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E-Learning Evolution and Experiences at the University of Zaragoza

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1. Introduction

Due to their dynamic and motivating nature, e-Learning tools provide academia with powerful mechanisms to alter the potentially inertial passivity that in-person learning at a physical campus may sometimes bring to students. These tools also try to promote communication and to actively involve students in their learning process. Moreover, they foster interdisciplinary collaboration among academics as well as the dissemination of experiences.

Since its foundation in 1542, the *University of Zaragoza* has been adapting to changes in society and to in-fashion educational practices. During the last decades, the use of emerging technologies such as e-Learning tools have revolutionized the way teaching-learning models had been understood and implemented and they have promoted the Continuous Professional Education (CPE) or Life Long Learning (LLL) and/or the Collaborative Learning (application sharing, discussion threads, etc.) (Perry, 1995). Due to this fact, the *University of Zaragoza* developed its own Virtual Campus, a section in charge of the online offerings of the university where college activities can be completed either partially or wholly online. The Virtual Campus at University of Zaragoza (Spain) is known as "Anillo Digital Docente"[1] (ADD) (*http://add.unizar.es Anillo Digital Docente, Universidad de Zaragoza*, n.d.) and it comprises a number of technical software systems and even hardware devices that support e-Learning, such as Learning Content Management Systems (LCMS) like Moodle (Dougiamas & Taylor, 2003) or Blackboard 9.1 (*http://www.blackboard.com/Platforms/Learn/Overview.aspx BlackBoard e-Learning Platform*, n.d.), and more recently also Clickers and *Opern Course Ware (OCW)*[2] Alternatively, some colleagues at the institution have also been utilizing their own collaborative workspace software systems or groupware such as Basic Support for Cooperative Work (BSCW, also known as Be Smart - Cooperate Worlwide). All of them contribute to create a complete learning management model, which is focused on the learning process rather than on specific technologies.

The aforementioned LCMS support and manage the creation, edition, storing and delivering of e-Learning content and assist with the creation of integral teaching-learning environments (Laviña-Orueta & Mengual-Pavón, 2008). However, as discussed in the 4th

[1] Educational Digital Ring, in English. Website: http://add.unizar.es
[2] A free and open digital publication of university-level educational materials organized as courses installed on `http://ocw.unizar.es`.

Conference on Learning Innovation of the *University of Zaragoza* (Zaragoza, Spain, September 2010), different uses of the LCMS within the institution can be observed:

- a use that exploits LCMS to assist the in-person learning in the physical campus, or even combining on-line learning activities (asynchronous) with in-person learning activities (synchronous) –a learning model that is often known as b-Learning (Wolfe, 2001);
- a use that exploits LCMS to assist the on-line learning courses in a completely asynchronous way.

In this Chapter, we describe the evolution and experiences of the *University of Zaragoza* Virtual Campus, ADD, and we present and analyze official statistics about the courses, number of students and academics that have been involved with e-Learning activities. We highlight the efficient use of these emerging technologies as the foundations of most innovative teaching initiatives. We support the thesis that states that the e-Learning model not only must be technology– and contents– centered, but also oriented to learning quality, processes and contexts. Thus, e-Learning technologies should enrich academics in their role of knowledge builders rather than just merely knowledge providers. In short, we believe that e-Learning promotes an important methodological change where active methodologies go beyond knowledge transmission. In this context, where technology and teaching methodologies co-exist, we present three selected real case studies undertaken in our institution where the role of e-Learning technologies in the development of a number of different methodologies is analyzed. In particular, we analyze the application of e-Learning tools to tutorship, collaborative work and laboratory assessments.

The rest of this chapter is organized as follows: initially, we overview the technological environment of the *University of Zaragoza* in Section 2. After that, we focus on the three selected real cases. The first study case examines the tutorship in the contexts of b-Learning and in-person learning and the technological tools that support the tutorship between academics and students (for more details see Section 3). The second experience is focused on the advantages of collaborative working and the need for adequate technology for implementing this model (for more details see Section 4). In the third case, we highlight the effectiveness of the management of last generation LCMS such as Blackboard 9.1 compared to a number of ad-hoc developed scripting tools in order to automate the assessment of laboratory lessons at a number of courses at the Computer Science Department (for more details see Section 5). Finally, the conclusions and future work are given.

2. Technological environment at the *University of Zaragoza*

A great percentage of the educational activities in the *University of Zaragoza* is supported on Web technological platforms, known as *Learning Management System (LMS)*, used to create, distribute and manage educational material. These platforms are excellent tools in order to facilitate the development of teaching-learning environments as they support the creation and management of a complete educational model. In fact, they provide repositories of materials, communication tools, monitoring and evaluation tools, collaboration systems, management of different roles involved in the teaching-learning activities and different kinds of permissions and licenses, etc.

From our point of view, a virtual learning environment or virtual campus must be considered beyond the idea of simple “distance learning" as it must integrate many factors, such as technology, services, assessment, educational contents and particularly human factors

(students, teachers and other staff involved). Moreover, it must be focused on the online learning process and not just on technological aspects. According to this idea, as a starting point we consider the definition of e-Learning from the perspective of quality of learning by García Peñalvo (García-Peñalvo, 2008): Teaching-learning process, aimed at acquiring a set of competencies and skills by the student, characterized by: 1) the use of web-based technologies, 2) the sequencing of a set of structured contents according to predefined and flexible strategies, 3) the interaction with the network of students and tutors, and 4) a set of appropriate assessment mechanisms for both the learning outcomes and the training intervention as a whole, in a collaborative working environment enriched by a set of value-added services that technology can provide to achieve maximum interaction, and where the presence is not immediate but deferred in space and time. García Peñalve considers that this ensures the highest quality in the teaching-learning process.

