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by Nicholas Moss

In 1995 the School of Dentistry at the University of North Carolina (UNC) at Chapel Hill created an intranet system to provide support at several levels in the school's operations. At the administrative level these operations included the management of complex tasks such as class scheduling and admissions management. At the clinical level the system would be used to organize a new computerized patient records system and provide access to a digital X-ray imaging system. At the educational level the system was envisaged as a means to create a Web-based structure for the DDS curriculum. This structure took the form of an electronic syllabus, or e-syllabus.

The e-syllabus is a set of Web pages in which each course in the curriculum is assigned a "course page" and multiple "session pages." Course pages have a standardized format that provides course objectives, course policies, required or recommended textbooks, grading scales, and faculty listings. A separate session page is created for each lecture/lab session conducted within the course. Together with specific objectives for each lecture or lab, these pages provide links to handout material (in PDF format) for use in that session, to supplemental Web resources maintained within the e-syllabus, and to outside Web sites. Session pages are accessed from links on the course page and from electronic calendar pages, one for each of the four years in the curriculum.

In what follows, I provide an overview of the e-syllabus framework as it evolved through several different stages at the UNC dental school. In particular, this article describes my attempts to bring more student involvement and educational relevance to the e-syllabus in the first-year curriculum. This initially entailed the creation of an online syllabus with a Web site development program, and eventually led to implementing rich media presentations that enhanced the interactive component of the syllabus. By tracing these steps, I hope to show how online technology in lecture-based courses can be utilized in ways that go beyond the mere presentation of supplemental course materials, such that it may promote active student learning.

Stage One: Supplementing Lectures with Online Materials

This article focuses on DENT 114 (Physiology for Dental Students), a course that first-year dental students take in the spring semester. The first-year class always contains 80 dental students as well as one or two graduate students in allied dental health programs. Within the current curriculum structure the physiology course is preceded by Gross Anatomy and Biochemistry in the fall semester; it also runs concurrently with Oral Biology and Microbiology in the spring, and is followed by Pharmacology and Pathology in the following summer and fall semesters, respectively. The DENT 114 course is designed to bring all students to an adequate level of competence in physiology to fulfill the prerequisite knowledge for pathology and pharmacology, and to prepare students for part one of the dental boards exam. One challenge in the physiology course is to accommodate the broad range of backgrounds among the students. Some have taken physiology courses in previous degree programs, whereas others have little if any physiology experience. This means that the course presents few difficulties for a certain proportion of the class, who achieve cumulative percentage scores in the low to mid-nineties, while other students may struggle to achieve a passing grade of 60%.

Exhibit 1 is a screen shot of the physiology course page. Fifty-eight hours of contact time are allocated to the course, scheduled in two or three-hour time slots on Tuesdays and Wednesdays. The course is conducted entirely through didactic lectures that provide a broad survey of the physiology of the nervous system and other organ systems. Exhibit 2 is a screen shot of the session page for the first lecture.

This sort of lecture-based course structure is the norm for biological sciences in the first year of dental school, though there is broad agreement that it is an inefficient way to convey the information to students. Thus, the introduction of an e-syllabus was seen as an opportunity to develop more effective teaching practices. In support of this thinking, the associate dean for academic affairs initiated a serious effort on the part of faculty to incorporate alternative teaching methodologies into the dental school curriculum. In a series of meetings, however, course directors failed to identify alternative teaching methods that appealed to the faculty, either practically or intellectually. The time and facilities available, coupled with the small number of faculty members assigned to each course, limited the extent to which more interactive and self-directed learning modalities could be incorporated into courses. Reluctance to deviate from the traditional lecture format also probably reflected a comfort level associated with the regular routine in which each faculty member delivers a total of five to eight lectures over an intense two- to three-week period. This is certainly an efficient way to fulfill a teaching commitment, and it minimizes the time and energy that must be diverted from research and writing. An additional (and valid) concern was that any deviation from the traditional lecture structure might jeopardize the established level of achievement in board scores. In any event, the biological science courses have retained a lecture-based format and the e-syllabus has remained a repository for handout materials, additional readings, and old tests.

Beyond this early flurry of interest in alternative teaching methodologies, there has been little effort to bring Web-based teaching into a more prominent position in the curriculum. Indeed, the only obligations course directors have are to update the course page as needed and post all handouts on the session pages. For their part, students are required to purchase a notebook computer, which provides access to the e-syllabus in the first year and then, beginning in their second year, allows them to access online patient records and digital radiographic images. Thus, the only purpose for the computer during the first year is accessing session pages and downloading course materials. Even this meager application is somewhat undermined by the requirement that all "critical" materials be distributed as paper handouts as well as posted electronically to session pages.

In the face of these limitations, I sought ways to make the e-syllabus a more effective resource for teachers as well as students. This required further thought regarding the syllabus design and how its features might incorporate more of the pedagogical advantages offered by a Web-based learning environment.

