

Experiences in the use of online teaching for engineering education

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ABSTRACT: Information Technology (IT) advances have brought enormous changes to the way people interact on both a personal and business level. Universities have not been immune to these changes and face many new challenges in pursuing their goals. These new methods range from the use of *PowerPoint* presentations to the employment of duplex communication channels between the instructor and his/her students. The College of Engineering at Florida International University, Miami, USA, is expanding its capabilities by offering distance-learning courses recorded on CDs, while also utilising general Internet or Internet educational packages. The article focuses on the experiences gained in using *WebCT* for teaching engineering courses. One important advantage that has been obtained with this software is the tracking of students and the assessment of student learning. The package is used together with other tools, such as computer simulation, in order to improve the quality of teaching. Advantages in the utilisation of these packages are also analysed in comparison to the use of the general Internet.

INTRODUCTION

It is known that we live in an ever-changing age of transformations. The economic success of individuals and nations in the 21st Century depends on education and the way that knowledge is implemented.

Universities must play a major role in preparing individuals to be key players in today's society. With the new concepts of globalisation, competition in the advancement of science and technology has become a race. Universities will increasingly compete in the quality of education – the quality of their graduates – because the opportunities for graduates will be global. Big corporations will be hunting worldwide for the best graduates to incorporate into their organisations. In a global market, the competition will be fierce indeed [1].

Traditional education cannot give an adequate response to this situation. Instruction in traditional classrooms is limited basically by two prime factors, namely:

- Classroom teachers rely on a very limited number of visual and unobtrusive cues from their students in order to enhance their delivery of instructional content.
- The audience is limited since many students are unable to attend on-campus classes.

Within this context, the only way to improve the quality of education is through the introduction of distance education. There exists a wide range of technological options in distance learning that have been analysed in: print, voice, video and data [2].

Over the last few years, the Worldwide Web (WWW) has become the basic tool for instruction using computers. The Internet presents a wide range of possibilities to help students.

These possibilities include the use of e-mail, establishing a classroom bulletin board, engaging students in dialogue with other students, the development of course content that is available at any time, as well as fast access to the posted information.

OBTAINED BENEFITS

The spreading of distance learning has made possible the appearance of many commercial Internet applications for education purposes, including such software applications as *Blackboard* and *WebCT*. Any of these packages include tools like syllabus, course content, chat room, e-mail, calendar, testing/assessment, grade book, access to public Web sites, etc.

The use of these Internet application programs in education expands the teaching capabilities in aspects like:

- *The expansion of campus boundaries.* Students will not need to be located on-campus in order to receive their instruction. This facilitates many students from remote places to receive a quality preparation at affordable prices. It also offers new opportunities for workers and elderly students who do not have the possibility to attend classes everyday.
- *Continually drive students' performance.* These software permit a complete personalisation of the learning experience through the dynamic learning information management. This is possible because of the contact between student and instructor, and the constant interaction using tests, quizzes, reports, etc.
- *Continually improve course and degree programme quality.* Teachers have to place course materials on the Web site for students to have access to it. After having this material online, it is very easy to add new content and continuously improve what is already online. Furthermore,

experiments can be achieved via the Internet. An example of this is presented by Ewald and Page, where virtual instrumentation, based on *LabVIEW*, is utilised for the remote control of experiments [3].

Some of the problems that have been faced when using this new technology include:

- Limited access to the Internet worldwide.
- Resistance to new and alternative forms of teaching, learning paradigms or methodologies.
- Privacy, security, copyright and related issues.
- A lack of uniform quality [4].

COURSE DESCRIPTION

The School of Engineering at Florida International University, Miami, USA, has faced the challenge of providing high quality, cost-effective educational experiences to a rapidly growing student population. Two basic methods are being used to reach students, besides the common face-to-face instruction: instructional video tools and the Internet. The video tools only permit the information to flow from the instructor to the student. In this case, feedback, which is considered to be an important factor, is not the best, taking into account that there is some time lag in the flow of information between students and the instructor.

By using *WebCT*, it has been possible to transform the educational experience offered to students, while at the same time increasing access and providing students with more flexible instruction. The Departments of Construction Management and Electrical and Computer Engineering at Florida International University are introducing *WebCT* in some of their courses.

The Department of Construction Management has proven ideal for the implementation of distance learning utilising the Web, due to the following two reasons:

- *Characteristics of students:* Students enrolled in the Department of Construction Management are at the same time workers who are forced to move as the construction site moves, or are located in different counties. This makes it difficult for them to regularly attend to classes.
- *Programme characteristics:* Compared with other programmes in the College, the construction management programme requires fewer laboratories for physical simulations. Enrolled students need to work more with software for scheduling, estimating, etc, which are more related to the use of computers. This situation generates an optimal result for distance learning courses by using computers and simplifying distance learning and teaching.

