Drawer: an Innovative Teaching Method for Blended Learning

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Abstract—**During the last decade there has been a shift in the way learning process is conducted. One of the main reasons is that technology is changing. Due to this fast movement, concepts like "class", "workgroup" and "learning process" are changing too. Learning processes are going beyond the boundaries of what was known as "class". Face-to-face models get mixed with online environments where students are remotely connected through the Internet. This new approach is called blended learning, and it is aimed at improving learning as well as bringing learning where it was impossible or complicated. Nevertheless, one of the main issues is that teachers need innovative tools that support these different learning models.**

As a consequence, this work is focused on the development of a tool for dealing with the main issues found in blended learning scenarios. It is divided in three phases. First, the blended learning experiences and models of the last decade are reviewed. In a second phase, a tool called Drawer, for supporting the main features of the design and use of blended learning experience is developed. In the last phase, an evaluation is made to assess the outcomes of the new tool.

I. INTRODUCTION

INFORMATION Systems are a widespread component of the current society. Computer science, multimedia technologies, telecommunications, Internet and other concepts of the "*digital age*" are essential in a wide range of fields. Information and communication technology allows the creation of tools and infrastructures for information management, data processing and communication with others, both individuals and groups. These tools can be used in almost every activity, including teaching and learning. But tools are only a part of the equation. How to use them and how to put in practice the related concepts may be firstly understood for a successful implementation of these activities. Therefore, experiences about their use are essential for the understanding of how and when to put them in practice.

In the case of education, the curricula are increasingly incorporating a combination of traditional face-to-face learning models and non-face-to-face models (mainly online through the Internet). Institutions and teachers are aware of the potential of using such approaches in the implementation of successful learning experiences. With the emergent tech-

nologies and the wide array of technological support at our disposal, there is no point in putting aside blended learning. But setting up blended learning environments is not a trivial task. There are a lot of things to take into account. All the involved stakeholders are crucial when setting up these learning experiences: teachers, students, institutions and academic staff, among others.

As a consequence, the first goal of this work, the study of the different perceptions of blended learning during the last decade, arises. In this period, technology has been leading the evolution of learning as well as teaching processes. But it is important to point out that technology is not the goal; it is only a tool to facilitate the connection between the different elements within the learning process. Pedagogical implications have to be always kept in mind.

When understanding how to use blended learning, teachers will have to choose and use the correct tools. But nowadays there is a gap between the perception of how these tools will look like and how they are built. This is why the understanding of blended learning is important in order to develop tools for helping teachers. And that is the second goal of this work: to gather the knowledge of the study of a decade of blended learning to develop a tool that combines the key elements for supporting blended learning environments. Finally, the third goal of this work is to make an evaluation to ensure that students get benefits through the use of the developed tool.

The paper is organized as follows: firstly, it is presented how blended learning has been understood and used during the last decade. Then, the lessons learned are highlighted. Next the developed tool is described. This tool follows the key elements previously found. Subsequently, a comparative evaluation of the developed tool is presented. And finally, the conclusions and the future work are presented.

II. A DECADE OF BLENDED LEARNING

In this chapter different course experiences and models for the design of e-learning and blended learning in the last decade are reviewed. The main objective is to infer the key elements for the design of tools for supporting successful blended learning scenarios. Teachers, through this review, will know different experiences and approaches to apply in their education curricula. They also will be able to use exis-

tent tools in a different manner, by taking advantage of the depicted course models and experiences.

Valiathan in [1] categorized three different blended models. Skilldriven learning combines selfpaced learning with instructor support to develop specific knowledge and skills. Attitudedriven learning mixes various events and delivery media to develop specific behaviors. Competencydriven learning blends performance support tools with knowledge management resources and mentoring to develop workplace competencies.

