VIRTUAL AND COLLABORATIVE ENVIRONMENT FOR LEARNING MATHS

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Abstract: This paper presents the experience of interaction between students and the new teaching-learning system, using eLearning platforms to support and improve classroom teaching. The proposed system tries to achieve a new common space between some European countries, that will allows the adaptation to a comparable and compatible common system of higher education. This study has been developed specifically with students from the first engineering courses and will show an online platform that helps them to interact with other classmates and acquire knowledge using the computer.

1 INTRODUCTION

The origins of human-computer interaction (HCI) could be found in the technological explosion that occurred in the seventies, when it was necessary the direct communication between humans and computers (Hernández, 2008). Since then new and several technologies have been used in educational innovation.

Teachers are increasingly adopting computers as a daily tool needed to carry out a more effective teaching and greater quality levels. The Information and Communication Technologies (ICT) are an important element in the convergence of universities to European Higher Education Area (EHEA) (Queiruga, 2008), contributing to learning, and culture changes associated with the common European area. This common system of higher education promotes the training of more responsible and active citizens by making academic degree standards and quality assurance standards more comparable and compatible throughout Europe.

ICT has grown from being a simply object to be viewed as an instrument to support innovation in teaching, enabling the personalization of the learning process and changes in strategies and methodologies that enhance continuous learning to the students (García, 2006), (Kirschner, 2001).

The teaching of mathematics is not an exception and is not liable for the use of these methods (Queiruga, 2007). The subjects of mathematics required for obtaining a degree in industrial engineering include the linear algebra course which will focus this studio. We are realizing the integration of eLearning as a model of further education by significantly increasing their use in recent years (Mason, 1998).

The University of Salamanca has a virtual environment called Studium (Hernández, 2006), and also has licensing campus for various software packages specifically suited for calculations in general. Without going any further we might cite the Mathematica (Wolfram, 1999) or Matlab (Moler, 2004) for solving equations, operate with matrices or perform various simulations useful for practical classes.

As we know, mathematics is very close, generally, with computational sciences. The area of mathematics is therefore, one of the most adapted for the incorporation of the new technologies, since it is not only one purely formative subject, but is a

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scientific tool for the students who must help them to solve the problems that are generally throughout their race and in its professional development.

This paper is organized as follows: In section 2 we show the work environment in which carried out the experience detailled in this paper, the linear algebra is detailled in Section 3, and in Section 4 the conclusions of the study are presented.

2 WORKING ENVIRONMENT

The working environment in mathematics classes is diverse and is now extended with the possibility of using computers for classes. So far, traditional classes consist of lectures in which most of our students attend class as an auditor, without participating and only to take notes.

In recent years, due to changes leading to the common European space, we use computers to complete the classes and provide students with different activities and new tools.

2.1 Online Platform

Studium, the virtual campus of the University of Salamanca, offers teachers and students at the University a technological structure that channels education through the Internet, and provides different online tools that transport to the network the student-teacher interaction processes. Studium is based on the web platform Moodle (Modular Object Oriented Distance Learning Environment), a virtual teaching environment that allows placing contents and tasks in the network and provides online communication tools.

The Moodle environment is within the construction learning mode, pedagogical approaches in teaching, trying to establish consistent relationship between what to learn (new knowledge) and what already knows (prior knowledge), thus the new information that get students is integrated into the background and acquires a appropriate significance with respect to what is already known (Weiss, 2007). This platform is currently used by many Spanish universities from that in 2004, the University Jaume I of Castellon and University of Las Palmas de Gran Canaria institutionally adopted Moodle. On this platform the students construct their learning through the use of different activities and collaborative tools posed by teacher and communication tools between participants (students and teachers). This online platform is based on free software and available, along with manuals and installation software in http://www.moodle.org.

One advantage of the use of online learning platforms is that are built based on social constructivist pedagogy (Brooks, 1999), which favours a collaborationist model of learning, where students share their experiences and work, and can communicate among themselves or with the course tutors at any time to answer questions or ask for help, thus becoming a space for social interaction, that connects individuals through a computer.

