

AN INTERDISCIPLINARY APPROACH TO TEACH ODE - DEVELOPMENT AND IMPLEMENTATION OF THE EV & C UBB PLATFORM

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ABSTRACT

An active learning approach has been developed and implemented to teach Ordinary Differential Equations (ODE) for Food Engineering undergraduate students using an Internet-based package (EV & C UBB).

A variety of learning strategies have been introduced to support and extend the traditional lectures making it easy for instructors to design and deliver online learning. To achieve those goals we have implemented an Internet-based package that includes several sections for learning and teaching, some of them interactive.

The internet-based package works like a distance educational platform, so the student can use it from anyplace. EV&C UBB includes class calendar and bulletin, interactive tests, secure access for students and instructors, homework and projects forum, peer review, and resources area.

The ODE course was originally designed so the student could make his (her) own projects, and be evaluated at the end of each project. Now with the introduction of the Internet-based package the student can receive help whenever he (she) wants, and it is possible to know at every step of his (her) work all advice that has been given by the instructor or peers. We believe that EV & C UBB is an extraordinary teaching aid strategy to learn from research projects in ODE. Students interact with instructors and peers to improve his (her) project. Therefore we have contributed to develop a teaching and self-learning comprehensive system that reinforces active and constructive learning.

Key words: Collaborative learning, Distance Educational Platform, Peer instruction, Mathematical modeling, ODE Lab.Work Book.

1. Introduction

Engineer students at the undergraduate level, very often, have serious problems applying theoretical concepts to real and concrete problems, especially when doing the mathematical modeling. Furthermore, in order to be updated with our fast and growing technology, we have to promote critical thinking development in our university lecture practices (Bates, 2001). Therefore we have developed and implemented a teaching-learning platform system to be used by teachers or instructors with their students. In particular, our university is situated in a city surrounded by rural underdeveloped and economically poor communities. Therefore, our students face for their first time in their life courses with technology that allows them to think and develop own ideas. We believe that the virtual platform developed here would encourage that attitude in any student. The main objective of this device is to guarantee a greater communication with and among students.

Our continuously changing world society triggered the current developmental needs in our global university educational system. The structure of this new educational system is sustained by innovation, which in turn is being supported by didactics, curricula and education itself. This global society has changed because science and technology has played an important role in their cultures. In that sense, our students will have to face a society that works based on high productivity patterns and standardized global requirements. So, the university teaching strategies have to change ahead of time in order to prepare those students for critical thinking behavior, an intellectual tool for a constantly changing world culture (Machamer *et al* 2000). It is well known that traditional lectures have proved to be ineffective promoting critical thinking in students. Such academic training is obtained through other kind of strategies where students are active learners (Brussee, 1999).

We have chosen to apply a distance educational platform strategy to teach ordinary differential equations to undergraduate students. That course requires skills that are difficult to obtain in traditional lectures. Evidence comes from comparing the high failure rate among students that have taken the traditional course in the past, to the greater rate of success among students that learned using the platform.

We believe that one of the major challenges for teachers is to teach so students can learn, in that way we describe here an active learning approach that has been developed and implemented to teach Ordinary Differential Equations (ODE) for Food Engineering undergraduate students. The device uses an Internet-based package (EV & C UBB) including a variety of learning strategies to support and extend the traditional lectures making it easy for instructors to design and deliver online learning. To achieve those goals, the Internet-based package includes several sections for learning and teaching, some of them interactive.

Distance educational platforms values any kind of learning, favors communicational skills among classmates, strengths interaction between instructor and students, weakens paradigms that are opposite to innovation, and strengths education outside classrooms. Distance educational platforms are a strong complement for on site teaching practices. In this paper we show how this platform works, what is the teacher role in the course, what are the general administrator functions, and how is the course ODE taught using this device.

2. Implementation

The virtual platform “Virtual Education & Science at UBB” (“Ev & C UBB” in Spanish), using a remote way, supports academic development for undergraduate students, teachers and other users in general with an easy delivery of contents, knowledge and experience exchange among participants. The platform “Ev & C UBB” is designed so any user (teacher or instructor), from now on called administrator, can have a personal area programmed with a variety of supporting modules according to each user needs.

It also has a working area that contains all different sections or courses saved inside the platform. These courses may be designed by each course administrator with high flexibility, allowing a module development according to each particular course needs.

Technically, the platform has been developed using a professional language for web applications called PHP (Personal Home Page), which interacts with a data base created inside a data base server MySQL. Personal Home Page and Mysql are tools used to develop “Ev & C UBB”, and altogether can offer a robust distance educational platform.

2.1 THE PLATFORM

The platform EV & C UBB is flexible, may be used for any course by any teacher because it can be designed and modified at any time by the course administrator. Therefore, the administrator has total control of the course and the information students put into the platform; in that way the administrator can view at any time contributions or progress made by the students in the course. On the other hand students may navigate freely through the platform and can make contributions, talk to the administrator, or with other students, solve a variety of tests and questionnaires on line, get into discussions, review other students contributions, set their own web page, and so on. The internet based package provides the student with general information about the course, the student may have access to all the course members personal information (addresses, phones, picture), and if the administrator wishes, the student may also view his(hers) peers reports or comments.

