

LABORATORY-ORIENTED DISTANCE LEARNING

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ABSTRACT

When university faculty are confronted with the prospect of converting their courses into *distance learning*, they are faced with a number of concerns, such as the audio/video quality of distance learning facility, the assessment of student learning, and how a laboratory-based class should be taught. Wayne State University's Division of Engineering Technology offers the Advanced Digital Design course with a laboratory section through distance learning and faces these very challenges. This paper, describes the challenges of offering such a course, recommends solutions, and assesses student view on the effectiveness of learning in a distance-learning environment with a laboratory section.

INTRODUCTION

With the advent of high-speed networking and its associated technology, traditional education is changing rapidly. Many universities are integrating the Internet to supplement traditional courses rather than replacing it or creating completely on-line classroom environments. However, the amount of time and expertise needed for creating such a course the very first time is enormous for the instructor. Recognizing this labor intensive process of converting traditional courses into distance learning, Wayne State University's (WSU) Division of Engineering Technology (ET) give incentives, such as release time, to professors to create such courses. The release time allows instructors to learn the course-management software they will use and prepare the initial lecture slides required for the course. Currently, ET has three distance learning courses and one completely on-line course offerings.

A number of courseware-management systems are available to instructors to develop and deploy courses, such as Blackboard and WebCT. WSU supports Blackboard as a course-

management tool throughout the university. WSU also makes the training available for instructors through the Office of Teaching and Learning (OTL). The OTL offers seminars for beginners and more advanced faculty. Blackboard's online teaching environment includes the following functionalities: (a) *Content management tool* for instructors to post their lecture notes, homework assignments, study guides, homework and exam solutions, (b) *Communication tool* for asynchronous and synchronous collaboration between faculty and students and among students, (c) *Assessment tool* which includes test and quiz capabilities along with an online gradebook, and (d) *Control tool* for faculty managed utilities. Fig. 1 shows the control panel of EET 3100 Advanced Digital Design course, which was delivered the first time during Fall 2002 semester.

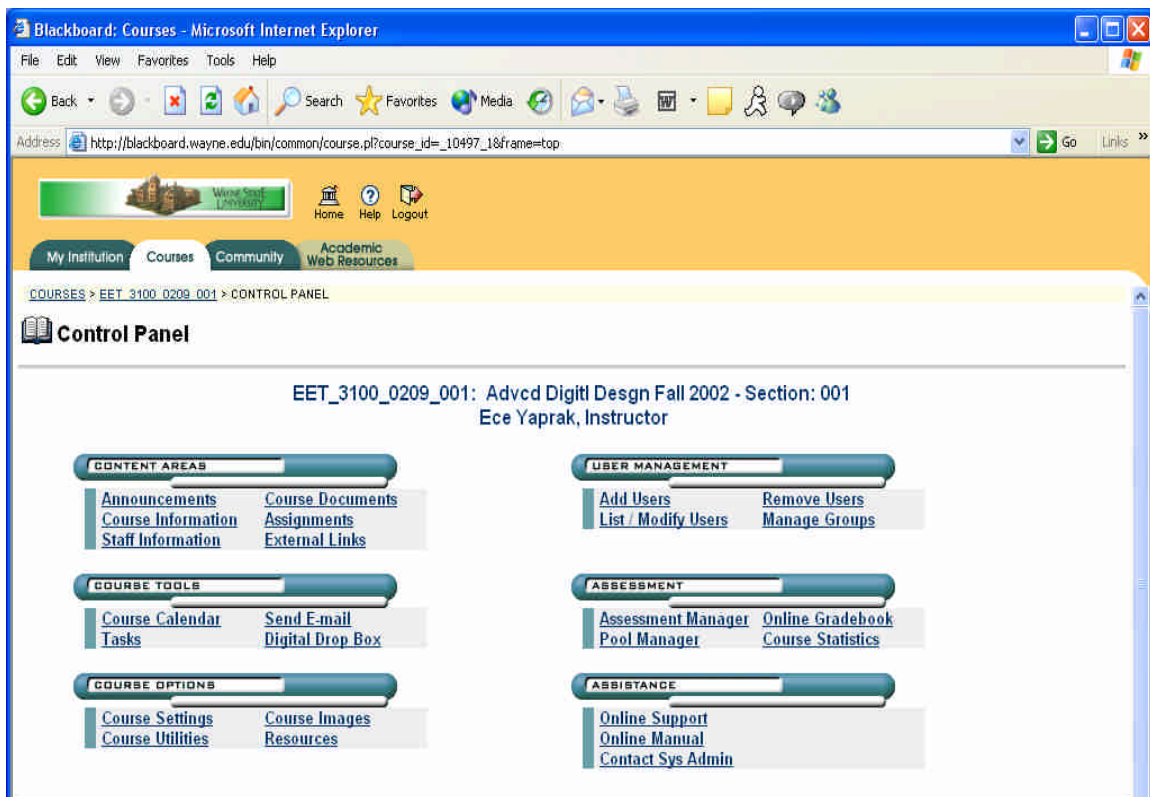


Fig. 1: Blackboard Control Panel

Course-management tool Blackboard is available to students 24 hours a day, seven days a week and makes it easier for students who travel often. In this learning environment students can plan their work to fit their schedule as long as they complete each assignment by its due date. This maximizes students' flexibility in learning the course material as best fits their learning preference and schedule.

Advanced Digital Design (EET 3100) course is selected to be converted to web-centric distance learning environment during the fall 2002 semester. This course was the first distance-learning course to be taught with a laboratory section. This course is taught face-to-face on the main campus and also broadcasted to another location for distance learning students.

