A Distance Education Course with both Lecture and Laboratory Components

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ABSTRACT: *Described are distance education techniques used in a course having both a lecture and a required laboratory component. The third year course, entitled "Analog Network Signal Processing," stresses network theorems and solutions to both time and frequency domain problems. The lecture was delivered live to a group of about 60 Electrical and Computer Engineering Technology students at the West Lafayette campus of Purdue University. Each lecture was videotaped and then loaded onto a web site for asynchronous delivery to students at remote campuses in Kokomo (80km away) and South Bend (170km away). Students could view the lectures at any location with Internet access. The laboratory exercises utilized a combination of simulation using MATLAB, PSPICE, and hardware using an IEEE 488 interfaces. The remote campus students performed laboratory exercises with minimal supervision. Lecture and laboratory assistance was provided by a visit from the instructor prior to each of the three examinations and the final examination. In order to encourage the students to maintain currency with the lectures and course material, graded homework was regularly assigned and weekly quizzes were administered. Both examinations and quizzes were proctored by a remote campus instructor who coordinated activities at that location. The paper discusses results from a survey administered following the course. In addition, challenges encountered during the course and recommendations for those considering distance education with laboratory courses are presented.*

1 INTRODUCTION

Purdue University School of Technology (SOT) in West Lafayette, Indiana, USA, has eight departments offering four-year baccalaureate and two-year associate degrees. In addition, several departments offer degree programs at nine other locations across the State of Indiana through the Statewide Technology (SWT) program. The SWT locations primarily offer two-year associate degree programs. A significant portion of the students at SWT locations are non-traditional aged students who work and support families making a transfer to the West Lafayette location impractical. Traditional aged students choose to attend SWT schools so that they may live with their parents, thereby reducing the cost of their education. Once completing their associate degrees, the majority of the SWT students find local employment, but discover that having only an associate degree severely limits their career growth.

Unfortunately, in many cases there are not enough students at a SWT location desiring a baccalaureate degree to justify hiring additional faculty to provide the degrees. In cases where baccalaureate degrees are granted, the offering of elective courses in the area of specialization is limited by low enrollment. Although distance education offers a way to meet the needs of the baccalaureate SWT students while controlling the cost of adding courses and programs, there are several challenges.

2 DISTANCE EDUCATION IMPLEMENTATION

In the authors' department (Electrical and Computer Engineering Technology - ECET), laboratories are an integral part of student learning and are a component of nearly every course in the curriculum. This poses a challenge to implementing distance courses.

There are many proponents of using simulation as a substitute for laboratory practice; this would ease the burden of offering laboratories in distance education courses. In 2002, ABET, the U.S. engineering accreditation board, held a colloquy on laboratory objectives in the light of emerging distance education courses. ABET defined thirteen laboratory learning objectives for an undergraduate engineering curriculum and defined, "in broad terms, the ***Instructional Laboratory Experience*** as 'personal interaction with equipment/tools leading to the accumulation of knowledge and skills in a practice-oriented profession.'"[1] The ABET objectives allow a single course to use simulation entirely for the laboratory component; and a conventional laboratory course could be used to gain hands-on experience. However, the philosophy of our department and school mirrors that which Gustavsson wrote, "Real experiments are indispensable for developing skill to deal with instrumentation and physical processes. Practical projects provide the framework for a group of students to learn to cope with real world problems."[2] The graduates are technologists and the faculty believe that hands-on laboratories should be part of each technical course

Distance education courses have been offered in the past with some success and the insight gained from those efforts correlate with this experience. In the early attempts, regular lectures were videotaped at the West Lafayette location for student viewing at a later date. Laboratories were performed at the remote location under control of a laboratory technician or instructor. Another solution included offering a course live via television broadcast; this technology was not only expensive, but it was plagued with technical difficulties. Some laboratory exercises were completed locally and, where equipment needed was not available, students travelled to West Lafayette on a Saturday to perform multiple laboratory exercises. [3] More recently this was implemented using Internet cameras between two SWT locations with laboratories performed by local personnel. In cases where laboratories are performed locally, it is still necessary to have faculty or technical support personnel available. This can be difficult in cases where there is no local subject expertise. Where local expertise is available, these personnel also became resources for questions on lecture material adding additional burden on typically busy schedules.