At the time of writing this chapter (July 2011), the *University of Zaragoza* offers Moodle 1.9, Blackboard CE8 and Blackboard 9.1. Moreover, previous courses in Blackboard CE8 are being migrated to Blackboard 9.1. These platforms host 5,675 online courses which involve 4,056 academics and 64,897 users with the role of student. In Figure 1, we can observe the evolution of the number of courses in the last four years.

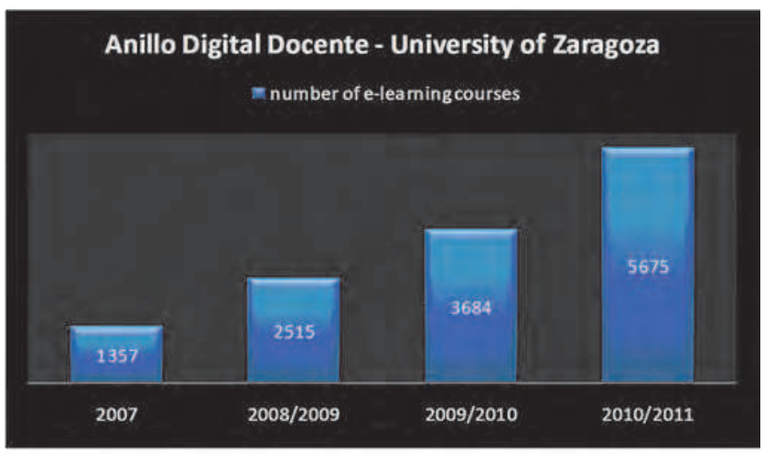

Fig. 1. Evolution of the number of online courses at the University of Zaragoza since 2007

Nevertheless, there exist different uses of these tools in our university. Most courses use them as a support or as a supplement to teaching-learning activities performed in the face-to-face environment. However, there also exists an important percentage of courses where a more advanced model of mixed or hybrid learning called *b-learning* is used. In this case, tools are used to supplement or even to develop the lectures at school. Thus, this model is used to design teaching-learning scenarios including simultaneous synchronous classroom activities and other asynchronous activities commonly used in e-learning. Finally, an increasing percentage of courses are being completely developed in a virtual environment where the teaching-learning model is completely asynchronous, as generally this kind of courses are included in masters and specialized programs where it is very important to leverage the ubiquity in order to create inter-university collaboration with other national and international universities. In this way, a scenario and strategic framework to internationalize our university is being built. However, on this regard, it is important to emphasize that a wide range of

academic and legal aspects need to be considered and their complexity increases with the number of countries involved.

In summary, in the University of Zaragoza, the tools are used in teaching-learning activities by considering b-learning methodologies promoting the design of active learning scenarios and collaborative learning. Moreover, this fact also facilitates the continuous assessment and fosters not only the acquisition of specific knowledge, but also the development of attitudes and skills. However, we also find that a great percentage of the students still have a passive attitude towards LMS and that they consider them as mere repositories. This is sometimes aggravated by the limited use of this kind of tools by a number of academics and it must be overcome.

In any case, these tools are a suitable means for selecting teaching-learning resources and encourage interdisciplinarity. Besides, we can affirm that the use of current platforms increases the value of indicators used commonly to evaluate the quality for the integration of methodologies and information and communication technologies, such as active learning, the improvement of student's achievement, the improvement of communication among students and teachers, the promotion of coordination among academics, and the improvement of the quality of the contents.

On the other hand, from the experience of using the different platforms, we know that there are certain shortcomings related to the management of contents to enable, for example, reusing or sharing them collaboratively, especially in the university context. In this sense, *Learning Content Management Systems (LCMS)* are based on a model of content objects or learning objects, which facilitates the management of the repository and the reuse of such objects. Besides, they provide authoring tools or collaborative tools to create them. Moreover, the most modern platforms also incorporate the philosophy of Web 2.0 (Weber & Rech, 2010), as it happens with the latest releases of the platforms currently available at the University of Zaragoza, in particular Blackboard 9.1.

Alternatively, there are specialized platforms such as *Document Management Systems (DMS)* or systems oriented to *Basic Support for Cooperative Work (BSCW)*. In our university, we have the experience of several groups working with BSCW as a platform for collaborative work. The good results obtained with this platform have encouraged its use and demand by other professors. However, currently, in our institution the workload of the collaborative work can only be performed with Blackboard 9.1.

Regarding open educational resources, we consider that it is interesting to distinguish different elements: 1) contents included in courses with open access, 2) open source development tools and open standards, and 3) tools to create flexible licenses that enable flexible reuse of educational activities. At this point, we consider that legal aspects about the access and the distribution of information are essential. Besides, we have to take into account the new formats and interfaces provided by some emerging distribution channels such as university TV channels, iTunes U, youtubeEDU, etc.

Open or free-access projects in the context of e-learning are widely disseminated and they serve as excellent "showcase" for the promotion of educational institutions, and even for the work of their research groups. In our case, they enhance the dissemination primarily among the hispanic-culture institutions. Thus, for example, the University of Zaragoza has recently incorporated to the Open Course Ware Project (OCW).

2.1 The role of information and communication technologies in innovation projects in higher education and e-Learning

The OCW project, like many other educational projects, was born under innovation initiatives by professors and teachers. Nevertheless, the importance and growth of innovation in an educational institution usually depends on a strong institutional support. The University of Zaragoza has been heavily promoting innovation projects in higher education and e-learning by funding them during the last years. This support has led into the creation of innovation groups and interdisciplinary networks oriented to deal with different educational topics among professors specialized in different areas and with different backgrounds. A great percentage of the Innovation Projects are focused on the use of new tools based on Information and Communication Technologies (ICT) but there also exist projects whose research pursues to create models and methodologies for teaching-learning activities with ICT. In the last academic course (2010-2011), 482 innovation projects were developed and 1,237 professors participated in them.

