tutorial CD be present in the CD-ROM drive) or fully installed, which places all files on the hard drive. Similar functionality is available for server installations. Selected server installation was used because of minimum disk space requirements. This means that students must place their tutorial CD in the drive to access and use the program.

e-Test

Another objective was that testing modules provide sufficient breadth and depth to permit testing at various time periods without compromising test integrity. In addition, the system should have some form of pre-assessment methodology.

The e-Test, by Course Technology, uses a simulated environment which has the look and feel of a real desktop environment. The testing module has adequate security features and tests are immediately evaluated. Regrettably, those taking the test cannot use the help functions in the software package and the instructor cannot turn off the exam once a student has started it. Those wishing to limit the amount of time a student can spend taking an exam cannot do so. Each exam however was usually completed within 40 minutes.

CyberClass

CyberClass is a software package developed by the HyperGraphics Corporation (www.cyberclass.com) to support Internet-enabled delivery of course material. Templates are easy to use and content can easily be modified. Our first experience required about one hour to create a working Web Site. A password is required to access the site or chat area. A hardcopy of the course syllabus and calendar were distributed in class to reduce the cost of printing, and because students clearly did not want to continuously log on to review calendars and assignments. The online submission of assignments by students worked well, however, grading e-mail assignments was difficult and inconvenient.

Evaluation

Internet and self-paced instruction are viable alternative course delivery methods where technology is a driving force. All methodologies presented have advantages and disadvantages. The key to successful selection, adoption, and use of any of the tools discussed, begins with a clear assessment of institutional needs, student capabilities, resource requirements, and instructional objectives.

Interactive Electronic Laboratory Reports for Freshman Chemistry

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Background

The importance of experiments in a laboratory class in science and engineering curriculum cannot be over-emphasized. Unlike in lecture classes, in which students are mostly passive, listening and taking notes, lab classes provide students an excellent opportunity for full class participation in the lab activity; hence, they can benefit from active learning. Laboratory classes are also excellent in promoting collaboration among students, when an experiment is carried out as a team effort. Providing laboratory classes occasionally presents a problem, especially in a smaller college setting where resources are rather limited. One particular problem is that both writing and grading of lab reports are often tedious and time-consuming processes. This is particularly evident when the analysis of data involves extensive calculations, because examining data and calculations is often the slowest part in the grading process. In major universities, man-power to process lab reports is not a problem because of availability of graduate assistants. In a smaller college setting, however, faculty/staff members have to spend about eight to ten hours (a full day of work) per week grading 40 to 70 laboratory reports. Therefore, an electronic method of grading can be very beneficial because of its speed. Such a method has recently been developed and presented here.

Organization and Grading Method of the Electronic Lab Report

At the Georgia Perimeter College (Dunwoody Campus), students can take an electronic lab report interactively with any of the sixteen cluster computers in an open computer lab on campus. The computer program for the Electronic Lab Reports (ELR) is organized as follows:

Part I asks for a name, an ID number, and a lab section ID of a student.

Part II asks questions on basic concepts, fundamental principles, methods employed, and related mathematical formulas and chemical reactions regarding that particular experiment. Credit is given for each correct answer.

Part III asks for entry of raw data, several intermediate results of calculations, and key results from calculations.

Part IV examines whether or not the raw data is in a reasonable range. It also crosschecks whether or not the calculations and the results are consistent with the raw data. If not, the program applies penalties by deducting points.

Part V asks questions on the interpretation of results, sources of errors, and conclusions. Answers for several pre-lab and post-lab questions are also requested.

Part VI assigns and records a grade in a file server. Normally two trials of an ELR are allowed. Only the one with the higher score is counted.

Comparison of Written and Electronic Lab Reports

Written laboratory reports, in general, are time-consuming to write and grade. Feedback to students can take one to two weeks or even longer. Grading can be subjective depending on instructors or graders. Grading can also be inconsistent, even with the same instructor. On the other hand, electronic lab reports are time-saving for both students and instructors. Feedback is promptly done within days. The grading with a computer is absolutely uniform and impartial. Electronic reports are also environmentally friendly because they save reams of papers, hence trees.

A Brief History

It is informative and interesting to glance at how the implementation of ELR has evolved at our campus with the new emerging technologies:

Fall 1994: First, two ELR programs were written for two lab experiments. They were installed in four separate IBM 286 PC's without any network connections in the Chemistry Laboratory. We observed frequent congestion at the computer stations in the lab as there were no time limitations on each report. Although it normally takes 15 to 20 minutes or less for an average student to finish, occasionally it took more than half an hour for a less- or ill-prepared student to finish the ELR, thus tying up the computers.

Spring 1995: A total six of fourteen lab reports was converted into the electronic form. A time limit of 15 minutes had to be imposed to free the computers. Because of the lack of a network, each program for a different lab experiment had to be installed separately in each and every PC whenever a program was revised or updated. Grades for each lab report had to be retrieved by physically accessing every one of the four computers. The lack of a network among the four PC's presented a big maintenance problem.

Summer, 1995: All four chemistry lab PC's were upgraded with four 486 PC's with the addition of a file-server. These five PC's were networked with the Windows for Workgroups 3.11 Operating System (Microsoft). Although this implementation of ELR's under the LAN environment made maintenance much easier and tidier, still, the computer stations were often congested because of the limitations of computer resources.

Fall, 1995: Twelve out of fourteen lab reports were converted to ELR format.

Winter, 1996: As most of the PC's in the entire college became networked (with Ethernet Link and T1 Cable) at the end of 1995, the program modules were moved and installed in a campus-wide server (named "ACC-N01" Server). Students were now able to access the ELR from any of the sixteen cluster computers in the open computer lab. This provided us with a total of twenty computers accessible for Electronic Lab Reports. Therefore, it was possible to extend the time limit of each ELR to 20-25 minutes, at the request of students.

Fall, 1997: The cluster computers were upgraded to Pentium 200 with Windows 95. The ELR program became one of the commonly used software packages at the Dunwoody Campus.

Fall, 1998: As the University System changed from the quarter to the semester system, more experiments were added to the lab courses. Now sixteen out of twenty lab reports are in the electronic form.

Conclusions

The ELR System saves time for both students and instructors. It also saves other resources, requiring no paper input/output. Students save time by bypassing the word-processing of written reports, hence find more time for study and other work. Faculty members spend less time grading, hence finding more time for other work. The grading is standardized. Therefore, the implementation of electronic lab reports in other fields, such as in math, biology, physics and engineering, is encouraged because of its efficiency.

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