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On the effectiveness of teaching Optics as a webinar

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Abstract

In response to a move by the State to encourage smaller, more costly programs to explore potential efficiencies due to the improved technology available for distance learning, the Physics departments across the state formed a collaboration in which we could share responsibilities for course delivery across institutions. The idea was that it would be more efficient to have one instructor teach a course to several small classes at multiple institutions, rather than have several instructors teaching the same course to small classes at multiple institutions. No money changed hands between the participating institutions; students registered and paid their tuition locally for the course. Though skeptical, the department chairs across the state agreed to a plan that would begin with teaching an elective course to test the effectiveness of the webinar delivery method. If the webinar delivery format was deemed to provide a reasonably effective learning experience for students, we would then move on to a course that was required in some programs and elective in others. Finally, we would deliver a course that was required in all Physics programs, such as Mechanics.

Optics is a course that is not required in all Physics programs. The course has now been taught twice using the webinar format to students at three institutions simultaneously. Students were polled both times to obtain feedback on their learning experience compared to a traditional classroom delivery. This paper reports on the advantages and disadvantages of the webinar delivery method as revealed by these surveys.

Introduction

Due to pressure from taxpayers to keep tuition increases in check, politicians and university administrators at public institutions have had to become very creative. One way they have cut costs is to simply eliminate small, costly programs at all but the largest institutions. Of course, this limits access to these programs for many place-bound students. An alternative is to exploit the increasing effectiveness of distance learning technology to maintain those programs locally, but with fewer faculty members and therefore lower cost.

The governor initiated a statewide review of programs that included such metrics as the number of majors, the number of graduates, and the cost of each graduate. Minimums were then set, and under such a rubric most Physics programs do not fare well. But since nearly everyone recognizes the economic need to produce more graduates in science, technology, engineering, and math, an alternative to cutting Physics programs entirely was desired. Distance learning technology seemed like a reasonable solution to this dilemma. The governor agreed to relax some of the minimums if institutions across the state would collaborate on the delivery of low-enrollment courses in these small, costly programs, which in the long term would reduce the number of faculty members needed at each institution and thereby reduce the cost to deliver the programs at each institution. Physics department chairs across the state met, and though skeptical that it could be done effectively in Physics, we agreed to try it. We began with offering

an elective course. That went pretty well, so we then offered a course that was required in some programs and elective in others, which is the optics course described in this paper. Finally, the plan was to offer a required core course such as mechanics or quantum mechanics. We have yet to offer a core course.

Any course offered through this collaboration was administered through the sending institution's learning management system (Blackboard, Moodle, etc.). The Registrar at the host institution had to enable the students from the other institutions to have access to that system so they could access the course materials. As part of the administration of the course, there were local faculty members at each participating institution who were assigned to facilitate local logistics. One of their primary tasks was to administer the exams in a proctored environment if desired by the faculty member teaching the course. They also submitted final grades for the local students. One unanticipated challenge was that the semester schedules did not align across all institutions, but that was relatively easy to accommodate.

Course Description

The course discussed here is a typical, upper-level physical optics course that uses the textbook *Optics*, by Eugene Hecht. It covers selected topics in geometrical optics, the Fresnel relations, electromagnetic plane wave theory, Maxwell's Equations, interference, diffraction, and Fourier optics. There is also a design project done in teams as well as a presentation on a contemporary topic in optics by each student.

The primary delivery mode of the traditional course is the lecture because, as is typical of physics courses, it involves a lot of derivations. Students come to class, take notes as fast as they can, ask a few questions along the way, and then go home and work a few problems, some of which involve deriving or proving some result from the lecture. Each offering, a few students comment on student evaluations that the course does not have enough worked example problems during class, that is, it is not applied enough.

When this course was revised for webinar delivery, PowerPoint was the logical way to present the material. So, all the notes had to be put into PowerPoint slides, which was no small task since they mostly involved detailed mathematical derivations. It took three to four hours to prepare the slides for each webinar class period.

The software used to deliver and record the webinars was Adobe Connect. Among its capabilities are screen sharing, chatting, polling, and both audio and video interaction among those in attendance. It also can record each session. Links to the recorded webinars are placed on the class website in the learning management system, which is Moodle at our institution.

This course was offered the first time in the spring of 2012. Three institutions participated, and there were ten students enrolled at each institution. The second offering was in spring of 2014. Again, three institutions participated, two were the same as in 2012 and one was different. Enrollment from the three institutions was twelve, ten, and one.

The instructor went to the classroom to deliver the webinar during each scheduled class period. About half of the locally enrolled students attended the class in person and a few chose to attend live online. About half of the students enrolled from other campuses attended the webinars live online. The remaining students who chose to take the course asynchronously by watching the webinars at their convenience did so for a variety of reasons such as their desire to take another class during the scheduled time for this class or their need to work during that time.

Qualitative Assessment of Webinar Delivery Format

From a pedagogical point of view, there are several advantages to this delivery format. One advantage is that the instructor can make the slides available to the students before class, so they can print them and take notes directly on them during the lecture. Since students do not have to worry about writing down lots of equations, they can focus on following the reasoning. However, the disadvantage of doing this is that because students do not write down the equations, they do not learn as well as they might the proper notation for writing the equations. This shows up in incorrect notation in homework and on exams.

Another advantage is that students can watch the lecture a second time or they can stop, rewind, and listen to a particular section again. A disadvantage for students taking the course asynchronously is that they cannot interact with the instructor or their classmates in real time. One way to mitigate that is with online office hours using the Adobe Connect software. Moodle also has a facility called Big Blue Button, which has the same capabilities as Adobe Connect.

The students also recognized some of these advantages and disadvantages. Surveys were done at about mid semester both times the course was taught. Following is what they revealed.

Question 1 - With respect to the webinar format versus a traditional classroom format – are you finding that your learning is more effective than a traditional classroom, less effective than a traditional classroom, or about the same as a traditional classroom? Why?

Table I. Results for Question 1

	More	**Same**	**Less**
2012	7	9	7
2014	5	6	6

Four of the "less" responses in 2012 and one in 2014 indicated that their learning was only a "little less" effective. Four of the "less" responses in 2012 and three in 2014 indicated that they found it harder to be disciplined and watch the recorded lectures than when they had to go to class. Nonetheless, the conclusion from analyzing the responses to this question is that the webinar delivery was perceived as at least as effective as a traditional classroom by the vast majority of students (69.6% and 64.7%), and more effective by a significant minority (30.4% and 29.4%).

Question 2 – What aspects of this class are going well in your opinion? Why?

The ability to watch lectures and/or access slides online was mentioned by ten students in 2012 and nine in 2014. It was clear that students really found this feature helpful.

Question 3 – What aspects of this class can be improved in your opinion? Why?

Dominant themes were not as clear in the responses to this question. Due to the theoretical nature of the course, a few students thought more worked example problems were needed during class. A few mentioned some technical issues near the beginning in 2012, but these were resolved quickly. A few students did say they felt more distant from the instructor, even those who were coming to the classroom and could ask questions live, because the instructor was stuck at the computer. Some of those making this comment were watching asynchronously and added that they understood that this was the price for the benefit of taking the class asynchronously.

Conclusion

The author has now taught an optics course twice using distance learning technology, specifically, as a webinar. Results from student surveys indicate that about two-thirds of students perceived the webinar is an effective method of course delivery for an upper-level Physics course. Therefore, the model described in this paper for collaboration in course and program delivery across institutions seems to be a reasonable way to cut the costs without reducing access to high cost, low enrollment programs such as Physics.