AC 2012-4790: APPLYING DISTANCE EDUCATION TECHNOLOGIES TO A LARGE-SCALE ENGINEERING MECHANICS COURSE

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Applying Distance Education Technologies to a Large-Scale Engineering Mechanics Course

Introduction

Distance learning and continuing education programs are a growing component of higher education in engineering. The technological investments that colleges and universities commit to are substantial in both financial outlay and strategic vision. But over time as the video production facilities and computing support infrastructure matures for distance learning courses, the ability to utilize these new capabilities towards enhancing traditional "in-person" courses at colleges and universities becomes ever more feasible. This paper discusses how a traditional live-taught engineering mechanics course (Statics) with a very large enrollment (500 students) was enhanced by leveraging the existing distance learning technologies originally purposed to serve distance engineering students in online programs.

Background

The course in this work that benefitted from distance learning technology is Engineering Mechanics: Statics. This three-credit course is required by 80% of all undergraduate engineering majors and consequently has the largest enrollment in the college of engineering for engineering undergrads. The enrollment fluctuates between 400 to 500 students across semesters. The course is considered one of the "bedrock" engineering courses in the college and covers many of the most basic analytical skills that aspiring engineering undergraduates must master before graduation.

Previous to this work, the course was split into three different sections with approximately 150 students per section. Each section would be instructed by a tenure-track faculty member of the Mechanical and Aerospace Engineering department (MAE) and would have 2-3 graduate teaching assistants assigned to it. Each lecture would have several homework problems assigned that would be due by the following lecture that the TA's would physically collect, grade, and return to the students on a lecture-by-lecture basis. Three large assembly exams would be administered for the entire course during the term.

A New Approach

The distance learning engineering programs had established a functioning model where students not physically present at lectures could effectively participate and complete rigorous coursework in the engineering curriculum. Based on the success of these programs, a proposal was formulated to extend the distance learning model to on-campus students taking Engineering Mechanics: Statics. The rationale was that a single live section could be taught, recorded, and the video delivered over the campus course management system to the students enrolled in the course who were not physically present at the taping. The on-campus course would be effectively transformed into an "attendance optional" course

where the maximum capacity room with recording capabilities would serve to accommodate students who felt compelled to attend the live lecture. All homework in the course would be electronically submitted and graded over the course management system, obviating the need to turn in any hardcopy documents. Large assembly exams were retained to address issues of academic honesty.

Technology Impacts

The following distance learning/continuing education technologies had various impacts on the Statics course:

On-demand, high-definition video recorded lectures

The most widely endearing aspect of the attendance-optional Statics course as reported in student feedback surveys was the recorded lectures. The high-quality video and audio recordings coupled with server-archived lecture library allowed students greater freedom in both time and location in which to partake in the provided material. An example of these videos is shown by a lecture screen-capture in Fig. 1.

Course management system

The course management system (in this instance Sakai) greatly streamlined user-authentication issues pertaining to electronic homework submission and video content delivery. The integration of the course management system with a course grade book allowed for easy dissemination of individual grades without running afoul of any privacy concerns with students having access to grades other than their own. The course management system also provided a uniform framework from which the instructor and teaching assistants could conduct academic business with students.

Social media

The use of outside social media platforms (Twitter, Google+) was used to broadcast time-sensitive information as well as provide collaborative tools outside the capabilities of the internal course management system. The use of outside social media was not integral to the course, but future incarnations may utilize them more greatly.

Efficacy and Efficiency Results

The increased instructional efficiency of this course model, as measured starkly in terms of student enrollment/FTE ratio and shown in Fig. 1, is the most immediately obvious benefits of the shift to on-demand video lectures from completely live course sections. However, does this increased logistical efficiency come at the expense of pedagogical efficacy? Are students performing at the same technical level and are they being retained at the same rate (at worst) than traditional live sections? Figure 1 also shows that indeed the shift towards an on-demand video lecture Statics course shows no measureable

effect on the number of students withdrawing from the course within the semester, which is a general indicator of overall retention in this course. The qualitative feedback from students taking the course actually showed a significant groundswell of enthusiasm for this type of class with 65% of survey respondents indicating “very strong” support for the course in its new hybridized form.

