Comparing Traditional with Web-based Learning

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Abstract

We taught a graduate level distance-learning course in the winter 2001 semester. This asynchronous course had several synchronous online interactions between instructor and students. On-line, the topics are divided into slide presentations with vocal commentary produced by the instructor using Real Media software. Each session lasted between ten and fifteen minutes in length with the scripted voice and images merged into one visual display.

Assessment of the course entails student surveys and grades. The surveys used HTML forms. Grades for this course were compared with historical grades of students taking earlier versions of the same course in the traditional manner.

The survey showed that the students were satisfied with the tools, technology and system performance of the presentation system. The students were also satisfied with the course, but less than 20% of the respondents were unsure that they would take another web-course. Grades were compared for the 3 exams given either throughout the course's historical record with traditional students (last 3 years) or the current crop of online students.

In all cases the grades spanned the same range, and tests of significance failed (not significantly different). The good news is that students respond positively and they can be expected to do as well using the web as in traditional settings.

Introduction

The interactive capability of the World Wide Web and its ability to house and distribute course content improves the learning options available to students. Learners have the option to log into lecture and obtain notes without physically being present.

The look and feel of the classroom is changing. The web appeals to the student's visual and interactive learning mode. It provides flexibility in learning times, either synchronous or asynchronous. And it enables collaboration and access hitherto unavailable.

This has facilitated implementation, growth and increase in usage of online courses. Distance learning is a booming market. In 1998, there were 1.6 million students taking more than 54,000 courses online(1), more than double the number of distance learners recorded in 1995.

This paper relates our experience in a graduate level quasi-asynchronous course called Systems Modeling. This course was also offered over the Web, and we additionally had students from the University of Puerto Rico-Mayaguez. This course was offered asynchronously and exclusively on the web in the winter semester 2001 (2). The course, of course, was not strictly asynchronous since students were brought together at various times for feedback to the instructor and for examinations. This assured that students stayed within the schedule of the course, which encompassed one standard semester.

The explosion of interest in what is variously called distance learning, asynchronous learning, and web learning, parenthetically not quite synonymous but largely sharing the same technology, is evident for the over 180 posters and presentation at the 2001 ASEE conference. Of course entire conferences, publications and even organizations underscore the high interest in this area. We have been concerned about the paucity of actual performance metrics. Is this technology-based teaching better, worse or the same as traditional methods. By traditional, we mean of course, the lecturer model of instruction.

Here we contrast student performance by means of exam grades. The exam grades were those obtained from the historical record of traditional instruction and those obtained from the class taking the course in the distance education mode. We also obtained student feedback evaluation of the course, it's technology and value to the students. The bottom line is that there was no difference in student performance, and the students were satisfied with the straightforward technology that we used

Methods

The course covered computer network performance using Markovian modeling systems at the graduate level. The prerequisite was a standard senior-level course in probability and statistics, but the course provided substantial review in this area.

Lectures were broken up into lecturelets lasting from 10 to 40 minutes. Each lecturelet was called a presentation and consisted of a self-contained topic in the course. Each presentation was in the form of PowerPoint slides with voice over. We show below examples of the first slide of two presentations, Poisson Distribution and Markov Random Processes and Markov Chains.

Since we created our own means of distributing content, our approach was as follows. We first developed the presentation and placed it into PowerPoint. Next we used Real Presenter from Real networks to provide voice over for each PowerPoint slide in the presentation. Each presentation was a single real media file with streaming audio and power point slides

Students could download the presentation either on a high speed or telephone line and were provided access to the Real Player web site to download the player. Furthermore, the presentations were placed in various downloadable formats for the students to print out. Problems provided for each lecturelet examined the student's mastery of the subject.
The course web site provided access to all the presentations, scheduling of the presentations, problem exercises, and examinations. The web site also contained an email archive and other features expected of a web site course. The course web site is http://lion.cecs.missouri.edu/~tyrer/cecs482/index02.html

