Integrating Internet and Electronic Classroom Resources: A Model for Improved Student Learning in Parallel Resident and Distance Education.

John W. (Jack) Carter

Abstract – This paper will describe a currently-applied educational environment that integrates the physical classroom, the Internet, multi-media equipment, and appropriate course management software, into a model that serves a broad constituency of educational needs, including the learning of both information and skills to resident and distance students. This model serves to present a curriculum in electrical engineering technology in parallel course cohorts where one cohort resides on campus, and the other is scattered around the geographical region, connected to the professor through the resources of the Internet. The two cohorts receive the same course materials, observe the same lectures, participate in the same homework assignments, take the same tests, and observe the same class schedules, resulting in what are very similar experiences.

Keywords: distance education, WebCT, pedagogy, Internet.

INTRODUCTION

The fundamental task of the educational enterprise is to provide an environment where the student engages new information and skills in a manner that best facilitates their retention. The developments in information technology that have taken place over the last few years have provided new resources that can be employed in learning environments that are characterized by original and effective ways to immerse the student in the subject of study and at the same time address a multitude of learning styles. Though the chalk-and-talk format has served as an effective teaching platform for centuries, the introduction of electronic information technology to the classroom has opened up new and exciting opportunities to better address various learning styles, facilitate student interaction, and provide for a wider range of matriculation needs for today's students.

This paper will describe a currently-applied educational environment that integrates the physical classroom, the Internet, multi-media equipment, and appropriate course management software into a model that serves a broad constituency of educational needs, including the learning of both technical information and skills by resident and distance students. This model has been implemented in an upper-division collegiate electrical engineering technology curriculum that serves parallel course cohorts where one cohort resides on campus, and the other is scattered around the geographical region, connected to the professor only through the resources of the Internet. The two cohorts receive the same course materials, observe the same lectures, participate in the same homework assignments, take the same tests, and observe the same class schedules, resulting in what are very similar experiences.

The model has been in practice for five years, with subtle improvements taking place during that period. In order to reign in what is a broad course offering, we will investigate the experience of one course in particular, and data will be presented that compares the success of students within the model, both resident and distance education, with those of the previous chalk-and-talk model. The differences are dramatic, and may prove interesting..

PARADIGM CHANGES

The most important asset to implementing any new process is the ability to investigate, acquire, and be open to new ways to do old things. The American educational enterprise has been operating successfully for over two hundred years, giving birth to the world's best colleges and universities and providing the world's best education across the broadest spectrum of subjects of study imaginable. With such a track record, it would be tempting to rest easy and continue to rely on time- and experience-proven pedagogical methods with the assumption that these methods are quite sufficient for modern application. Many might assert the old cliché, "if it ain't broke, don't fix it." No, the classical classroom model is not broken, and so it is not in need of repair. However, if we insist on continuing to do old things the way we have always done, we may be failing to take advantage of new and real opportunities that new technologies present.

Consider for a moment the classical classroom environment as the baseline for our comparison. One can visit any of the great institutions of higher education and quickly recognize its classrooms. Students are organized in neat rows and ranks of chairs or tables, each facing the focal area of the room. At the center of this area is a lectern from which the learned professor can speak loudly and clearly to his/her classroom of students, presenting information with eloquence and confidence to a room of listening ears and flashing pens. Behind the lectern is a wall upon which the professor has the opportunity to write with chalk or pens as he/she illustrates the minutia of the subject matter. Many classical courses will include periodic homework assignments that are submitted on hand- or type-written documents, graded by the professor or his minions, and returned to the student after a period of time. There are some characteristic strengths of this classical environment: the student has direct access to the professor, enabling the timely resolution of questions. Students also learn from each other as they share the experience.

However, the classical classroom environment also has some characteristic limitations that modern technology may be able to eliminate:

- Students must be physically located in the classical classroom, so students must reside in communities where the education is accessible. This limits access to those who can fit the time and geographic location into their schedules. The opportunities for "life-long learning" are significantly hampered for the community at large.
- Students must gain all of their knowledge from hearing and seeing the presentation during a single event in time, necessitating good aural and visual learning skills.
- The time delay necessary to return graded assignments all but eliminates the opportunity for the student to interact with the material in a timely fashion. This is particularly limiting in skill-based learning.

