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Electrónica enREDada: An experience with a webinar program

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Abstract

Information and communications technologies (ICTs) are an invaluable tool to facilitate meaningful learning. In this work, a webinar program ('Electrónica enREDada') is presented that complements the teaching-learning process in selected courses of electronics in degree and master studies in Physics. These webinars allow an innovative approach to the study of specialized topics, improving the training of the student and promoting his/her scientific knowledge in the field of electronics by means of specific and informative modules. This learning activity is part of a comprehensive strategy towards the implementation of e-learning activities in all courses taught at the Electronics area. This learning activity consists of two webinar modules: one being of a synchronous nature and specialized contents, and the other one of an asynchronous nature and featuring distributed learning, which is intended not only for students of physics but also of other related degrees.

Keywords: *electronic learning; significant learning, webinar; TIC-based learning.*

1. Introduction

Today's society is immersed in a transformation process with effects at all different levels, and which in particular is shaping scientific and technological aspects. As a consequence, all reflections about the evolution of education need to take into account this context and the critical role that the information and communication technologies (ICTs) will play in higher education (Piramuthu, 2005; Regueras, 2009; Zúñiga, 2012). On the other hand, the shift to a teaching based on competencies requires a drastic change in the conceptions and habits of both students and teachers. Not only are ICTs a powerful tool to facilitate tasks taken on by teachers towards the students' learning autonomy such as guiding and support, but they are also widely used to create spaces to promote a detailed and systematic analysis of selected topics in each discipline (Kirkwood, 2005).

In the last years, many pedagogical innovation actions as well as the update and renovation of teaching resources are being carried out. The most representative of this process is the ongoing incorporation of the majority of courses taught in all high education institutions into software learning management systems such as Blackboard or Moodle. This allows ensuring that the use of ICTs in the courses is important and, therefore, they appear as one of the methodologies used in a number of formative activities.

Web seminar (webinars) programs have a very positive impact on student learning (Verma, 2009; Sypsas, 2015) and, in particular, the creation of a webinar program particularized for the Bachelor's and Master studies in Physics will serve to complement the specific teaching programs of the courses on electronics with experiences to discuss the methods and peculiarities of the scientific work. The webinars are scheduled throughout the academic year to grant students access to professional training programs that are taught by experts with relevant experience in their fields, which would otherwise be out of their reach because of their prohibitive cost and exclusivity. This is particularly relevant in our current economic situation because it provides the students with a realistic view of the career opportunities open in the field of microelectronics while at the same time introducing them to the tools that are used in the industrial sector.

2. Web Seminars Program

This project presents the integration of technological tools into educational practices with the objective of providing support, serving as a tool, expanding training possibilities, and being used only when necessary. Although this pilot experience has been developed specifically for the course Micro and Nano Systems, it is planned to be extended to all the courses of the Electronics area.

The webinar program consists of two modules. The first one, which is synchronous and has a specialized nature, has 4 90-minute sessions that deal with topics related with the design and fabrication of microelectronic integrated circuits. These topics are presented remotely in virtual sessions, making use of the training resources that the consortium *Europractice* (www.europractice-ic.com) offers to its members. In particular, the topics that are presented are:

- Virtuoso Electronic Design Environment, which gives a general view of the computer-aided design (CAD) tools
- Virtuoso Schematics Editor, which introduces the tool to create schematic representations of electronic circuits
- Analog Simulation Techniques in Virtuoso, which analyses the tools to perform the simulation of electronic circuits
- Layout Creation in Virtuoso, which describes the tools to generate the layout of electronic circuits from their schematic representations

The webinars are scheduled for November (Virtuoso Electronic Design Environment), February (Schematic Editor in Virtuoso), March (Analog Simulation Techniques in Virtuoso) and April (Layout Creation in Virtuoso), and they are followed by a one-week period to answer online questionnaires on the main topics covered in each of them.

The learning in the second module is asynchronous and distributed, and it is intended for students of the discipline and other related degrees. The webinars of this module are split into those designated to encourage the knowledge of electronics and its applications, and those constituting a form of mixed learning. The first type of webinars of the second module include videos on the design and fabrication of microelectromechanical systems (MEMS) to give a realistic view of the industrial processes involved. They cover the following aspects:

- Design and simulation of a MEMS
- Stages of the fabrication of an integrated circuit (IC)
- Revision of the presence of microelectronics systems in current processes and instrumentation

In the second type webinars of this module, the students are exposed to the materials outside the classroom sessions, which are used for active learning and, in some cases, for the development of higher skills such as conceptualization, analysis and application of the new information. The scheduled activities include the development of animations to visualize the operation and fabrication of MEMS by the adaptation of Matlab applets (Dimitrijev, 2000; Sánchez-Azqueta, 2014) and their conversion to Java, and the use of CAD tools to replicate the most important steps of the design and simulation process of a

microelectronic system, for which the students have access to academic licenses of the tools.