Twigg presented new models for online learning improving learning and reducing costs [2]. Six characteristics were found when designing blended courses: 1) whole course redesign; 2)active learning: all of the redesign projects make the teaching-learning enterprise significantly more active and learner-centered; 3) computer-based learning resources; 4) rather than depending on class meetings, student pacing and progress are organized by the need to master specific learning objectives which are frequently in modular format; 5) on-demand help. Enhancing students feel that they are part of a learning community is critical in regard to persistence, learning, and satisfaction; 6) alternative staffing. Not all the tasks associated with a course require highly training and expertise. This work also identified five distinct approaches for course design: a) supplemental model: retains the basic structure of the traditional course, particularly the number of class meetings; b) replacement model: the key characteristic of the replacement model is a reduction in class-meeting time, substituting it with online, interactive learning activities for students; c) emporium model: the re-design model allows students to choose when to access course materials, eliminates all class meetings and replaces them with a learning resource center featuring online materials; d) fully online model: the instructor must be responsible for all interactions; e) buffet model: information technology in teaching and learning means that it can radically increase the array of learning possibilities presented to each individual student.

Aspden [3] asserted how a blended learning approach alters the dimensions of the relationships between the students and the other aspects of their learning experience. The findings reported indicate that the blend itself makes effective engagement in a range of possible situations, allowing students to fulfill their different activities together with more flexibility according to their particular circumstances.

Heinze [4] concluded that face-to-face, blended learning and e-learning are difficult to understand separately, mainly because there are overlaps between then, as depicted in Figure 1. So, the different learning strategies are represented in two axes: use of technology and time spent on online learning. Blended learning is located between face-to-face and online modalities.

Graham [5] described trends and future directions for blended learning systems. In Figure 2 it is depicted the progressive convergence of traditional face-to-face and distributed environments, by allowing the development of blended learning systems. Graham found six major issues relevant to designing blended learning systems: 1) the role of live inter-
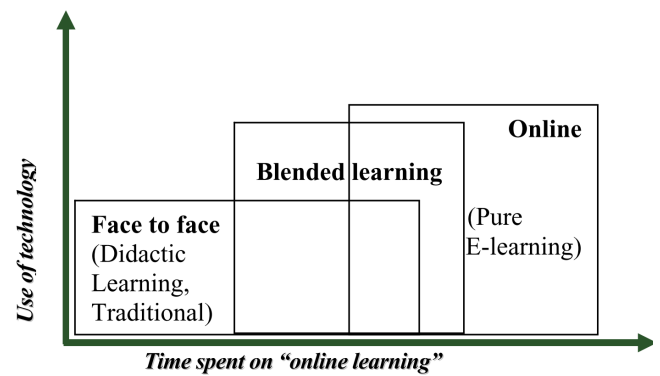

Fig. 1 Learning approaches

action; 2) the role of learner choice and self-regulation; 3) models for support and training; 4) finding balance between innovation and production; 5) cultural adaptation; 6) dealing with the digital divide.
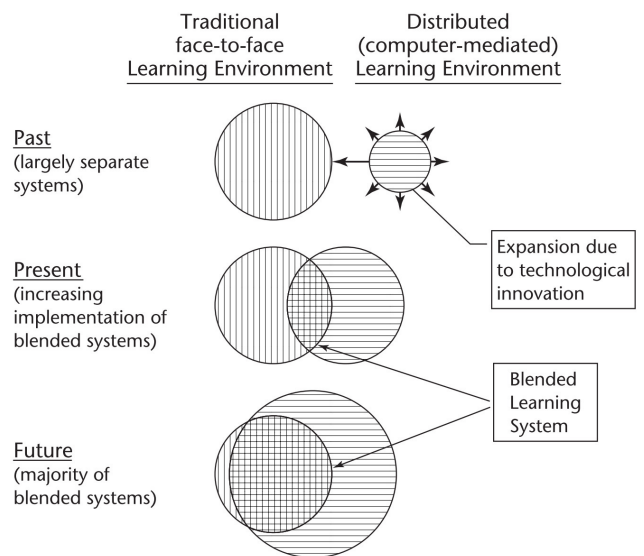

Fig. 2 Progressive convergence in blended learning systems

For Kulvietiene [6] the integration of a virtual classroom into learning managing systems has many advantages: a) opportunity is presented for provided blended learning; b) learning activities including both virtual classroom sessions and learning in a virtual classroom can be managed from a single location; c) information about learning activities is stored in a single location.

Draffan [7] identified the challenges for blended learning from two perspectives: the learner and the teacher. From the learners point of view, the main challenges are: skills, e-skills, preferences, content interaction and design, learning interactions and assistive technologies. From the teachers perspective, the main challenges are: the issue of context, learning design and to facilitate inclusive learning. It is needed to ensure that the students can interact successfully with the technologies, among themselves (through reflection), with their peers, with their teachers, with the support workers and with the learning materials.