Regarding the efficient use of ICT in a blended learning model, in most innovating initiatives it is agreed that the mere use of a technology does not constitute an innovation process, since the technology by itself is not enough. We think that the use of ICT must mature. The learning scene that is constructed usually starts from a model centered on the materials, which is always possible if an appropriate infrastructure is available. In this process of maturity, this model must be developed considering the applications, platforms, portals, and finally end up in what we could call the service management, which will imply the real and effective implementation of the methodologies.

In consequence, we think that the role of technology in that evolution, and in general in e-learning, must be focused on both the technology and the contents, but oriented towards the quality, the processes, and the learning environments, enriching the role of the academics as facilitators of the learning process to generate (and not only to deliver) new knowledge in a teaching approach based on the student, his/her context, and his/her previous outcomes.

Furthermore, the use of ICT as dynamic and motivating tools succeed in breaking the inertia and the passive attitudes of students, highly increasing their interest in their own activity and education, encouraging their participation, etc. Summing up, ICT are very good instruments to improve the communication in education.

In addition, the use of ICT as a support in this process favors the interdisciplinary and interdepartmental collaboration, motivating our colleagues and improving the dissemination of experiences, in a way that it is possible to share the benefits and the good results obtained, the weak points observed in the development of the activities, and the implementation of the activities.

From all the experiences conducted in our university, we can conclude that ICT are essential to perform the methodological change that is completely introduced with the European Higher Education Area (EHEA), based on the use of active methodologies that go beyond the mere transmission of knowledge. With this approach, traditional classes are reduced by fostering students' participation, the collaborative work, and the tutoring. In this context, the use and diffusion of multimedia materials is encouraged, but tools such as webfolios, chats, blogs, forums, and the Web 2.0 itself, are also of great importance. All these options, platforms and tools favor also the acquisition of competencies. In this sense, a good educational tutorial action for the students is essential.

Nevertheless, we also want to emphasize that, despite all the possibilities offered by ICT tools, current platforms are still frequently used as simple repositories of information. In any case, the cultural level and the computer abilities of students entering the university after leaving the Secondary Education keeps improving, although there is still a need of initiation courses for the acquisition of ICT competencies.

The final efficiency, not only for handling ICT tools, but in all the educational dimension of the repositories of materials, depends on their configuration as reusable learning objects. These objects should follow open standards, that should be easily interchangeable, allowing their use and querying, which could even enable the creation of a common repository of resources. Finally, besides training in the use of tools for educational innovation, in order to enable their effective use in a virtual learning environment both educational and technical support is required, which calls for appropriate funding.

3. Case study 1: Online tools for tutorship in technical and scientific courses

Tutorship is becoming a fundamental role in the context of educational virtual campus of our university, and in general in European Higher Education Space (EES) (Seoane-Pardo et al., 2007). We have a virtual campus and a strong institutional support for the development of high-quality virtual teaching-learning activities. However, in order to be successful, the consideration of human factors on the different on-line strategies is of great importance.

In our educational model, we perform “academic tutorship", which fosters the resolution of students’ doubts and questions and allows professors or tutors [3] to monitor and track the evolution of their students and educational activities.

Firstly, we focus our attention on timing, because though the efficient time management and scheduling of the teaching-learning activities of students has not been studied in depth in our university, we firmly believe that it is an essential aspect in the new European Higher Education Space (EES) which we are converging to. In fact, we ask ourselves whether the use of ICT actually affects the workload of our students, and whether it increases/decreases the students’ workload. Therefore, we analyze the students’ workload and the time they invest in their study and training. Moreover, in our opinion, the influence of a proper student’s time management in her/his academic results and how a tutor can help students to organize their activities by means of tutorships should be also analyzed.

Regarding how to measure the students’ workload, the unanimous opinion in several forums of our university is that this work should be in charge of the coordinating teams of the different degrees which are institutionalized in our university. In fact, this challenge is being faced nowadays due to the introduction of the new degrees adapted to the European Higher Education Space. It is important to remark that it is easy to talk about perceptions about the relationships between scheduling, timetables, planning, timing, etc. and the use of ICT tools or methodologies. However, conclusions must not be established from only perceptions due to the relevance of this topic. In consequence, we need to quantify the workloads, and develop the methodology, indeed, the measurements can differ among the different areas or subjects.

At this point, we propose a reflection about the concept of timing in higher education spaces by considering timing as the ability to recognize and react immediately to changes and opportunities in the teaching-learning process. We could study how to choose momentum

[3] Generally professors and tutors are the same persons in our institution

for changing or reacting; i.e., how to get a dynamic management of our teaching-learning activities. In this context, we could also reflect upon how to use methodologies such as “Just and Time" with ICT tools. Our conclusions are very diverse, but we agree on that the tutor’s role is crucial in this process.

3.1 Experiences with graphic tablets and Wimba tools

Regarding the experiences with ICT tools for academic tutoring, we would like to point out our experience with the use of graphic tablets based on our experience in virtual as well as face-to-face environments.

A graphic tablet, composed by a pen and multi-touch input, provides a new way to work with a computer. Due to its features, in our institution, it has been proven to be a useful complement for other technological systems that can be found in most lecture rooms such as desktop computers, video projectors, etc. During lectures, it increases students’ motivation and interest, and fosters active participation. Besides, graphics tablets also are another way for helping students with the use of multimedia materials, educational software, and Web 2.0 (Weber & Rech, 2010) resources during lectures (not necessarily in laboratory sessions). The tablet can replace more powerful hardware such as tablet PC, but its main advantage is its low cost.