Conclusion

The usage of existing technical distance engineering education capabilities programs was very useful for instructors and students alike. The ability to pause, rewind, and archive lectures enhanced the learning capabilities of the students, allowing them to watch lectures multiple times in various locations. Additionally, the “attendance optional” model did not significantly affect overall metrics of retention (number of students withdrawing from the class, likely due to poor performance). Lastly, the economy and efficiency of reducing the number of live sections is clearly advantageous to engineering departments in the era of shrinking budgets and reduced

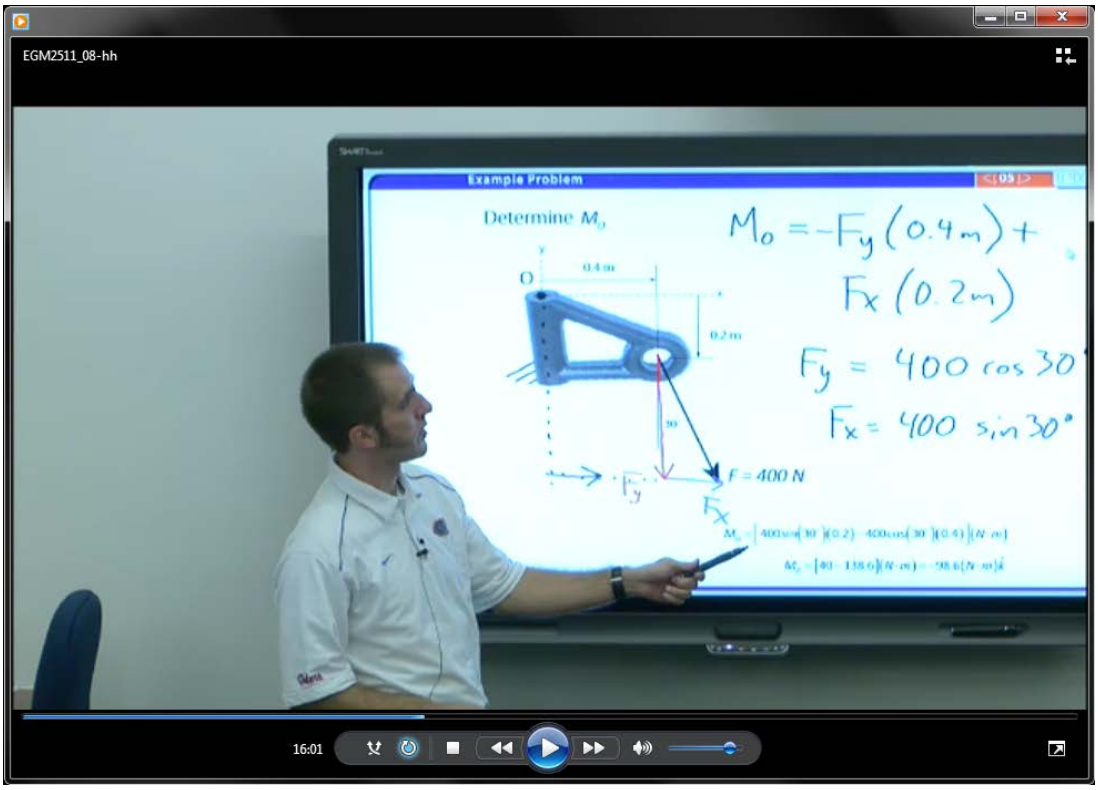

Figure 1. Example of recorded high-definition lecture video delivered on-demand to on-campus students.

