Role of On-site Facilitation in Delivering Statewide Engineering Education

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Abstract

Engineering instruction at a distance can be enriched through the efforts of an on-site facilitator. Responsibilities of the facilitator include documenting classroom activities, summarizing key points, prompting student questions, coordinating group exercises, consulting on homework problems, and providing real-time feedback to the primary instructor. On-site facilitation requires less effort than offering an independent course and is a tremendous vehicle for faculty development. This model has been successfully used in conjunction with courses in Mechanical and Electrical Engineering at the University of Idaho.

Introduction

In the past two years, industry demand encouraged the University of Idaho to extend much of the capabilities of its engineering college from the main Moscow campus into the Boise area 500 km away. In doing this, industry wanted the university to establish itself quickly but insure consistency in instruction and evaluation at each location.[1,2,3] One of the University of Idaho's strengths has been its individual and small group, face-to-face approach to learning. Unfortunately, completely duplicating this approach for every aspect of the engineering curriculum at a distance was not financially possible. More efficient means of extending the resources of the Moscow campus had to be developed.[4,5,6]

To meet this challenge, the University of Idaho was able to build on its Engineering Video Outreach program which has been in place since 1975. Through this program, the university has offered individualized videotape instruction to nearly 1000 graduate students worldwide. To meet its engineering education responsibilities around the state, the university began to explore interactive ways to extend this video instruction capability to undergraduate students. The first step was to use the existing Public Broadcasting System (PBS) microwave link to simultaneously connect classes in Boise and Moscow. The second step was to install a two-way compressed video system.

Experience soon indicated that teaching a course with a single instructor at one location and students at both locations was less than optimal. While student performance was comparable at both campuses, summative course evaluations were consistently lower at the location without the instructor in residence. Students were especially unhappy with the lack of personal contact, but the university could not afford additional faculty.

A pool of qualified instructors was available at each campus, but the number of required courses out-numbered the faculty resources at the satellite campus. However, faculty members were willing to assist in the delivery of a single course which served both campuses, while someone else assumed the lead instructor role. In this environment, the concept of facilitated instruction appeared appealing--a primary instructor at one location and a facilitator at the other location. Staffing at the satellite campus could be leveraged with faculty from the main campus.

This paper describes the role of an on-site facilitator within the context of a four-part model for distance education: course planning, classroom delivery, course evaluation, and revision. Two video courses, one in Mechanical Engineering and the other in Electrical Engineering, serve as examples.

Course Planning

In designing a distance education course, the fundamental steps are to determine the need, analyze the audience, and establish instructional goals.[6-11] The overall need for engineering instruction in Mechanical and Electrical Engineering to serve the industry in the Boise area was well-established in reports to the State Board of Education and in feedback from college advisory board members.[4,7] Since 1965, Boise State University had offered the first two years in the engineering curriculum. Because of work and family commitments, many of these students were place-bound and could not transfer to another school to complete their degrees. As such, a substantial pool of students existed who were eager to enroll in junior and senior level coursework. These included required courses as well as technical electives.[5,3]

The student audience was somewhat diverse. All had taken the appropriate prerequisites and had received comparable grades, although the vehicles each used revealed the nature of that diversity. Most traditional students in Moscow had recently taken other courses as they were videotaped and felt comfortable with the live videotaping environment. Students in Boise had taken some previous courses from instructors at Boise State University and had watched others on videotape.

An interactive delivery method would be the primary change in format for each group.[6] Moscow students, accustomed to a videotaping environment would be less affected than Boise students. The latter would experience more timely feedback under the new format. Because the example courses rely heavily on student group interaction, building a lively learning community at a distance would be the big challenge. It was hoped that facilitation would catalyze this process.[4]

The Mechanical Engineering course, Kinematics and Dynamics of Machines, was a required junior level course for which a nationally recognized instructor resided on the Moscow campus. Co-author Don Blackketter had spent the last four years developing an innovative textbook around an equation solving software package.[12] Co-author Steve Beyerlein was a specialist in thermal systems and had not previously taught any courses in solid mechanics. However, Dr. Beyerlein had interacted with Dr. Blackketter extensively over the previous three years on ways to incorporate cooperative learning in the classroom and had published about application of these techniques in computer-based classes.[13-15]
Dr. Blackketter, Dr. Beyerlein, and Engineering Video Outreach personnel had a meeting during the semester prior to the course to establish course objectives, formulate a

scheduling request, and to clarify instructor as well as technician roles.[4] The course would stress a structured approach to engineering problem solving, would involve ten hands-on sessions in a computer lab, and would require students to work together in a mini-design/modeling project. Both classes would meet together twice a week in a lecture environment and would meet separately once a week in a computer lab. Twenty-five students were expected on the Moscow campus and ten students were expected at the Boise campus.