Graphics tablets are also used to support the tutorship of on-line technological and scientific courses such as mathematics. In many cases, on-line tutorship for mathematics arises many challenges, for instance the writing of mathematical formulae in the content of messages in an agile way. Moreover, in LCMS of the ADD, graphics tablets can simplify the assessments, as academics can correct the exercises in the device, marking the documents directly in the touch-screen, and they also optimize the use of digital boards of LCMS. During the current course (2010-2011), we have also enriched virtual classrooms with new functionalities for the accomplishment of a complete video conference though the Web. In particular, we have used Wimba Classroom which will be updated to Blackboard Collaborate soon. This tool increases the possibilities for tutoring as it allows us to deliver content, communicate, collaborate, share and interact with on-line participants in real-time by means of text, chat, audio and video. In fact, the tools of Classroom provide students with webcast model or lived broadcast where they have access to professors, course contents, practices, laboratories, etc. beyond the boundaries of the traditional classroom.

In addition to audio and video tools, Wimba Classroom also allows users to use whiteboards to show documents, presentations, images, etc. Moreover, it is also possible to share applications, the desktop, or a particular URL, etc. It also allows users to ask questions to the members in a session and to receive their answers, and to perform surveys and process their answers by displaying statistics. Another interesting option is to record a session to make it available later in our courses in the virtual campus (ADD), or by any other means (MP4 players, iPod, iPhone, etc.). Thus, tutoring sessions can be reused by other students who have the same kind of doubts.

The first experiences with Wimba Classroom for tutorships have shown that it is possible to perform a power online tutoring for all areas of knowledge and that this tools facilitates the establishment of a non-face-to-face tutoring timetable in virtual classrooms. Moreover, it also facilitates collaborative work as for example its “breakout rooms" can be used to divide students into virtual working groups in a classroom.

Another interesting application available on our virtual campus is Wimba Pronto. With this tool, online tutoring can be done by means of an instant messaging platform fully integrated with Blackboard 9.1. The administrative staff creates an account in this tool for each student and professor automacatically when they are admitted in our university, so that they can collaborate among themselves. Moreover, in this way, professors are not in charge of managing contacts (adding and removing their students). The next release of Wimba (Blackboard Collaborate) integrates this functionality with the virtual classroom of Blackboard 9.1 and it will be installed in a short period of time in our university.

In our institution, we have also already tested other instant messaging platforms, such as Microsoft Messenger, but it is difficult to integrate those tools with our virtual campus platforms, because each user has to manage all her/his contacts explicitly. In any case, whatever the tool used, students must be familiarized with the tutorships and tools available to perform them as soon as possible in the courses.

These tools -and in general tools that enable e-Learning tutoring- are considered to foster the involvement and the motivation of the students in the processes of teaching-learning. Moreover, they also promote to receive feedback, and they can be used as a vehicle for teaching-learning activities. Therefore, it is important to establish a set of the best practices for use them in this context.

4. Case study 2: Technological support to collaborative work management

In this section, we present our experiences with the use of the system Basic Support for Cooperative Work (BSCW) (*Web oficial de BSCW. [Available on: http://bscw.fit.fraunhofer.de/] [Last access: 27th July 2011]*, n.d.) for the management of collaborative work at the course "Herramientas Informáticas en Ciencias Experimentales". This is an optional course in the syllabus of the veterinary science degree at the University of Zaragoza. During the last years, the course has received one hundred students per year on average despite its optional choice nature for students. Due to this fact, around one thousand digital documents per course on average are generated as a consequence of the activities that students have to perform individually and cooperatively. This number of documents requires from academics a great effort in order to assess them and provide students with proper feedback. After generating the documents and receiving the feedback, students must do corrections and modify them accordingly to the notes provided by the academics. Thus, the document versioning control, as well as the cooperation with other students (document sharing) is a key aspect.

From our experience, we consider BSCW provides great benefits in the management of these activities, because of its functionality, its easiness of use, its efficiency, its robustness, and its fault tolerance capabilities. Thus, it supports document re-use, document versioning, document access control (with different roles of users such as academics and students and with different levels of sharing). Moreover, BSCW also supports the creation of discussion boards (essential for collaborative work), helps users organize materials and information (by means of repositories), fosters effective communication among users, promotes decision taking, etc. In summary, BSCW assists in the generation of documents in a collaborative way by integrating different functionalities within the same platform (Alejandre-Marco & Allueva-Pinilla, 2007; Alejandre-Marco et al., 2008).

In our case, the installation of the software required to implement this experience was done in Grupo3w server (`http://grupo3w.unizar.es/bscw/`) of the Innovation in Higher

Education group of our university in the course 2006-2007. The administration of such software has also been performed by the staff of that group so far.

4.1 The BSCW platform

The BSCW considered by our group can be used from a public server or installed on a private server under a free-pay license for educational purpose which supports until 1,000 users, and is available on http://bscw.fit.fraunhofer.de. BSCW is a useful tool to manage collaborative work as it is easy to use, efficient and stable and it supports the reuse of documents and their different versions and the establishment of different levels of access permissions for teachers and students to share documents. Besides, it supports the creation of forums and discussion spaces (essential for collaborative work), helps organize materials and information in repositories, enables effective communication means for their users, fosters decision-making, etc. In short, it allows us to integrate several tools under a platform in order to foster the creation of products in a collaborative way. The main features of this platform are:

- Access by means of login and password mechanisms.
- Different levels of access permissions.
- Discussion forums with chronological monitoring of interventions
- Facilities for searching on the Web and on the shared repositories in the tool.
- Conversion among different formats of documents.
- Management of versions of documents.
- Multilingual facilities to customize the interfaces.
- Event services within a robotic system.

Some of the major benefits due to the use of the BSCW platform are:

- Its use is simple, efficient and stable.
- It is an open source software which have been developed under free-pay license for educational purpose.
- It supports the reuse of materials, structures and contents.
- It manages different levels of access permissions to share documents.
- It supports to create forums and discussion spaces for debating.
- It supports to create repositories of materials.
- It supports easy management of people, groups and courses (with different roles)
- It helps to organize the material and information of a course.
- It supports the generation of specific products in collaborative way.
- It facilitates student assessment and evaluation process.
- It supports asynchronous tutoring processes.
- It provides their users with effective communication means.
- It helps foster decision-making.
- It integrates several tools under an unique platform.