Poisson Distribution

Derivation of the Poisson distribution from the binomial distribution.
Plots of the Poisson distribution
Comparison to binomial distribution

Markov Random Processes and Markov Chains

Random Processes
Stochastic modeling
Independent increments
Markov Processes
Discrete Time Markov Chain
One - Step and N-step Transitions
Chapman Kolmogorov Equation: proof and use
Example of a two state Chain

Examinations
Three examinations were given to the students; two one-hour exams and one final exam. It was observed that the content of these examinations was very similar to the corresponding examinations given to the traditional students in the previous incarnations of this class.

To assess student performance of the line course compared to the traditional course we did the following. Corresponding exam grades for the traditional class were pooled together, these grades compared to the on line course exam grades, and histograms allowed comparisons as follows. For each exam, all of the traditional grades obtained in the previous 3 semesters were placed into a histogram, and similarly for the corresponding exam in the on line course. These grades were then normalized and the difference between the cumulative normalized histogram of the traditional exam was taken from the values obtained for the asynchronous class. Also for each exam, the data from the traditional class was compared to that of the asynchronous class using a t test analysis as well as the Kolmogorov Smirnoff (KS) test of significance (3).

Student Assessment of the Course

To obtain an assessment by the students for the course, we provided on the web site a questionnaire which students were asked to fill out. The students were assured that the questionnaire was anonymous and that no effort was made to associate the students' questionnaire response with the student. The data were collected and reduced by someone other than the instructor. The university Institutional Review Board approved this use of human subjects.

Results

One of the motivations for this undertaking is to resolve the following two issues: How does web-based, or asynchronous, learning methodology compare to more traditional means? What constitutes adequacy in providing web-based learning?

Examinations

To answer the first question, we compared test results from this graduate course taught in an asynchronous learning mode to the historical record of traditionally based teaching for the same course. Much to our surprise, for the metrics we examined, there was no difference in student performance whether taught in an asynchronous mode or the traditional mode. We demonstrate this in three ways. First by examining the range of grades, second by providing a comparison of the histograms, and third by using two independent objective metrics to assess significance.

The ranges of the exam grades were substantially the same, as shown in Table 1. In all exams, the highest grade was the same. In Exam 1, and in the final exam, the lowest grade was experienced by the traditional students, whereas the reverse was true for exam 2. We point out that the final exam had a maximum score of 200 reflecting its rate compared to the other two hourly exams with a maximum score of 100. However, the number of student grades in the low end of the range was extremely small.

TABLE 1

	Asynchronous	Traditional
Exam 1	55-100	40-100
Exam2	40-100	47-100
Final Exam	125-200	100-200

TABLE 1 Compares exams taken by the asynchronously taught class to the historical record of the exams for the same course taught in the traditional manner.

We compare the asynchronous course to the traditional course by looking at a normalized histogram of each exam. We form the cumulative distribution and show the difference in Figures 1, 2 and 3, corresponding to Exams 1, 2 and the final. In each of the three figures, the difference curve is obtained by subtracting the traditional from the asynchronous curve. Hence the negative appearance of the difference would indicate that traditional students perform better than those taking the course in an asynchronous mode, or by web-based learning. We note that in Exam 1 (Figure 1), the difference curve is predominately negative, whereas for Exam 2 (Figure2), the difference curve is predominately positive, and in the final exam, the curve forms a sigmoid shape crossing through zero – showing both positive and negative values.