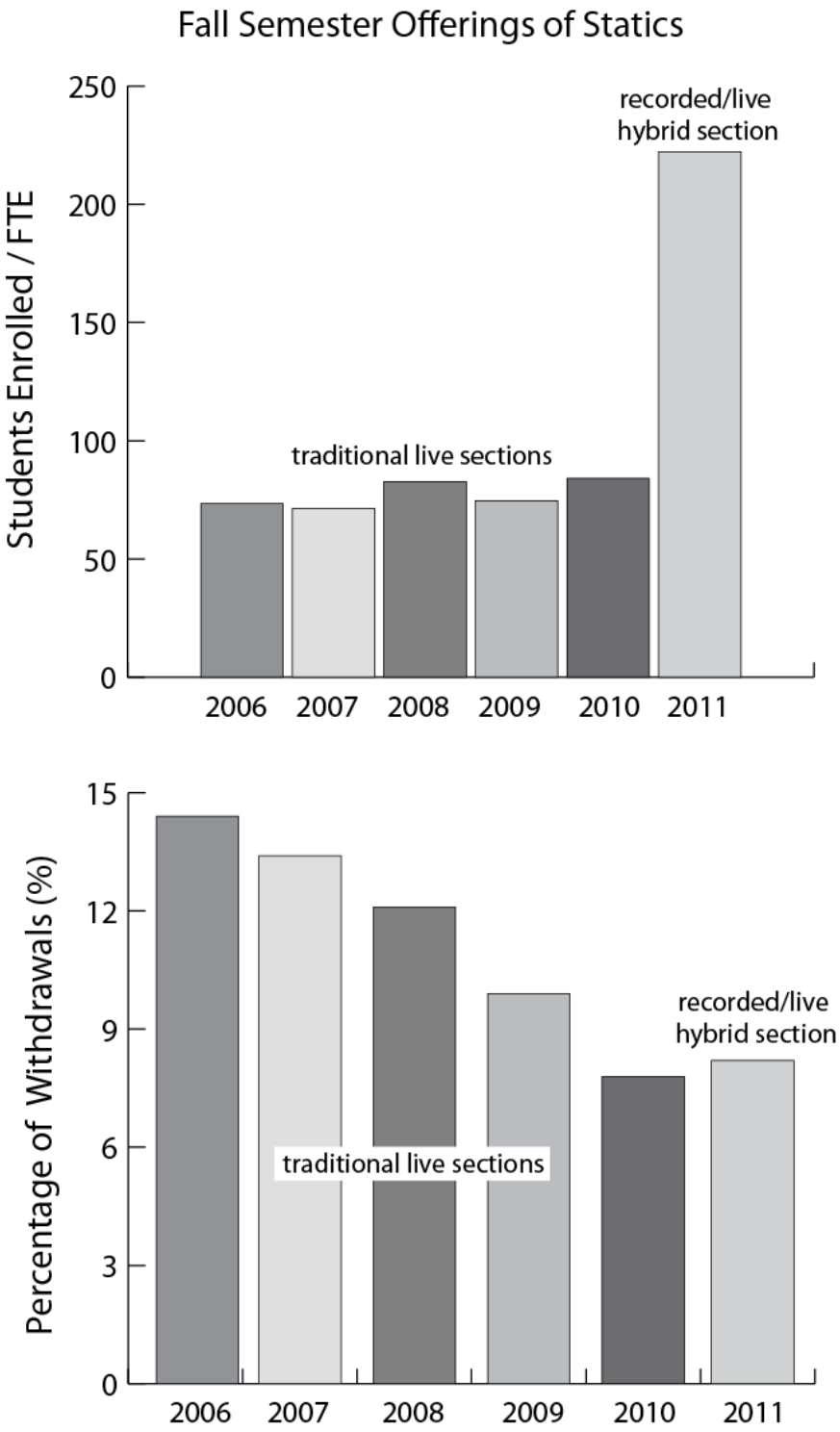

Figure 2. Graph of student enrollment numbers in Engineering Mechanics: Statics normalized by FTE expenditures (faculty and teaching assistants combined) for Fall semesters. The three-fold increase in cost efficiency of reducing the number of live sections from to a single recorded/live hybrid section is evident. The percentage of withdrawals (students dropping the course mid-semester) was not affected by the changing in course delivery and continues an overall improvement trend in Statics.