A more detailed description of the features of the BSCW platform considered and the benefits that such tool provides us can be found in (*Foro sobre BSCW de RedIRIS. [Available on: http://www.rediris.es/list/info/bscw-es.html] [Last access: 27th July 2011]*, 2011; *OrbiTeam Software GmbH and Co. KG. [Available on: http://www.bscw.de/unternehmen.html] [Last access: 27th July 2011]*, n.d.; *Proyecto ITCOLE–Synergeia-BSCW. [Available on: http://bscl.fit.fraunhofer.de/] [Last access: 27th July 2011]*, n.d.).

4.2 The collaborative work

Collaborative activity developed by students in the course "Herramientas Informáticas en Ciencias Experimentales" was accomplished during the practical sessions even though the students also worked at home in order to develop a final project. In the first session, students organized themselves in working groups. This task was difficult for them because they had to schedule and coordinate different timetables. Besides, they had to register each student in the group in the BSCW platform which requires his/her e-mail address. On the other hand, the platform controls the different shared work spaces by organizing them as folders of a group in an specific course. The folders can contain documents, images, Web links, multimedia objects, discussions, calendars, searches, information about the members of the group, personal Web sites, ...

Practical face-to-face sessions last for two hours and they are distributed along the four months of the course (approximately one session per week). Previous to each practical session, professors provide students with material on the topic to be dealt with, a script for the collaborative work and software to be used by means of the BSCW platform. The collaborative projects defined by professors are about different issues and require different levels of depth.

Each working group must generate one or more documents depicting the work done during their session, being submitted at the end of this. The generated documents must be uploaded in the BSCW platform and can be consulted, discussed and reviewed after the session by the members of the group or the members of the rest of groups. The BSCW platform provides a exhaustive control of the different access and events. Later, these documents are assessed by the professors and sometimes by other groups selected randomly, due to the large amount of information generated.

The final products of each group are uploaded in another repository of the BSCW platform and a forum with different issues is created for each product to discuss about the work done. In addition, face-to-face sessions are scheduled in order to allow each group of students to make a presentation about the work done and share the knowledge and skills acquired during its realization. At this point, it is important to emphasize that along with the realization of the work, students can also have online and face-to-face tutoring sessions. Moreover, their work is evaluated weekly by professors or other working groups by means of BSCW platform (Alejandre-Marco & Allueva-Pinilla, 2007; Alejandre-Marco et al., 2008).

4.3 The methodology for the assessment of the students

Students enrolled in this course can choose between two options to be assessed: 1) evaluation based on a continuous assessment of their works in practical sessions and on the development of a final project; and 2) evaluation based on the mark of two traditional final exams at the end of the course (one exam is a hands on session with the computer and the other consists

of a series of development questions). If the student chooses the continuous assessment, we consider four categories in our methodology:

- Evaluation of documents and multimedia material produced in the practice sessions of the course (30% of the final mark).
- Assessment based on other collaborative activities where the student participates in and based on the use of the BSCW platform: how he or she uses the tools for annotating materials, how many times he or she participates in the discussion forums, how many documents of other groups he or she evaluates, etc. (20% of final grade).
- Individual assessment based on the results of four tests about the topics dealt along the course (20% of final grade).
- Evaluation of collaborative working projects developed in his/her group(30% of final mark).

Estimating a final mark for each student that chooses the evaluation based on a continuous assessment is very hard due to the high number of students who often participate in the course and it would not have been possible if we had not had the tools provided by BSCW.

4.4 The document management

All the documents that students generate in all the activities are considered for the continuous assessment. Moreover, the text of the activities, hints, additional information and other documentation that students require for the activities are also considered and hosted in the BSCW platform. In this way, all the digital documents and information generated can be successfully managed by the professors of the course "Herramientas Informáticas en Ciencias Experimentales" of the Veterinary degree at the University of Zaragoza.

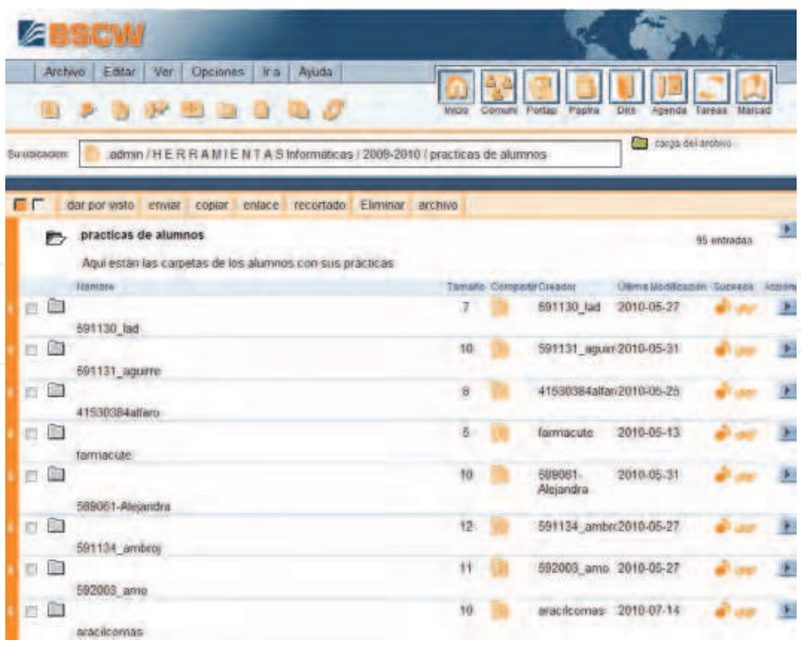

Fig. 2. Working Space

We have to take into account that the overall number of students participating in this course has exceeded 100 on average in the last editions of the course. Due to this fact the number of documents generated is around 1,000 documents per course. Without the support of this content management system, the task would have been really hard and probably impossible.

