Utilizing Web Enhanced Technology in Environmental Courses

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Purpose:
The purpose of this paper is to present how Internet based resources have successfully complemented environmental engineering technology course delivery and developed students' life long learning skills.

Introduction:
"Traditional Learning", lectures at a prescribed place and time, is a proven teaching method especially effective for communicating large amounts of information. The lecture method is instructor centered, not student centered. The teacher is in control of the pace and order of the material. It does not accommodate the wide range of student backgrounds or adjusts easily to variations in learning styles. Materials presented in class are determined and limited to those selected by the instructor or included in the textbook. Professional communication skills, through the Internet or in a team atmosphere, are also limited. Furthermore, time and costs limit the instructor's ability to present multiple materials to accommodate more than one learning style thus affecting the student's education and life-long learning skills.

Based on input from various employers the emerging opportunities for engineering education is in the development of skills that utilize Internet resources. However, the opportunity for students to engage in professional Internet communication skills is limited to available resources and applications. Computer hardware and software are constantly changing thus inflicting a monetary burden on most educational institutions. More computers are needed for the students. The President's Committee of Advisors on Science and Technology concluded that a ratio of four to five students per instructional computer is desired for effective use within the schools. (1) The percentage of public schools connected to the Internet has increased from 35% in 1994 to 95% in 1999. Furthermore, the ratio of students to computers with Internet access in 1999 ranged from seven-to-one among schools with the lowest concentration of poverty, to sixteen-to-one among schools with the highest concentration of poverty.(2) While the progress of computer access is encouraging, research by the Center for Research on Information Technology and Organizations (CRITO) indicates that academic applications involving the computer is significant in only a small minority of secondary schools.(3)

The CRITO research goes on to say that only 17% of science teachers and 11% of math teachers regularly incorporate computers in their instruction.(4) This means that while the ratio of students to instructional computers has improved, the utilization of computers has not encouraged professional and technical development.

The effectiveness of Internet course enhancement is suggested by a study at Massachusetts

Institute of Technology by Wallace & Weiner.[5] This study involved two groups of students. One group was offered Web-Lecture and traditional class lecture (*Web + Class Lecture*). The second group was offered Web-Lecture combined with faculty guided experiential activity (*Web + Limited Experience*). Between the two, the second group of students, *Web + Limited Experience,* performed better than the first group, *Web + Class Lecture*. This result was partially attributed to a qualitative survey of all students. Students in the first group indicated they anticipated the classroom lecture, so they did not take advantage of the Web-Lecture. Students in the second group anticipated working with faculty during the classroom time. The second group took responsibility for learning the material from the Web-Lecture. The interpretation of the observation was that the second group of students placed a high value on the opportunity to gain experience while working with the faculty. The design of the course allowed students to learn (selecting the materials and pace) and to integrate instruction with practice.

Based on the value of web based course enhancements as an essential ingredient to student development, the Dean of Engineering & Industrial Technology (E&IT), established a goal to create, by December 2003, a course enhancements for every course offered in the E&IT Division. Sinclair Community College has thus recognized that Internet course enhancements encourage the technical and professional development of its students and complement hands-on learning skills. These course enhancements are websites that organize student-learning resources, facilitate course administration, and when integrated with hands-on learning experiences, fulfill the present and future needs of students and employers.

Discussion:

Course enhancements can be created using software packages for web page design like Dreamweaver from Macromedia or Fusion from NetObjects. In addition, enhancements might be created using templates of software packages developed for on-line instruction delivery. Sinclair Community College is one of many schools utilizing an on-line instruction software package called Web CT. This software package includes templates, tools and graphics to facilitate the development of educational materials for higher learning environments. WebCT was implemented at Sinclair to develop both on-line courses and enhancements.

