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WEB-BASED TECHNOLOGY IN UNDERGRADUATE INSTRUCTION: A PRIMER FOR MOVING BEYOND ACCESSIBILITY TO MEASURES OF EFFICIENCY

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ABSTRACT: Inarguably, the Internet has revolutionized the manner and speed of information transfer. The Internet as a course supplement represents a new reality in higher education and has moved from a novelty to a near obligatory component in course instruction today. Arguments for and against the use of the Internet in pedagogy have been made. For example, in plant identification courses the Internet allows students to experience the visual component of flora that is often difficult to bring into the classroom. However, the Internet can also add a significant time sink to already overtaxed university instructors, who likely maintain research programs, outreach and service, and instruction, often without assistance from teaching assistants or office staff in preparing Internet materials. It is within the context of these tradeoffs that the questions of this poster were born: How do we measure the efficiency of the Internet in pedagogical scholarship in higher education when expectations for research, service, and outreach have not diminished? As educators, we must advance from the generic methods of course evaluations (e.g., student postclass reviews) to the development of metrics that critically and fairly evaluate the effectiveness and teaching/learning efficiency of Internet instruction, both from the student's perspective (which we believe has already begun), as well as from the instructor's.

To begin development and discussion of these metrics, we examined long-term trends in student evaluations (1996-2001) from an Internet-supplemented course taught at the University of Wisconsin-Madison by Dr. Phillip Barak to: (1) test the assumption that students have grown comfortable using the Internet, and (2) assess the evolution of student behavior using the Internet as a course supplement. This annual, 3-credit, junior-level course served as the model in our analysis. These data are presented as a primer to foster discussion and future research in this area.

We chose this course for analysis because it formally pioneered the Internet as a classroom supplement and, most important, because records of student feedback pertaining to Internet usage had been assessed since 1996 using essentially the same questionnaire. This course serves as the main undergraduate class for teaching management of plant nutrients and enrolls both undergraduates in soil science as well as students from agronomy and horticulture. The course consists of two lecture periods and one two-hour laboratory per week, with an enrollment of 30 to 40 students.

Beginning in 1996, the Internet plays a significant role in this course by providing a stand-alone Web resource entitled "Essential Elements of Plant Growth" and class material consisting of lesson-by-lesson course information, announcements, assignments, online readings, postclass notes, e-mail connections, and links to external Web sites. In addition, it provides interactive 3-D chemical models as part of "The Virtual Museum of Minerals and Molecules." Internet usage in this course was not designed as an alternative to the teacher-student lecture or person-person contact. Instead, it was viewed as a course supplement by which instruction could be extended to all hours of the day and all days of the week, increasing time on task by the students with course material and objectives. In other words, the Web was not intended to replace the classroom with distance education, but to enhance residence education by greater proximity and interactivity.

Student grades are determined on the basis of three exams, including the final (each counting 20%), lab work (15%), lab exams (15%), and five calculational problem sets distributed during the semester (10%). There were no grade rewards attached to student use of the Internet portion of this course. However, without using the supplemental information provided by the Internet, student performance was, at best, diminished, and at worst, suf-

ferred considerably. Students were provided a formal opportunity to anonymously evaluate the effectiveness of the Internet components one week before the final exam using a combination of multiple-choice questions and short open-ended essay questions. They were also encouraged to provide written feedback, from which our analysis also draws. This format provided the freedom for students to contribute honest evaluations without risk of consequence and provided the data used in our study.

Examining the six-year record of student responses, we found that the novelty of the Internet has diminished to the point that students now expect that Internet-based technology accompany traditional classroom instruction. Students have progressed from being unfamiliar with the Internet to a comfort level where they now possess the experience to critically evaluate our Internet-based instruction; by 1997, all students declare themselves comfortable with using the Internet. In the six-year period, Internet access has largely moved from access points at the university to home computers, and the frequency of visiting the course site has been at least once per week over the six years of our study. Students are now concerned with the efficiency by which they can extract information from course Web sites rather than how to gain access. However, the Internet supplement does not appear to have caused a decline in class attendance since its inception in 1996, nor has it decreased the need for a direct student-teacher relationship. Students appear to be increasingly more inclined to attend courses with Internet supplements, as opposed to those that do not offer this technology.

Regardless of our individual level of enthusiasm for using this technology, our data suggest that most students now encourage, if not expect, the use of Internet-based course material by instructors. Students have moved from concerns concerning mechanical difficulties with usage (e.g., download times on 14.4 kbs modems, access through the phone modem pool, and availability of color printing) to concerns with the quality and delivery of Web-based information. We believe that in future years educators and administrations will increasingly evaluate the teaching/learning effectiveness of combining Internet technology with traditional classroom instruction. Moreover, advancements in Internet technology have and continue to evolve quickly, forcing educators to learn and maintain their command of a teaching tool for which they may be judged.

If Internet course materials are just a substitute for "Bob's Copy Shop," then pedagogy has not progressed much through this technology. In the glitz of the information era, it is easy to miss that the key element in pedagogy is *interactivity and learning*, not information per se. The true advantage of the Internet in pedagogy is its interactivity, both students with the material and students with instructors, which simply further extends one of the core concepts of the successful traditional classroom.

Therefore, a discussion and development of new metrics that evaluate the efficiency and effectiveness of the Internet in pedagogy must begin in earnest so that the tradeoffs between enhanced learning and the time and effort it takes to maintain this electronic environment can be evaluated quantitatively. To this end, we intend to expand this study to include other courses around the country that have and currently maintain Internet-based classroom supplements.