

Use of the Internet to Support an Integrated Introductory Course in Engineering, Calculus, Physics, Chemistry, and English

R. J. Roedel, D. Evans, R. B. Doak, M. Kowski, M. Green, S. Duerden,
J. McCarter, P. Williams, and V. Burrows
Arizona State University
Tempe, AZ 85287-5706

Abstract

Arizona State University has been offering an introductory course that integrates engineering design and modeling, calculus, physics, chemistry, and English through the Foundation Coalition, an Engineering Education Coalition sponsored by the National Science Foundation. One of the critical components of courseware developed through the Foundation Coalition is the infusion of technology enhanced education. This paper will describe the use of the Internet, through the World Wide Web and through videoconferencing, to support this introductory course. It is interesting to note that the success of Internet usage is directly tied to the performance of the net. That is, when Internet traffic or bandwidth problems arise, both the students and the faculty become less enthusiastic about using the technology.

Introduction

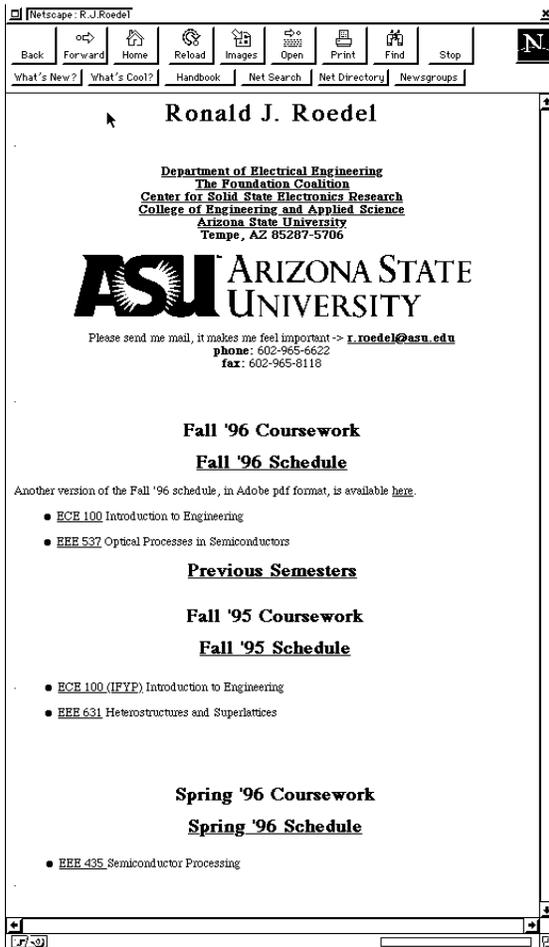
At Arizona State University, an integrated first year program is being offered to engineering students. This program is sponsored by the National Science Foundation through the Engineering Education Coalition known as the Foundation Coalition. In short, the chief goal of the Foundation Coalition is to provide to engineering students a program that features integrated coursework with a strong infusion of technology enhanced education taught with active learning strategies. In the first semester, students take a course that integrates an introduction to engineering with physics, calculus, and English composition. Engineering serves as the over-arching theme of the course; engineering projects are the focus of the class, incorporating the physics, math, and rhetorical skills the students have learned in a just-in-time fashion. More details concerning the course and its projects can be found in

reference [1] and in the ASU Foundation Coalition homepage [2].

The integrated course was first piloted in the Fall'94 semester and the technology infusion at that time included student training and use in two hardware platforms and a vast array of software items. Each team of four students was given access to both a Windows-based 486 PC and a Quadra-class Macintosh. The Microsoft Office Suite, MAPLE, and email service was available on both platforms. On the Macintosh computers, special software for data capture and graphing was available; on the 486 machines, video capture and manipulation software was installed. Each student in the class was expected to become proficient with both platforms, and it became apparent to the faculty involved in the class that the students had no difficulty whatsoever in moving back and forth between the two systems.

Apart from email and a few instances of file transfer between machines by anonymous ftp, the students in the first offering of the integrated class did not use the Internet extensively. But during the Spring'95 semester, as the World Wide Web started its exponential climb in acceptance and popularity, we decided to add technology components to the integrated course that would rely heavily on the Internet. We modified the content of the engineering course and included for the Fall'95 semester an "introduction to modeling" component and chose to deliver this material through a WWW homepage. Furthermore, we put together a point-to-point Internet-based videoconferencing system that would tie together the classroom and the faculty offices. The purpose of the videoconferencing system was to generate an "electronic office hour" system. In the remaining sections of this paper, these two Internet technology approaches will be described in detail. There were both successes and failures with the introduction of these two approaches. Even though the students and the faculty were

Figure 1
Condensed Instructor's Homepage



enthusiastic about trying these systems, the enthusiasm would wane whenever there were network difficulties, such as sluggishness due to network traffic or bandwidth deficiencies. It certainly appears that when new technology is introduced, we expect it to work flawlessly.