Kim [8] presented a survey that found blended learning gained popularity in many organizations but also that several barriers exist in implementing it.

Wang [9] used asynchronous tools for online collaboration and offline interaction between students in blended learning. The offline atmosphere in carrying out the asynchronous computer media communication activities were sorted into five major categories: struggling with platform operations, handling technical problems, passive attitudes towards the procedure, tense atmosphere in class, and engagement in tasks. Blended learning does not automatically help students in their adoption of active learning strategies. The roles should be recognized to promote effective and efficient online/offline interaction.

Dziuban [10] reached a reasonable conclusion: students react generally to the course, the content, the instructor, the learning climate, and themselves. One remarkable and well-known conclusion is that the boundaries of what has been called the "class" are disappearing.

For Khan [11] assessment was, without any doubt, one of the major tools in the teaching and learning process. Assessment is considered an effective tool in determining student's knowledge gain in any particular course they enrolled. Traditional learning is more class oriented and less flexible in terms of class schedule, use of latest technology and learning methodology, while blended Learning is flexible and supports both classroom and online teaching.

Fleck [12] depicted the opportunities and challenges in blended learning communities. They presented the case of The Open University and its explicit social mission to provide educational access to those who were otherwise denied the opportunity for learning. To provide it, different models for blended learning arise throughout the time: a) correspondence and broadcast models: printed course materials sent by surface mail in a correspondence course style; b) purpose-designed quality distance education model: systematic consideration of pedagogic principles, professional editing, and explicit design for effective delivery over a variety of media; c) practice-based model: between learning materials and students; between tutors and students; between student peers; and above all between students and their work colleagues; d) learning community model: thanks largely to the web and readily accessible search procedures, raw information and data are available very easily and increasingly at little or no cost.

In his work, Fleck describes which features the next generation of learning models would have: a) the creation of a learning community; b) emphasis on process & activities, not content and assets; c) use of a wide range of existing & specially designed assets; d) focus on student-driven learning; e) use of Web 2.0 and mobile devices to support communication; f) design of face-to-face residential schools for business networking.

Moskal [13] proposed some questions for an initial blended learning: 1) Why should the institution engage in blended learning? What are our goals and what outcomes do we expect to achieve? 2) What student benefits do we seek? 3) What courses or programs will we offer in a blended for-

mat, and why? 4) How will we engage in and support our faculty in order to make them successful? 5) How will we roll out blended learning throughout the institution? 6) What levels of investments are we prepared to make and what returns do we expect?

Graham [14] presented six cases of institutional adoption of blended learning to examine the key issues that can guide university administrators interested in this endeavor. He describes three broad categories for the adoption of blended learning: strategy, structure, and support.

In [15] Bohle proposed four factors as crucial elements for a successful bottom-up change process in blended learning environments: the macro and the micro contexts, the project leader and the project members. He also revealed that bottom-up change process leads to three important outcomes: 1) the development of blended learning programs which match the needs of faculty and learner; 2) incentives for new task forces to solve institutional bottlenecks which only the faculty could have discovered; 3) new knowledge for the institutes.

Taylor [16] identified facilitators and barriers to systemic implementation of blended learning. It was found that, as teaching and learning environments are socially dynamic, strategic institutional change would only happen if there is a shared vision and energy that touches all parts of the organization.

Owston [17] examined the relationship between student perceptions in blended learning courses and their achievement. The overall conclusion of this study is that high achievers are very satisfied with the blended format. On the other hand, lower achievers may not be able to succeed in this learning environment as well.

Taplin [18] analyzed the monetary value students place on having access, via the Internet, to recorded lectures in a blended learning context. The principal results are that the average price students are willing to pay is approximately $30 per equivalent full time student.