3 SYNCHRONOUS OR ASYNCHRONOUS OFFERING

Synchronous courses are easiest to manage because lectures are offered at a specific time and all participants are studying the current topic. However, asynchronous courses better meet the scheduling needs of our working clientele. Distance courses seem to work quite successfully for graduate courses aimed at working students. These students typically only take one or two courses at a time allowing them to focus on a particular subject. Unfortunately, with full-time undergraduate students, past experience tells us that self directed study often gets postponed until just before examinations; often this is too late.

For this reason, this distance learning experience used can be considered a "pseudo-asynchronous" distance model. Lectures are delivered via the Internet for viewing anytime at a computer on campus or at home. Each week there is a graded homework assignment and a scheduled quiz to assess the lecture material of the previous week. The short quiz meeting (typically 30 minutes) facilitates course administration such as homework and laboratory submission. By maintaining the course pace students are forced to keep up with the current topic. Because of this, the instructor need not handle student queries from multiple topics on the syllabus. Furthermore, having all the assignments submitted simultaneously facilitates consistent grading. Aleksic-Maslac and Jeren apply this method effectively in their asynchronous distance learning (ADL) model where students are given weekly laboratory assignments. "The exercise is accompanied by a test which the students have to fill in and return to the lecturer. Based on these results from the laboratory, it can be decided whether or not a student has understood a certain problem."[4]

4 COURSE DESIGN

ECET 307 is a third year course, entitled "Analog Network Signal Processing." The course stresses network theorems and solutions to both time and frequency domain problems. Topics include both passive and active filters.

In the fall of 2003, the lecture was delivered live to a group of about 60 Electrical and Computer Engineering Technology students at the West Lafayette campus of Purdue University. Each lecture was videotaped, digitized and then loaded onto a web site for asynchronous viewing. The SWT locations at Kokomo (80km away) and South Bend (170km away) had nine students and one student enrolled, respectively. Laboratory exercises utilized a combination of simulation using MATLAB, PSPICE, and hardware using an IEEE 488 interface. The remote campus students performed these exercises at their local campus laboratory with minimal supervision.

Following the "pseudo-asynchronous" model, weekly quizzes were administered by a local proctor and graded homework was assigned. One component that contributed to the course success was the fact that the instructor met with the students at Kokomo prior to each of the three examinations and the final examination. These sessions, called "Super Saturdays," allowed students to address problems in performing the laboratory exercises as well as questions regarding the next examination. These sessions were also attended by a few of the West Lafayette students. Because of the challenges of unsupervised laboratory exercises, deadlines for submission of laboratory reports were not as strict as those who attended supervised sessions at West Lafayette.

5 RESULTS

One student in Kokomo and the only student in South Bend withdrew from the course. The eight Kokomo students completing the course were surveyed to assess ways to improve future distance offerings. The final grade average was a 2.375 on a four point scale; there were two failing grades which is comparable to the grade distribution at West Lafayette.

The group was enrolled in 12 to 17 credit hours. Students said they worked an average of 4.63 hours on this class, not including laboratory or lecture viewing time. Since there are three lecture hours per week, that would be slightly above 1.5 hours of study outside class for each hour of lecture; a normal rate. More than half said they spent five or more hours per week on laboratory exercises. This is comparable to the West Lafayette campus where laboratory sections meet three hours per week in addition to time spent performing pre- and post-laboratory analysis. Five of the eight respondents used a dial-up Internet connection at home; the remaining three had high speed Internet access at home. Interestingly, three-quarters of the students viewed lectures at home indicating that some were using dial-up modems for lecture viewing.

Figures 1-10 show responses from selected questions posed to the distance students using a five-point Likert scale. Due to the limited number of respondents, the data was taken and tabulated by a third party to ensure anonymity for accurate responses. The students felt that the instructor was effective; however, they rated the course and laboratory low. This is typical of evaluations in most courses in our department. All but one student rated the Super Saturday sessions as helpful. Most likely this was the student who had a work conflict on the scheduled Saturdays. It is anticipated that this could be improved by announcing the Saturday schedule prior to the course offering. Student assessment of the video quality was neither positive nor negative. There were some video quality issues at the beginning of the course, but the instructor soon discovered that increasing the font size and using bold print on prepared lecture slides improved the quality. In addition, the students learned how to size the PC display window so that they could view both the lecture and pre-printed notes.