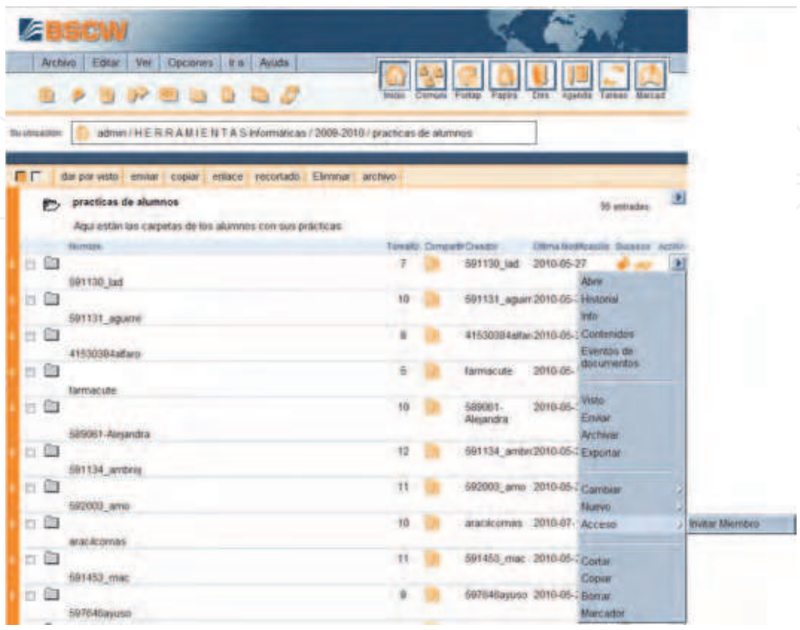

Fig. 3. Share Folder

Several screenshots where the structure of the course in the BSCW platform during the 2009-2010 course are shown bellow. In the figures, we can appreciate the great amount of material generated by students for their assessment. In Figure 2, we can observe how the folders for each student are organized in the 2009-2010 course (there were 95 students). Moreover, we can also see the size of each folder (number of documents that it contains), being the average value 10.

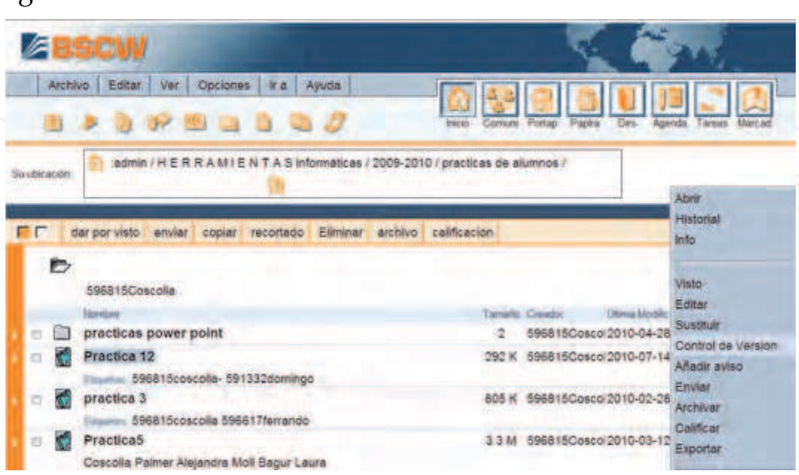

Fig. 4. Versioning Control

In Figure 3, we can observe the option that a user (a student) should use to share his or her folder with others students, forming in that way working groups.

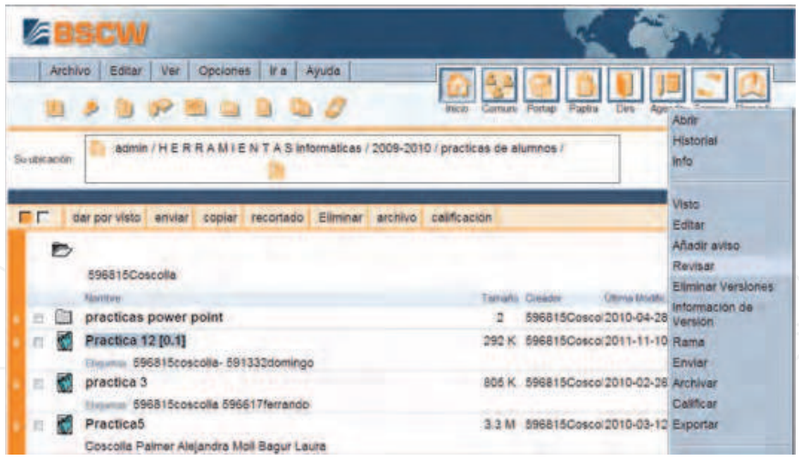

Fig. 5. Review version

The BSCW platform provides us with a complete document management tool which includes document versioning and logging of the different events associated to each document. It supports the monitoring and tracking of the students' evolutions in order to assess their work, and provide them with feedback. In Figures 4, 5 and 6, we can observe how different versions of a document can be generated as well as maintaining its previous versions.

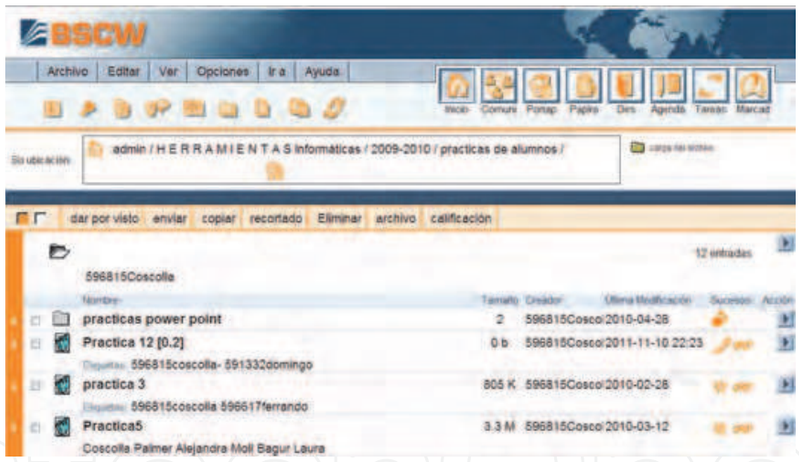

Fig. 6. New version

In Figure 7, we can observe a number of modifications performed to a specific element: which user created it, which users have modified it, cut it, marked it, copied it, etc.