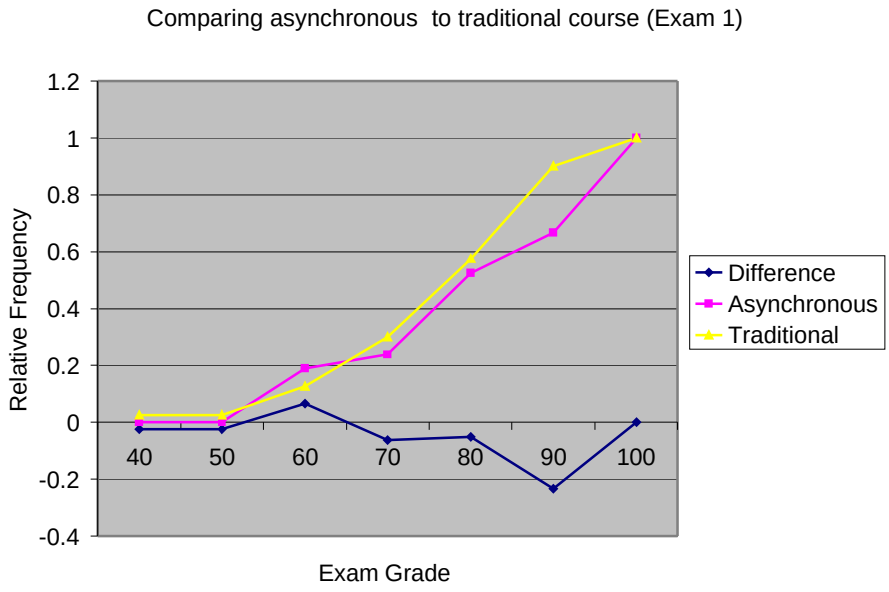

FIGURE 1 The normalized cumulative distributions of the grades for exam 1 obtained by students taking the course asynchronously and the historical grades from those taking the course in the traditional manner. The difference curve subtracts the values of the traditional from the asynchronous curve.

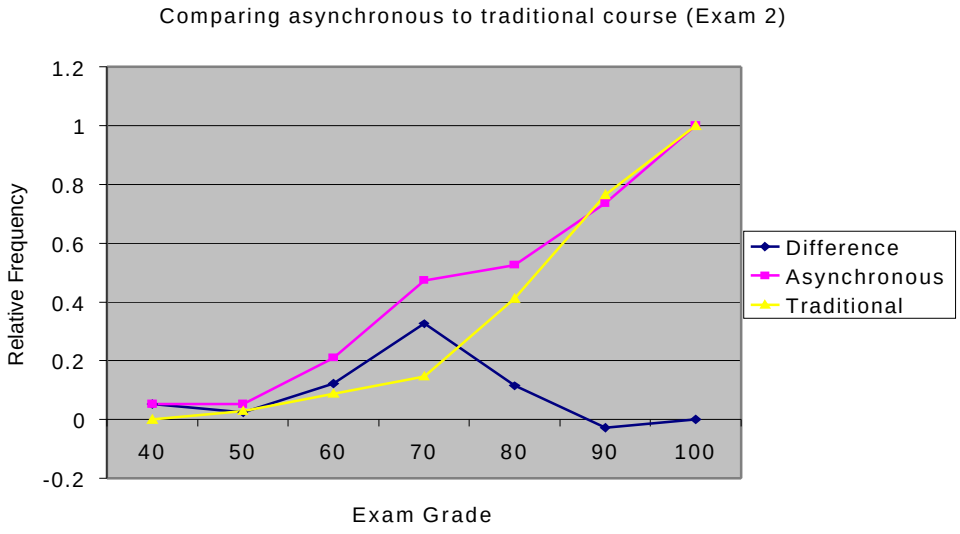

FIGURE 2 The normalized cumulative distributions of the grades for exam 2 obtained by students taking the course asynchronously and the historical grades from those taking the course in the traditional manner. The difference curve subtracts the values of the traditional from the asynchronous curve.