Two courses have been made fully available to students using *WebCT*, namely: Environmental Control I and Environmental Control II. These courses contain the following elements:

- Syllabus;
- Handouts with all of the course information;
- Course schedule;
- Exercises;
- Quizzes;

- Tests;
- Projects.

The syllabus includes the objectives of the course, the general rules to be observed during the course, the method of evaluation, course content, course literature, and the expected knowledge that each student will have upon finishing the course.

The handouts contain all the basic material that are taught in the course, including a full explanation of the different topics, *PowerPoint* presentations, review problems, sample tests and a sample project.

Figure 1 presents a partial reproduction of the handouts for the course Environmental Control I. It can be seen from Figure 1 that the topics are presented in a weekly format so as to facilitate auto study. Four quizzes and two tests are included. Students have the necessary information about the expected knowledge before each quiz or test and the time and duration assigned to each activity is indicated. Before each test, a sample test is also presented, acting as an auto test and practice for students. Also, a sample project is included to clarify ideas about the general content of the final project.

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- 1.1. [Introduction](#)
- 1.2. [Temperature and Heat](#)
- 1.3. [Quiz 1](#)

2. Week Two

- 2.1. [Heat Gain and Loss](#)
- 2.2. [Heat Transfer Examples](#)
- 2.3. [Quiz 2](#)

3. Week Three

- 3.1. [Psychrometry](#)

4. Week Four

- 4.1. [Cooling Load Calculation](#)

5. Week Five

- 5.1. [Load Calculation Problem](#)
- 5.2. **Review**

6. Week Six

- 6.1. [Sample Test 1](#)
- 6.2. **Test # 1**

Figure 1: Partial reproduction of handouts.

Those students registered in the course have to enter a personal code in order to have full access to it. The course information and assignments can be downloaded individually. In order to increase the quality of the course, as well as give accurate and timely information to all on-campus and off-campus students, the courses on *WebCT* force students use the computer as a natural tool in their problem solving activities.

OBTAINED RESULTS

In general, students are very satisfied about the change in using computers in practically all of the course's activities. This is derived not only from students' general comments, but is also

reflected in their academic results. However, this improvement is more evident in the results of off-campus students.

Figure 2 shows some quantitative data that reflects this improvement by comparing the grades between two groups: summer 2002 and summer 2003. The summer 2002 group was taught using the traditional method, while the summer 2003 group used *WebCT*. The imparted material is the same, the same instructor, as well as a similar group composition. Nevertheless, an increase in the average grades from students enrolled in the summer 2003 course was noted. The data reinforce the general students' impression with regard to the increase in the level of comprehension when *WebCT* was utilised.

CONCLUSIONS

There are two main factors that limit the response of traditional education to the new challenges faced in the world at this time. Firstly, classroom teachers rely on a limited number of visual and unobtrusive cues from their students so as to enhance their delivery of instructional content. Secondly, the audience is limited since many students are unable to attend on-campus classes.

The use of distance learning presents the following advantages: expanding campus boundaries, continually driving student performance and continually improving course and degree programme quality.

The College of Engineering at Florida International University utilises widely new technology in order to enhance the teaching process. The use of *WebCT* appears to be a very interesting option for improving quality in the process of acquiring knowledge in engineering and for expanding the campus boundaries. At least two courses have been fully implemented using *WebCT* with positive results.

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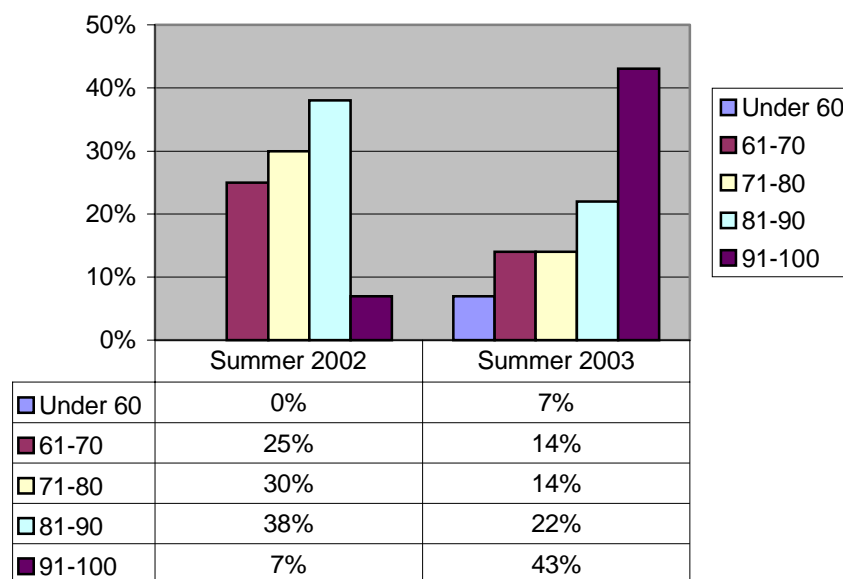


Figure 2: Student grade distributions for the Environmental Control I course during summer 2002 and summer 2003.

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