Stage Two: Making Lecture Supplements More Web-based

My first goal was to use the Web to provide a more up-to-date, modern feel to the physiology course. An impressive feature of the UNC dental e-syllabus is that, beyond the basic requirement of posting some form of PDF-formatted handout material, there are no further guidelines. This means that faculty members have unrestricted license to utilize any type of presentation format or delivery medium to provide students with supplemental material in the session pages of the e-syllabus. In the physiology course, instead of posting pre-existing paper handouts as PDF or Word files, I used the NetObjects Fusion Web site development program to convert existing handouts into a more "Web-oriented" HTML format in which the separate components of the course can be viewed as part of a consistent, integrated program in physiology (Exhibit 3). To comply with the requirement for paper handouts and corresponding PDF files within the e-syllabus, I distribute all lecture-related PowerPoint files in handout format (3 slides per page) the week before each lecture sequence. I also post these handouts on the session pages of the e-syllabus as three PDF files of the PowerPoint presentations. One file contains full-page slides; the other files (one in color, one in black and white) each contain three slides per page, which is the same style as the paper handouts. The handouts and PDF files provide a complete record of the material that I present in lectures but do not substitute for the material contained in the Web pages that I created with NetObjects Fusion. The latter pages provide a more complete set of notes that describe the material in greater detail.

Other faculty members who also were interested in leveraging the electronic format recognized my approach as "above and beyond expectations" and "cutting edge." Certainly, conversion of handout material to HTML format in a Web environment facilitated rapid navigation within the entire course structure and created the

possibility of including attention-grabbing animations and additional information about dynamic processes. As such, this design was an initial step toward fostering the sort of interactive experience that Richards (2003) identifies as an essential characteristic of the e-syllabus. However, the format at this point was essentially static and offered little advantage over the original paper handouts from which the material was created. Not surprisingly, anecdotal student feedback was never more than lukewarm. Some students thought the Web-based material was helpful for reinforcing and expanding the lecture material; others did not use the former material at all. In this respect, students utilized the e-syllabus very much like the recommended textbook: as an optional supplement to the lecture material. This result was unsatisfactory and contrary to the original intent of the Web-based material, which was to improve the effectiveness of information transfer to the students by involving them in an interactive, absorbing environment. I retained this type of descriptive material and redesigned it within a Flash format to improve its stability and maintainability (Exhibit 4); however, I still could not regard it as the primary interface between the course and the students.

This experience made it clear to me that any Web-based instructional material must generate a strongly positive reaction from class members to sustain their continued interest. This positive response will occur when they perceive the material as a means to improve the efficiency of study time and to obtain a better course grade. Moreover, to have true educational, in addition to instructional, value, it should include a strong interactive component that provides faculty members with feedback about student progress and teaching success. I was unable to identify a practical way to achieve these goals using available software packages that could be integrated easily into the existing course structure.

Stage Three: Promoting an Interactive Learning Environment

This situation changed when I discovered the potential of Macromedia Breeze to fulfill a large part of what I had hoped to accomplish with the Web-based lecture notes. I integrated Breeze presentations into the physiology course as the first step in a plan to remove a substantial portion of the course content from a didactic, lecture-based format and provide this material in an alternative format outside of the lecture hall.

PowerPoint presentations are the accepted modality for lecturing to students in all dental classes. The extent to which the faculty has embraced such presentations has little to do with any educational advantage over earlier methodologies; they simply have been regarded as the most efficient way to organize and deliver a large amount of material in a short period of time. In this respect PowerPoint presentations have removed the spontaneous intellectual engagement and stagecraft that were once integral components of a successful lecture. Students respond in kind and watch passively as slide after slide flashes before their eyes. However, through a colleague's demonstration of how the Breeze program could be used to convert PowerPoint files to Flash presentations (Howerton 2004-05), I realized that Breeze could provide a means to generate much of the interactive functionality that was missing from the existing system (navigate the presentation in Exhibit 5 for an illustration). In addition to the capability to add highly compressed audio to the presentation, Breeze includes a quiz module that allows multiple-choice questions to be embedded in the PowerPoint file. Students are registered in a database maintained on the Breeze server, and their responses to the quiz questions are logged and tabulated. This enables teachers to monitor the progress of students as they work their way through the quiz sections of each lecture presentation. This is exactly what I had envisioned when thinking of how the Web could be used to provide more interactivity in the course. It should be noted that there are other programs that convert PowerPoint presentations to Flash format, but Breeze is distinguished by the database feature and quiz function, both described in greater detail below.

A well-prepared Breeze presentation comes close to providing the same level of information transfer as a conventional lecture using PowerPoint slides. The advantage is that students can "attend" the lecture at any time and then pace the presentation to suit their needs. Conversion of the PowerPoint file to the Breeze format requires no special skills and, in many cases, the close scrutiny required to fully explain the context, content, and significance of each slide with audio and notes results in a better, more concise presentation. Audio input is recorded into the Breeze file with a standard voice microphone and is facilitated by a "wizard" that guides the user through the production of a voice track to accompany each slide. The audio input window

displays the notes associated with each slide so that they can be read into the audio file. A simple operation updates slide notes when the user makes changes to the recorded input text. The high compression of the audio files means that, in terms of download time, there is no practical limitation to the amount of audio material that can accompany each slide. The high compression makes Breeze files significantly better than PowerPoint slides for transmission over phone lines, and my experience has been that they present no downloading difficulties for students using telephone modems. See Exhibit 6 for a short excerpt drawn from a Breeze lecture.

