

## **A Blended On-line Engineering Technology Course Using Web Conferencing Technology**

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### **Abstract**

Today, universities must compete for students while searching for ways to be more cost effective. Many Universities that have long used the in-residence model for course delivery are now turning to the virtual classroom. On-line or distance learning methods make courses available to a potential student population that would not otherwise be accessible in a cost effective manner.

The University of Dayton (UD) has traditionally been an in-residence institution, and many students go home for the summer and take courses from a college or University in their local area. By offering distance learning or on-line classes during the summer, the University of Dayton could attract some of those students to take UD courses. There has recently been some effort to make UD courses available to distant students. Courses in Engineering Technology are currently being offered to students physically located at Edison Community College in Piqua Ohio using videoconferencing technology. There are courses being offered on-line and as study at home by some departments through the University's summer distributed learning program. The Engineering Management Department is currently offering graduate courses using interactive Web Conferencing. However, there were no school of engineering undergraduate courses that were offered in a blended on-line mode.

Over the last year, University of Dayton Information Technology (UDit), in cooperation with Engineering Technology and other academic departments, evaluated several Web Conferencing Technologies. This technology delivers courseware with live streaming video and interactive streaming audio web casts. In the summer of 2004, Engineering Technology faculty developed a course in Engineering Economy that took advantage of the University's new Web Conferencing system. This course was delivered in a blended learning mode using a combination of synchronous and asynchronous modes.

### **Instructor Preparation to Teach On-line**

Since this was the first on-line course delivered in this department, considerable preparation was necessary. To prepare for developing and teaching an on-line course, the instructor researched articles on the subject and attended several seminars for teaching on-line. The instructor also attended a six-week reading group for on-line instructors.

The attendees for the reading group were given a package of material about teaching on-line to read and discuss at the meetings. The reading group attendees were mostly faculty that had not taught on-line before, along with a few faculty who had taught some form of on-line or distance course.

### **Online Course Structure**

A number of general education courses at the University of Dayton are offered through the summer distributed learning program. Normally, students are given assignments that are self-paced and in some cases, all course assignments may be due at the end of the summer. There may be little interaction between the instructor and students or between students in this type of course structure. This type of course delivery requires students to be very disciplined to get the course work done without prompting or pacing by the instructor. Problems arise when students put off the work and try to get it done at the last minute; or worse, forget to do the work at all. Course completion is an issue for students who are not prepared to take self-paced courses. In order to have more interaction between the instructor and the students, some institutions use a hybrid model that combines some face-to-face classes within on-line instruction. This model typically requires students to attend a certain number of face-to-face classes at the beginning of the term with the rest of the course delivered using on-line classes with little or no additional face-to-face contact.

In designing this on-line Engineering Economy course, one of the objectives was to allow students to take the course from any location and to not require them to attend any face-to-face classes, yet still have the course-work paced throughout the summer term. Because many students participate in cooperative education or take summer jobs at various locations, attending face-to-face classes is not convenient or in some cases, not feasible. The students who enrolled in the on-line course were physically located in various cities. In addition to some students who were located in the Dayton area, other students were in Michigan, Kentucky and one student was sent to China for the last two weeks of the course. The course was structured using a blended model, which combines synchronous and asynchronous on-line instruction. This learner-centered model allows instructor-student interaction as well as interaction between students. One of the keys to the effectiveness of this blended model was the software.

### **Features of the Web Conferencing Software**

Interwise ECP Connect software was used for this course. The Interwise software allows live streaming video and interactive streaming audio Webcasts using Voice over Internet Protocol (VoIP). Two types of Interwise software were required to teach the course; moderator software and participant software. The moderator software is used by the instructor and controls what the participants are allowed to do. The participants cannot speak until given permission by the moderator. Normally, the participants click a button that indicates they are holding up their hand, like in a face-to-face class, asking permission to speak. The software has the ability to conduct tests, and instant surveys. Course materials such as PowerPoint slides were loaded on the server and shown during

the class. Two other significant features of the software that supported the interactivity of the course are the whiteboard and application sharing.

### *Whiteboard*

A whiteboard is a shared drawing space on the computer screen. The instructor can write freehand equations, draw charts and type text on the whiteboard. All students can see the screen and when given permission, students can take control of the whiteboard to write, draw or type on the screen.

### *Application Sharing*

With application sharing, the instructor can share anything that is running on his/her computer with the students. This feature allows the instructor to bring up an application such as Excel and create programs or manipulate data as the students watch on their computer monitors. As with the whiteboard, the instructor can pass control of these applications to the students. The students do not have to have the same application software resident on their computers.

