DELIVERING TECHNICAL EDUCATION THROUGH INTERACTIVE DISTANCE DELIVERY INSTRUCTION

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Abstract

Despite the recent downturn in the nation's economy, the demand for well-trained engineers and technologists who are prepared to make immediate contributions to the industry continues to be at an all time high. Recent innovations in communications and networking technology have produced an explosion of distance delivery methods and techniques. This has provided academic institutions with the much-needed opportunity to reach remote audiences with their program offerings. Many educational institutions have become engaged in delivering their technical courses to remote locations within the country in order to try to meet the high demand for graduates.

This paper will discuss the efforts undertaken at Florida A&M University (FAMU) to deliver the upper division courses of its Electronic Engineering Technology (EET) curriculum to its satellite campuses within the state of Florida. The preferred means of delivering its technical courses that has been chosen by FAMU is through the use of compressed video with taped backup in an interactive instructional setting. A review of established distance delivery techniques reveals that the use of compressed video and the Internet are the most prevalent techniques employed by academic institutions throughout the nation. It appears, however, that interactive classroom instruction via compressed video is the preferred means of delivery for highly technical content. The experiences gained at FAMU through this program will be discussed.

I. Introduction

The demand for well-trained engineers and technologists who are prepared to make an immediate contribution to the industry remains high despite the recent downturn in the once booming economy. With the recent and ongoing advances in telecommunication technology, academic institutions have been provided with the much-needed opportunity to reach remote audiences with their program offerings. In many parts of the country, there are pools of engineers and technologists who are already employed in industry and who, due to their employment, are place bound at remote locations away from a university setting. Many of these individuals seek to further their education in order to advance their careers. These are the audiences that are mainly targeted by these higher education institutions. It is not, however, possible for many of these

targeted remote audiences to attend traditional classes on campus. Distance learning techniques offer the best opportunity to deliver course material to these audiences. Either synchronous or asynchronous means of distance delivery can be utilized, depending on the self-motivation of the audience and/or the technology available at their location[1, 2, 3].

A review of established distance delivery techniques reveals that compressed video and the use of the Internet are the most prevalent techniques employed by academic institutions throughout the nation[1-8]. Synchronous distance learning classes can be modeled closely after traditional classes. The effectiveness of such classes can be increased through the use of the World Wide Web and other Internet applications. Asynchronous distance learning classes require a substantially different model with the World Wide Web as the fundamental enabling technology[1]. In the case of delivering highly technical content, it appears that interactive classroom instruction is still the preferred means of delivery.

The Division of Engineering Technology at Florida A&M University (FAMU) currently offers a four-year Bachelors degree in Engineering Technology with specialties in the areas of Electronic (EET), Civil (CET), Construction (CNET), and Manufacturing (MET). In order to bring these program offerings to audiences around the state, FAMU's Engineering Technology Division has established articulation agreements with eleven (11) community/junior colleges around the state of Florida. These agreements allow FAMU to deliver its upper division technology programs at these eleven locations.

In the preliminary phases of planning, it was determined that the most effective means of delivering these programs was through the use of distance delivery techniques. Initial delivery of programs began during the fall semester, 1998, with an undergraduate course offering in computer-aided circuit analysis to the Miami-Dade Community College (MDCC) campus in Miami, Florida. Subsequently, other courses in EET, CET, and CNET have been offered to some of the eleven campuses. Being a new program within the division, the manufacturing engineering technology program has yet to offer any distance learning courses to these remote sites.

II. Technical Course Development and Delivery

Most of the courses in the various disciplines in Engineering Technology have a required laboratory component. While the theoretical aspects of most courses can be delivered through distance learning means, the challenge has remained as to how to effectively deliver the laboratory component to those courses that require them.

As an example, the computer-aided circuit analysis course is a required upper division course in the EET program at FAMU. It is normally taught to students on campus in a traditional classroom setting. Homework and laboratory assignments are usually done using the available software in one of the computing laboratories within the Division of Engineering Technology.

The course involves a study of the available tools for computer-aided circuit analysis and

the design of electronic circuits. The material covered includes a study of waveform analysis, circuits in the time and frequency domain, network analysis up to microwave frequencies, Laplace transform circuit analysis, and Fourier analysis. Electronic Workbench and PSpice are used for circuit simulation, and Mathcad is utilized for numerical calculations and display of waveforms.

Microsoft PowerPoint (PPT) was chosen as the preferred means of offering the course for distance learning. Worked example problems were demonstrated using Mathcad, PSpice and Electronic Workbench as appropriate. An overhead document camera was used to demonstrate problem solving. The laboratory exercises for this course were conducted using the Pspice, Workbench and Mathcad software packages on computers located at the remote sites. Each classroom session is recorded for asynchronous delivery of course materials to the remote sites. This provides the student with further opportunities to review the course material at their own pace in order to enhance the learning process. These tapes are kept for a while and then recycled. A teaching assistant is employed at the remote site for the purposes of dealing with technical issues in the classroom, distributing course materials and exams, and for administering tests and examinations as necessary. Class notes are delivered by snail mail or via the use of email. Email is also used extensively for communication between the instructor and students and among students. Students are encouraged to submit their work via the Internet as email attachments where possible. It is anticipated that as the distance-learning offerings increase, the course notes will be made available for download from a website set up specifically for each course. Additionally a chat room facility will be used for each course to facilitate communication among students and between instructor and students[9].

