Teaching Engineering Economics via Distance Education

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Abstract

Driven by demand for distance education, the instructor lecturing to a room of students is replaced by a "virtual classroom". This new method of delivery, coupled with the necessity for unique course administration procedures, requires a teaching approach that differs significantly from that of a traditional classroom. This paper outlines demonstrated challenges with learning and teaching via streaming video over the internet as they relate to teaching a technical class such as engineering economics. Effective communication both in and out of the classroom is discussed, along with administrative issues such as remote submittal of assignments and administration of exams. Finally, the paper presents a recommended approach to managing such issues so that instructors may provide a student-friendly learning environment.

Introduction

Motivation
With the evolution of internet technology, new communication tools have facilitated the development of non-traditional classroom environments. Driven by demand for distance education, the instructor lecturing to a room of students is replaced by a "virtual classroom" with live streaming video broadcast over the internet to students around the world. This new method of delivery, coupled with the necessity for unique course administration procedures, requires a teaching approach that differs significantly from that of a traditional classroom.

In recent years, many universities have begun to offer courses and even complete degree programs via distance education. Some universities are completely internet-based. For instance, Cardean University offers online business courses and an accredited M.B.A. degree through its affiliation with leading business universities. Alternatively, traditional universities have begun to offer courses and degrees over the internet. One such program is the Boeing Systems Engineering Program, which began in 1999. The program is a collaboration between the University of Missouri at Rolla and the University of Southern California, which where chosen by the Boeing Corporation to provide a systems engineering education to many of their employees.

Although students outside Boeing are allowed to participate in the program, the majority of students in the program are full-time Boeing employees. Boeing supports its students financially by completely funding tuition and fees and also providing time off from work to attend classes and meetings. Students in the program must meet the admissions requirements for a masters degree in Engineering Management, including having a previous engineering degree with a minimum grade point average and a minimum score on the GRE. For most students, Systems Engineering is their first graduate degree program, but some have previous masters degrees

ranging from engineering to business. Students' work experiences range from just out of undergraduate to more than 30 years of experience with Boeing.

Systems Engineering is an interdisciplinary program housed in the School of Engineering at the University of Missouri at Rolla. The Engineering Management Department teaches core courses, with technical specialty courses provided by several other cooperating departments. The program consists of 18 hours of core courses in systems and management and 12 hours of coursework in one of several specialty tracks. The core courses consist of 9 hours of systems engineering, 6 hours of engineering management and 3 hours of engineering economics.

Classes are taught via live streaming video over the internet. Students watch and listen on a computer with approximately a one-minute delay, and they may call into a teleconference and listen via real time audio. Classes are videotaped and archived for students that miss class or wish to review class lectures at a later time. Students on campus as well as off campus may enroll in this degree program, or participate in the courses as part of another degree program.

Methodology
This paper shares the author's experience teaching engineering economics via the internet within the Boeing Systems Engineering Program and highlights the methods developed for managing the internet classroom. These methods have been derived from experiences teaching engineering economics in the internet-based classroom and from a survey of former internet students. The insights gained regarding an effective learning environment will be discussed along with their consequences and role in the development of internet-based teaching methods. Many of the findings apply to internet courses in general, while some are specific to engineering economics; however, all should be useful to instructors teaching via the internet.

The paper outlines, from the perspective of both student and instructor, demonstrated challenges with learning and teaching via streaming video over the internet. The paper addresses the topic of communication, both student-instructor and student-student, in lecture and outside of the virtual classroom. It also addresses unique administrative issues, such as remote submittal of assignments and administration of exams. Finally, the paper presents a recommended approach to managing such issues so instructors may deliver engineering economics via the virtual classroom in a student-friendly manner.

Communication

Effective communication is essential to providing a positive learning environment. This section discusses communication between instructor and student, as well as between students.

Student-Instructor Communication During Lecture
Many aspects of lecturing via the internet have the potential to negatively affect communication. These can generally be divided into two main categories: technology, including streaming video and audio feed, and presentation format.

The technology involved with the internet streaming often leads to limited or no student interaction during lecture. It is difficult for students to watch the video, follow notes, and

participate via phone. If the student chooses to watch and listen via the internet, any comments or questions that they may have would lag behind the lecture and the student may be discouraged from participating. If the student chooses to listen via the real time audio, then the audio doesn't match the video. In fact, some students feel the video is unnecessary for engineering economics and resort to following notes and listening only.

Some students may not be comfortable with technology and may be unfamiliar with the web tools used in class. Others are frustrated with the reliance on technology; streaming audio and video may freeze, and static feedback may be bothersome when listening on the phone. These students may choose not to use video streaming or call-in features and simply watch the archived class lecture. Since they are not participating live, they cannot participate in classroom discussion.

As a result of students' limited use of available technology, the instructor must assume students may not *see* the lecture. The instructor should prepare thorough, detailed notes to post on the internet before lecture so that students may download them and follow along. Deviations from the posted lecture notes must be limited. Discussion periods should be announced so students may call in at the specified time if they are not already participating via real time audio. This will eliminate much of the static feedback and allow for effective participation, which is crucial for technical courses such as engineering economics.