## **Weekly Class Schedules**

As previously stated, problems with study at home courses arise when students take advantage of the self-paced nature of this type of course, and put off the work until the last minute, or forget to do the work at all. An extreme example of the latter was one such student who stated that he had forgotten that he had registered for a study at home course until he got his grade sheet at the end of the summer with an “F” for the course. In order to keep students focused on the course requirements, this course was designed to be in continual communications with the students. A number of methods were used to communicate with students in this course. Communications technology used for the course included the on-line classes and virtual office hours using VoIP, threaded discussions, e-mails, and chat. A class schedule was posted on the course web site each week. The schedule included the dates and times for:

- Attending the mandatory on-line classes
- Optional on-line office hours
- Homework assignments
- Online quizzes and exams
- Threaded discussion assignments.

### *Online Classes*

Instead of face-to-face classes, students were required to attend synchronous on-line Webcasts one day per week. Course materials, such as the syllabus, schedule, PowerPoint notes, handouts, etc., were stored on WebCT. Students downloaded the PowerPoint notes and handouts prior to class. The classes were taught using PowerPoint

slides that were loaded on the Interwise software, and the instructor solved sample problems on the interactive whiteboard using a Tablet PC. The software synchronizes the audio and video transmissions so that students using both dial-up and high-speed connections could see as well as hear the instructor's explanations simultaneously. Students were also able to ask questions and answer questions posed by the instructor and other students. On-line polls were used to obtain feedback on the students' understanding of the course material. Questions were formed so that students answered yes or no, such as: "Do you think this is the correct way to solve this problem?"

### *Online Office Hours*

Live on-line office hours were conducted one hour per week. During the office hour sessions, students asked questions about problems they were having. The software allowed the students to use the whiteboard to show the instructor how they attempted the problem. The instructor could then see where the students were incorrect in their attempt to solve the problems. Also, other students could see the attempted problem solution on the whiteboard and hear the discussions as well as ask questions or offer help in solving the problems.

### *Homework Assignments*

Weekly homework was always due on the same day and time – midnight on Thursday each week. This provided an element of consistency and was one the pacing features of the course. The on-line office hours were always on Wednesday night, which allowed the students to ask questions about homework before it was due. Students submitted their homework by email or Fax.

### *Quizzes and Exams*

All quizzes and exams were administered on-line using WebCT. One quiz was scheduled each week and students could take the quiz twice within a 24-hour period; the highest score counted for a grade. There were two exams, a mid-term and a final. The exams could only be taken once and were required to be taken during a specified small time period. The difference between the quizzes and the exams is that by allowing students to take the quizzes twice, the quizzes were used as a learning tool. One concern of most instructors using on-line tests is dishonesty<sup>1</sup>. One deterrent to cheating that was used in this course was the short time frame allowed for tests. The instructor assumed that students would use their textbook and class notes during quizzes and exams. Problems were designed so that if a student was not already familiar with the material, it would be difficult to read the text and work the problems correctly within the short time frame. Use of randomized multiple versions of questions limited the ability of students to work together on the quizzes and exams. Four or five versions of multiple-choice questions were selected at random by the computer for each student. Also, the WebCT software allows equations to be embedded that generate multiple versions of problems requiring calculated answers.

### *Threaded Discussion Assignments*

Students were encouraged to use the discussion board to communicate with the instructor and other students about the course. Each week, students had to respond to one or two discussion items, which were posted by the instructor. The first discussion required students to post an introduction of themselves. Other discussion items generally required students to discuss something that they did not understand about the reading or homework. Students who answered questions from their peers were given extra credit. Using written communications allows students to compose well thought-out questions. This allows a higher quality of instructor response that can go to the heart of what the students are not learning.

Just-in-Time Teaching (JiTT) is a pedagogical system that uses the Internet to enhance learning in the classroom setting<sup>2</sup>. One of the objectives of JiTT is to adjust and organize classroom lessons in response to students' submissions on a Just-in-Time basis. A form of JiTT was used in this on-line course. The instructor collected students' questions that were posted to the discussion board and at the next on-line class, the instructor answered those questions that had not been previously answered by another student. A benefit of using this mode of communication is that some students, who are hesitant to ask a question in a face-to-face class, may be more apt to ask questions on-line.

### **Course Evaluations**

#### *Formative Evaluation*

A pilot of this form of on-line class using Web Conferencing technology was conducted during the Winter Semester of 2004. Two classes of an Engineering Cost Estimating course, which is a traditional face-to-face course, were taught using the web conferencing software. One of the classes was taught from the instructor's office and the other was taught from the classroom. Half of the students attended the classes from home, over the Internet, and the other half were in the classroom. Students completed a short evaluation form for the two classes. Based on the favorable student evaluations of the classes, the decision was made to use this type of software for the summer on-line course.

