BLENDED LEARNING IN ELECTRONICS AND AUTOMATION ENGINEERING: A STUDY OF SOFTWARE SUPPORT AND BEST PRACTICES

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Abstract

Online and distance learning courses have gained a great interest and have been included as teaching modes in several Universities. In the past, the Escuela Universitaria Politécnica de Teruel (EUPT) at the University of Zaragoza offered blended-learning courses for undergraduate students of Computer Engineering. Nowadays, the EUPT intends to offer blended-learning courses for undergraduate students of Engineering on Electronics and Automation. In this paper, a study on supporting software and best practices for online and distance learning courses in the University of Zaragoza is presented.

Keywords: blended learning, online learning, distance learning, best practices.

1 INTRODUCTION

Up to date, about 58 million people have already enrolled in Massive Online Open Courses (MOOC) [1]. Several institutions also offer online and distance learning courses with the aim of attracting the attention of international students [2]. Blended learning combines both online resources and traditional face-to-face activities.

In this paper, a study on supporting software and best practices for online and distance learning courses in the University of Zaragoza is presented. The study is based on consolidated experience. Regarding software, we have analyzed the suitability of Moodle, the open-source learning platform used in the University of Zaragoza, for distance learning. We have also compared Moodle with other learning platforms for blended learning. In addition, different software packages for the development of learning contents and its integration with Moodle have also been studied, analyzing their most important features. Finally, with regards to lessons learned from our consolidated experience in distance learning, we state what we consider some good teaching practices for blended-learning.

2 MOODLE PLATFORM FOR BLENDED-LEARNING

The virtual classroom is the space where all the learning interactions take place. It is based on four key components: planning, contents, communication and monitoring components [3]. So, it is necessary that a learning virtual environment as Moodle provides with the tools that develop these aspects of learning.

2.1 Planning

An adequate planning of the course is one of the main necessities for blended learning in order to guide the student in his learning process. First of all, the teacher needs to schedule all the activities and materials through the duration of the course. Then, this program is transferred to the student by means of notifications and making accessible diverse information. Moodle platform has several elements facilitating this planning as:

1. Study guide. The study guide is a document where the teacher presents a global view of the course.

2. Calendar and next events. The calendar reflects all dates that may be of interest in the development of a course. The teacher can add Events, and also some Activities, such as Tasks or Questionnaires, which automatically mark their delivery dates in the Calendar. Next events block highlights the upcoming events.
3 Unit availability. The courses are structured through different themes. These topics can be made visible to students or not, according to the planning of the subject.

Each teacher only has the information of their courses and in the programming of their subject it is complicated the coordination with other courses. The student having dates of all the courses may be overwhelmed by the amount of information.

2.2 Contents

Making available reference materials is essential in the teaching-learning process and even more for blended learning. Materials must be adapted for this kind of learning, as they should be self-explanatory.

Moodle allows the inclusion of any type of documentation or content no matter the format (text, audio, video), such as files, folders, books, pages, IMS Content Packaging (a standard format that allows their use in different systems), Uniform Resource Locators (URLs), lessons (the Lesson allows the teacher to create a sequence of pages with content and a conditional itinerary with several branches and more interactive content can be added), Sharable Content Object Reference Model (A SCORM package is packaged in a way that follows the SCORM standard of learning objects), glossary, and database (it is an activity in which students must incorporate data using a form designed by the teacher).

On the one hand, the documentation that can be made available to the students is of great amount of types and formats. On the other hand, although reports inform about the access of students to the contents, there is no control about the usage or treatment of this documentation.

2.3 Communication

All Moodle communication tools are specifically oriented towards online teaching. The strengths of this platform reside in the diversity and quantity of communication tools: chat, video conferencing, forum, discussion, news, e-mail and wiki. The set allows the teacher to keep a high quality digital relationship with the student, offering the possibility of interactive tutorials (synchronous communication) at the level of simple conversation (chat) or direct interaction using audio, video, exchange of documents and digital blackboard (Openmeetings plugin), as well as allowing to complement the educational activities with asynchronous communication channels in the teacher-student relationship: news, forum, discussion, e-mail and wiki.

