interactions. The motivation for supporting synchronous interactions among peers was primarily intended to provide a compelling social experience that motivated students to engage in learning collaboratively.

A set of tools for implementing Peer-Assisted Learning was introduced in [23]. This paper explores the potential of Wimba software, within an institution-wide Moodle learning management system, to extend Peer-Assisted Learning programs in a Web 2.0 context. The main goal of the paper is to discuss how PAL strategies can be implemented and how this may affect the social aspects of the learning experience and by extension influence academic results and retention.

Kirkwood is interested to study how Social networking behaviors and Peer-Assisted Learning strategies, along with knowledge management through guided folksonomies, provide the backbone of a social systems approach to learning support [24]. His paper presents the development of the SNAP Platform which was designed to support the development of students' academic skills. It is based on the principles of wikinomics and incorporates Web 2.0 tools, communicative and collaborative potential between staff and students, the opportunity to discuss and share resources, peer engagement and mentoring, the creation of learning communities of practice and—at its core and as its acronym indicates—social networking for academic purposes.

Despite new technological solutions were not developed for implementing PAL strategies, some further efforts make a more theoretical/analytical approach in order to verify or validate the benefits of PAL strategies, such as the behavior study (group/individual and face-to-face/on-line) when applying PAL strategies in teachers education [1]; utilization of learning styles and peer-assessment to improve ICT skills [9]; the proposal of a PAL model to build online Peer-Assisted Learning community [25]; implementation of Peers and Parents-Assisted Learning for school-aged children in order to verify the social, motivational, and self-esteem benefits for both the helpers and the helped [26]; and exploring the potential for virtual learning environments or social networking sites to complement or replace the existing face-to-face models of peer mentoring [27].

As concluded by Gaofeng and Yeyu, the implementation of PAL strategies provides two main advantages. First, different from traditional learning models are oriented to assess students and boost competition, Peer-Assisted Learning encourages mutual help, supervision, and communication among group members, corrects learning attitude and motivation [25]. To some extent, it stimulates learning interests and consciousness. Secondly, Peer-Assisted Learning in online learning contributes to develop consciousness and ability to inquiry and improve collaboration ability, understanding and command of knowledge.

6. CONCLUSIONS

This article presented the main aspects about the development and functionalities of an adaptive and collaborative learning environment based on student's pedagogic needs, the Blended Peer-Assisted Learning (Blended ePAL) platform. The Blended ePAL platform integrates different paradigms (ePortfolio, Blended Learning, and Peer-Assisted Learning) in order to propose a rich synchronous e-Learning environment and improve the student's learning experience.

As presented in the related works, we can verify the interest and benefits of the utilization of PAL strategies throughout different face-to-face and on-line learning experiences. Some solutions have been implemented as mobile and web-based technologies, and most of these solutions came to the same conclusions regarding the benefits of PAL strategies in order to overcome the student's first year's transition issues.

Based on the results of the case study, we were able to validate the implemented functionalities and the platform usability. As in the related contributions, we also concluded that the implementation of PAL strategies on Moodle seems to represent an asset to this platform turning it into a dynamic and synchronous learning environment. The case study allowed us to verify that the Blended ePAL platform improves the student's learning experience and outcomes providing: (a) an effective communication (since students feel more comfortable to work among peers); (b) a more meaningful student's participation (and learning); and (c) an improvement in the socialization and role modeling since students are able to create identity with their senior fellows.

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