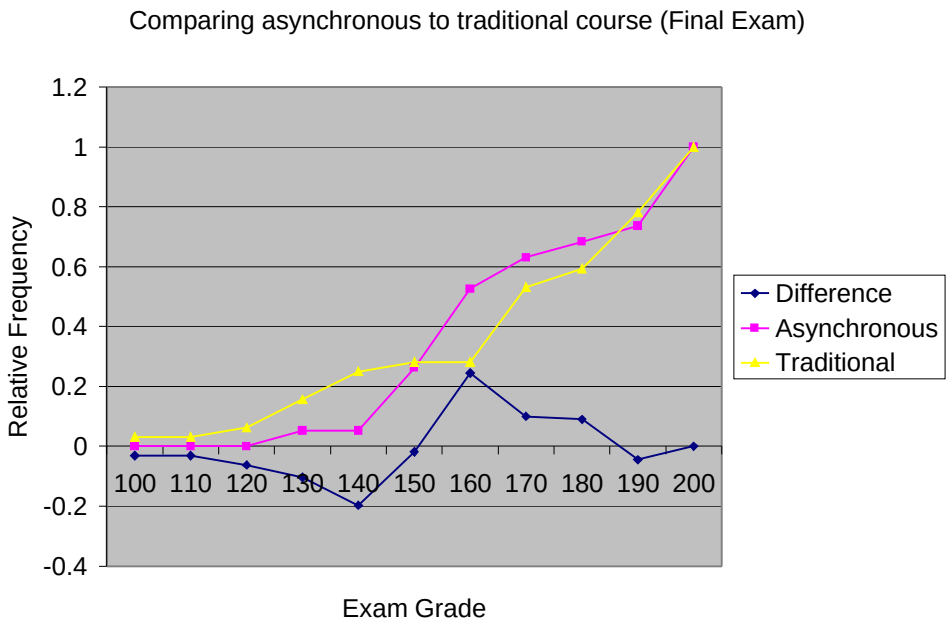

FIGURE 3 The normalized cumulative distributions of the grades for the final exam obtained by students taking the course asynchronously and the historical grades from those taking the course in the traditional manner. The difference curve subtracts the values of the traditional from the asynchronous curve.

In the traditional course, the number of grades ranged from 40 to 32, whereas in the asynchronous the number ranged from 21 to 19. These numbers were sufficient to provide a useful comparison of the histograms to determine the absence of a significant difference. We determined that there was no significant difference using both a t test and the Kolmogorov Smirnoff (KS) test of significance. (Calculations not shown).

Student Assessment of the Course

In order to determine the value of the course to the students, we provided a web-based form that the students could anonymously fill in. After the questionnaire responses were in, we subdivided the questions into four areas, technology and tools, presentation effectiveness, student needs, and communications and learning.

In the technology and tools area, the students all agreed that the overall technology is adequate, the course was useful, and that the web was not useless. Furthermore, in the methodology for the presentations with the audio comments, the students also agreed that the presentations helped in learning as did the audio comments. Thus we feel that this approach is correct and useful for the students.