Distance learning facilities at Wayne State University's College of Engineering utilize a custom-built system by ICI Company. The system operates using the ISDN technology, through a provider (Sprint) and it is capable of data transfers up to 12 channels (56K per Channel) for audio and video - resulting in a fairly sharp and fast signal of 672K. Any other combination (2 channel, 6 channel, etc.) is also possible as well as simple teleconference calls (This is especially useful if the other site is limited to 2, 4 or 6 channels and different data rates). The user can operate and choose between the cameras and other signals via the touch screen interface. The current setup provides 6 signals that can be sent to remote sites: one instructor camera, one student camera, one document/transparency camera, PC/laptop, S-VHS/VHS video and audio CD. Further, it is possible to remotely operate these signals from another site (and vice versa) if the other system is identical.

Blackboard's on-line teaching environment allows our distance-learning students to download class and laboratory materials, assignments, solutions, announcements, submit assignments, and check grades. It also allows group communication and provides password-protected and timed tests. The laboratory makes use of the Max+Plus II Digital Design Platform, where students are able to design, simulate, and program a chip. Even though the integration of Web-based learning brings added value to distance education, managing the laboratory portion of this class is still a challenge since the laboratory is in the main building on campus.

This paper presents the conversion process and summarizes the challenges on how to address the laboratory setup.

COURSE/LAB SETUP

Two sections of EET 3100 is taught face-to-face on campus and at the same time is delivered to another campus for our distance learning students, where they see the faculty on a big screen. The faculty is able to adjust the settings of the communication system so that the students can see and hear each other as well as the instructor. PowerPoint lecture notes are posted on the Blackboard weekly before each lecture. Students are expected to bring the printed lecture notes to the lecture and take notes instead of constantly copying the lecture material. If a student misses the lecture, the notes are on the system for him/her to use. Students are expected to find the assignments on the system and submit assignments through the digital dropbox. They are encouraged to post questions on the discussion board or use synchronous chat tool with each other and the faculty. The exams are given in-class for both sections, however, the distance-learning class is administered by a proctors and the instructor is able to see both sets of students.

This class had a traditional laboratory before the change. In the traditional laboratory setup, students employed state of the art programmable chips via Altera software and hardware development packages. The students use two types of Programmable Logic Design (PLD) in the 7000 series in conjunction with Altera Corporation's MAX + PLUS II design software package. MAX+PLUS II software is a complete development system

that includes design entry using graphical and hardware description languages (HDL), design compilation, design verification, and especially **device programming**.

Altera's University Program facilitates the digital logic design learning process by donating development software to the universities who apply and offering design laboratory kits for purchase at a low cost of approximately \$149. The UP1/UP2 Design Laboratory Package kits are suitable for all types of digital design courses, from entry-level logic design to advanced computing architecture and include the following items:

- MAX+PLUS II Development Software, Version 10.1
- UP2 Development Board with a FLEX 10K Device
- ByteBlaster download cable
- Power supply

Engineering Technology Building has a 20-station laboratory that contains MAX+PLUS II student version software and UP1 design kit for each station. Students also receive instructions on how to download free MAX+PLUS II software student version on the Blackboard. Distance learning students are then asked to download the free software onto their computers in order to perform the labs. On-campus students are given a choice: they can either come to WSU or use their computers in order to perform the labs. This gives flexibility to students who are working students, parents, or travel constantly for work. Students who perform the labs at home can post questions on the Blackboard or e-mail the instructor. These students can then submit their lab reports through Blackboard's digital drop box.

Most of the laboratory experiments are done using this software and students enjoy the flexibility that comes with it. However, towards the end of the semester, some laboratory experiments are hardware labs, where students are asked to download their designs onto UP1/UP2 board from the computer thru ByteBlaster cable and test their designs. We do not require students to purchase this board since each station in our laboratory on the main campus contains this board. Students are asked, however, to come to the lab, just a few times during the semester, to program a chip on this board. Some of them choose to buy the Laboratory Package since another class (EET 4100 Microcomputer Hardware Design) makes use of the same software/hardware laboratory setup.

COURSE ASSESSMENT

All students who participated in the distance-education sections of the course submitted an anonymous questionnaire prepared by the instructor. This questionnaire is planned to be used to improve the course for the upcoming semesters. Students were asked to rate on a scale of 1-5 (5 being full agreement) their opinions on some of the properties of the course. Students' responses were very positive as shown in Table 1. As survey data illustrates in Table 1, shown in the last three items, the students especially enjoyed the freedom of performing the laboratories on their own computers and on their own time. This gives them the flexibility.

Table1: Course Assessment Results

The use of Blackboard communication system allowed me to improve my studying habits	4.37
The use of Blackboard communication system allowed me to improve my communication with the instructor	4.00
The use of Blackboard communication system allowed me to improve my understanding of the course topic better	3.95
I would recommend this web setup to other students	4.32
The open lab set-up (working anywhere with a free downloadable Altera program) facilitated a better schedule for me	4.79
The open lab set-up (working anywhere with a free downloadable Altera program) helped me to learn at my pace	4.84
I would recommend the open lab setup to other students	4.89

CONCLUSION

While some courses have been developed that are heavily dependent upon information technology and the Internet, thousands of courses have taken a more conservative approach and chose to augment conventional classroom instruction rather than replace it. Wayne State University’s Division of Engineering Technology and Lawrence Technological University’s Electrical and Computer Engineering Departments have taken the second augmented approach. Using a course-management system, like Blackboard, and having an open lab set-up have been well received by students as shown by the survey and given student comments from an anonymous survey. It is recommended that to implement a use of a free software tool for such distance learning classes. If the class requires hardware lab(s) then an inexpensive set-up can be considered for student purchase. This should eliminate or minimize travel for distance-learning students.

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