Many of the distance-learning courses offerings also make use of the Microsoft PowerPoint software, application software for demonstrations, and the overhead document camera for problem solving. Each site has a designated teaching assistant to handle all contingencies related to the course.

The challenges involved in delivering the laboratory material, differs from program to program. For the EET courses, some of the laboratory exercises can be performed using available computers at the remote sites. Those courses that require the use of laboratory hardware have been handled by using available equipment at the remote sites, loaning equipment from the main campus to those sites, or having the students come to the main campus in Tallahassee for a couple of weekends each semester to complete all the laboratory requirements during intensive sessions in the labs. In comparison, the majority of the civil and construction laboratory exercises have to be conducted on the main campus since, in most cases, the equipment is not available at the remote sites and is too bulky, or are fixed in place at the main campus.

III. Available Distance Learning Facilities

The initial delivery of the computer-aided circuit analysis course to the MDCC campus was from the College of Engineering Sciences, Technology, and Agriculture's (CESTA) teleconference facility. Subsequent delivery of this course and all other courses offered within the Division of Engineering Technology have been done at both the teleconference site and the

FAMU distance learning classroom facility located in the main library building on campus.

The FAMU distance-learning multi-media classroom facility is a multi-use facility with a capacity for up to 20 people. It is utilized by the continuing education division to deliver distance education courses in various disciplines at several remote campuses within the state of Florida. The facility is also utilized by the University to conduct meetings and workshops via video-conferencing. Since this is not a dedicated teaching facility, Engineering Technology classes have had to be scheduled around the other activities at this facility.

This interactive classroom is a turnkey integration of videoconferencing equipment, multimedia, Internet service, and multipoint conferencing via an Integrated Services Digital Network (ISDN). The classroom is equipped with an auto-tracking camera system for both instructor and students. The distance-learning classroom is capable of delivering and receiving fully interactive, real-time broadcasts between colleges and universities, community colleges, corporations, K-12 schools, and other organizations throughout the United States. Currently, FAMU has three classrooms in the state of Florida: Tallahassee, Tampa and Miami. The Distance Learning classroom is equipped with a VTEL TC2000 videoconferencing system, which offers a picture quality equal to TV broadcast. The classroom is fully integrated, allowing the instructor to easily operate the equipment. The ability to videotape classroom sessions is also available at this facility. Table 1 is a listing of available equipment in the distance-learning classroom[10].

Table 1. FAMU distance learning classroom equipment

- VTEL 227 Codec (56-512Kbs, 30 frames per second, Pentium Processor, Data Ports, CD-ROM; 1+Gig Hard Drive, 32MB RAM, Modem for remote diagnostics)
- Pen Pal Graphics/AppsView Control Tablet
- Electronic Whiteboard
- Instructor Podium
- 35" Dual Monitors to display remote sites and graphics
- 32" Monitor for teacher to display remote sites and graphics
- Elmo 400AF Document Camera with side lights
- CameraMan Presenter System (auto-tracking camera, tracking ring, and wireless lavaliere microphone to support instructor voice transmission to remote sites)
- CameraMan Student System (auto-tracking camera)
- Push-to-Talk Microphones (support student voice transmission to remote sites)
- Polycom Speakerphone System
- VCR
- Cordless Phone
- Fax Machine

The CESTA Teleconference center is also equipped with a video-conferencing facility. It provides video-conferencing for small groups through its VTEL LC3200 video-conferencing unit. Users are able to communicate in a synchronous environment through three ISDN lines. The facility also has the ability to videotape sessions for Asynchronous delivery of course materials to

remote sites. The facility is used primarily for extension activities conducted by the Agricultural Sciences program within the college. It can be used as a small classroom (less than five) for instructional purposes. It is not large enough to teach a traditional sized class on campus, but is quite suitable for delivering a synchronous distance delivery course to an extension campus. Compared to the distance-learning classroom, the teleconference site provided some unique challenges in delivering the courses. Table 2 lists the available equipment at this facility.