In order to eliminate these restrictions, the classical classroom model must change, and change often comes hard. When one considers the attempt to provide educational resources to students who reside in other communities, it may be difficult to envision how it can be done. How does one teach a skill to someone at a distance? How does one form the curriculum to enable student learning at a distance? The success of many distance education programs in the collegiate environment indicates that there are solutions to these problems. However, implementing new ways of student-instructor-coursework communication involves creativity and a willingness to change.

What changes are necessary? Lectures must be converted from vocal to electronic form. Homework assignments must be implemented in a way that facilitates Internet communication. Examinations must be designed in a way to provide easy student access and timely grading while still maintaining academic integrity. Figure-1 illustrates the avenues of communication utilized in this model. The faculty member communicates with the student via Email, phone, postal service mail, through the posted course materials, and through CD-ROM-based lectures. The student interacts with homework through the WebCT® interface. Other important resource connections are indicated in this figure.

Though this model has been implemented in a number of courses, the course described herein is "Digital Logic Design with Programmable Logic Devices" taught to Engineering Technology students in the William States Lee College of Engineering, UNC Charlotte. One can envision the challenges of converting such a technical and skills-based course to an environment suitable for distance education students.

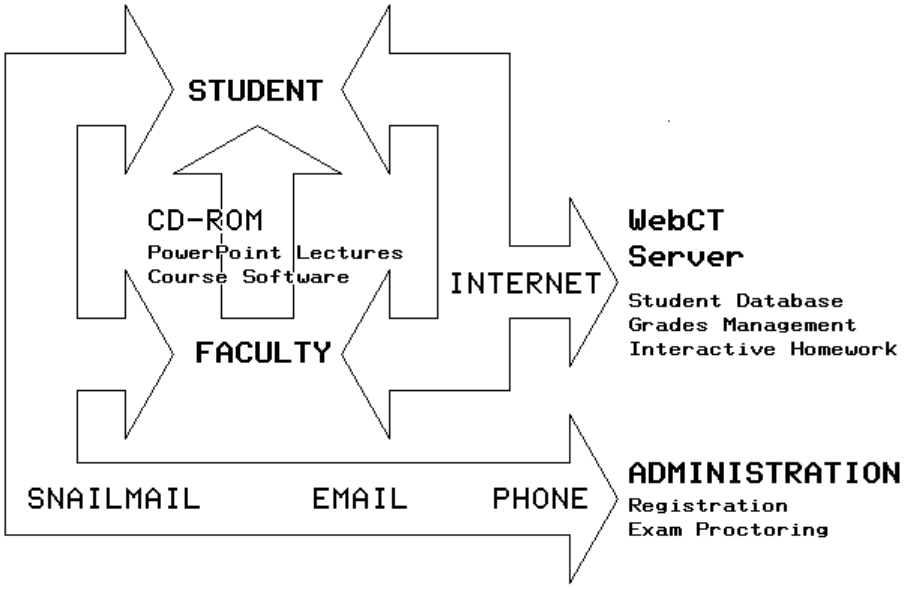

Figure-1 Electronic-Enhanced Course Model.[1]

THE ELECTRONIC LECTURES

Of course, the key component of teaching involves the immersion of the student in the material to be learned. Classical thought engages eye-to-eye, ear-to-mouth communication: thoughts and ideas are expressed verbally, spread as sound waves, and fall on the, hopefully, receptive and alert ears of the student. When teaching at a distance this form of communication is not an option. All of the communication processes in the new environment must be reduced to some electronic form. The model that we are going to investigate solves this problem through a multiple of interfaces in order to address a multiple of learning styles.

First, all of the "board-work" for each lecture is digitized. In our application, this was done using Microsoft PowerPoint® for the basic platform. Computer-assisted design and drafting programs were used to create the technical graphics, screen-capture programs were used to insert graphic images. By far the most difficult and time-consuming portion of the course development process, this electronic presentation must entirely replace all of the written information presented during the lecture. One can expect to invest eight to twelve hours of development work for each hour of presentation, especially for an engineering course that utilizes schematic diagrams, equations, computer programs, and other technical materials.