We can conclude by saying that, in the field of communication tools of the LMS (Learning Management System) among the platforms that exist in the market: Moodle, Open edX, Coursites by Blackboard, Google Classroom, Sakai, Latitude, Dokeos, eFront, Schoology... Moodle stands out for its diversity (many tools), reliability (proven by many users) and flexibility that derive from being an open source platform that enables the development and testing of new plugins from the community of open source developers.

2.4 Monitoring

One of the main differences between face to face learning and virtual learning is the lack of direct interaction. When teacher and students meet at the classroom, the first one is aware of which students are following the course and can directly check their involvement. At the same time, students can receive from the instructor feedback about their advances. Moodle offers tools that collect information about the level of activity inside the virtual classroom and tools that assess the students’ learning progress and provide them with the proper feedback.

Activity reports: A set of logs about performance and participation are available inside the options of the Administrator Block of a course in Moodle. They provide data about how many times a resource is accessed, when this access has taken place and which students have worked with this resource. This information can be personalized to a student and filtered in base of time or kind of actions done. These data can be downloaded by the teacher so that he can analyze it later. These report tools are essential in the case of no direct interaction. But, as a drawback, some of the information obtained is not clear. It is necessary to work with the data to get statistical information.

Assessments activities: Assessment is another one of the most important elements of the learning process. The formative assessment informs the participants about the learning advances and detects concept errors. This assessment can be carried out by means of a set of activities that can be self-
testing exercises or can be directly corrected by the teacher. Most of these activities provide feedback in different ways. The origin of this feedback is not limited to the teacher. Others students (peer assessment) or the student himself (self-assessment) can value the results aided by assessments guides or rubrics that can be easily built in Moodle.

Besides, formative assessment must resemble the methodology followed for the learning process. There is a great variety of Moodle activities that allows the teacher to adapt to different learning profiles and methodologies. For example, there are specific tools adapted to online collaborative learning.

These activities may have associated a grade that contributes to the qualitative assessment that determines if a student passes the course. At the Administration Block, the Gradebook tool shows the scores and the corresponding feedback to the students. This global information helps them to visualize their learning advances.

This tool has as an advantage the possibility of using algorithms to calculate partial and global degrees in real time. To mention some drawbacks, it can be difficult to learn how to use all the feedback options and can be time consuming. Besides, it is not possible to configure conditional degrees.

3 SOFTWARE PACKAGES FOR THE DEVELOPMENT OF LEARNING CONTENTS

We have analyzed different software packages for the development of learning contents and their integration with Moodle. In particular, we have found the following software packages as valid options for preparing learning contents to be deployed in the platforms considered in the previous section: Active Presenter [4], Camtasia [5], Movavi Screen Capture Studio [6], Screen Recorder of Apowersoft [7], Cam Studio [8], Ezvid [9], Gamecaster [10], Hypercam [11], FlashBack [12], Jing [13], Wink [14], Krut [15], Showmore [16]. We have considered a set of features which would be desirable for the software packages to support in order to consider the tools adequate for blended-learning: audio and video recording, audio and video editing, interactivity, quizzes, multiple layers, technology for focusing on a particular area of the screen, image editing and support for subtitles. In addition, since Moodle is the platform used by the University of Zaragoza, support for SCORM & xAPI is also desirable. At a first glance we have ruled out several of the packages: Gamecaster, as it is focused on the recording of videogames, and Wink and Jing, since screen recording is not allowed, but these two programs only allow screenshots. The remaining software packages do allow audio and video recording. In the following table we can see the results of the analysis of the remaining features.

<table>
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<th>Video editing</th>
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<th>Interactivity</th>
<th>Quizzes</th>
<th>Multiple layers</th>
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According to the previous table the most complete software packages are Active Presenter [4] and Camtasia [5]. FlashBack could also be a good alternative although it does not allow quizzes neither Moodle integration. The three best packages are proprietary software. The price of one license of
each one of these packages is the following: 299$ for Active Presenter, 167.01€ for Camtasia and 79€ for FlashBack. Taking into account features and prices, Camtasia can be a good choice for blended learning.