Table 2. CESTA teleconference facility equipment

- VTEL 227 Codec (56-512Kbs, 30 frames per second, Pentium Processor, Data Ports, CD-ROM; 1+Gig Hard Drive, 32MB RAM, Modem for remote diagnostics)
- Pen Pal Graphics/AppsView Control Tablet
- Instructor Podium
- 35" Dual Monitors to display remote sites and graphics
- Elmo 400AF Document Camera with side lights
- Camera System (non-tracking)
- Push-to-Talk Microphones (support student voice transmission to remote sites)
- VCR
- Cordless Phone

The MDCC facility has a similarly equipped distance-learning classroom. The instructor is able to control both the local camera and the remote cameras at the MDCC site from the control tablet. He or she is thus able to pan the remote classroom to see the activities at the remote site. Each student has a voice-activated microphone on their desk that allows the remote camera to focus in on them directly should they wish to ask questions or make a comment during the class. This ability to achieve two-way communication greatly enhances the general quality of the classroom experience for both the students and the instructor. Each of the eleven remote sites has similarly equipped classrooms that are accessible from the FAMU campus. Investment in distance-learning capabilities has been a priority for most of the two-year community/junior colleges in the state of Florida. In some instances the facilities available are far superior to those available on the FAMU campus.

IV. Issues and Challenges Encountered in Delivering Course

Several issues and challenges, both technical and non-technical, were encountered in the delivery of the course materials. These issues had to be addressed in order to effectively deliver the courses at the remote sites with minimal disruptions. The following technical issues were encountered:

- Difficulty transferring large PowerPoint files to the VTEL computer system.
- Insufficient memory on VTEL equipment to allow for simultaneously running the VTEL software, the PowerPoint software, as well as one of the application

software.

- Insufficient hard disk space to load multiple application software at the same time.
- Frequent hang-ups due to software errors caused by system overload.
- The fixed camera in the telecommunications center did not allow the instructor to move around as in a traditional classroom environment. The instructor had to be cognizant of looking into the camera when it is switched over to provide a torso view.
- An inherent delay introduced by the software in switching between the fixed camera, the PowerPoint presentation, and the overhead document camera.
- Inadvertent loss of connection during transmission.

The problem of large PowerPoint files was resolved by installation of ZIP drives or LS-120 drives on the computer and transferring data files on compatible media. More recently the class notes have been burned on CD-R disks for transfer to the VTEL system. Unfortunately, the VTEL computer warranty does not allow for third party upgrade of the computer system. As a result the hard disk and the RAM memory has not yet been upgraded. To circumvent the problems created by this lack of memory, only one software is run at any given time. This slows down the process of switching between notes and computer simulations, but minimizes system hang-ups. For each class session, only one type of simulation package can be loaded onto the hard drive once again limiting the spontaneity of working through simulation examples. There is currently no remedy for the delay in switching between the views presented to the remote audience. There are many possible causes for the inadvertent loss of connection. These are usually outside the control of the classroom technicians. This causes a delay in course delivery and severely impacts the recording process. Continuation of a session is then dependent on how quickly the connection is re-established.

In addition to the above technical issues, there were some non-technical issues encountered that also impacted the efficiency and effective delivery of the courses. Among these were the following:

- Inability to establish the dial-up connection prior to class time.
- Problems with delivering the course materials to the remote site on time – mail delays etc.
- Inability to send large files via the email system (insufficient memory on student accounts).
- Absence of site administrators at class time, or for proctoring examinations.
- Failure to receive student course work in a timely manner.

Whereas the first two issues are usually beyond the control of the instructors, the problem with delivering course material via email is alleviated by the use of course websites from which course material can be downloaded. The integrity of student work can be assured by ensuring that an administrator is always present at the remote site for the duration of the class period. This site administrator is responsible for collecting all student work and returning them in a timely manner for grading.

V. Conclusions

Despite some initial problems, the Division of Engineering Technology at FAMU has successfully demonstrated the ability to deliver highly technical course content to remote sites via interactive distance-learning techniques. The effective delivery of a technical course like the computer-aided circuit analysis has been assured by addressing most of the technical and non-technical problems that are encountered during course delivery. It is imperative that many of the potential problems should be eliminated prior to the class session. Effective planning for the course delivery alleviates many of the non-technical issues that may crop up. Whereas some of the technical issues are currently insurmountable, their effects can be reduced by the judicious use of the available hardware and software.

The preliminary student reviews of the courses offered to date indicate that the students were quite satisfied by the method of delivery. The choice of a combination of synchronous and asynchronous distance delivery of the course materials has contributed in no small measure to the perceived effectiveness of the courses. The students liked the interactive nature of the courses, which is similar to the traditional classroom methods of teaching. They also indicated that they like the ability to review tapes of the lectures to enhance their learning of the course materials. The apparent success of the courses delivered so far, indicates that the chosen method of delivering the technical content has been effective and challenging for the students.

With regards to laboratory exercises, there have been a number of papers and demonstrations where it has been shown that remotely accessing equipment over the Internet to conduct experiments is possible. Some of these techniques may be applicable to the course offerings in Engineering Technology.

Finally, the methods used to deliver the Engineering Technology programs are suitable for other programs that contain highly technical material, such as Engineering, Math and Science courses.

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