Asynchronous Learning in the Small Engineering Classroom

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Abstract

Two small enrollment engineering courses have been taught using the methodology of the Asynchronous Learning Environment, in which computer networking and conferencing capabilities are used to make student-instructor and student-student interaction more immediate. Included in the effort was the creation of all-electronic assignments, where homework posting, execution, reporting, submission, grading, and return were done with personal computers over the network.

Asynchronous communication is clearly successful in extending office hours, which is especially important for freshmen. However, since the classes were small, critical mass could not be routinely achieved to facilitate intensive interchanges among students and instructors. Instead, it was found that asynchronous technology facilitated groups through exchange of materials as they completed their work and assembled their reports. Homework assignments can be done more efficiently in all-electronic format, provided file size and complexity are not great. Similarly grading of these assignments is easier electronically until monitor screen size curtails the grader's ability to scan the documents.

Introduction

Two engineering courses at the University of Illinois at Urbana-Champaign (UIUC) were taught utilizing Asynchronous Learning technology in order to facilitate interaction among students and instructors. One is a senior electrical engineering and bioengineering elective entitled Modeling of Biological Systems, with an enrollment of 25, in which the conferencing package First Class was used. The other is a freshman elective Introduction to Bioengineering: Focus on Medical Imaging, with an enrollment of 10 for which PacerForum provided conferencing capability.

In both courses students were encouraged to use conferencing software for the discussion of all matters relating to the course. The courses shared a common approach to homework in which a number of computer based exercises were completed, written up, and submitted using a personal computer without the need for hard copy. In both courses students used conferencing software to help them write and edit group term

papers.

All-Electronic Homework

Most students worked at UIUC public computer sites, where all the required software was available. Ambitious students were able to work from their dormitory rooms or apartments via modem or ethernet connection.

The Freshman Imaging Course:

<u>**Description of Exercises**</u>

Freshmen in the Medical Imaging course completed four homework exercises using the software package NIH Image, which is available in the public domain, but which runs on Macintosh platforms only. The first exercise asked students to become familiar with the basics of the package, including loading, enhancing, labeling, and storing images. Subsequent exercises on X-ray, computed tomography, and magnetic resonance imaging required students to inspect images, label anatomical parts, contrast modalities, and to diagnose disease states.

Reports were written using Microsoft Word. Images were reproduced in the lab report document by either insertion of image files or screen images acquired with the utility FlashIt. The reports were submitted to the instructor using PacerForum. Instructors downloaded the student reports electronically, edited and graded them, and returned them to students via PacerForum. In many cases the reports were never printed.

<u>*Evaluation: Successful Adaptation*</u>

It was assumed that freshman would complete the exercises at a single setting by having multiple open windows at any given time. In practice students took several sessions to complete the exercises and had difficulties due to both their inexperience and computer memory limitations which slowed their progress. Whereas the computer difficulties were a source of frustration at the beginning of the semester, by the end of the semester students appreciated the ease with which they could complete and submit their work.

Instructors found the electronic forum to be a great advantage. Last minute additions and corrections to the homework could be distributed instantly using PacerForum. Reports could be collected and returned easily. Advantages in electronic grading and editing included the use of color and other highlighting effects to emphasize both strengths and weaknesses. Comments relevant to several students were easily copied and inserted. Relevant characteristics of the reports include brevity (at most four pages, including images) and standard presentation format, which made grading and commenting relatively easy.

The Senior Modeling Course:

<u>**Description of Exercises**</u>

A similar strategy was pursued in the senior engineering course on Modeling of Biological Systems. Course materials were available using browser software over the World Wide Web. The computer exercises relied on Matlab, which was made available on both Macintosh and Windows platforms, as well as on Unix workstations. The conferencing software package FirstClass was also available on Macintosh and

Windows platforms, but not on the Unix machines. By encouraging the use of Microsoft Word 6.0, the course largely achieved platform independence.