Then, once the electronic lecture materials are presented, they are presented in a real classroom before a class of real students. PowerPoint® provides the capability of recording the narration during the presentation, allowing the instructor's voice to be recorded with the slide set. The instructor repeats the questions students raise, allowing the recorded lecture to contain all of the dynamics of a real classroom setting.

The resulting presentation requires about one megabyte of disk space for each minute of the lecture. The set of lectures are recorded on CD-ROMs that are then distributed to both distance and resident students at the beginning of each subsequent presentation of the course. This presentation package provides for a new and powerful review format for both constituents, as the students can easily repeat any segment of the lecture. Furthermore, each lecture presentation has been broken down by subject into two to five segments of ten to thirty minutes each. This makes

the material more easily absorbed, allowing the student to take breaks at opportune points in the lecture. Figure-2 illustrates an example lecture module resource that is available to the student. The left column is an index page that provides direct access to the materials for each lecture as well as to other pertinent information. Illustrated is the material from the 20th lecture in the semester. Note that complete instructions for completing the module are provided. This is followed by links to the PowerPoint® lectures, some text pages that provide additional materials, and graded homework assignments. Many modules also contain self-tests that are optional and do not impact the student's grade.

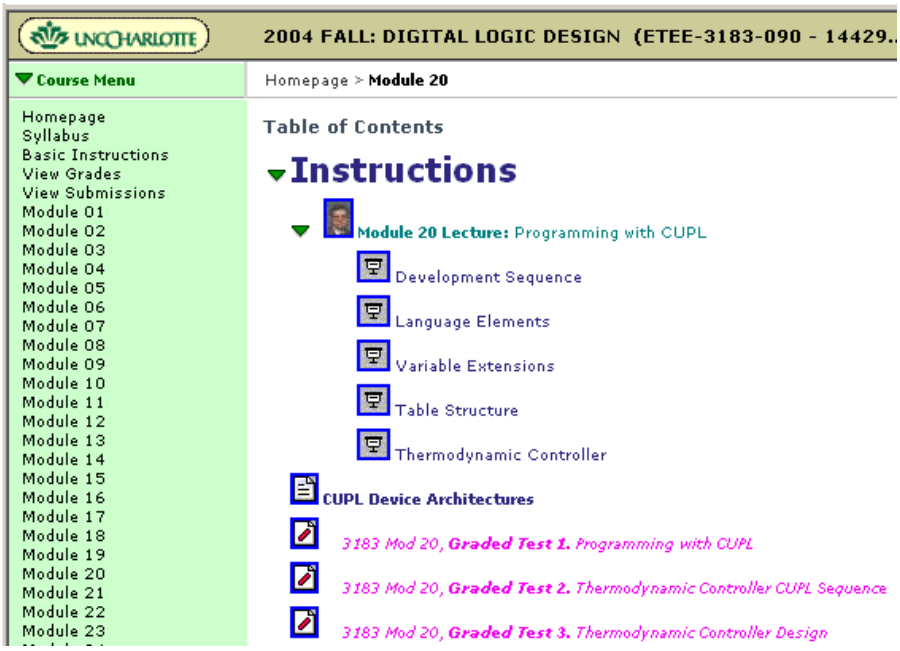

Figure-2. Web-Based Lecture Module

Though the PowerPoint® lecture component is provided on-line, their delivery on CD-ROMs allow the students to interact with them without tying up the family telephone line in Internet access. Much may be said about the stress in a home that is introduced when the telephone is not available.

ELECTRONIC HOMEWORK

The key to immersing a student in instructional materials is guiding of the student through his/her interaction with it. Few students learn effectively from listening alone. The success of this model can be attributed in a large part to the change that electronic homework has made to the way students interact with it. In the classical classroom, students are made aware of an assignment at some point in a classroom session. Students will then submit their assignment in a later classroom session only to wait for a period of time before learning of the results of its grading. By the time the assignment has been returned, the lecture material has moved on to other subjects, and the student is given little opportunity or motivation to interact further with it.