The Electrical Engineering curriculum requires the student take three of six introductory senior-level technical electives for technical breadth. The Electrical Engineering course, Power Systems, was one of these electives.[16] In the same manner as the mechanical engineers had done, Dr. Law and Dr. Hess, the electrical engineers, met to discuss course goals and objectives. After an initial structure was agreed upon in person, the balance of the course development was by telephone and FAX. Since this would be the first attempt of it kind, the electrical engineers, to minimize variables, decided upon a team-teaching format with shared responsibility and a traditional lecture format. Because the electrical course had matured before being adapted to the interactive video format, acceptable course content and instructional outlines already existed.[17] Textbooks tended to reinforce this observation with a relative uniformity of topic selection. In the case of the electrical course, a new (fifth) edition of the most popular text was selected.[18] Dr. Law built a syllabus around its excellent presentation and then Dr. Hess reviewed it and provided recommendations for improvement. Eight students enrolled in Boise and four took the course in Moscow.

Classroom Delivery

Developing a close community of scholars between the two locations proved to be a challenge. If a few students already know each other, this helps break the ice, but this is not always the case. Monitors located at the front of the classroom, but focused on students rather than the instructor help tremendously. Showing the students at the other location before class and whenever the local instructor is talking acted to increase student comfort.

In the mechanical course, the first class period was devoted to explaining the context of the class and the roles of student, instructor, and facilitator in distance education. Students were given handouts on strategies for learning at a distance and teaching at a distance. These were part of the series 'Distance Education at a Glance' prepared by Engineering Outreach.[7-11] During the second class period students interviewed another classmate and then introduced their interviewee to both classes.

Some trimming of content was necessary to encourage interaction in the video environment. For both courses some review topics from a prerequisite course along with some advanced topics were deleted without significant loss. For the electrical course, the role of instructor and facilitator alternated with each new chapter of the textbook. When a student asked a question, the instructor normally answered. However, if the facilitator was at the location of the student who asked the question, special care was taken to insure that the facilitator contributed to the answer. For both courses the primary instructor organized and presented the lesson, and the facilitator provided commentary, clarification, and summarization as requested by the primary instructor. The most successful class periods tended to be ones where there was nearly as much dialogue from the facilitator as the instructor.

Unique materials that strengthen a video presentation supplemented both courses. An example was a video tour of a power plant. The document camera enhanced the value of physically small items in a demonstration. These included various mechanisms in the kinematics course and motor details in the power course. Frequently students were asked to present homework solutions on camera and were questioned by their peers at both ends. With computers readily linked to the video monitors, students often opted to share their work in soft-copy form. During lectures the computer was used to animate motion of vector loops in the kinematics course and state variable response in the power course.[18]

Laboratory sessions in the mechanical course were conducted from 'activity sheets' drafted by the primary instructor and refined in email/telephone discussions with the facilitator.[9] A common 'activity sheet' format was used throughout the semester. This consisted of a short explanation why the activity was important, a list of objectives, supporting discussion and computer models, a list of questions about the models, and hands-on exercises. All lab activities were developed around teams of 2-3 students. Students were required to submit written answers, notes, and software print-outs from the laboratory session as part of their grade. Important discoveries and unresolved questions were inventoried and answered during the next lecture period.

In the mechanical course, both instructors provided guidance in the out-of-class mini-design project. At mid-semester, the primary instructor visited Boise for a guest lecture. During this visit, both instructors met with each of the design teams to define expectations and establish the scope of each project. Three weeks before the end of the semester all groups met with both instructors during a video office hour where they presented their hardware prototype and outlined their analytical model. These were then revised based on instructor and student feedback. A final presentation was given by each team during the last week of the semester in lieu of a final exam. All groups were required to submit a poster describing their engineering analysis as well as their prototype. These are kept in a gallery maintained by Dr. Blackketter on the Moscow campus and will be used in future course offerings to illustrate different mechanisms as well as the supporting computer models. Similar strategies enhanced the electrical courses also, including the mid-course visit by Dr. Hess to Moscow and joint guidance and presentation of the course’s small design project.[1]

Course Evaluation and Revision

Common exams were used in both courses. Questions were developed based on interaction between the primary instructor and the facilitator. Exam content and format were established before the class period prior to the exam. Exam guidelines and example problems were then discussed during a common review period. Completed exams were express mailed to the primary instructor and the corrected exams were faxed back to the facilitator before the next class period. In this way, all students had their exam results at the same time, graded by the same instructor. Exam statistics (i.e. mean and standard deviation) were comparable at both locations.