The administrator can organize the course contents at will. For example, create files titled Laboratory Guides, or Special topics discussion, or Teacher’s lectures notes. The administrator may have access to most frequent questions asked by students and can check when the student have logged in or has made a contribution. The platform has a private area for the student where documents and links may be saved, and there is a personal calendar to schedule an agenda for the whole year or beyond. This personal calendar may be shared or not by the student with other group members, for example to schedule meetings among them. In the working area the student may read or unload information about lectures, create and be part of forum, read or add documents and links, see the course calendar. The student may also create his(her) own web page using the resource My page.

The cascade forum resource is interesting since the administrator may give a topic for discussion with a date and time limit to make contributions. The student contribution can either answer the administrator ideas or any other student idea, identified by the student’s name. In that way the package will create a cascade of opinions linked to the original source. The administrator and the students as well, can see all contributions.

The administrator can also have a data base with all the questions for a given test or survey. In that way the questions can be selected for a given group of students or any other purpose. The

multiple-choice test can be done once or as many times the administrator wants; the administrator can choose to let the student know about the answer or else give clues to answer properly. The administrator can set a date and time to solve any given test. At the end the administrator can see the statistics for the student's answer and evaluate performance in the course.

The platform has a variety of modules that can be useful to the administrator and are designed according to the course characteristics and necessities. The modules are Calendar, Files, Cases, Simple Forum, Users groups, Peer review documents, Peer group review, Questionnaires and Surveys, Cascade Forum, Resources, and Webmail.

3. The Ordinary Differential Equations (ODE) course.

The ODE course is taught at the third year of Food Engineering after the students have taken at least two Calculus, Elementary Algebra, and Linear Algebra Course. The ODE course teaching strategy is based on projects design and computer simulated experiments. These methodologies motivate the student to modify their learning styles and therefore develop independent critical thinking. The platform Ev&C UBB with all its modules have helped students to develop analytical thinking, using intuition, and logical arguments. The administrator would give each student or group of students a problem related to real cases from food industry, where it is required to manage ideas linked to areas like heat transfer, and fluids mechanics. The students interact through the platform using symbolic packages like Maple, Modellus and Scilab. This software would help the student to understand and do mathematical modeling about real situations. Softwares like the above-mentioned can be used to simulate experiments (Borrelli *et al* 1998), and therefore to infer changes in a discrete field to understand in depth processes in a continuous situation.

The administrator can allow students to peer review their reports on line. This exercise has shown to be effective since students who do peer review with detailed and constructive comments may enhance their own work (Tsai *et al* 2002). Tsai *et al* (2002) also suggest that anonymity offered by networked environments may help build up a more objective way of judging peers work.

Transition from discrete to continuous thinking requires adequate problem searching and design of motivational exercises by the instructor. In that way the student can move in a comfortable and increasing way among symbolic contexts, numerical concepts and graphic development. For computer modeling experiments we followed Borrelli *et al* (1992), and for project design problems we used strategies in common use by American universities (Cohen *et al* 1991) plus special and slight modifications (Toledo *et al* 2001). Evaluation could be done at any time using forum modules, questionnaires and survey modules, homework assignments, computer experiment assignments; grading was done based on forum participation performance, weekly tests or quizzes, and 2 or 3 mid-term testing. Furthermore, this Platform can be used during laboratory work where every student is working in his own computer; the instructor would ask questions to be solved by students, the answer can be displayed on the instructor's screen. In that way, the instructor can manage a survey about concepts or skills acquired by students, allowing the instructor to reinforce concepts in case is necessary.

Performance in this course in the past was poor, only 40 to 50% of the students would pass the course. Now, with the current use of the platform students feel that teachers keep them "in their toes", they have a continuous feedback not only from their teachers but also from their classmates.

Good performance in this course has increased and the percentage of students that pass are over 80%. We have done student surveys about the platform and the students say that they feel more comfortable talking to the professor through a machine, another opinion is that they feel they can solve any problem, and is a real pleasure to face one when you think that you are solving applied engineer problems just like in the real world.

4. Conclusions

Platform EV&C UBB has been created and implemented as a complement for student learning. This strategy promotes a greater dynamism and participation among students, teacher assistant, and teacher or instructor. The ordinary differential equations course has been enriched using project design exercises, and computer modeling exercises in the teaching and learning process. These activities has been reinforced continuously with periodic evaluations through all semester by teachers or instructors given the fact that student's work and participation can be followed daily using the platform Ev&C UBB.

Opposite to traditional kind of communication in classroom lecturing or through office hours attention to students, the platform offers an active type of communicational tool. The students feel their case or question can be assisted at all times not only by a teacher but also by peers. The student acquires knowledge, a higher selfsteem, and communication skills through message interaction with peers. The platform offers a collaborative environment, where students can identify themselves and can be influential or accept other ideas towards building a teaching and learning process fitted for everyone individually in a academic community.

We believe that Ev&C UBB is a platform that can be used to collaborate in the teaching and learning process not only in mathematical fields but in any field, so it can be used by all teachers and students. Since the administrator can modify any of the modules adapting the platform to his(her) own uses, we feel that this is a strong communicational and teaching tool for everyone. The language used in the platform is Spanish but we are working to translate it to English so it can be used as a universal learning strategy tool.

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