As is known, one of the main purposes of a virtual campus is facilitate and enrich the interaction between all members of the community.

This platform represents a graphical user interface intuitive enough for students to use it without prior knowledge of the environment. Another important feature of this virtual campus is that it allows the integration of interaction tools like chats or foros, and activities designed specifically for teaching, such as the Web-Quest (http://webquest.org), which represent a new methodology for teaching via the Internet, the Hot Potatoes software (http://hotpot.uvic.ca), free distribution, which allows developing exercises interactively, especially useful and used to propose questionnaires, games, online exercises for students, or any other web activities, which makes the Moodle platform considered a set of Web 2.0 tools (Oberhelman, 2007).

2.2 The Internet and Classes

The Internet provides a comfortable and fast form to access, to represent and to use the information (Díaz, 2009). Some of the advantages of its use that could be mentioned are:

- The ease and speed with which tasks and problems are managed and resolved, allows students to spend more time understanding and analyzing the results to the mechanics and the potential difficulty of its solution.
- The students find the job in mathematics with the more attractive possibilities that the computer offers, since it eliminates the routine work and power the creative part, which increases its motivation.
- It is able to quickly catch the attention of the students.

The Internet use enables students to find information quickly. The problem is that they often do not know how to filter the information and data found, so it is convenient and important the work of the tutor in these cases.

Is of great importance that students learn to discriminate the information obtained by browsing the Internet and know that not all information is equally valid or good. In addition, they must also learn to develop the information obtained with their own words, so they understand all the read and learn how to summarize it.

2.3 Activities and Useful Tools

The ICT provide the students the possibility of simulating experiences and of raising very different situations, comparing them, something that manually can be difficult or at least tedious in the majority of the cases. It allows them, for example, to include/understand the true reach of a problem or the effectiveness of an algorithm analyzing the initial results obtained when varying the hypotheses, initial conditions, etc. Thus we can mention, in addition, other possibilities that can be useful for math subjects:

- To graphically represent successive curves that shows the different solutions from a problem.
- To modify, to suggest to the student the data of the proposed problem and to see the repercussions of these modifications in the solution.
- The conviction power that gives the accomplishment of the calculations with computer in the presence of the students.
- To represent graphically, in seconds, all the solutions of different problems.

Thus, using computers in the classroom, it is possible to offer to the school students' more and more complete and deep formation in mathematics, that allow them to face their future professional activity, adapting to the advances of science and technology. From the appearance of computer science, one of the main utilities of the computer in relation to the mathematical work has been the case of numerical calculation. Nevertheless, the mathematical applications in engineering require not only of numerical calculation, but rather an algebraic mixture of numerical calculations and manipulations on mathematical formulas. The symbolic calculation is indeed the technology specialized in the automatic manipulation of formulas, vectors, matrices, etc., with numerical and/or symbolic elements. It is in this specialty where the use of specialized software is especially useful, as can be the packages of symbolic calculation Mathematica (Wolfram, 1999), Maple (Bauldry, 1995), or Matlab (Moler, 2004). These software packages have syntax easy to learn, since the orders and commands remember the mathematical operations that they execute and, therefore, its learning is fast and intuitive. In addition, the aid that offers these software packages is very complete and is informed with numerous examples. The University of Salamanca owns a license "Campus" for some of the versions of this mathematical software.

Mathematica package is a system of computer algebra originally developed by Stephen Tungsten. It is also a powerful programming language that emulates manifolds paradigms using re-writing of terms. It uses code blocks (bookstores), to extend the capacities and to reorient the calculation. The programming language of Mathematica supports the use of functional programming and procedures (although generally, the functional programming is more efficient). It is implemented in a variant of the Object Oriented Programming language C, but the thickness of the extensive code of bookstores in fact is written in the Mathematica language, that can be used to extend the algebraic system.