Students' opinions were mixed on whether firm deadlines on homework assignments helped them keep on schedule. There was a slight indication that they felt the work load was higher than normal, but that is typical of any course. Although they indicated that the instructor was available, they felt that they needed additional support in the laboratory exercises. This problem was exacerbated by a laboratory manual that was written for use with different measurement instruments. Finally, only one student responded that they would be likely to take another distance course while five indicated a preference for a traditional lecture course saying that they would be unlikely to take another distance course.

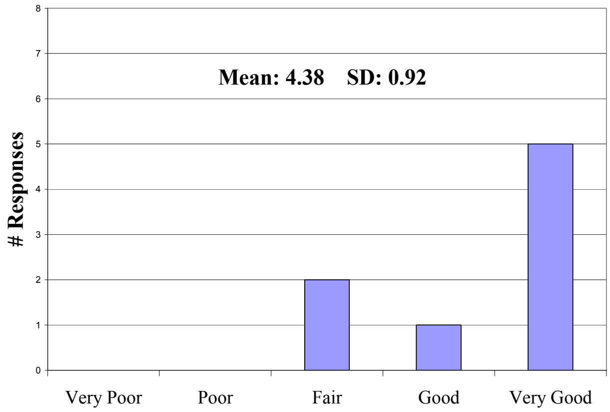

Figure 1 – Student rating of instructor's effectiveness

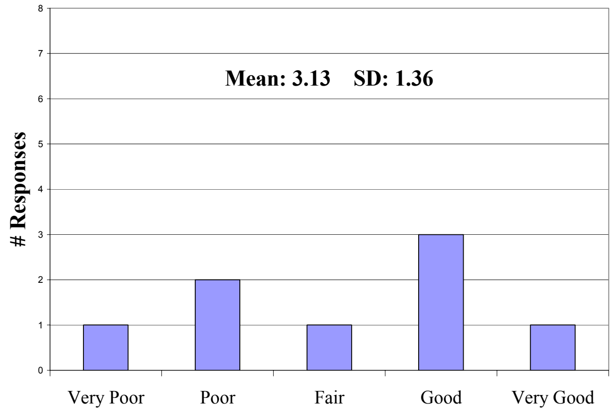

Figure 2 – Student rating of course quality

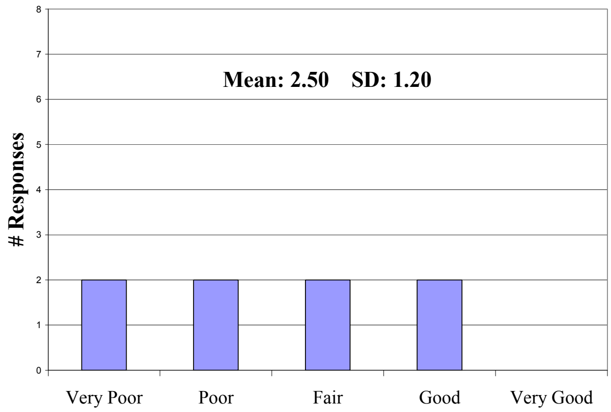

Figure 3 – Student rating of laboratory quality

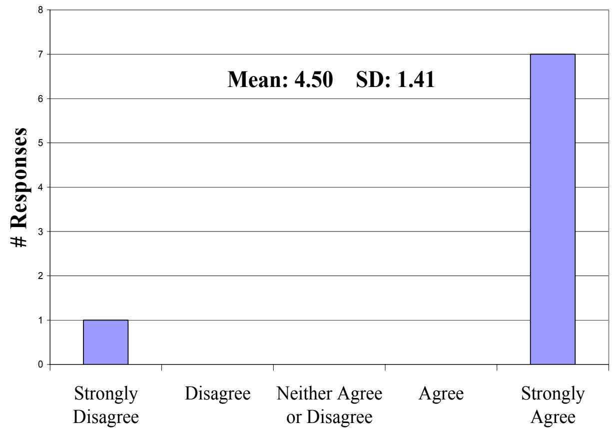

Figure 4 – Student rating of Saturday laboratory sessions

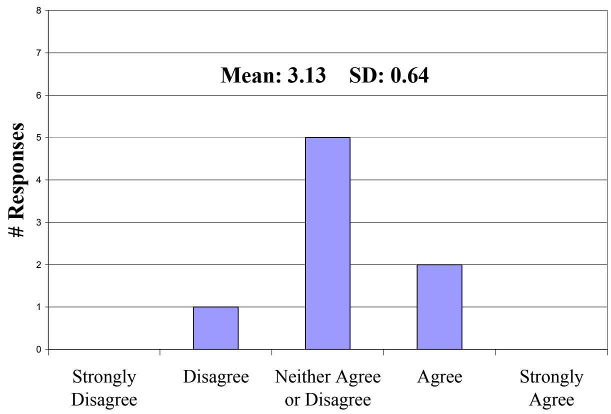

Figure 5 – Sufficiency of digitized video quality

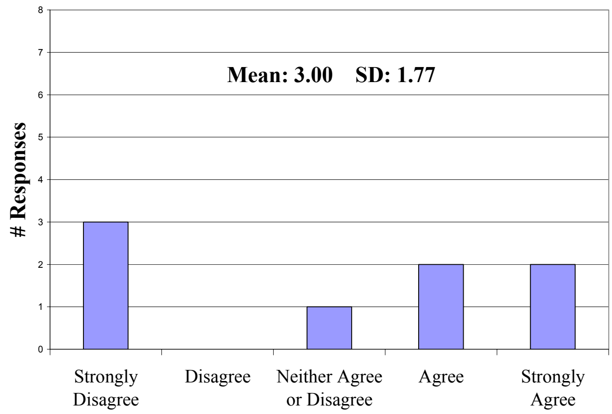

Figure 6 – Student opinion that deadlines helped keep them current

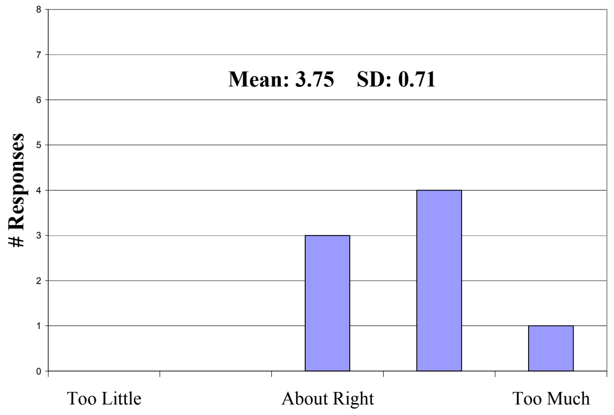

Figure 7 – Student assessment of course workload

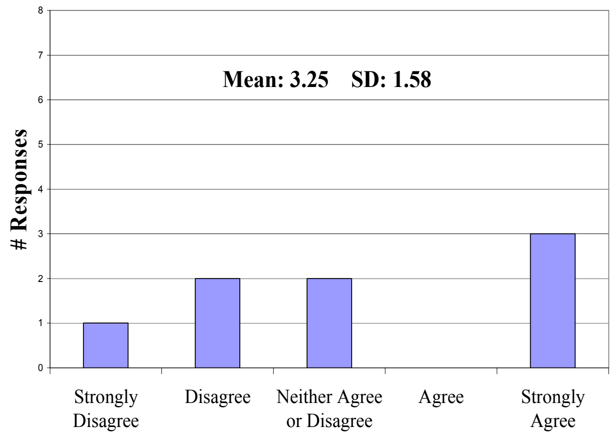

Figure 8 – Student assessment of instructor availability

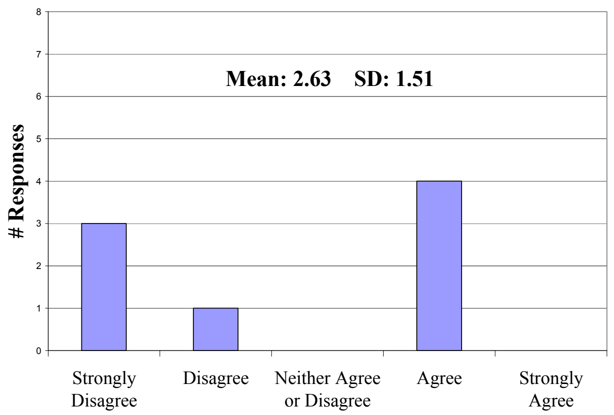

Figure 9 – Student assessment of laboratory support

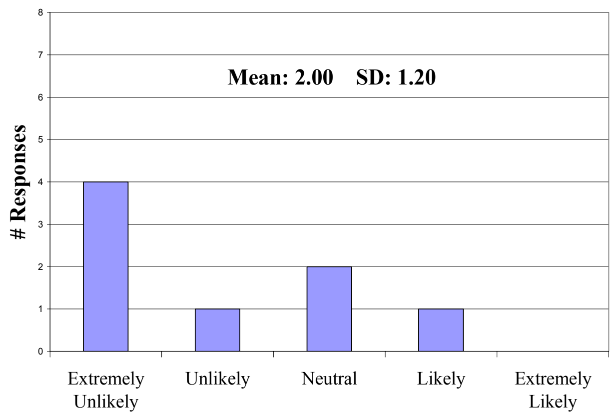

Figure 10 – Likelihood that student will take another distance course

6 RECOMMENDATIONS