There were eight computer exercises over the course of the term. A typical exercise required students to utilize Matlab functions to simulate or analyze a biological system. Usually the output consisted of graphs which were incorporated into reports. The homework topics included the Hodgkin-Huxley model of the nerve cell membrane, the linear systems model of the vestibulo-ocular reflex, the control system model of the pupil, and a pattern recognition problem using both classical and neural network techniques. A more complete description is available (Wheeler, 1993).

Students completed homework exercises in teams of two, three or four. As in the freshman course, they submitted their work electronically, and instructors graded and returned the work electronically.

Evaluation: Long Reports are a Mixed Blessing

Most students rapidly adapted to the method of constructing and submitting the homework reports, although a small minority had continuing difficulties manipulating Matlab graph images. Students often made use of FirstClass as a means for storing files while they integrated and edited their individual assignments into a team report. This was convenient electronically and reduced the number of face-to-face meetings needed to accomplish the same ends.

As the exercises and reports became more complex, it was found that the advantages of the all-electronic format became equivocal. Often more time was involved in electronic cutting and pasting than in the old-fashioned method. Graphs and figures are very easily printed and copied, whereas image file conversion is sometimes a nightmare. When reports are long and have many images, they can be too large for a floppy disk and require substantial transmission time over a modem from a student apartment. When in the second half of the course students were given the option of either electronic or paper submission, roughly half chose each.

Instructors had similar observations while grading the reports. Long reports were difficult to critique because modest sized computer screens do not permit one to scan a report nearly as efficiently as a paper document. At the end of the semester instructors routinely printed all electronically submitted reports before grading them.

Team Term Papers Are Enhanced

In both courses it was found that conferencing software was useful for groups to construct term papers. In each the team members had individual assignments which required editing and integrating into a group report. Students exchanged documents asynchronously instead of having to meet in person, thus saving considerable personal time. Conferencing software provided students with convenient, mutually accessible electronic storage which was preferred over passing floppy disks or exchanging files via FTP. Some students found it preferable to attach files to electronic mail messages to achieve the same effect.

Students in the senior course were required to give oral reports using Microsoft PowerPoint. Report information was shared asynchronously over the network using conferencing and other electronic means. Students rapidly produced high quality report materials in part due to their prior course experience in integrating information with the computer.

Virtual Office Hours and Critical Mass for Conferencing

In both courses, electronic mail provided a means of extending office hours. To a lesser extent conferencing software was used to the same effect. Electronic interaction was especially valuable for freshmen, who were easily intimidated by both faculty and by long walks across campus. However, since the classes were small, critical mass could not be routinely achieved to facilitate intensive interchanges among students. Instead, this quality of interaction could be achieved several times during the semester when focused on a particular event, such as completion of homework or term papers described above.

Neither course was able to sustain a conferencing software mediated dialog among students in which they solved homework problems together. There were surprisingly few interactions with instructors via the conferencing software. The most successful interactions were always in person, presumably because the it was necessary to have a continuing dialog to solve the problem, whether it be related to computer problems or course content. The interval between interactions via the conferencing software was so long that the students and instructors became conditioned not to expect them and returned to the use of electronic mail which they used extensively for other communication needs, as well as to telephone and personal contact.

Summary

Asynchronous Learning technology has been used with two small engineering classes, one at the freshman level and one at the senior level. Common characteristics of these courses include the use of conferencing software, computer homework assignments, team term papers, and electronic grading of student work. It was found that Asynchronous Learning technologies could enhance the student experience. The best examples of enhanced activities were group execution of projects and construction of reports, where electronic file exchange made progress possible without the extra time needed to meet in person. However, the small size of the classes precluded the achievement of the critical mass needed to support a highly interactive asynchronous environment.

It was found that the all-electronic assignment methodology was effective once students were comfortable with the computer environment and as long as the assignments were relatively simple. More complex assignments often brought inefficiencies stemming from the difficulties of assembling large files from multiple sources. Instructors often preferred printed documents to enable them to scan more efficiently reports for grading.

Reference

Wheeler, B. C. (1993). MATLAB Exercises to Demonstrate Principles of Biological Modeling and Signal Processing. In <u>Proc. ASEE Annual Conference</u>, July (pp. 1789-1790). Urbana, Illinois.

Acknowledgment