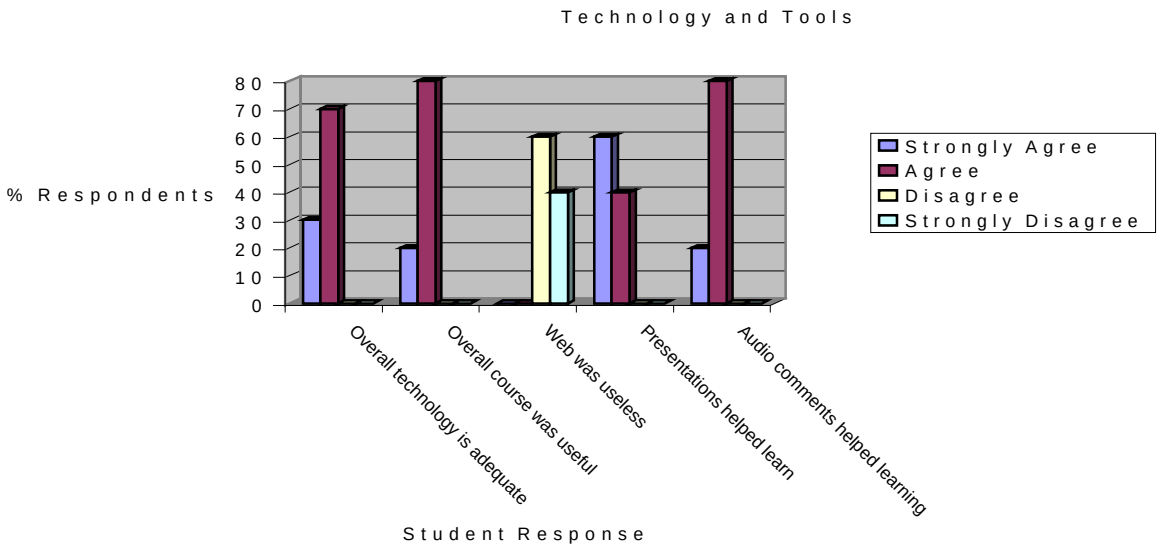

FIGURE 4 Student responses to technology and tools questions.

In terms of the presentation effectiveness, again we had either strongly agree or agree responses: The slides are clear and legible, the presentations are of appropriate duration, they were effective, the voice was clear and the site loaded in moderation.

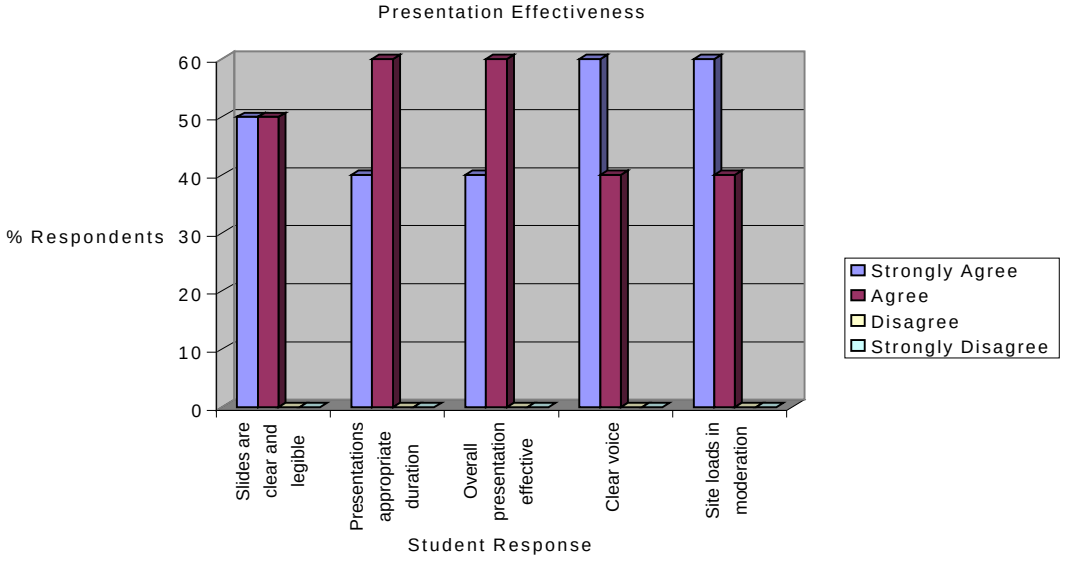

FIGURE 5 Student responses to presentation effectiveness questions.

For meeting the student needs, there was some disagreement. First, the course met student needs, and presentation reviews helped the students to learn. Interestingly, a small fraction of the class would not take another course on line.