WebCT uses icons to guide the student through the enhancement program. The primary icons used in E&IT course enhancements include:

- Start Here
- Syllabus
- Course Material
- Calendar
- Discussions
- Mail
- Links

Other course enhancements include teaching resources such as photos, videos and hyper-linked text. These formats allow the students to select when and where they receive instruction, and to control the speed and order of instruction. Students can access, through the web links, supplemental resources or tutorial assistance. For example, it is easy to integrate within a course enhancement on Environmental Regulations, a link to the Toxic Release Inventory web site:

(www.epa.gov/tri/report/). From this site, the student can download materials to guide and practice completing this annually required report. The student can access reporting forms, instructions, and help desk resources. This procedure enables a unique integration of specific job training for employee applications. The course design also provides opportunities to apply whatever materials are included in the enhancement. Other benefits of computer-enhanced learning include:

- Life long learning
- Computer operations
- Written communication
- Professional communication
- Internet research

Utilizing WebCT, the Environmental Engineering Technology Department developed and incorporated four enhancements into the classroom during the 2001 – 2002 academic year. Currently there are eight enhancements available and six others in varying stages of development. Each of the enhancements includes the following basic tools:

- Class Reading Materials
- Handouts & Links
- Homework Management
- Private Mail
- Class Discussion Forum
- Testing

Following is a description of these tools:

"Class Reading Materials" includes presentation and complementary reading materials. Students have access to class materials before, during and after the lecture. Course presentations (i.e. Power Point presentations) act as guides and allow the students to better prepare for class. Access to the presentations during the lecture facilitates taking notes. After class, the notes become the individual student's personalized study tool. Complementary reading materials, specific examples and illustrations applicable to the student, provide options to select the materials most appropriate for his/her learning aptitudes.

"Handouts & Links" is used to distribute materials and to direct student research. Utilizing this tool for handouts eliminates the burden and cost to make hard copies for in-class distributions. Furthermore, updates can be distributed between class periods. By utilizing the Links Tools, students learn to use web pages for research. Such exercises in research develop life long learning skills.

"Homework Management" is one of the most useful of the WebCT tools. This tool enables the instructor to provide access to homework anytime and anywhere. Furthermore, instructors can access and grade submitted assignments. This tool eliminates the need to organize and manage hard copies of the homework. Homework assignments can include life-long learning skills such as Internet research, professional communication, and analytical creativity. Since homework assignments must be typed and edited,

there are no excuses for spelling errors. The instructor can verify when homework was turned in and control whether late homework is accepted. Grading is conducted on-line and grades are accessible to the students at the discretion of the instructor. In WebCT, grades are automatically recorded and managed within a database.

"Private Mail" enables students to access instructors regarding course materials. It is an email function located within the shell of the course and is accessible only by the respective student and instructor.

"Class Discussion Forum" enables the students to communicate with each other, to form groups, or to jointly work on projects. Discussion forums include chat rooms and bulletin board style postings. This tool has been especially useful as the complexity of homework problems becomes more technically demanding and challenging. The opportunity for anonymity, intrinsic with the Discussion Forum, can create a more comfortable environment to discuss issues associated with strong opinions. More introverted students have an equal opportunity to be "heard" via the Discussion Forum.

"Testing Tool" automatically grades true/false, multiple choice, and matching questions. It eliminates the need for hardcopies. The instructor can enable the students to actually initiate grading of quizzes and tests. This function expedites feedback in that right/wrong answers are recorded and immediately displayed to the student. In WebCT, grades are automatically recorded in the course management. The Testing Tool does include short answers and paragraph question options. The instructor must grade these questions.

Evaluation:

As previously stated, four enhancements were incorporated into the classroom during the 2001 – 2002 academic year. Approximately 40 students participated in these enhanced courses. During the previous academic year, approximately 65 students participated in the same three courses taught in the traditional fashion without enhancements. The performance of the students in the enhanced courses was compared to the performance of the students in the traditional courses by calculating a grade point average for each section of each course. Taking the number of students who earned each letter grade multiplied by the assigned point value (Table 1), summing the total for each course, and then dividing that total by the number of students in the course determined the course grade point average.