The quiz module in Breeze is an important capability that, to me, made it extremely attractive as an instructional tool. As well as tracking student participation in the central database and providing simple summaries of responses, the Breeze server can be set to send e-mail reminders to students who do not complete the quizzes within a prescribed period. The system also can provide an ongoing assessment of the level of student comprehension, which the instructor can use to determine the areas in need of reinforcement. See Exhibit 7 for an illustration of the quiz function in Breeze. Conversion of a presentation to Breeze format is simple: After incorporating the audio and quiz features into the PowerPoint file, the user simply selects the "publish" option in the Breeze plug-in menu.

Thus, without compromising the basic structure of the course format, and without placing extensive additional demands on themselves, faculty members can convert lecture material into rich media Breeze files for students to assimilate in their own time, prior to class. Class time then can be used for more interactive activities that draw upon the knowledge students gain from the preparatory Breeze presentations. The possibility that students would neglect the online portion of the material, sit quietly in class, and end up with a deficient level of knowledge can be avoided by tracking the participation of students in the test modules and providing credit for their participation. This approach requires reappraisal of the best use of the lecture time, which can be at the discretion of individual faculty members. Ideally, instructors would conduct the class with more specific objectives or activities than those addressed by a general lecture—for example, an instructor might have students solve problem sets based on the lecture topic using Flash-based interactive modules. Since more and more students are using wireless connections in class, such activities could include real-time worksheet exercises. Information on student performance on the online quizzes would also allow faculty members to create a more focused, interactive environment in which key features of each subject area are emphasized and integrated into a broader view of the overall system. I spent 2004 laying the groundwork to implement these ideas and to provide a proof of concept as justification for further development.

Implementation and Student Response

I prepared Breeze files for many lectures in DENT 114, which were posted alongside the normal PDF files in the e-syllabus session pages. Since our trial access to the Breeze server did not allow tracking of quiz activity, the files were essentially PowerPoint slide shows with text and audio. For the most part students gained access to the Breeze presentations after the lecture sessions for the purpose of review and clarification of course materials. As such, we tested the utility of the Breeze materials as study aids.

The files received an immediate, enthusiastically positive response from students, as reflected in the unsolicited feedback transcribed in Exhibit 8. Student demand for PowerPoint files converted to Breeze format was insatiable; in more than 20 years of teaching dental students, I have never seen such a positive reaction to any other type of presentation format.

Midway through the course, a student survey of the relative merits of different file formats revealed that the audio component of Breeze was its principal advantage. The value of the audio compensated for the fact that students could not download and print Breeze presentations, a perceived inconvenience. Students considered Breeze files without audio only marginally more effective than PDF versions of PowerPoint files with slide notes (Exhibit 9). Following the course, as part of the normal questionnaire, students were asked whether Breeze files would be an acceptable substitute for lectures. Seventy-eight percent of students said yes, 20% said maybe, and 2% said no. Supplemental comments indicated that, as might be expected, some

students would favor the Breeze format even though they recognized that they would benefit more from attending live lectures. It is important to remember, however, that Breeze presentations would only lay the groundwork for a better use of the lecture time and would not constitute the only exposure to the material.

To track student opinions on electronic teaching methods, since 1998 the course questionnaire has included two questions about the electronic syllabus: (1) How do you feel about the electronic syllabus? and (2) How would you rate the potential of Web-based teaching? As shown in Exhibit 10, there has been a positive trend in the responses to these questions over the past five years, but 2004 saw a dramatic increase in the positive responses and a decline in the negative responses. Exhibit 11 contains a summary (in Breeze format) of the experiences and outcomes of the Breeze presentations.

Conclusion

The findings outlined above indicate that students receive Breeze-formatted slides enthusiastically, apparently because the rich media content serves to reinforce content in a highly effective way. For the instructor, the quiz feature also provides an opportunity to spend less class time presenting information and more time responding to questions about the material and discussing how well students did on the quizzes. Converting lectures to Breeze files does not compromise the educational integrity of a course if they are introduced cautiously and incrementally in order to fulfill established pedagogical objectives.

While my initial experience was very positive, I was not able to take full advantage of the testing component of the Breeze system. This precluded any monitoring of student performance on testing. When enabled, however, this feature will no doubt foster greater faculty involvement in the process. Once the teaching faculty members are comfortable with the presentation format and quizzing capabilities, they will be able to more fully utilize the interactive elements of the program. At that point student and faculty interactions will be combined into a unified and mutually beneficial instructional environment.

The advantages of online learning tools may not seem relevant to instructors who still use a predominantly lecture-based mode of teaching. However, these instructors may not have discovered all of the available technological resources or considered all of their pedagogical options. Due to the emergence of tools like Macromedia Breeze, instructors now have a range of new choices for enhancing their lectures and generating higher levels of focused student engagement. The success achieved so far at the UNC School of Dentistry may provide a useful model for attaining similar results in other contexts, whether in professional-study programs or in other university programs where the lecture format remains a necessary component of instruction.

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