World Wide Web Homepage for the Classroom

Extensive use of the World Wide Web is carried out in this course. For example, in the engineering design portion of the course, the courseware is delivered directly from a WWW homepage in real time. The "lecture" is replaced by the students and the professor examining homepage "slides" during the class period. These slides are based on material from the text, "How to Model It," by Starfield Smith, and Bleloch [3], and are contained in a section

of the homepage called "In-class Work." The students, who work in teams of four, read the slides (which are stored in the web server as portable document format, or pdf, files) from their team's workstation, and carry out the tasks required of them during the class period. These tasks can include (1) building a model on a spreadsheet, (2) retrieving data or other files located elsewhere on the web, and (3) using MAPLE or other software for calculations and graphing. The homepage section called "Out-of-class Work" describes the homework that the team (or individuals) are to submit.

An example of this is demonstrated in Figs. 1-3. Fig. 1 is a condensed version of an engineering instructor's homepage. The students generally open this page upon launching the Web browser (Netscape Navigator) and then navigate to the ECE100 (Introduction to Engineering) link, either through the link to previous semesters, or the current semester's link. Fig. 2 is a condensed version of the ECE100 homepage. This

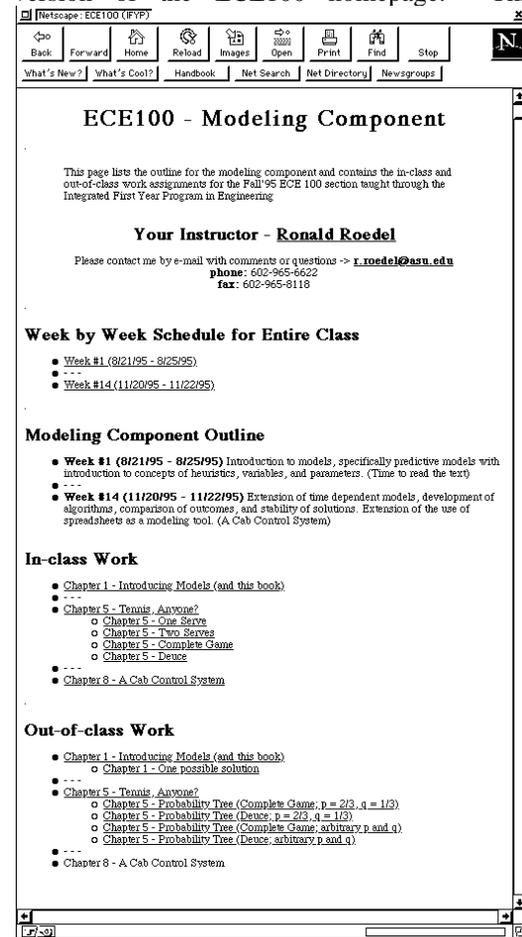
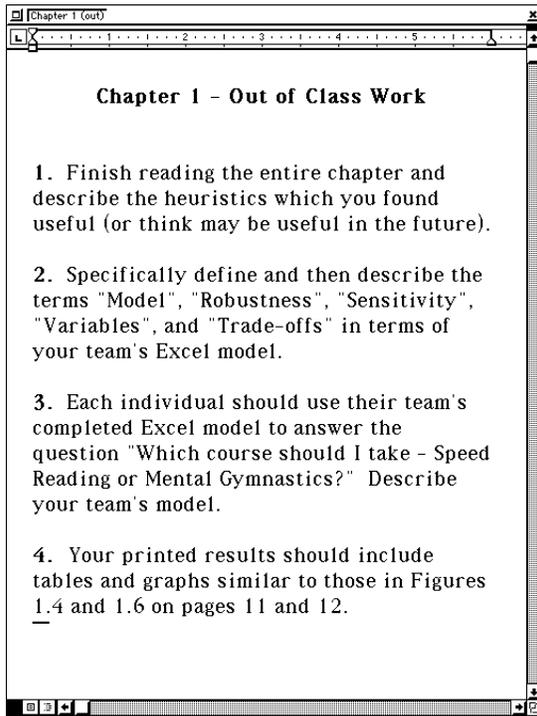


Figure 2 Condensed Course Homepage

Figure 4
MS Word File Converted to PDF Format



homepage contains links to the week-by-week schedules, brief descriptions of the engineering modeling projects, links to the in-class work, and links to the out-of-class work and possible solutions. Although these documents were constructed with Microsoft Office tools, they were converted to pdf format with Adobe Acrobat and added as links directly to the ECE100 homepage. The advantage of the pdf format is that any student can read these documents with an Acrobat Reader on any computer platform, and output from nearly every application can be converted into pdf format. The Reader is installed as a helper application in Netscape on the computers in the Foundation Classroom; and for students who want to read these documents on a home computer, for example, Adobe provides the Reader free of charge. Interested readers can examine the ECE100 homepage and Adobe pdf files in more detail by directing their web browser to <http://www.eas.asu.edu/~roedel/>.