4GOOD TEACHING METHODOLOGIES AND PRACTICES FOR BLENDED-LEARNING

4.1 Teaching Methodologies

With regard to blended learning, it is important to take a careful look at how to transmit a series of knowledge and skills to the student, so that he is able to achieve a university academic qualification through a learning system different from the traditional one. Since, in the case of semi-contact, the contact between teacher and student is established according to guidelines different from those practiced in classical teaching, it is appropriate that the teaching methodology considers this specificity. In the present case, in addition to similar situations that may arise in classical teaching, a change of role of the teacher is noticed. The teacher, in addition to possessing a deep knowledge of the academic discipline in question, becomes a collaborator, guide, facilitator of learning strategies, exerting of motivating agent towards the student ([17], [18], among others), so as to enable the coating of this in the course, its monitoring and participation and avoid abandonment.

In this way, an analysis has been made in this respect, based on the different existing teaching methodologies, applied to the cases in which the face-to-face teacher-student contact is made in a timely, if regular, manner. This has been complemented by applying the sieve of the existing experience in the teaching staff of the Polytechnic University School of Teruel, given that in the past decade participated in the delivery of the blended modality in Technical Engineering in Management Informatics.

In conclusion, a number of forms of teaching that can be applied to the blended case have been detected, as will be summarized below. Firstly, it indicates the origin of some activities prior to the delivery of the course itself, such as the provision of a computer-based support to the faculty - in terms of the possibility of specialized assistance for them at the time of creating materials - or the provision of training courses for teachers and students - for the operation of the new modality - as well as a definition of protocols per subject, including a detailed definition of face-to-face sessions, tutorials or evaluation procedures, among other aspects ([19], [20]).

Considering already direct methodologies in teaching, as a summary, it is worth emphasizing the implementation of a flipped classroom ([21], [22], among others), peer tutoring ([23]), short video lessons ([24], [25]) or self-assessment sessions of the students ([24], [26]).

The flipped classroom includes the issuance of autonomous reading material and a video-based platform to be viewed by the students to get closer to the contents, so that in the classroom sessions the students interact with the teacher, working aspects already seen. Through peer tutoring, students participate in a common forum with the teacher acting as moderator in case of conflict. This way, that reflection and critical thinking is stimulated, enabling work in different directions, such as pooling of aspects, resolution of doubts or accomplishment of a collaborative work. By means of lessons according to short videos, the contents of the different subjects can be presented in a more attractive way than the written documentation, in such a way that the former completes the latter. Through the students' self-evaluation, they become aware of their situation and development through a strategy of reflection on their achievements and difficulties, and this can be transmitted to the teacher in order to detect possible elements of improvement in their action.

In addition, it should be added the existence of some support or tools that make possible the aforementioned methodologies, with the philosophy of fostering teacher-student contact and between students, where, as it has been already mentioned, the teacher acquires the role of motivating agent. This is the case, among others, of the implementation of glossaries - lists of definitions, concepts, encyclopedia - chats - real-time conversations - wikis - collections of authorized web documents - or the classic video conferences or employment of the email ([24], [18], among others).

4.2 Good Teaching Practices

As in the case of teaching methodologies, which must take into account the specificities that arise in blended education, it is important to generate new didactic innovation processes, as well as to adapt
the existing ones in such a way as to facilitate, to the possible extent, the learning process of the students. In this way, a series of "good practices" are developed. Such good practices are aimed at achieving a more autonomous work of students than in traditional teaching, characterized by a strong flexibility regarding the students' own organization of their study time, thus facilitating the management of the same based on the person, work and family conditions of each one, and encouraging the change of the teaching role.

The set of "good practices" that are designed and implemented in the face of blended learning should be structured based on the type of combined learning model to be applied. In this way, Bersin ([23]) identifies two main models of combined learning: the "Program Flow Model" in which learning activities are organized in a linear and sequential order and students have deadlines for various assignments (similar to traditional training, but some of the activities are done online), and the "Core-and-spoke" model which provides a main program (e-learning or face-to-face: "F2F") and a set of supplementary materials (optional and unscheduled) to reinforce the main course. In the case of the first model, the structuring of teaching in three phases is considered very effective: (i) an "online pre-class" so that the students reach the same level before the F2F class, (ii) a phase in which core concepts of the subject are introduced, followed by independent on-line experiences and activities, and (iii) an evaluation phase consisting of online pre-assessment, F2F class and online post-assessment. In any case, this kind of teaching should be characterized by an attractive content, centered on the student to enable him to reach the necessary skills and knowledge in order to carry out his future professional life, and segmented in order to facilitate the assimilation of the new knowledge and enable flexible programming of learning time. It is also very important that there is a high degree of student interaction ([23]). In order to carry out the process of designing training tools and supporting effective performance, the "ADDIE Model" is a descriptive guide that divides the interactive instructional design into five phases: Analysis, Design, Development, Implementation and Evaluation.

