An Alternative Approach to Web-Based Education: Technology-Intensive, Not Labor-Intensive

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Abstract

This paper argues that, contrary to common textual approaches to Web-based education, the most feasible approach to disseminating factual information online is through Web posting of unedited, automatic audio and video recordings of traditional classroom sessions. Such an approach addresses each of four major problems with online education described in the paper: (1) extended, labor-intensive nature of course development and delivery, (2) lack of economies of scale, (3) difficulty maintaining course currency, and (4) potential lack of robust interpersonal communication. The experiences of DePaul University's School of Computer Science, Telecommunications and Information Systems (CTI) in implementing such an automatic recording approach yields a list of ten guidelines for success.

Keywords: distance learning, online education, Internet-based education, Web-based education, video recording, streaming video

1. INTRODUCTION

Overview

This paper is divided into four major sections. In the Introduction, common approaches to Web-based education are discussed, noting the relatively heavy reliance on text based dissemination of material and the relatively minor use of full video lectures. The second section defines and describes four major problems with Web-based education, while the third section describes the experiences of DePaul University's School of Computer Science, Telecommunications and Information Systems (DePaul CTI, 2002) in addressing these problems by posting automated, unedited recordings of traditional classroom sessions on the Web for use by traditional and distance learning students alike. The fourth section offers ten principles for success, along with a discussion of the limitations of the approach described here.

Common Approaches to Web-Based Education

Many technologies are available to support Web-based education, and there is variation among universities in their approaches to providing this type of distance learning. Shea et al. (2001) reported on the results of a survey of 68 distance education program directors, as shown in Table 1. Further data about accredited online degrees in business, engineering, and education provided by *U.S. News and World Report* (2001) was organized for this paper according to technology employed, yielding the results shown in Table 2. The results of these two studies are generally supportive of one another, with surface differences that may be attributed to the different ways questions were phrased. For example, the Shea study asked what means were

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used to deliver a typical Internet course, while the *U.S. News and World Report* inquiry simply asked schools to list all means employed in their online degree programs. Thus, for example, a school that uses one or two minor video clips to supplement one of their online courses likely would be listed as using video in the U.S. News report, and not in the Shea study.

Table 1. Shea et al. (2001) study results

Delivery Means	Percentage
Email to instructor	96%
Posting class notes	88%
Bulletin boards	82%
Email to other students	81%
Telephone contact with professors	74%
Live chat	63%
Streamed audio	32%
Streamed video	28%
Videoconferencing	24%

For any online course, the selection of available technologies must answer two major technology questions: (1) how will interaction be handled? (2) how will material be disseminated? Tables 1 and 2 clearly indicate that interaction is usually handled with email and threaded discussion, supplemented in a significant number of cases with telephone contact and synchronous chat. As for how material is disseminated, the Shea study clearly shows that posting of class notes is far more common than use of streaming audio or video. This conclusion is supported by the online learning literature in general. Although some universities rely heavily on audio or visual recordings of lecture material (Muller et al, 2002), most universities begin their Web-based course development with text-based courses. As Sharma and Gupta (2001) have noted, "Text based courses are the most simplistic means of teaching a course over the Internet. This will help reduce technology and resource costs including infrastructure, hardware, and software and technical support." Smith et al (2001) agree that Web-based instruction tends to be highly text based. Some, including Carr-Chellman and Duchastel (2001), who emphasize a constructivist view and want to minimize the "lecture" aspect of online courses, have argued that the use of audio or video recordings in online courses should be minimized, "If audio or video lectures are used within a course, it is essential that they remain minimal (in the form of audio- or video clips) as opposed to lengthy lectures. Their purpose is not specifically to convey information in the form of content to be learned, but instead to enhance the student's identification with the course, motivation to learn, and sense of instructor personality at a distance."

Contrary to the common emphasis on text-based material in Web-based education, this paper argues that for factual material that would have been presented by using a lecture in a traditional classroom, video lectures are the preferred approach to disseminating material in an online class environment. The fact that, as Table 2 shows, more engineering schools are using video recordings than are business or education schools lends credibility to the argument that more factual material is more suitable for such recording. Further, this paper argues that, rather than producing labor-intensive semi-permanent professional quality videos, a far more feasible approach is to automatically record actual classroom lectures and post them on the Web without any editing. Such an approach addresses all four of the major problems with Web-based education discussed in the following section.