With each distance course offering, methods and ways to improve upon the methodology are discovered. Here are some recommendations to those embarking on a distance course offering based on these experiences:

- Let the students know early that they will be taking a distance course. In this case, the decision to offer the course as a distance course was made after students had registered; many were displeased with that change.
- Prepare guidelines for the students on the expectations and requirements that the course instructor has for their participation in the course from a distance learning perspective.
- Plan your course schedule/syllabus with minimal deviations.
- Keep the students current with the lecture. This was encouraged using regular quizzes and graded homework using the pseudo-asynchronous model.
- Where laboratories are involved, try to have identical equipment at all locations. Prepare the laboratory material to anticipate frequently encountered problems and questions. Where different equipment must be used, verify and/or modify the assigned experiments form compatibility.
- Make firm deadlines, but be prepared to be flexible when things go wrong.
- Decide upon role of the lecturing and remote instructors and staff. Who will perform grading? Who will proctor examinations? Who will copy and mail the materials? In some case, who will pay for copying?
- The students must build a rapport with the lecture instructor. Unless a remote instructor has the course as part of their teaching load, they should avoid providing excessive help to students.

Supporting a distance course can easily become overwhelming to the remote location instructor because students will rely on that instructor rather than the lecturing instructor.

- Plan, plan, plan. Check schedules at all locations. Find out when classes begin and end; check holiday schedules at all locations.
- Set up a discussion board or some simple method for the instructor and students to communicate. We initially had a toll-free telephone available for evening office hours of the lecture instructor. No one utilized it and it was discontinued after a few weeks. Basma and Kallas describe using "e-office hours." During specified times the lecturing instructor was available to answer email questions submitted by the students. [5]
- Communication between student and off-site instructor for lecture and laboratory questions is essential and needs to be addressed. This is a technology problem, whether video conferencing, PC cameras or other means are used.
- Informal discussions with the students indicated that laboratory deadlines that were firm, but not weekly, was beneficial. A deadline, such as having the first 3 labs due at the beginning of the 4th week was deemed as beneficial from the students' point of view.

7 CONCLUSIONS

Distance education has evolved significantly over that past several years with faster and readily available access to the Internet. Quality has improved as experience is gained with distance education methods. Courses which include laboratory sessions present a distinct challenge to distance offerings. The course was offered using a so-called "pseudo-asynchronous" model in order to keep the undergraduate students, who are more accustomed to traditional lecture courses, current with the lecture material. Laboratories were performed with minimal supervision, but augmented by regular Super Saturday sessions where the instructor was available for help. It is believed that both these components contributed to the success of the course.

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