In Figure 8, we can observe the information associated to an event of a specific element: which user read the document, when the document was read (time and date), etc.

5. Case study 3: Assessment of laboratory lessons at programming courses at the Computer Science Department

The Department of Computer Science and Systems Engineering of the University of Zaragoza has currently 220 faculty members, teaching at different engineering degrees as well as in the computer science degree. Around 800 students are taking undergraduate and postgraduate

Fig. 7. Log of updations

Fig. 8. Log of different events

degree courses taught by this department. Most of these courses comprise practical laboratory sessions where activities related to programming are accomplished.

In general terms, the process cycle for any programming activity can be characterised by the following steps as depicted in Figure 9. In the process, a professor elaborates a programming activity, writes its specification, and disseminates it to the students. Then, the students have to follow the instructions, and as a result implement a computational program: they require a computational environment, which typically consists in an editor, and a compiler. Once, the program required is finished, they have to submit it, this often involves the submission of a set of files. Then, the professor can assess it, this step can be sometimes automated, though this may not be always possible (it will depend on the nature of the activity). Finally, the professor notifies the assessment, and an optional feedback.

A decade ago, the computational environment where the programming laboratory lessons were undertaken was an HP-UX machine with 4 processors and a Solaris operating system –a UNIX based and multi-user environment. Under these circumstances, most of the courses utilized the HP-UX machine itself not only for the development of the lessons, but also

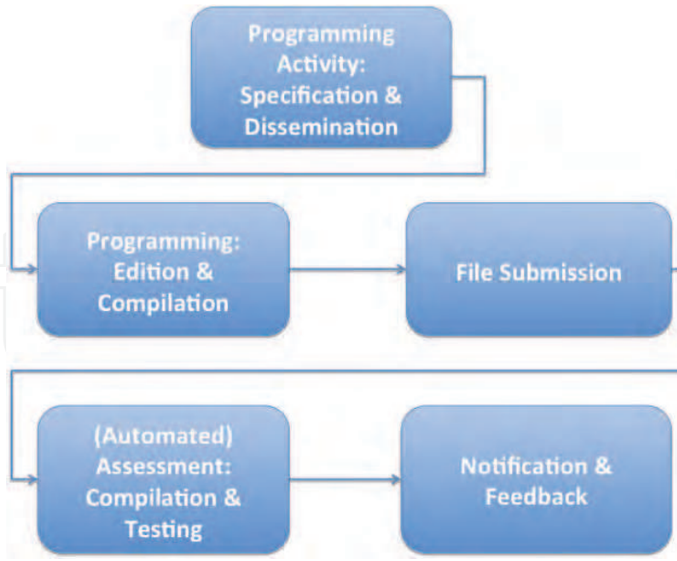

Fig. 9. Process Cycle of a programming activity

Technological Solutions Comparison		
Feature	UNIX-based	LCMS-based
Activity Dissemination	✗	✓
Built-in Edition & Compilation Environment	✓	✗
File Management & Submission	✓	✓
Automated Compilation at the assessment stage	✓	✗
Automated Built-in Assessment & Testing	✓	✗
Assessment Notification	✓	✓
Scalability	✗	✓

Table 1. Comparison between the UNIX-based solution and the LCMS-based solution for the practical lessons in programming courses

for the whole activity process: dissemination, submissions of source files, assessments, and notification. For such a purpose, the technical staff at the Department developed specific UNIX-based scripts for the HP-UX machine that automated some of the steps in the process: the submission of files, the assessment, and the notification. The scripts related to the submission of files were made available to students, and they used them to upload their files. The scripts copied the files in the course disk account in the UNIX machine, and changes their ownership, so that once submitted, the students could only observe their own submissions at the directory (read-only mode), but the academics owned the file and had read and write permissions on it.

Once a submission was done, professors could use other scripts in order to automate as much as possible the assessments: file management, automated compilation, and automated testing when possible. Additionally, by using the operating system mailing service, the assessments were also sent to the students. As a result, there was a set of independent scripts which in co-operation help manage the laboratory activities. With the introduction of new machines, and new operating systems, the ad-hoc traditional solution had limited exportation, and due

to its dependence to the operating system, the integration of new functionality, a feature that we can refer to as scalability, for instance, in order to improve communication, is also dependent on the operating system, or to further software development that is not often administratively affordable. Furthermore, the design of the scripts also offered a number of limitations. For example, a submission by a student could only be accomplished once, and in case of mistaken submission, an academic with permissions had to delete the previously submitted file, prior to any other re-submission. This is not a frequent situation for last-year students, but it is rather frequent, however, when first-year students do it.

A more modern approach to tackle this problem is the use of an integrated environment of a LCMS such as the one offered by Blackboard 9.1 at the ADD. The main advantage of such an approach is that LCMS typically integrates a number of other tools, and this characteristic can be exploited in order to improve eventual needs. For instance, in case the development of a practical requires the resolution of many challenges by students, any of the communication tools available at Blackboard could be used for such a purpose. Besides, the Web interface of the system makes it accessible from most of the environments: Blackboard is not constrained to specific operating systems or machines is not needed, a charactersitic which benefits subjects such as introduction to programming in industrial engineering degree where UNIX is not introduced and Windows is the Operating System used. The listing of students is also integrated into the course account in Blackboard, but most importantly, it can be configured in such a way that multiple submissions of a practical exercise are allowed and even the system tracks all of them. Blackboard also integrates the submissions with the qualification centre, so that once an exercise is assessed, then it can be notified to each student in isolation via the Blackboard systems itself.