III. LESSONS LEARNED

The e-learning approach takes advantage of the benefits that information technologies provide to learning environments. They bring new opportunities in learning environments. But, contrary to the general believe of most teachers, distributing knowledge elements through electronic media is not always enough to take advantage of the e-Learning capabilities. It should not be only regarded as a cheap way of distributing resources to a big number of students. For understanding what blended learning is, how it has been used and how it be implemented in an effective way, next are presented blended learning definitions during the last decade:

- A solution that combines several different delivery methods, such as collaboration software, Webbased courses and knowledge management practices [1]
- Learning which combines online and face-to-face approaches [4]
- Learning that is facilitated by the effective combination of different modes of delivery, models of teaching and

styles of learning, and founded on transparent communication among all parties involved with a course [4] [7]

- Systems that combine face-to-face instruction with computer-mediated instruction [5]
- A combination of various networked technologies in a single learning package; a synthesis of various pedagogic methods that enables to achieve an optimal quality of learning process; a combination of various lecturing technologies (video cassettes, compact discs, internet material, etc.) together with direct lecturing by an instructor [6]
- An approach of combining face-to-face instruction with computer-mediated instruction is called blended learning [9]
- Blended approach studies how to join the best feature of face-to-face and online instruction [11]
- Instructional approach that substitutes online learning for a portion of the traditional face-to-face instructional time [17]
- A combination of online learning and face-to-face approaches to teaching [18]

Other lessons learned from the previous study are the main characteristics to keep in mind when designing blended learning approaches. These characteristics have been inferred from the review done in this research. They are intended to guide teachers, but they could be also interesting from other points of view, such us for measuring the quality and for evaluating courses based on blended learning scenarios. Main lessons learned are: a) Students learn by doing, not by listening to some one talk about doing. There is a wide range of learning approaches, from face-to-face to fully on-line. b) The "right way" to design a high-quality course depends entirely on the type of students involved. c) Students need to be treated like individuals, rather than homogenous groups. d) Effective blend of face-to-face and online learning opportunities have to take into account individual students' particular needs. e) Blended learning will be characterized on how they blend instead of whether. f) To guarantee inclusive learning is fundamental for creating successful blended learning. g) The term "class" goes beyond the boundaries of the physical location. h) One of the key issues is the role of technology. But technology is not an end in it itself, pedagogy must lead.

Through the review of the blended learning models and experiences, the weaknesses and the strengths have been also gathered.

The main weaknesses found in blended learning are:

- Need of effective guidance
- Technical issues
- Lack of communications
- Unsatisfactory use of the face-to-face session time
- Implementation
- Robust and reliable infrastructure is required

- Social interdependence among the participants, the tasks assigned, and the e-learning tools remain challenging for teachers

The main strengths found in blended learning are:

- Compatibility with working life
- Flexibility
- Good student support
- Improved pedagogy
- Increased access and flexibility
- Increased cost-effectiveness
- Information from the face-to-face activities to total online interactions is stored in a single place.
- Promotion of social interaction
- Quick feedback to learners which will help them in their learning process
- It provides collaborative activities among teacher and students
- It allows access to everyone who needs training by providing it in different ways

These characteristics produced a shift in teaching and learning from simple knowledge transmission in which "content" is transferred to the devising of processes and activities that enable deep learning following the "triple A" paradigm: Anytime, Anywhere, Anyone.

This change could be described by the Table I [11], where it is characterized the shift between traditional and blended learning from the point of view of the features of learning.

TABLE I.
SHIFTS BETWEEN TRADITIONAL AND BLENDED LEARNING

Characteristics of learning	Traditional learning	BlendedLearning
Place	Mainly in class-rooms (Not flexible)	Combination of classroom / home, library (flexible)
Learning Methodology	Offline	Offline as well as Online Learning
Time of learning	Fixed as per the schedule (Not flexible)	Adjustable as per personal choice (Flexible)
Use of Technology	Not must up to the instructor to choose the teaching methodology	Latest use of technology is must

Creating scenarios that allow teachers in the process of setting blended environments is still challenging and complex. As a result of the aforementioned characteristics, collaboration and social factors are key aspects when designing these environments. In the Table II, Lambropoulos [19] describes social awareness requirements and propositions.