Classroom technical support staff is critical to ensuring video quality and providing assistance to students who need help with the technology. Detailed information and tutorials on the technology used in class should be provided. The technical staff, instructor and students should cooperate throughout the course in order to correct problem areas. Also, students should have high-speed, reliable internet access, as well as a speakerphone with mute, which allows them to listen to the class live without static feedback or tying up their hands.

Presentation format plays a major role in the effectiveness of internet-based lectures. As previously noted, the instructor must post lecture notes in advance so students may download them and follow along. Deviations from the posted lecture notes must be limited since hand-written notes are difficult to read over video. PowerPoint™ has proven to be the best presentation format, allowing students to download clear notes before lecture and add comments during lecture. This format works well for engineering economics, as it allows tables, equations, graphs, etc. to be inserted in a clear and concise manner. Smartboard™ technology allows the instructor to write on presentation slides, which can then be seen by the students over the internet. This technology may be used effectively in some instances for clarification, especially since archived lectures allow review of lecture.

Student-Instructor Communication Outside Lecture
Students may require further explanation of concepts and examples presented in lecture, but have limited access to the instructor due to remote locations. Email and phone are difficult modes of communicating technical, numerical engineering economics material. Communication is further complicated if the student and instructor are in different time zones. The textbook is an additional source of information that must be linked to lectures. Students rely heavily on the

textbook for examples and detail, and may not have access to library resources unless they are available online.

One solution to communication outside of lecture is the use of Blackboard™. Blackboard is an instructional tool that allows for file exchange, chatting, and even has a virtual classroom feature with whiteboard. The whiteboard, which allows the instructor and student to display information via the computer as if they were writing on a classroom whiteboard, may be used in combination with other media as a means of effective communication with students. For example, students may submit questions via email or the discussion board, and the instructor may post detailed examples and explanations on the course page. Blackboard also has many administrative capabilities that will be discussed in more detail in a later section.

Other actions that can improve communication are limiting class size and having regular visits with the remote students. A limited class size ensures that the instructor has adequate time for communication outside of lecture. Regular visits to remote locations allow for face-to-face communication between students and instructor. These visits should be scheduled in advance so students may prepare to meet with the instructor. Visits before scheduled exams may be most beneficial, as students can ask for further explanation in person.

Student-Student Communication
Students face similar difficulties communicating with other students. Some students may be located in the same city, but most are separated geographically. Distance leads to difficulty in forming study groups, especially when group projects and cases are involved in the course. In an engineering economics course, the objective, mathematical course content does not always necessitate significant student-to-student interaction. However, the learning environment is negatively affected, as the ability to learn from other students is limited. Some of these difficulties may be overcome by similar means as the Student-Instructor communication issues. For example, students may post a question on the message board within Blackboard, and another student that sees the question may post an answer. If the students are online together, they can work on problems through the virtual classroom feature.

Administration

Administration of an internet-based course is a challenge in itself, and has consequences on the preparation of class materials, submittal of assignments and exams, delivery of exams, and return of grades and graded material.

The course description should indicate what technologies are used, including software requirements, so that students can prepare in advance. Often software is not available off campus, and students may not have adequate access to the university computing system, specifically the ability to run programs remotely. Also, some software may be incompatible with the operating systems at remote locations.

Submittal of assignments and exams is a challenge. Electronic submittal is difficult for hand-written work. Students are forced to either fax or scan assignments, creating an additional burden on the students and instructor. Delays may occur when an entire class is attempting to fax

at the same time, such as at the end of a timed exam. Often, space limitations and email server problems cause delays in the electronic submission of assignments. These problems may be overcome with the use of the digital dropbox feature of Blackboard, which allows files to be uploaded to a site that may only be accessed by the instructor.

Administration of exams is an area of great concern. For timed exams, it is crucial that students receive the exam on time and that exams are returned on time. Often, email servers do not deliver email in a timely fashion, and fax machines are somewhat unreliable. Again, the digital dropbox feature of Blackboard may provide a solution. If the instructor is able to write a time-independent exam, students may choose when to take the exam and how much time to devote to the exam. They will also be able to take the exam in a relaxing environment, and can set aside time for submittal of the exam. Scheduling proctors for exams is also a logistical issue since students are at remote locations.

Blackboard is a good tool for file exchange, posting of grades, lecture notes, announcements, and chatting. However, some students don't want to use it due to the perceived "hassle" involved; having to remember passwords, periods in which the site is inaccessible, etc..

Summary and Conclusion

Communication is the key to a successful internet-based course. Even issues classified as "administrative" primarily involve communication of information. Instructors must modify their teaching approach relative to traditional classroom methods in order to accommodate the special circumstances of distance learning. It is imperative to receive feedback throughout the course to ensure that all modes of communication are working and providing an effective learning environment. Internet-based courses are not the same as being in the classroom. Technology allows for learning, but does not provide the same feel as being in the room with the class and instructor. Again, communication is the key to an effective learning environment, and instructors and students must work together to better utilize technology in order to provide quality learning experiences.

Blackboard is a powerful tool that can alleviate some of the communication and administrative issues. However, it is still necessary to make the current technology more user-friendly. Specifically, students lose the feeling of being in the class when at a remote location. The course may be structured to encourage participation through the existing video format. For more information on Blackboard visit http://www.blackboard.com/.

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