Electronic homework has a similar impact on the student that is provided with the electronic lecture: random access. All homework assignments in this Digital Design course have been formatted into batteries of on-line quizzes that contain fill-in-the-blank, multiple-choice, and true-false questions. When a student submits an assignment, it is graded by the course management software (WebCT®) and returned to the student immediately. Tests that utilize fill-in-the-blank questions can be resubmitted with corrections during a relevant period of time, in this case within four days of the lecture. It is in this capability of resubmission an unexpected and positive result

was obtained: students interact with their homework! Few students are satisfied with less than an outstanding grade, and will resubmit their work a multiple of times in an effort to improve their grade. The result of this interaction is a dramatic improvement in the attainment of those skills necessary to complete the work.

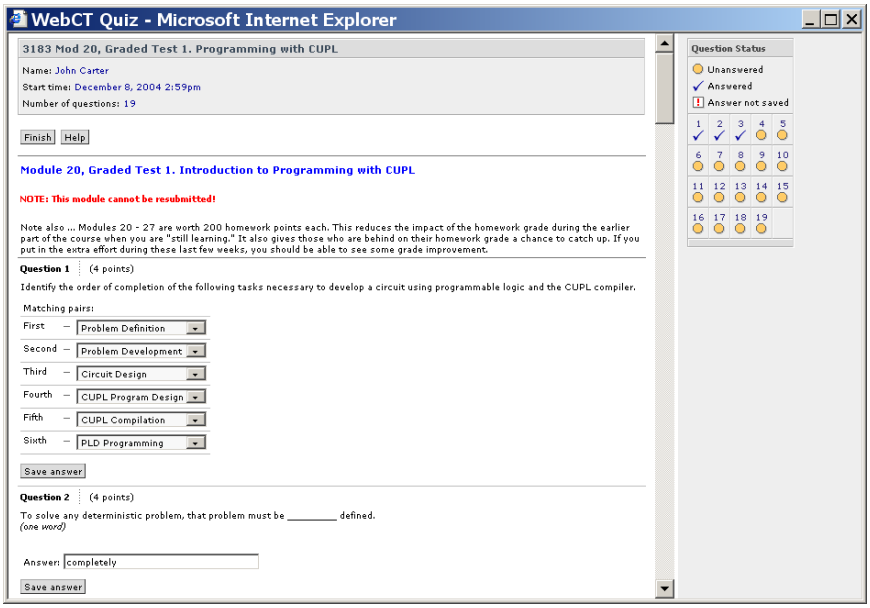

Figure-3. Web-Based Homework Example

In an effort to reduce on-line time, students complete their homework assignment by first visiting the course web-site and downloading the assignment. Once completed, the student returns to the web site to upload the answers. Students typically do not spend hours of time on-line with such a homework model. Figure-3 illustrates a portion of a typical on-line homework assignment. The window in the upper-right portion of the page allows the student to ascertain which questions have been saved.

End-of-semester evaluations have revealed that the students are very happy with this interface, and are particularly appreciative of their ability to resubmit most assignments for a higher grade. They do realize that their interaction with the homework improves their skills.

PROCTORED EXAMINATIONS

One difficulty associated with this model is the administration of examinations that maintain an appropriate level of academic integrity. In the resident classroom, there is no change from the classic model as the instructor proctors the three formal examinations that take place at appropriate points in the course. With distance students, the administration is more difficult. A volunteer proctor needs to be recruited who will administer the test and hold to the rules of security and integrity set forth by the instructor. At UNC Charlotte, the Department of Continuing Education has taken on the responsibility of recruiting and communicating with these proctors. This department will obtain the examination sheets and instructions from the instructor and mail them to the proctor who will then administer the test and mail the results back to the campus. Usually the location of proctors is not a very difficult task as most students are full-time employees of companies that have human resources or training personnel who are glad to assist in this effort.

ACADEMIC INTEGRITY

The need for academic integrity is relevant for both the homework and examination segments of this model. The academic integrity of the proctored examinations is maintained by the responsible administration of those tests by the proctors. Identification of the student is required, as is an assurance that the environment required by the instructor is maintained. Both the student and proctor sign statements that clarify these issues.