Table 1 shows all the features described, comparing both technical solutions. The LCMS-based solution does not offer a built-in environment for edition and compilation of source files, and this is something that must be done in the traditional way. Additionally, the assessment may require from professors to download the source files and put them into the computational environment, so that the compilation and testing can be accomplished by professors. In spite of this, however, the usage of a LCMS-based solution has as an advantage that makes it a better solution than the traditional one, which is scalability. Indeed, the usage of LCMS for this activity allows professors to exploit the whole variety of tools that LCMS integrate seamlessly, and that can be utilised in order to improve learning processes –i.e by promoting communication skills, fostering students' participation, etc.

6. Conclusions & future work

In this chapter, we briefly describe the recent eLearning evolution of the University of Zaragoza, and we chose three case studies that highlight how eLearning technologies can help improve learning processes. The first case study describes how to exploit technology for developing on-line tutoring. We propose the use of graphic tablets in order to overcome the challenges that often arises when accomplishing on-line tutorship. For instance, the writing of mathematical formulae in the content of messages in an agile way. In addition to audio and video tools, Wimba Classroom also allows users to use whiteboards to share information. It also allows users to ask questions to the members in a session and to receive their answers, and to perform surveys and process their answers by displaying statistics. Another interesting option is to record sessions and make them subsequently available to the rest of the students. Thus, tutoring sessions can be reused by other students who have the same kind of doubts.

The second case study shows how the BSCW system can be exploited in order to manage collaborative work of a course with a hundred of students in an efficient way. From our experience, we consider BSCW provides great benefits in the management of these activities, because of its functionality, its easiness of use, its efficiency, its robustness, and its fault tolerance capabilities. Thus, it supports document re-use, document versioning, document access control (with different roles of users such as academics and students and with different levels of sharing). Moreover, BSCW also supports the creation of discussion boards (essential for collaborative work), helps users organize materials and information (by means of repositories), fosters effective communication among users, and promotes decision taking.

The third case study describes the experience at activities of programming of computers in practical laboratory courses. Initially, the programming activities were manages by using a set of ad-hoc scripting tools. We emphasize how the use of LCMS such as Blackboard has some disadvantages compared to the traditional ad-hoc approach, since it is not an ad-hoc solution. In contrast, it can exploit all the possibilities of an LCMS, such as the integration of many tools that can help promote learning processes in a better way. In particular, the communication skills during the learning process can be improved better with an LCMS rather than with an ad-hoc solution.

As a future work, it would be interesting to distinguish different roles for professors in an online course. This is technically possible when considering the way in which the platforms that we currently have in our university are configured, with different possible roles for a professor: the designer of the course, the designer of materials, the assistants, the tutors, etc. However, this design is not the usual one in the courses currently implemented in the platforms available in our university, which essentially offer an additional support for face-to-face teaching-learning process. Along the same line, different roles would be considered for a tutor: the academic one, the pedagogical and the personal. Each of these roles would be supported by appropriate ICT tools. There is still much work to do in the area of online academic tutoring, but we think that this is one of the strongest points in this education model, since a good utilization of tutoring for face-to-face students has been proved to be effective for increasing the results of the students.

Besides, if we analyze the strengths of tutoring in the framework of the European Higher Education Space, we find many advantages. For example, we can highlight that it facilitates the competency of the acquisition of a professional language. Regarding the weaknesses, we observe the need and the demand of training for teachers, especially in this case concerning ICT tools that facilitate an online tutoring (e.g., the aforementioned instant messaging applications) and that facilitate providing feedback to the student.

We would also like to emphasize the high workload usually derived from the monitoring and personalized attention in online tutoring models for courses with a large number of students. In our university, there are many courses with more than one hundred students. In the simplest cases where the students basically communicate through email, the number of emails could grow beyond what can be managed if this is not appropriately coordinated with other communication tools such as forums, chat rooms for students, virtual classrooms, etc. Therefore, we insist on the need of training, which should focus on both the tools and the management of online courses, time management, etc.

Finally, our research is focused on comparing these experiences with other technological platforms, so that we can analyze the outcomes of using one or another. In the case of the collaborative work, we also want to test alternative platforms to BSCW such as the new version of platform Blackboard (Blackboard 9.1).

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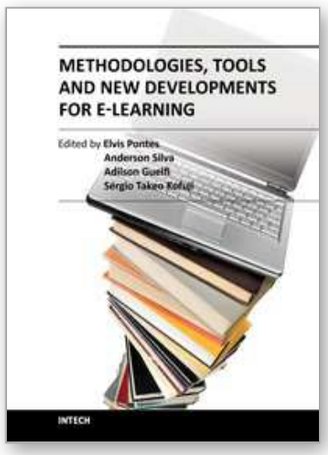

Methodologies, Tools and New Developments for E-Learning

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With the resources provided by communication technologies, E-learning has been employed in multiple universities, as well as in wide range of training centers and schools. This book presents a structured collection of chapters, dealing with the subject and stressing the importance of E-learning. It shows the evolution of E-learning, with discussion about tools, methodologies, improvements and new possibilities for long-distance learning. The book is divided into three sections and their respective chapters refer to three macro areas. The first section of the book covers methodologies and tools applied for E-learning, considering collaborative methodologies and specific environments. The second section is about E-learning assessment, highlighting studies about E-learning features and evaluations for different methodologies. The last section deals with the new developments in E-learning, emphasizing subjects like knowledge building in virtual environments, new proposals for architectures in tutoring systems, and case studies.

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