Course evaluation includes midterm feedback as well as the traditional summative evaluation. Much formative evaluation takes place automatically. A remarkable example of this occurred in the electrical course.[19-20] Dr. Hess required the students to present the homework on camera, beginning with his own location. This went smoothly for the first try. With the help of Dr. Law’s selection of a good student for the initial presentation, all went well on the second day. But when the rotation returned to the facilitator's location again on the fourth day, students there had found a way to get the videotapes from the library and all skipped the class rather than present orally on camera. Despite peer pressure, those students would not present orally and the method had to be dropped in favor of an informal question-and-answer format.

As part of the first exam in the mechanical course, students were asked to identify strengths and areas for improvement in three areas: (i) their personal performance as a learner, (ii) the delivery of lectures/activities, and (iii) the format and structure of lab activities. These were summarized and returned to the entire class. In the area of personal performance students cited their preparation by previous engineering science classes and their work ethic as strengths. They felt they needed to improve by spending more time reading the text, documenting their homework solutions, and asking questions in class. In the area of course delivery students cited the enthusiasm of the instructors, the use of working prototypes in demonstrations, and the effectiveness of dual explanations as strengths. They felt improvements could be made in shifting class focus between locations more frequently and in repeating student questions so everyone could hear. Students felt that the lab activities enhanced lecture topics, effectively used cooperative learning to reduce anxiety about new software, and revolved around real engineering systems. However, students at the Boise campus wished that they had the opportunity to examine and dissect the same diversity of prototypes that were available on the Moscow campus. While results of a similar midterm questionnaire in the electrical course were quite similar, students requested a less frequent shift of classroom focus between locations. They strongly applauded the strength and interaction of two instructors, particularly in out-of-class availability.

Summative evaluations in both courses revealed that students at both campuses were equally satisfied in a variety of areas. Average scores for each course at each location are reported below. These are given on a 0-4 point scale where 0 corresponds to strongly disagree and 4 corresponds to strongly agree. These scores are above the average for the College of Engineering the University of Idaho. The scores show the expected higher score for the on-site instruction, particularly for “effective instruction” and instructor preference. However, there are interesting anomalies, particularly on relevance of material, that may be a function of the nontraditional, more experienced student in Boise.

Table 1. Summative Data: Kinematics and Dynamics of Machines

Campus	Moscow (primary site)	Boise (distant site)
Instructor Prepared	3.3	3.2
Informed of Progress	3.0	3.5
Effective Instruction	3.3	3.0
Relevant Material	3.4	3.2
Would Recommend to Others	3.6	3.2

Table 2. Summative Data: Power Systems

Campus	Moscow (distant site)	Boise (primary site)

Instructor Prepared	4.0	3.7
Informed of Progress	3.0	3.4
Effective Instruction	3.5	3.7
Relevant Material	3.8	3.3
Would Recommend to Others	3.5	3.9

Facilitated instruction is an effective way to encourage instructors to learn from one another by spending time together in the classroom. Synchronous on-site facilitation has the advantage of giving credit for two courses during this mentoring process.

Discoveries described in this paper were regularly shared in departmental meetings. They will also be incorporated in future training sessions held by Engineering Video Outreach.

Conclusions

Distance instruction in engineering at the University of Idaho benefits greatly from having an on-site facilitator. The facilitator helps extend university resources, adding personal contact where it is too expensive to offer an independently staffed course.

In this paper, both interactive delivery and traditional lecture formats were found to be successful in a facilitated approach. Careful planning is necessary to simultaneously meet the needs of the students in environments that can be quite different from each other. If the instructor and facilitator are sensitive to the student's needs in planning and in delivery, a strong learning experience can be realized with a wide variety of students, instructors, and locations.

Evaluation shows that the facilitated approach provides the advantages of video instruction (for example, simply having the classes available at the distant site and easy viewing of physically small items.) with the advantages of on-site instruction (for example, immediate feedback and office hours from a local instructor, and more students with whom to interact.) The disadvantages of this approach seem to be mitigated somewhat (for example, minor technical problems can be overcome by the facilitator and overnight mail maintains timely and uniform grading by a single grader). Lack of laboratory facilities and hardware remains a problem. It does appear to be important that the primary instructors personally visit the distant sites once or twice in the semester.

Synchronous on-site facilitation provides an opportunity for instructors to learn from each other by spending time together in the classroom. This expands the pool of qualified instructors at all campus locations.

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