TABLE II.
SOCIAL AWARENESS REQUIREMENTS AND PROPOSITIONS

Social awareness requirements	Propositions
Embodied self & group presentation	Emoticons, avatars, group network representation
Visibility of social presence and connectedness, locality	Individual nodes, group ties and networks, online status
Social and cognitive awareness	Enhanced discussion forums, group network representation
Depiction of the individual and group locality to indicate the spatio-temporal relationship	Group network representation
Participation measurements	Participation graphs
Lightweightness & interoperability	PHP and JAVA programming languages
Simple to interpret and easy to use	User-centered design

IV. DRAWER

Drawer is a web application for helping teachers to design assessments. The main characteristics are the support for collaborative tasks, the sharing of information and the management of social interactions between users. Drawer has the advantage that all these functionalities are integrated in the same environment, making it easy to use. They are easily accessible, being easy to create learning experiences.

The application was made bearing in mind the findings made in the previous phases of the project. So, the key elements for developing successful blended learning experiences arise. To support them, the application manages the following elements: a) users and their relationships: user profiles, creation of groups, personalized shared workspaces; b) synchronous and asynchronous communication; c) information is stored in a single place: files, logs, conversations and other information.

The management of users and their relationships is made by the application. Drawer includes mechanisms for controlling the authentication and access to the application. Only registered users are allowed in the system. The main screen of the application is depicted in Figure 3. There, users are allowed to log in the system or to create a new account.

Once the user is logged in the system, the main screen for logged users is presented (Figure 4). There, there are two main areas. The main menu, that is located at the top of the screen, and the rest of the interface. The main menu has the following sections: start, alerts, mailbox, user information and search.
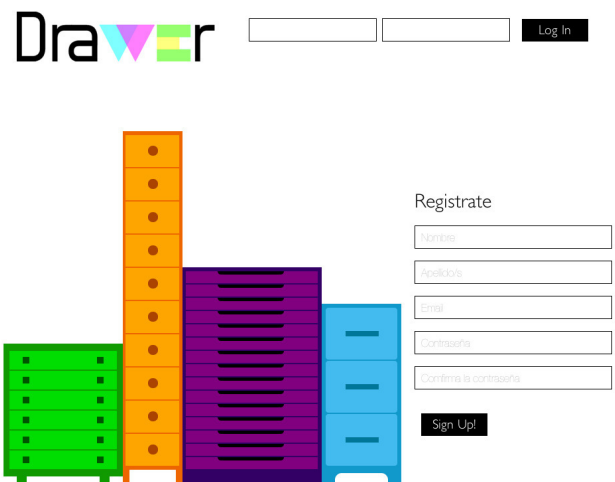

Fig. 3 Main screen of Drawer

The *"start"* section corresponds to the screen depicted in Figure 4. There, users view the available drawers. Drawers are stacked by categories for better organization or for grouping users. Users are allowed to create new drawers or stacks, simply by clicking the "plus" symbol located in the right side.

Fig. 4 Main screen for a logged user

One of the main characteristics of Drawer is the way it shares information among users. It follows the paradigm set in Drag&Share [20] allowing users to drag documents from his local devices to the shared workspace. As depicted in Figure 5, when users enter in a drawer, the shared workspace for that drawer is presented. There are allocated the resources and other users, as well as the synchronous communication means. All this in a single view, making it easy to follow others work and work in the tasks. Users are represented by their names over the shared workspace, showing their movements in real time. Each user has a representative color in the system for the chat and his cursor (the name over the shared workspace). Resources are represented in the shared workspace by the name and a representative icon. In the shared workspace, other users can be invited to perform collaborative tasks.
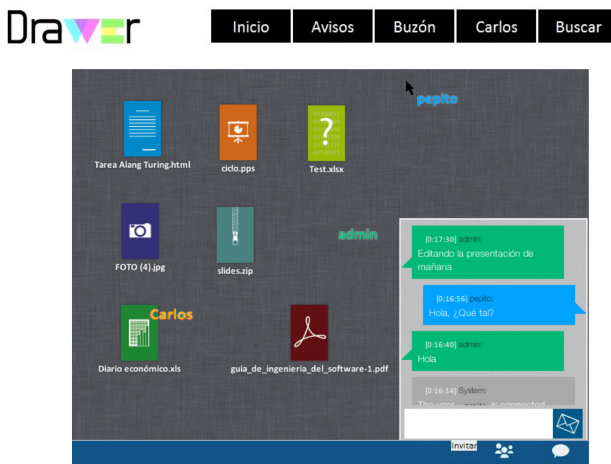
Fig. 5 Shared workspace