The use of "virtual classrooms", which must be characterized by the combination and balance of three dimensions: informative, communicative and experiential ([30]). Regarding the information resources that are incorporated in these "virtual classrooms", it is important to add a large number of them: initial presentation of the subject, program of the subject, schedules, agenda, manuals, evaluation criteria and information for its realization which can be textual, graphic, multimedia (animations, audio, videos ...), questions, links of interest, and so on. It is interesting to incorporate a virtual calendar of the course with the events that affect the subject as well as a work agenda for the student to facilitate the organization of their tasks ([27]). As for the use of educational videos ([28], [22], [29]), it is interesting the possibility of insertion of subtitles automatically by means of the poliMedia tool ([21]), since it facilitates the assimilation and search by subjects. In general, videos should be of a short duration (between 15-20 minutes) to avoid any decrease in interest and should contain the desired images in combination with the teacher's image, or only with the recording of your voice in order to avoid distractions. It emphasizes the existence of "Training Pills", which consist of videos of short duration (no more than 10 minutes) that synchronize two video signals (presentation and image of the teacher).

With respect to the communicative dimension ([30], [27]), it is necessary to create a specific space for communication and debate, based on synchronous or asynchronous tools, with forums, advertisements, cafeteria, chat, direct line, surveys, etc. As for the forums, it is important to differentiate two types of forums: forums for questions and problems related to the course of the subject and forums created for discussion of specific contents of the agenda. In addition to the forums, the use of the chat allows synchronous group discussions, aimed at students and faculty to ask and discuss issues related to the study of content and the implementation of activities. Another useful part of the chat as well as other tools of the virtual campus, such as videoconference, forums or e-mail, may be to solve virtual tutorials (synchronous or asynchronous ones), which allow to respond to the queries of the students about problems in accessing the Internet or the platform, in the use of Moodle applications, etc., or questions about the contents of the subject.

Regarding the experiential dimension ([30], [27]), different individual or group learning activities must be considered, for which the faculty will propose several tasks that require a theoretical revision, discussion or practice application around the contents of one or several subjects of the course. There are many types of learning activities, depending on the type of subject: the creation of a web page of the subject, a glossary of terms related to the subject, the development of learning journals, etc. The execution of these activities, together with the conduct of surveys, allows the teacher to evaluate the learning of the students in the virtual classroom, as well as the functioning and the progress of the subject in the virtual teaching platform.
For the design of the educational material, the "eXeLearning" resource can be used ([31]). It is an open source tool that facilitates the creation of educational content without the need to be an expert in HTML or XML and allows designing them according to several phases: Theory, Laboratory Practice, Proposed activities, Self-assessment Questionnaire and Surveys. In addition, it is very important that, at the end of the course, teachers prepare a report on the use of the tools used and possible future lines of research on these tools or others in semi-presential environments ([27]). Likewise, it is essential to stress that students should be allowed to download all content used in the course, both for students who cannot follow a rigid schedule of training and to solve the possibility that students can in some time not having access to the Internet, so they should be able to download the content offline and work on it offline ([23]).

5 CONCLUSIONS

We have seen that Moodle have a lot of useful tools and features on the four key components in which a virtual classroom is based: planning (study guide, calendar and next events, and unit availability), contents (great amount of types and formats), communication (diversity and quantity of communication tools oriented towards online teaching) and monitoring components (activity reports and assessments activities). Respect to software packages for the development of learning contents for blended learning we have seen that Camtasia is very adequate and its price is very reasonable. Finally, an analysis of good teaching methodologies (flipped classroom, peer tutoring, short video lessons and self-assessment sessions of the students) and practices (Program Flow Model, Core-and-spoke model, virtual classroom,...) has been stated.

ACKNOWLEDGEMENTS

This work has been partially funded by project PIIDUZ_16_347, Vicerrectorado de Politica Academica, Universidad de Zaragoza, Spain.

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