The homework model presents a challenge to the maintenance of academic integrity, and this model entirely surrenders the issue to the honesty of the student and a simple axiom: if you cannot do the homework yourself, you will not be able to pass the examinations. Five years of experience has resulted in an assignment of 25% of the course grade to the homework and 75% to the examinations. When less than 25% was assigned to homework, students did not feel it was "worth enough" to put in the effort to complete it. If more than 25% was assigned to homework, academic integrity becomes an issue. It has been found that the correlation between homework and exam grades approaches the best results at this level. Students who score poorly on homework score poorly on the exams. The same is true for those who score well on homework: they score well on exams. There is the occasional student who scores well on the homework and does very poorly on the examinations. In this latter case, a concern of academic integrity is raised as a result of an assumption that the student is using shortcuts in submitting homework answers. However, the student is more than compensated for his/her strategy by the impact the examination grade has on their overall success.

RESULTS

The motivation for the development of this resident/distance education computer-based model had nothing to do with an effort to improve student learning. The purpose for the development of this model was solely to provide the coursework to students at a distance. However, the improvement of student learning in this model came as a pleasant, if not shocking, surprise. Prior to the implementation of interactive Internet-based homework, 3 to 5% of the class attained grades of "A." After its implementation, that number jumped to 8 – 10%. Prior to the implementation of web-based homework (1992 – 1998) the average of all student exams was 68.3%. Since the implementation of the new methodology, the average jumped to 73.1% for resident students and 76.7% for distance-education students.

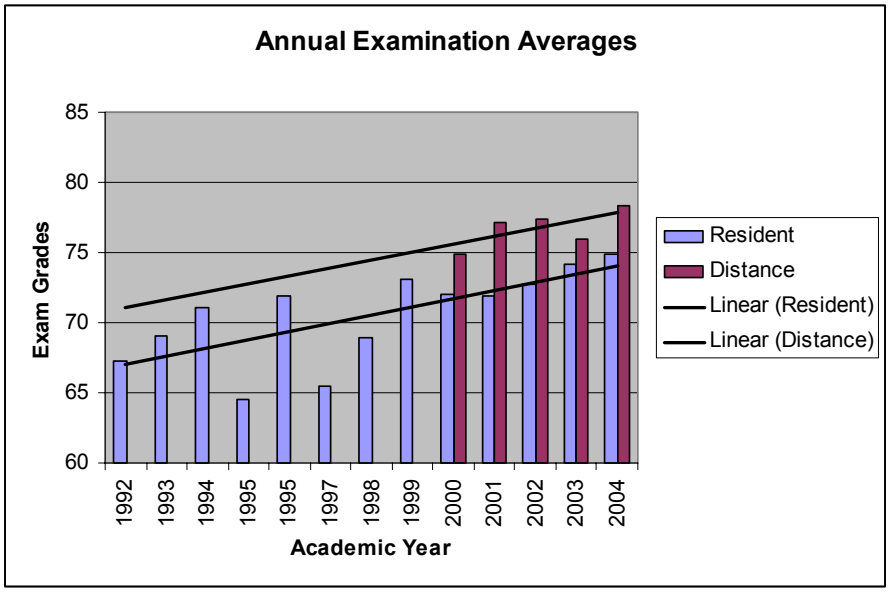

Figure-4. Examination Averages for All Students, 1992 – 2004.

Figure-4 illustrates some of the raw data used to obtain these averages. Since the Internet-based distance program started in 1999, data for this constituency is not available before that date. All exams from all students are included in these figures. Each student submitted three examinations each year, with the final exam covering the last third of the course and comprising one third of their overall grade.

Prior to 2000, the variation in student body personality and maturity seems to be shown by an inconsistent and varying examination average. However, upon entering the web-based homework environment grades both stabilized and rose. There may be too few data points to make any conclusions as to whether we are seeing continuing improvement as the students and faculty become more familiar with the environment. Improvement in the resident program is certainly evident as the two constituents are beginning to converge.

Though the process of converting the course from classical chalk-and-talk to a model that supplements with technology in the classroom took a tremendous investment in time and effort, it appears that there is a considerable value-add attained in the quality of student performance. In order to implement such a model, at least one important must be addressed The conversion takes a considerable amount of time and resources to complete. However, with the investment made, the results in student performance can be more than worth it.

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