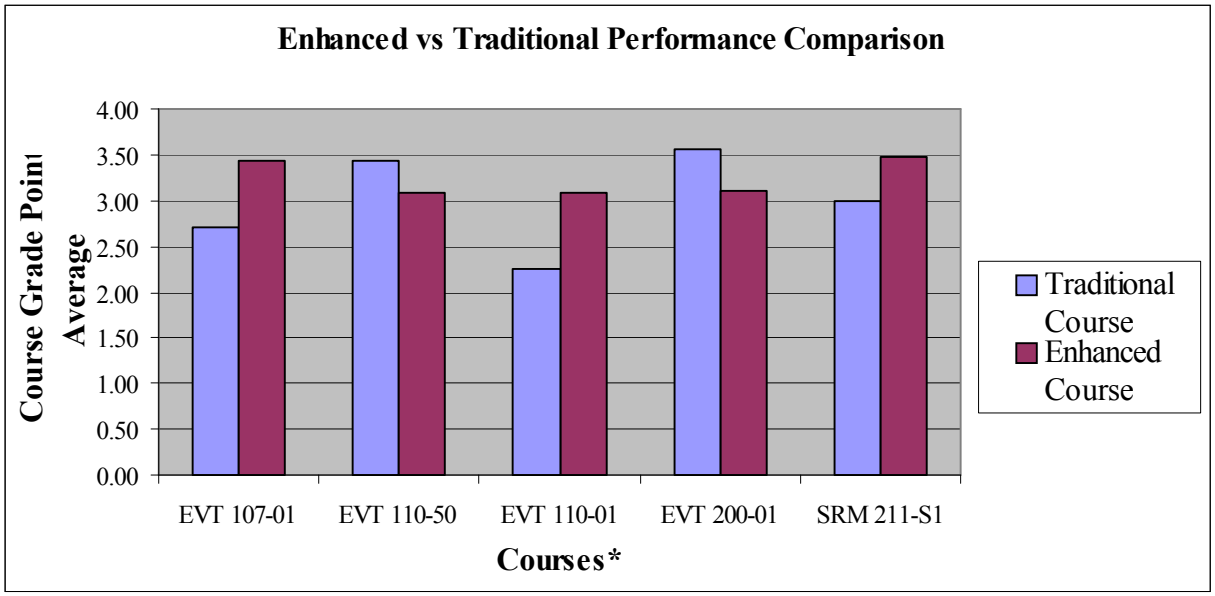
Table 1

A	B	C	D	F
4.0	3.0	2.0	1.0	0.0

Overall, the enhanced course grade point averages increased over 20%. In two cases, EVT 110 and EVT 200, the grade point average decreased an average of 13%. In the first case, a first time instructor taught the traditional section of EVT 110. The higher grade point average for the traditional class could be attributed to the teaching learning curve for the new instructor. In the second case, EVT 200 shows the enhanced delivery had a 15% decrease in grade point average. This could be an anomaly since the same instructor, utilizing the same syllabus and course design, taught both sections. Even though the data encompasses only the first year of enhanced delivery,

it is an early indication of a positive trend. The overall benefits of course enhancements are a subject for further study as more students are provided access to Internet/enhanced instruction. The results are illustrated in Figure 1.

Figure 1



* The suffix –01 indicates a daytime section, -50 an evening section and -S1 a short-term section.

Conclusion:

The integration of the Internet as a teaching resource, coupled with the instructor as a coach and coordinator, shifts the education process to a student-centered base. Computer, hands-on training and classroom education combine to provide professionalism, life long learning skills, and student goal achievement. For many students this leads directly to employment and/or promotion. The role of computer-enhanced courses will continue to hold value only as long as educational institutions support students in achieving their goals. We can develop the learning skills of our students and offer the demanding industry more capable and confident professionals.

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3. Center for Research on Information Technology and Organizations (CRITO), University of California, Irvine. Computer Technology and Instructional Reform, 1998. NSF Grant #: REC-9600614. Available online: http://www.crito.uci.edu/tlc/html/tlc_home.html
4. op. cit. Center for Research on Information Technology and Organizations (CRITO).
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