

EFFECTIVE DISTANCE DELIVERY OF TECHNICAL COURSES THROUGH INTERACTIVE INSTRUCTION:

Experiences in Delivering Technical Content at a Distance

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Abstract

Even with the recent downturn in the once booming economy there is still the need for well-trained engineers and technologists who are prepared to make an immediate contribution to the industry. Recent and ongoing advances in communication technology, has led to an explosion in distance delivery methods and techniques. This has provided academic institutions with the much-needed opportunity to reach remote audiences with their program offerings.

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. In the case of delivering highly technical content, it appears that interactive classroom instruction is still the preferred means of delivery. As a result, the Engineering Technology Division at Florida A&M University (FAMU) has chosen to use compressed video with taped backup in an interactive instructional setting as the preferred means of delivering its technical courses to its satellite campuses around the state of Florida. This paper presents the experiences gained at FAMU in delivering a course in computer-aided circuit analysis to students at one of its satellite campus through distance delivery. Some of the issues encountered (technical as well as non-technical) will be discussed.

I. Introduction

The recent downturn in the once booming economy does not appear to have had a major impact on the demand for well trained engineers and technologists who are prepared to make an immediate contribution to the industry. With 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. There is a pool of engineers and technologists who are already employed in industry and who, due to their employment, are place bound at remote locations away from the university setting. It is not 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 [1]-[3].

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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, however effectiveness can be substantially 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 4-year Bachelors degree in Engineering Technology with specialties in the areas of Electronic, Civil, Construction, and Manufacturing Engineering Technology on its main campus in Tallahassee, Florida. In order to bring its 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. These agreements allow FAMU to deliver its upper division programs at these eleven locations. It was determined that the most effective means of delivering these programs in a consistent manner to these sites was through the use of distance delivery techniques. Initial delivery of programs began during the fall semester, 1998, with a course offering in computer-aided circuit analysis to the Miami-Dade Community College (MDCC) campus in Miami, Florida, by the Electronic Engineering Technology program.

II. Computer-Aided Circuit Analysis Course Development

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 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. The laboratory exercises for this course were conducted using the PSpice, Workbench and Mathcad software packages at the remote sites. Each classroom session is recorded for Asynchronous delivery of course materials to the remote sites. This allows 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 was 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 were 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.

III. Available Facilities

FAMU currently offers distance education opportunities through its distance-learning multi-media classroom facility located in the main library building on campus. This classroom has a capacity for up to 20

people and 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 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. Using ISDN (384 kbps) technology, the Distance Learning system offers a picture quality equal to TV broadcast. The Distance Learning classroom is equipped with a VTEL TC2000 videoconferencing system. The VTEL system is PC based and closely resembles desktop PC. 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 [9].

The facility is also utilized by the university to conduct meetings and workshops via video-conference. Since this is not a dedicated teaching facility, Engineering Technology classes have had to be scheduled around the other activities scheduled at this facility.

The College of Engineering Sciences, Technology, and Agriculture (CESTA) at FAMU has a Teleconference center that is equipped with a video-conference facility. The Teleconference Center provides video-conferencing for small groups through its VTEL LC3200 video-conference 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. Table 2 lists the available equipment at this facility.

Table 1. FAMU distance learning classroom equipment

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| <ul style="list-style-type: none"> • 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 lavalier 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 |
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Table 2. CESTA teleconference facility equipment

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| <ul style="list-style-type: none">• 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 |
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The MDCC facility has a similarly equipped distance-learning classroom to the one located on the FAMU campus. 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.

The initial delivery of the computer-aided circuit analysis course to the MDCC campus was done from the CESTA teleconference facility. Subsequent delivery of this course has been done at both the teleconference site and the distance learning classroom site. The teleconference site provided some unique challenges in delivering the course.

IV. Issues and Challenges Encountered in Delivering Course

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

- Difficulty transferring large PPT 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 he would 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.
- In switching between the fixed camera, the PowerPoint presentation, and the overhead document camera, there is an inherent delay introduced by the software.
- Inadvertent loss of connection during transmission.

The problem of large PPT files was resolved by installing a ZIP drive or LS-120 drive on the computer and transferring data 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 the 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 being able to quickly establish the connection and resetting the tape recording.

In addition to the noted technical issues, there were many non-technical issues that were encountered that impacted the efficient and effective delivery of the course. Some of these were the following:

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

These non-technical issues are best solved by better advance planning for course delivery. The problem with delivering course material via email will be alleviated by the use of a course website from which it can be downloaded. The integrity of student work can be assured by ensuring that an administrator is always present at the remote site during examinations. This administrator will also be responsible for collecting all student work and returning them in a timely manner for grading by the instructor.

V. Conclusion

The effective delivery of a technical course like the computer-aided circuit analysis is best assured by taking care of the technical and non-technical problems that are encountered during course delivery. As many of the problems as possible should be eliminated prior to the class session. Effective planning for the course delivery will greatly alleviate 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 for the computer-aided circuit analysis course 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 contributed in no small measure to the perceived effectiveness of the course. The students liked the interactive nature of the course, which is akin to the traditional classroom method of teaching. They additionally liked the ability to go back and review tapes of the lectures to enhance their learning of the course materials. The success of this course indicates that the chosen method of delivering the technical content was effective and challenging for the students.

Whilst this method was effective for the contents of this particular course, other challenges will be presented when delivering other types of technical material. This is especially true where it is necessary for the students to perform laboratory experiments utilizing actual hardware instead of simulations.

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