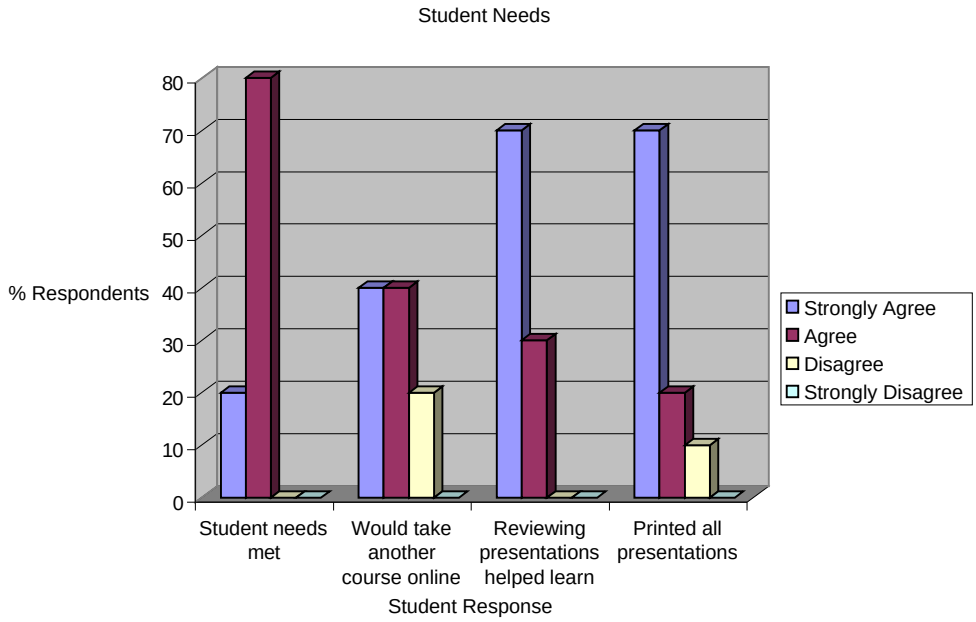

FIGURE 6 Student responses to questions on the course satisfying student needs.

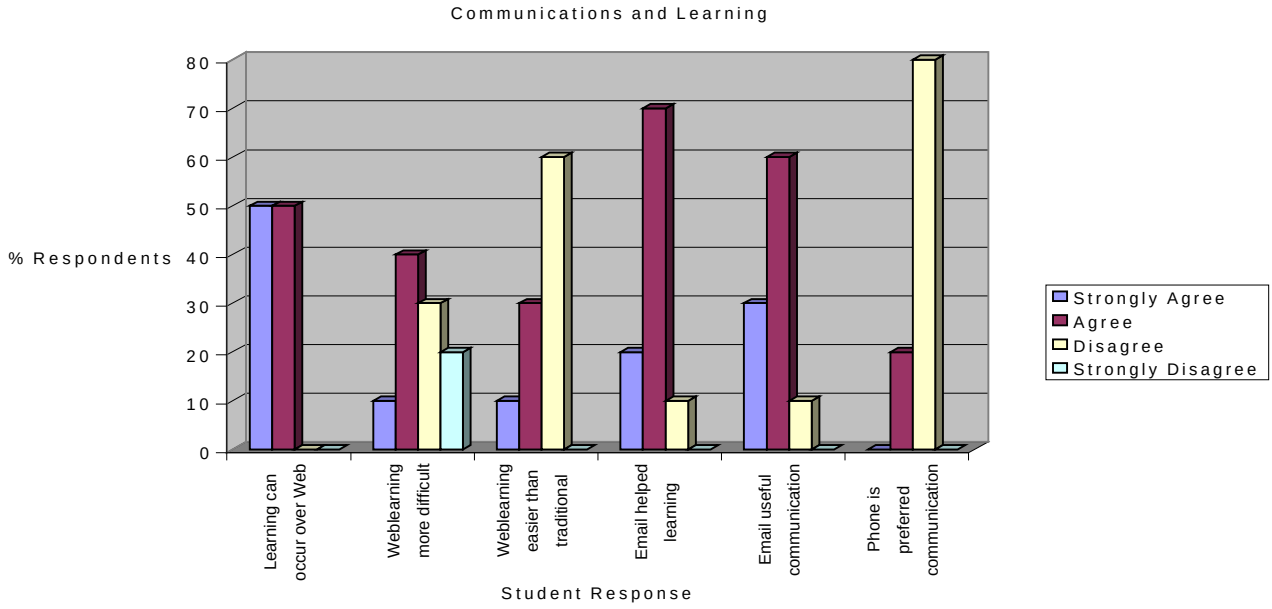

FIGURE 7 Student responses to questions dealing with communications and learning.