#### *Summative Evaluation*

After the on-line course was completed, students were asked to complete a web-based anonymous evaluation of the course. The evaluation asked 16 questions, three of which were open-ended. Eight of the 10 students who took the course responded to the survey. Following are the results of the survey:

- Five of the eight students used a high-speed connection and the other three used a dial-up connection. Students reported no discernable difference between using high-speed or dial-up connections.

- All students described their access to the Interwise website as relatively easy or about what they would expect.
- All students used either a headset or a microphone with speakers to communicate with the instructor and other students.
- Students responded that the web conferencing technology and clarity of the audio was adequate or excellent.
- Six of the students stated that the delay in transmission of the audio was tolerable or no bother; they got used to it. However, two of the students reported that the delay “really bugged them.” This is further addressed below.
- Most students described the visual aspects of the classes (PowerPoint slides, writing/drawings on the screen) as either excellent or adequate; none described the visuals as inadequate.
- Three of the students reported that they spent more time on the course outside of class than for a face-to-face class and the other five stated that it was about the same amount of time.
- Three students reported that they attended the virtual office hours, and that it helped their understanding of the course material. Four did not attend and one student who attended the office hours responded that it did not help in understanding the course material.
- The amount of material covered in the course was reported as too much (2 students) or about right (6 students).
- To the question: “do you feel the on-line quizzes were a fair and effective method to test your knowledge of the course content?” seven answered yes and one answered no.
- Six of the eight students stated that they would recommend this course to another student and take another on-line course that is taught in this format. Two of the students did not like the on-line learning format. They indicated that they learned better in face-to-face-classes.

The three open-ended questions were:

- What do you think about using the Interwise technology for the course?
- What do you think about using the WebCT technology for the course?

- Please provide any other comments that you have about the content of the course.

The responses to the open-ended questions were mostly positive. However, one of the comments concerned the delay in the audio transmission. The software synchronizes the video and audio so that they are both received at the same time. Thus, normally, any delay is transparent because students still see the video and hear the corresponding audio simultaneously. However, the delay was apparent when the instructor asked the students a question and waited for a response. Sometimes, it took so long for the audio to be transmitted that the instructor thought there was not a student response and would start talking at the same time as the student's response was heard.

### **Lessons Learned**

- The Web Conferencing software is an effective medium for blended on-line courses. Students using both high-speed and dial-up access were both able to participate in class without significant audio or visual problems.
- Classes can be delivered independent of the location of the students or faculty. Students were able to participate in class from various states and countries. The instructor taught one class from his hotel room in Salt Lake City Utah, where he was attending the 2004 American Society for Engineering Education conference.
- Students have the ability to send notes to the instructor. Because of the lag in the audio, it is recommended to use this method as the primary way to obtain student feedback. Notes can be accumulated by the instructor and then answered at an appropriate time during the class. This alleviates the problem with the lag in audio transmission.
- The Threaded Discussion was an effective way for students to communicate with the instructor and their classmates. It also reinforced the University's idea of a learning community where students both asked questions and answered other students' questions via this medium. The instructor also used this medium to collect students' areas of concern and respond at the next on-line class meeting.
- Student learning in the on-line class was about the same as for a traditional class. The distribution of final grades was about that of a traditional face-to-face course.
- Both quizzes and exams can be administered on-line. Students "signed" an honor statement before taking each quiz or exam and the student grades were about the same as for a traditional face-to-face course.

- Online learning is not for everyone. In this type of course, students must take more responsibility for their learning and do a lot of work on their own. Each student must decide if they feel they can be effective in an on-line class<sup>3</sup>.

## Conclusions

Online blended courses can be an effective way to deliver a course to students at remote locations. The software appeared to work equally well for students using dial-up and high-speed connections. Student performance in this on-line course was about the same as for a traditional face-to-face course. However, not all students can be effective in an on-line course. Some students are more effective in a traditional face-to-face classroom than in a virtual classroom. Each student must decide if on-line or traditional classroom learning is more appropriate for him or her. The success of this first course at the University of Dayton is very encouraging. In the future, faculty in Engineering Technology plan to expand summer course offerings delivered in this format. Furthermore, investigation is underway to integrate this technology into existing semester classes and expand into new degree areas.

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### **Biography**

Charlie Edmonson is an Associate Professor of Industrial Engineering Technology at the University of Dayton. Prior to joining the faculty at UD, he retired from the U. S. Air Force civil service after 30 years of engineering design, industrial engineering, and management experience at numerous Air Force bases throughout the US and overseas. He earned a BSME from Tennessee State University and a MSIE from the University of Pittsburgh.

Scott Segalewitz is Professor and Chair of Engineering Technology at the University of Dayton. He earned an MS in Biomedical Engineering from New Jersey Institute of Technology, a BSEE from Rutgers University, and is a Licensed Professional Engineer. His areas of interest include distance and asynchronous learning, technical communications, technology in education, and continuous improvement in the learning environment.