DEVELOPMENT OF PHYSICS AND ELECTRONIC VIRTUAL LABORATORIES IN A WEB LEARNING MANAGEMENT SYSTEM

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Abstract: This paper presents a new Learning Management System (LMS), which permits teachers to administrate the contents stored in the system. It also allows the carrying out of student handling actions: enrolment in a course, evaluations, generation of reports in PDF format or as tabulated data in CSV format, notification via e-mail, which facilitates both the management of subjects taught by the teacher and the learning of them by students, thus obtaining a personalized Virtual Classroom. This project presents some advantages in comparison to others LMSs, since we can develop and include some virtual laboratories as a typical content in the portal, adapting them according to the needs of the user, i.e. the teacher. Particularly, whilst in other tools virtual laboratories can be only linked to external resources, in this LMS they can be directly created, edited or designed within the same environment.

1 INTRODUCTION

Very many studies (Lopez Martin, A. , 2003; Babulak E, , 2009; Fang RJ, Chang YH, Tsai HL, 2009) have shown the usefulness of new technologies at an educational level (CIive L. Dym, 2004). Within the field of scientific and technological education, computers can be used as a tool for reflection, since thanks to them students are the protagonists of their own learning processes (Romero, C.; Ventura, S. Et al. 2009).

In the past few years we have developed and evaluated numerous computer science applications, which include different modules: diagnosis of knowledge and previous ideas, solution of problems, numerical simulations, virtual laboratories, interactive tutorials, etc (Martínez-Jiménez , P., Varo, M; et al. 2009).

The main advantages of this type of educational tools are: representation of situations which in practice are irreproducible, idealization of experimental conditions, depiction of situations requiring costly and complex equipment or without many prototypes available, the use of models representing partial aspects of reality, handling of dangerous processes, and control of variables, etc . Furthermore, very many changes have occurred in the "network above all networks" (Stefanovic M, Matijevic M, Cvijetkovic V, 2009) since 1995. In the field of Physics, numerous advances have been made, especially in the area of research and teaching.

Currently, teleinformation is an important challenge in education since it lets teachers teach subjects and resolve students' doubts through Internet,, and, at the same time, students can carry out a self-directed learning process.

In addition, most of the Learning Management Systems available on the market present a very generic philosophy and, consequently, the users (teachers and students) cannot make the most of them.

Inside this line of work, the department of Applied Physics has been compiling a large amount of links to different resources created for the department, each one focusing on an aspect of Physics (http://rabfis15.uco.es/lvct/
and http://rabfis15.uco.es/deptfisica/)

2 OBJECTIVES

The basic objective of the project presented is the creation of a Learning Management System or LMS, which permits teachers to administrate the contents stored in the system (inclusion or exclusion and modification of different types of contents: tutorials, practices, problems, simulations). In addition, organization actions can be carried out for students: enrolment in a course, evaluation, generation of reports in PDF or as tabulated data in CSV, notification via e-mail. This features facilitate both teaching and learning, obtaining a personalized Virtual Classroom, moving away from the pre-fabricated products in existence, such as Moodle, Dokeos and other LMSs.

The aims of this application are:

- A complete management of students. To enable teachers to administrate simply and intuitively the different groups of students they teach.
- A classification of the contents and teaching resources, problems, questionnaires and **simulations** in order to place them at the students' disposal.
- Generation of courses with personalized contents (tutorials, simulations and virtual laboratories) reinforcing the concept of the Virtual Classroom as a complement tool to teaching.

In view of the current tendency of using the web in our daily lives, with this system we shall be able to focus on teaching from a more up-to-date point of view and in accordance with the advances supplied by this technology. Among the advantages of this web aspects are:

- Magnetic support independence: it will not be necessary for the student to load magnetic or optic material for the installation of software in different computers.
- Geographical independence: The student can access to the application from any terminal possessing a connection to Internet, without any other special requirement.
- Adaptation to new technologies: there is no doubt that the web support contributes a nuance of progress to the project in accordance with the

technology of the information networks in force today.
- Restricting access to certain areas: It has become necessary to prevent non authorized users from having complete access to specific areas, mostly used for the organization of users and of the portal contents.

3 PROJECT DESCRIPTION

GCAD is a Web application which implements an information system useful in teaching as a LMS (Learning Management System). For that, the PHP 5 programm language, a database system such as MySQL and a Web server are used.

As in all the dynamic contents web management system, the application is divided into two visualization modes. On the one hand, the portal public views, that is, the front-end in which all the contents stored in the system are shown categorized according to the kind of content. On the other hand, the private block of the software, the back-end, which is only accessible to the users registered as administrators or teachers and with the corresponding licenses to create, edit or delete contents or to manage the different users

3.1 Development of the Front-end or Public View

In this part of the tool the external interface or front-end has been implemented. This permits us to show users the different types of contents to which each user is associated and which have been generated with the administration tool. To achieve this, the logic controlling the access to the contents was codified (figure 1)
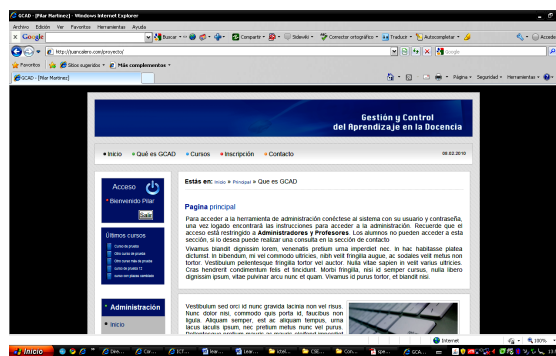

Figure 1: Public View Screen.