Finally, in communications and learning, the students agreed that learning could occur over the web. However, the class was split in agreeing that web learning is more difficult when compared to traditional learning. Furthermore, there was some concern that students found web learning more difficult than traditional learning. Anecdotally the students expressed the feeling that an online course is more difficult course than a traditional course. Finally, the primary mode of communication is email and by students' actions as well as response to this questionnaire, it is clear that students have a higher preference of email over the telephone.

Discussion

Originally there was no intention to compare the grades of the historical traditionally taught classes with the asynchronous classes. The expectation was that a meaningful control of the multiplicity of variables in the historical data could not be obtained. So that comparing historical data in a course to a particular course is problematic. After all, the course could be easier, the exams easier, the students better prepared, etc.

However, controlling the variables becomes seriously important when there is an improvement that is demonstrated and one wishes to isolate and find out the source of that improvement. In this case, we saw no difference in the performance between the asynchronous students and the traditional students. Had the data indicated that students perform better one way or the other, the absence of controls would have obfuscated the causes for improvement.

In this study the statistical variation inherent in the traditional data certainly encompasses the data obtained from the on line students. What this study demonstrates is that students can do as well on line as they can in a traditional setting. It will take careful controls to assess that specific proposed changes will improve the learning of students.

We should note that we did actively strive to get away from the talking head modality so common in these kinds of systems. The response from the students seemed to indicate that written comments in the presentations along with an audio explication are more than adequate for the needs of these students. It is worth recalling that this was a graduate course with graduate students who would all be expected to perform well.

Students' response to the difficulty in web learning and their equivocal desire to take another course on line reaffirms the difference in learning styles as an important contributor to the development of students. These data seem to indicate that in spite of some education critic's best hopes, traditional learning will not go away. Furthermore, it also says that on line study opportunities are useful for students. It seems clear that both traditional and on line resources available in the same class will be substantially beneficial, particularly in large classes. This will also assist students whom by virtue of work and other pressures cannot fully participate in the traditional learning environment.

Our original hope had been to set up real time systems to respond to student queries. The reality is that students have very little use for such systems. Furthermore, anecdotally, on line courses that try to force students to interact, require substantial effort from the teacher to make such

interaction an important aspect of the course. Much to our surprise, there was no “natural” student interaction. For the most part, the student questions were emailed to the instructor (or the TA) and these were posted in an email archive for the benefit of everyone. By far, email was the most important communication interface in this course.

There seems to be agreement in the literature that developing the material is a time consuming task. On average, the preparation per presentation yielded a ratio of approximately 10:1 – ten hours for the thorough preparation of one presentation. Developing the material is a time consuming task. Course-authoring systems (which we did not have, we in effect "rolled" our own) have a steep learning curve and can be time consuming even to the cognoscenti. As with any initial effort, when developing multimedia courses we predict a steep learning curve.

Researchers who have tried similar approaches warn that technology may not work when needed, and bandwidth intensive media may be unattainable for students resulting in slow access to the Internet (4). The technology may not work and bandwidth intensive media may be unattainable. So problems remain. Nevertheless, the presentations for this course are loaded locally on a server for faster access and students are provided with links to the presentations for both high and low bandwidth. This appeared satisfactory.

Technology should not be viewed as an end in itself but as a means toward reaching educational goals. The combination of traditional and online learning will facilitate reaching a wider audience - since those unable to attend all lectures need not be excluded, and will improve resource access to the traditional students. Of course this improved efficiency is done at the cost of more effort increasing content and in organizing the course.

References

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