Users can perform actions over the resources by making right click or a double touch over them. These actions are depicted in the Figure 6. They can create new documents with the included rich text editor. The text editor allows the creation of documents with enriched text. Also images, videos and any multimedia resources can be inserted within these documents. The next option is to download documents from the shared workspace to the local device. The edit option allows users to edit existent documents in the shared workspace. The preview option shows the selected document. To delete documents, users only have to select the delete option. Finally, users can hide documents selecting the corresponding option, preventing other users to view the document in the shared workspace.
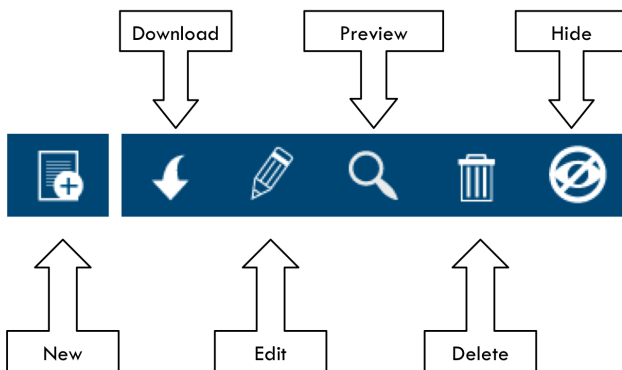

Fig. 6 Options in the shared workspace

The *"alerts"* section gives users information about the events produced in the system. There, they can see new friend requests, pending messages and request for resource sharing. The *"mailbox"* section, as depicted in Figure 7, allows the asynchronous communication between users. In this section, the active conversation between users or groups could be found. The section *"user"* contains personal information about the logged user. Also the information about the resources and interactions the user has made with the system is represented.
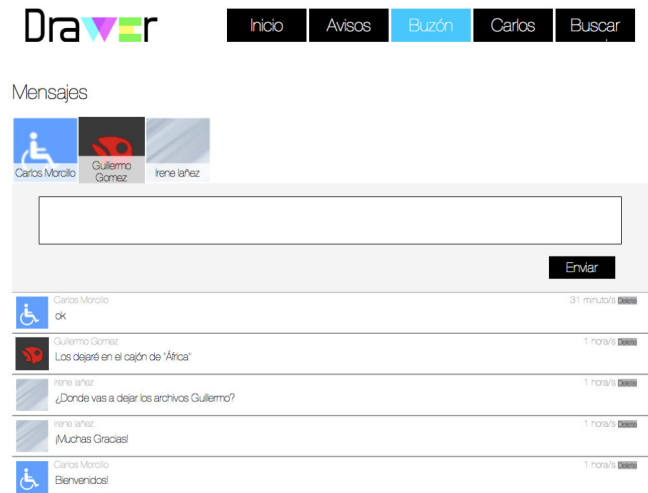

Fig. 7 Mailbox section

The section *"search"*, as depicted in Figure 8, allows searching for other users. This section is designed for viewing other users and to send them a friend request. This request may be accepted or rejected. Friends in Drawer are allowed to easily share information, send messages and perform collaborative tasks.
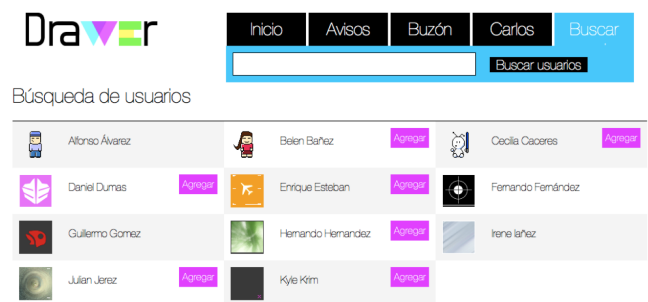

Fig. 8 Search users option and friendship management

V. EVALUATION

Through this evaluation, we want to assess the impact in a blended learning activity when using Drawer. An activity is done by using the means provided by Moodle by default and using Drawer. The aspects to be assessed are how the proposal affects the productivity in the task, that is, how much time users expend to complete it, and how usability of the system is affected. Therefore, the evaluation is focused on the level of productivity and the user's satisfaction while using the system. Tasks time has been used to measure productivity and satisfaction has been measured using a questionnaire based on SUS (System Usability Scale) test [21]. Time, as productivity measure, has been selected because it provides a good insight on the impact when performing tasks using different systems. The SUS test has been chosen because it has proved to be a valuable evaluation tool, being robust and reliable.