3. Results

Although "distance teaching" may result in less dialogue between the teacher and the student, it demands more autonomy from the students, which contributes their developing of critical transversal competences such as time management and self-organization.

In this respect, the webinar modules implemented in project improves the learning outcomes because it:

- Facilitates access to new resources of specialized training
- Contributes to a better understanding of physical phenomena by the combination of a conventional treatment with a more visual and intuitive presentation
- Delves into the different stages in the fabrication of microelectronics systems
- Introduces professional computer tools to design and simulate these systems
- Encourages the active participation of the student in the teaching-learning process

One of the methods to evaluate the level of achievement of the objectives of this teaching action is the design of a set of self-evaluation exercises and problem based learning (PBL) activities related to the items dealt with in the webinars. Another one is the realization of a survey to investigate on the students' opinion about the development of the activity, and also on their reflection on their own knowledge of the topics and the influence of the activities. In particular, the students are asked to evaluate if they are able to:

- Describe the principle of operation of the main microelectronic systems
- Enumerate and justify the stages of the fabrication process of these systems
- List their main application fields and analyse their roles
- Recognize and manage in a basic level the main computer tools used to design and simulate microelectronics systems
- Undertake the design of a simple microelectronic system according to given specifications
- Assess whether the scheduled activities have improved their understanding of the matter and their skills and if they have increased their interest in the subject

As shown in Fig. 1, students greatly appreciate the opportunity to use professional computer programs for the design of microsystems; moreover, a vast majority agrees that

the complementary materials have contributed to a better understanding of the course topics, increasing their interest and motivation.

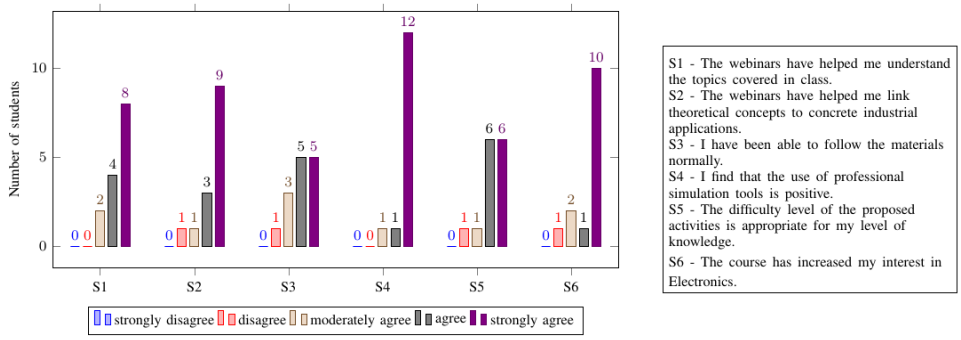

Figure 1. Results of the survey carried out among the students to assess the impact of the activity.

4. Conclusions

In the current framework of degrees adapted to the European Higher Education Area, it is essential to develop a continuous pedagogic innovation strategy, as well as to renew the educational media. This process must be realized in different fields, seeking that the students achieve more autonomy in their learning process. In particular, an adequate strategy is to provide students with tools tailored to achieve a deeper treatment of the most relevant topics of the courses, that are attractive to them to achieve that how they learn be as important as what they learn.

The creation of the webinar program: *Electrónica enREDada* has allowed students acquire specific skills that complement the teaching-learning process in courses of electronics of the Degree and Master studies in Physics. An innovative approach has been given to some specialized topics, improving the training of the students and their scientific knowledge of electronics. In particular, it has favoured the learning of complex physical phenomena while fostering the interest and implication of the students by a visual and dynamic description of the theoretical concepts. It has also allowed students the access specialized training resources in the adequate space and time and it has fostered their active participation in the teaching-learning process.

Regarding the assessment of the teachers, an improvement of the overall results of the course and, above all, a greater implication and motivation of the students is appreciated. Moreover, the incorporation of videos and other materials on the fabrication and operation of the devices has greatly reduced the problems found by the students in what regards the interpretation of the related mathematical expressions.

As an aspect to consider for forthcoming editions of the activity, the students express some difficulties in following the materials in English. The teachers attribute this fact to the sound conditions of the classroom and, above all, to the variety of accents presented by the various instructors of the online materials.

Finally, the strategy proposed in this project is transferable to the majority of the courses of the Degree in Physics and other similar courses in different educational levels in Engineering.

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