An original goal for homepage usage was to provide a repository into which the students could deposit their teams' results. This proved to be quite cumbersome, as the interactivity of homepages in their current embodiment is limited. It is easy to use a

homepage to disseminate information or distribute material, but putting material into a homepage is limited to information from CGI scripted forms at the present time. Consequently, students turned in hardcopies of their homework. Those who were interested in posting their results in the homepage were allowed to convert their material into Adobe pdf files which could then be directly added to the homepage.

The students rather enjoyed using the web as the source of the classroom material. They could access the in-class and out-of-class material at any time. If they so chose, they could print out the pdf files. However, they were discouraged from doing this, as paper use reduction was another small goal for this work. The students were extremely reluctant to post their solutions on the homepage - in fact, none volunteered to put their material on the web! The only complaint the students voiced about the system was that at the startup of class, ten or more people trying to log on to the homepage often reduced the server's response to a crawl. It seems that we all want instantaneous network access.

Point-to-point videoconferencing

We assembled and began testing a point-to-point videoconferencing system that connects the classroom with the offices of the faculty participating in the introductory course in the Fall'95 semester. This system uses the campus ethernet lines for connection and allows students in the classroom not only to communicate (with both audio and video) with instructors outside of the classroom, but to share applications and files. The Pentium server in the classroom used the application,

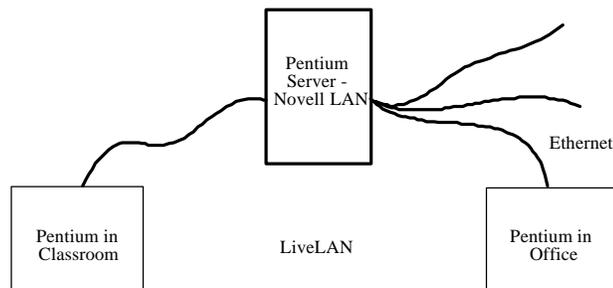


Figure 3 LiveLAN videoconferencing system

LiveLAN, from PictureTel, and the workstations in the classroom and the faculty offices were equipped with LiveLAN client software, video boards, and compact color video cameras. Figure 4 below is a schematic of the system.

Not only are video and audio signals sent across this system, but it is possible to share files and applications, in the manner of the Norton application, PCAnywhere. Our intention was to make it possible for faculty members to hold "electronic office hours" or to participate in classroom discussions remotely. This system uses PictureTel's proprietary compression/decompression schemes to route video and audio through the Novell LAN to the various computers that are connected to the system, but it is not a full motion video (30 frames per second). Although the students were eager to give the system a try, certainly in part because of the novelty of the idea, in practice, the idea did not succeed. Compressed video, even under the best circumstances, is shown in a reduced window and the picture quality is adequate at best. There are apparent synchronization problems with the picture and sound, and the video is typically described as "herky-jerky." Neither the faculty nor the students ever grew comfortable with the system, and it went largely underutilized.

Conclusions

The use of the Internet to support undergraduate coursework and learning has the same benefits and pitfalls as the use of any other technology in the classroom. The Internet, specifically the World Wide Web and coursework WWW homepages, can be a remarkable tool in the classroom - especially in a classroom that depends heavily upon computer usage for problem solving and communication. As the WWW browsers begin to support more interactivity, it is easy to envision an incredibly dynamic classroom, with students reaching out globally on the web for the information and skills they need for engineering problem solving. But just as the picturephone has been a technology which no one has embraced for the last 25 years, the technology must work nearly flawlessly for it to be accepted. In our recent experience, WWW homepages that support classroom activity are a natural extension of the "web surfing" that is already an extremely popular activity among

students, and were thus well received, but videoconferencing currently has the feel of an older technology, and has not been readily accepted.

Links:

PICT images of Netscape Navigator screen

- [Figure 1](#)
- [Figure 2](#)
- [Figure 3](#)
- [Figure 4](#)
- [Figure 5](#)
- [Figure 6](#)
- [Figure 7](#)

Acknowledgments

The authors wish to acknowledge the support of the National Science Foundation through the Engineering Education Coalition Cooperative Agreement, EEC92-21460.

References

- [1] D. Evans, M. Kowski, B. Doak, M. Politano, S. Duerden, M. Green, J. Kelly, and R. J. Roedel, "An integrated, project-based, introductory course in calculus, physics, English, and engineering," Frontiers In Education (FIE) Conference, November 5, 1995, Atlanta, GA
- [2] <http://www.eas.asu.edu/~asufc>
- [3] A. M. Starfield, K. A. Smith, and A. L. Bleloch, How to Model It, New York: McGraw-Hill, 1990.