3.2 Development of Back-on or Administration

The databases and the web environment have been designed to permit the development of the administration tool of the contents or back-end in accordance with the philosophy of the web creation. The whole web portal (those aspect related to the users and those related to the contents) can be administrated from this section. Access to this section of the portal will be restricted per user profiles.

The content is classified into courses, tutorials, questionnaires and the web portal front-page. Course content type include tutorials and questionnaires which can be linked allowing the creation of personalized courses with the desirable content. At the same time, tutorials are based on a page structure so that it is possible to create a "book" with a more comfortable navigation, which permits browsing to be easier in the form of "training pills" (Figure 2).

Next, each of the functions of the Learning Management System is explained:

- *Administration of users*. This is a basic functionality. With this administration tool we shall be able to incorporate users, modify the data or remove users as basic tasks, and other more advanced ones like the management of the applications for enrolment in the courses, grade control, sending of notifications, blocking of users or generation of reports. The users can play one of three possible roles: Administrator, Teacher or Student. These roles will determine access to the System's tools, so that access to the back-end is reserved for users with the role of Administrator or Teacher.

- *Administration of Courses*. This second tool is that which allows the incorporation, modification or removal of courses or **virtual laboratories** in the system. **A course or virtual laboratory,** as a type of content, is the framework in which the rest of the information stored in the system is encompassed.

- *Administration of Tutorials, Simulations.* A complete administration tool has been designed with the basic functionalities of inclusion, modification or removal for each of the types of contents that can be included in the courses or virtual laboratories. Contents already created with other technologies can be included, such as Flash, Applets, Java, Video, in different formats or other XHTML elements and make them the portal's own material, thus eliminating the need

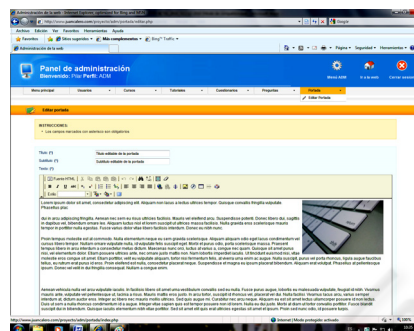to access to the source where they come from (Figure 3).
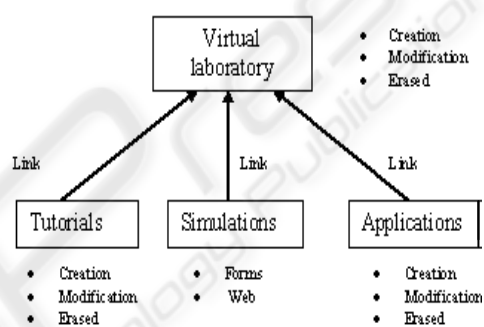

Figure 2: Administration screen.

Figure 3: General diagram of the Virtual Laboratory editor.

- *Administration of Questionnaires.* In the same way as in the previous sections, a tool for administrating questionnaires has been created with the basic sections of inclusion, exclusion and modification. The questionnaires can be used, as well as contents which can be associated with a laboratory or course, as an element which decides the admission of a student in a course or not. We can also use questionnaires as a filter for admitting a student in one course or another. That is to say, we can create several courses at a different level, and, depending on the result obtained in the questionnaire, the student will be included in a certain course.

3.3 Public Portal

The system has an access control for its users. Once they have been identified in it, they can access to the different courses in which they are enrolled, or can apply for enrolment in the rest of the courses available.

4 INNOVATION

Comparing this application with other LMSs such as Moodle, is the higher management content level, that is, users can edit their own pages without a predefine structure, being possible to include educational contents instead of linking it. This personalization system is based on the current CMS (Content Management System) not implemented in most of the LMS. This Web 2.0 feature makes the present project nearer to the current website design tendency.

On the other hand the GCAD Project is a dynamic tool specifically designed for the educational field that complements and makes up for the deficiencies on edition tools of the Applied Physic Department Website, which are very necessary in the present universitary learning-teaching process.

Finally, the main GCAD innovation is the personalization of the application, which is based on the application of the Content Management System philosophy to the LMS. Thanks to that it is possible to integrate all the contents stored in the system (questionnaires, tutorials, …) and to re-use them in different courses.

5 CONCLUSIONS

A new platform, Learning Management System, has been developed. It is somewhat removed from the traditional Moodle type systems, since it not only permits the administration of the actual tasks of learning management but it enables users to design, create, erase and modify lessons and/or virtual laboratories housed in the server as if they belonged to it.

In short, this project signifies an advance with respect to other LMSs such as Moodle in the sense that we can include these courses and/or virtual laboratories as an actual content of the portal, adapting it according to the needs of the user, in this case the teacher; whereas with other tools it is not possible to create, edit or design directly within the same environment the courses created, but one is limited to creating links to other external resources.

Together with this advance, which means managing the contents as one's own, it is important to point out the advantage signified by the fact of executing elements created externally on the same platform without taking into account the original source. This centralization of the contents permits: a greater fluidity in browsing since everything is housed in the same server; rapidity in localization at the moment of creating courses as the contents forming part of the portal can be used by different courses; and, generally, the generation of a large library of perfectly catalogued and permanently available resources.

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