The group of selected students to perform the evaluation has the following features. Seven students make up the

group. Four students are males and the other three are females. The participants are nearly 25 years old on average. The oldest and the youngest user are 28 and 22 years old, respectively.

To perform the evaluation it is selected a learning scenario where the teacher sends an assessment to a group of students in a blended learning scenario. Some of the students are in the same physical room, but other students aren't. They have to perform the task collaboratively. Students have a device for accessing the web application. The activity consists in an assessment where the students have to make a summary of a document provided by the teacher. Each student is responsible of making a part of the summary. They have to choose a leader responsible of joining the individual summaries. As a result, they will get the final summary. The task is divided into the following five subtasks: 1) the text is distributed, selecting the parts to be done by each student. At this time, the leader is selected among the students; 2) partial summaries are made and send to the leader; 3) the leader gathers the partial summaries into the final summary. It is send to all the members of the group; 4) the group reviews the final summary and decides if it is ended; 5) the leader sends the teacher the final summary.
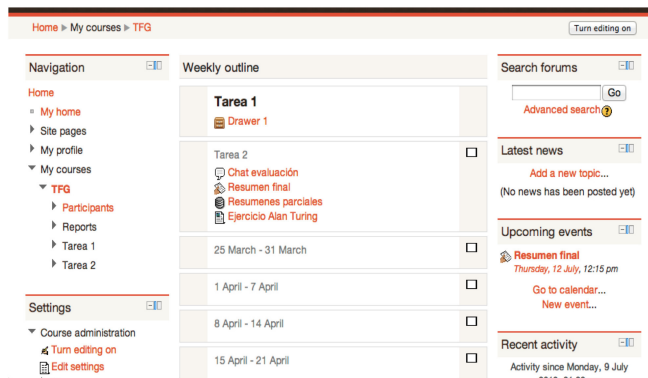

Fig. 9 Moodle setup to perform the task

The teacher is in charge of setting up the scenario for performing the activity. In Figure 9 it is depicted the scenario for performing the activity in Moodle. The scenario in Moodle is composed by the chat, a database for sharing partial summaries, and one link to upload the final summary. The scenario in Drawer is depicted in Figure 10. At a glance, this is simpler for users than the one used in Moodle.

The productivity of the system is analyzed based on the time spent to perform the collaborative task. This time is divided into the five tasks described above. The average time is shown in Figure 11 for the test developed in Moodle with default activities, and in the Figure 12 for the test developed in Drawer. The average time decreased drastically in four of the five measured tasks when Drawer was used.