Unlike other languages, like Maple or Matlab, Mathematica tries to use the transformation rules that know as much in every moment as it is possible, trying to reach a stable point. In a basic level, Mathematica can be used to realise numerical and symbolic calculations, as well as to realise graphical representations of functions. But in more advanced levels, it can also be used like programming language of great versatility to own built-in functions and instructions that in the traditional languages would require additional routines.

At the School of Industrial Engineering in Béjar, we use both Mathematica and Matlab. The first one has a great advantage that could be use together with the network through the WebMathematica environment. We do not know that possibility for the case of Matlab. On the other hand, Matlab with Simulink is the math software preferred by engineers for its versatility and utility in simulation process and toolbox availability.

3 LINEAR ALGEBRA SUBJECT

An important task for engineers is to learn how it is possible to model daily events and objects with mathematical tools. It is considered that problem solving is an important part of their education; by interpreting such problems as a context within which they can apply Mathematics in general and Linear

Algebra in particular, to aspects of the “real world”. Thus, students can learn how to make practical use of their mathematical skills (Lantz-Andersson, 2008).

Industrial engineering studies are based on a solid initial technical knowledge, complemented with enhancements that, depending on the choice of the student, go deeper into the study of specific technical problems and problems in industrial organization. However, in the training of industrial engineers, emphasis tends to be placed on the generalist, polyvalent and integrative nature of the teaching, and on the development of skills to learn and solve the technical, organisational, and management problems that are inherent to any industrial or services company. Owing to their multidisciplinary education, industrial engineers are able to develop a career in any technical industrial activity.

Within this type of training for engineers, of special interest is to solve different activities proposed in classes and in the virtual campus. We propose the students to solve some questionnaires, one for each module of the course. Besides the questionnaires, students must work in an application of linear algebra to daily life. To carry out this work students use the internet as the best resource.

Our teaching programs allow us not only to clarify -for our students- the processes they should follow to be able to understand the mathematical concepts they are in taught and to consult and take maximum advantage of the literature, but they also enable us to instil a solid formation in how to work with Mathematics. This, we hope, allows students to address new problems and research and hence to appreciate that both intuition and the real world can become bottomless sources of new studies and results in the field of mathematics. Additionally, the students must attempt to solve as many problems as possible, understanding by problems not only those that require an approach in which a rule or an algorithm is implemented for their immediate resolution, but also those in which the students must gauge the appropriateness of different strategies in order to tackle the problem in hand and must choose a method to solve it.

Engineers working in industry must acquire and develop basic knowledge and skills, in which the ability to work in interdisciplinary teams, an ongoing interest in new knowledge through the students’ own work, the ability to address the different problems of the company for which they work, and criteria to use the mathematics necessary to solve specific problems must all be combined.

One way to tackle the problems that arise for engineers in their job is to learn how to find solutions on the internet or with colleagues, so the activity that we propose, the realization of a work in groups, involves both learning algebra development and other skills such as teamwork, information search, and the use of tools like Mathematica or other open source language that can be found on the Internet.

As well as having knowledge of applied mathematics, engineers must be able to apply maths from the perspective of a true engineering professional. Knowledge of mathematics helps engineers to systematise logical and analytical thinking, with the help of other disciplines that will in turn help them to structure their synthetic thinking and awaken their creativity.

4 CONCLUSIONS

After using the eLearning platform and the activities mentioned in this study, which complement traditional teaching, at the end of the course we made a survey to students and we found the following aspects of online teaching and learning system (Kearsley, 1998): the student and teacher can access the application at any time, both to aid and to all information and documentation of the course, students have available and affordable all resources, like questionnaires, problems, practices, and the means for optimum use of the subject. The flexibility of platform involves a cooperative, rather than independently environment (Aliev, 2001), allowing students to interact and organize the course as needed. The online platform allows continuous contact with the students' work. These may solve questionnaires, exercises and the application proposed work, using forum or chats to be in contact with teachers and other students.

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