Regarding student's satisfaction, the SUS satisfaction questionnaire has been used. In this test, users have to express their agreement with 10 sentences after performing the task. For each sentence, a score between 1 and 5 is given, meaning 1 strongly disagreement and 5 strongly agreement. Then, based on these values, the SUS satisfaction question-
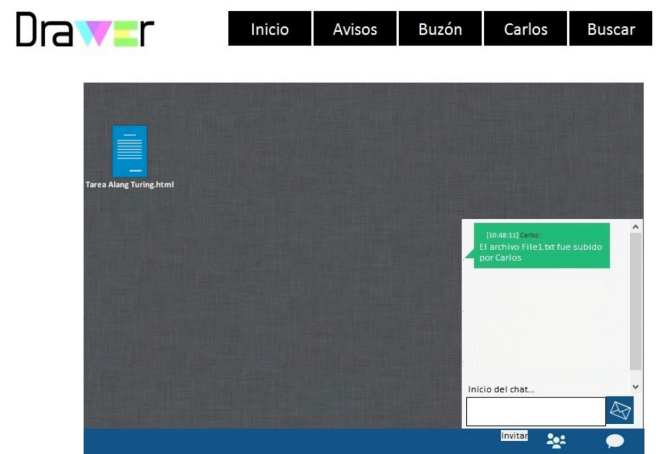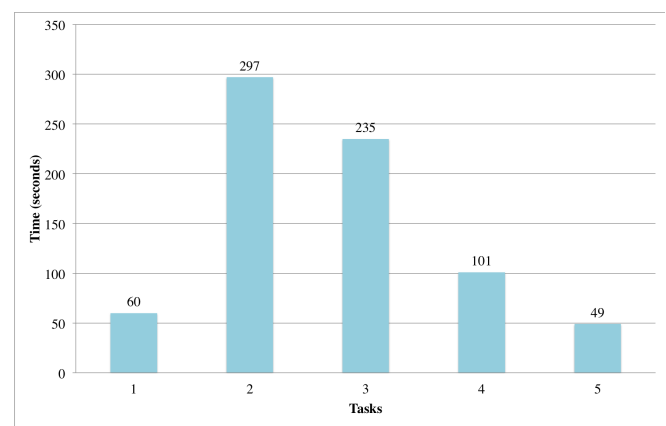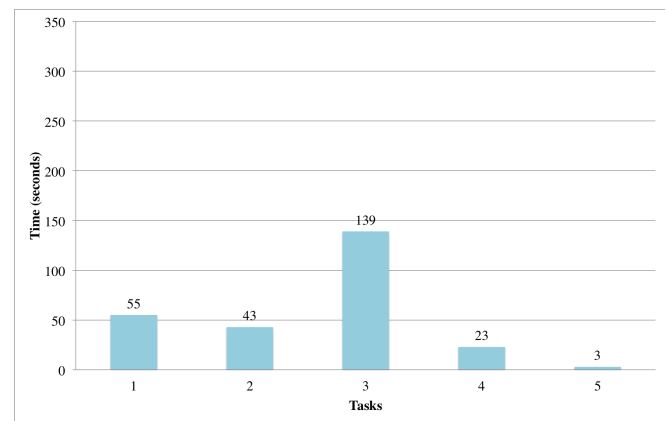

Fig. 10 Drawer setup to perform the task

Fig. 11 Average times on each task with Moodle

Fig. 12 Average times on each task with Drawer

naire final value is calculated. This value can be between 0 and 100. A final value near 100 indicates a complete satisfaction. In the performed test, the final value in Moodle with default activities was 33.10, which indicates that students were not satisfied with the system. The final value in Drawer was 84.2, which confirms that users were very satisfied when using it.

At the end of the test, users were invited to write their personal impressions about the tools. Next, some of the comments made when using Moodle in the evaluation are included:

- "I don't know where I have to upload the file"
- "When I manage to upload the file, I don't know if I did it well. I have to search on the list where all the files were shown to see if mine were there"
- "It is tedious, you have to download the final file, search for it and then open it"
- "Because the chat was opened in other window, there was a moment when other users sent messages to me but I didn't realized it"
- "Workgroup was complicated"

In the other hand, comments made when using Drawer in the evaluation were:

- "This tool is very useful for workgroup"
- "Intuitive and easy to use"
- "You can open and edit files within the application"
- "You are always aware of what is going on"

VI. CONCLUSION

Teachers need innovative tools for supporting new learning experiences. There are many issues to bear in mind when designing applications for supporting the curricula. So, this work is intended to present the main characteristics of blended learning approaches as well as the weaknesses and strengths found in a review of blended learning experiences and models of the last decade. A new web application has been designed and implemented taking into account the lessons learned.

Through the review the main characteristics that blended learning systems shared during the last decade have been recollected. We can summarize that blended learning is a wide area between a face-to-face and a fully on-line environment where students need to be treated as individuals and each institution has to understand the right model for delivering blended learning. Moreover, the fact that learning is more productive when doing than when listening how to do is taken into account. Finally, it is important to understand that technology is important, but pedagogy must lead.

With Drawer we make a contribution for dealing with the weaknesses present in most of the studied blended learning experiences: need of effective guidance, lack of communications, unsatisfactory use of the face-to-face session time and social interactions. The evaluation shows that Drawer improves the selected activity performed in blended learning scenarios compared to Moodle. The productivity and the usability have been taken as indicator for measuring the outcomes in one of the main tool in learning scenarios: assessments. Both indicators reflect a drastic improvement when using Drawer instead of Moodle.

As a future work, we want to introduce Drawer within the curricula of educational centers in order to receive feedback for the improvement of blended learning support.

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