Table 2. Percentage of institutions using various techniques for Web-based education (*U.S. News and World Report,* 2001)

	Education (n = 43)	Engineering (n = 33)	Business (n = 38)
Threaded Discussion	100.0 %	87.9%	94.7%
Chat	81.4%	63.6%	81.6%
Video	51.2%	72.7%	52.6%
Simulation	39.5%	45.5%	42.1%
Labs	16.3%	24.2%	21.1%
Audio without video	9.3%	3.0%	2.6%
No specifics listed	0.0%	3.0%	2.6%

2. PROBLEMS WITH TYPICAL WEB-BASED EDUCATION

Labor-Intensive Nature of Web-Based Course Development and Delivery

One reason why Web-based higher education has not reached predicted market saturation may be the extended, labor-intensive nature of typical Web-based course development and delivery. Faculty perceptions that Web-based courses take extensive time to develop and deliver are backed by the literature. A study at the University of Maryland's University College compared traditional and online teaching and found that despite smaller class sizes (median 30 in traditional classes, 24 in Web-based classes), online classes took almost three times as long to develop, and individual student communications for online classes took twice as many hours per week (SchWeber, 1998). Brown (1998) estimated "this mode of instruction requires roughly 40% to 50% more work on the teacher's part in comparison with conventional classroom delivery." As Sylvia Charp, Editor-in-Chief of T.H.E. Journal (1999), has observed, "The largest component of online cost is faculty time."

To some extent, extensive development time may be a reflection of the fact that, as Freedman and Lewis (2002)

have noted, many Web-based courses rely on the posting of online lecture notes. Smith et al. (2001) explained, "Because of the reliance on text-based communication and a lack of visual cues, every aspect of the course has to be laid out in meticulous detail to avoid misunderstandings. Every lecture must be converted to a typed document. Directions for every assignment must be spelled out in a logical, self-contained way. Therefore, Web-based distance classes require considerably more work, often including hundreds of hours of up-front work to set up the course." Brown (1998) agrees about up-front development time, and also notes that the time commitment extends to interpersonal communication, "absent face-to-face contact and ordinary non-verbal clues, even very mature students on the Internet demand more frequent interaction and reassurance in dialogue with their professors, an observation confirmed in student course evaluations." As Smith et al. (2001) noted, online instructors must spend considerable time each week creating an "online presence, a psychological perception for students that the instructor is out there and is responding to them."

Lack of Economies of Scale

A faculty member who dedicates countless hours to creating his or her first online course gains only minor transferable skills to use in the development of subsequent Web-based courses, simply because course development depends primarily on course content, not faculty member familiarity with the technology. This lack of economies of scale is another reason behind the generally disappointing adoption of Web-based education. If the unit of measure for Web-based education is a course, then the marginal development cost does not significantly decrease for each successive course added. Further, if the unit of measure for Web-based education is the student, then, while enrolling more students in the same course decreases the marginal development cost per student, the marginal implementation cost in terms of individual interaction does not decrease, and may in fact increase. As noted earlier, building a virtual community often requires substantial time commitments on the part of faculty, and may require significantly more time per student outside of class than is required by traditional classes.

Difficulty Maintaining Current Content

Course development does not end when a Web-based course goes live. Rather, like all courses, Web-based courses must be kept current. While currency for non-IT courses might consist of regular updating of examples to include current events and occasional additions of new theories, the problem of currency for information technology courses is much greater, and can involve major changes to the course outline, or even replacement of courses as necessary to keep pace with rapidly changing technologies. Further, the common practice of institutions paying a faculty member a one-time development fee for a Web-based course sets up situations where some courses are likely to be kept current only after they become so grossly out-of-date that the administration becomes willing to pay to have the course re-developed.

Potential Lack of Robust Interpersonal Interaction

A final often-noted deficiency in Web-based education is the potential lack of interpersonal interaction. This can take two forms. First, Web-based education is usually asynchronous. Thus while there may be opportunities for robust interaction through such features as threaded discussion groups (Brown, 1998), such interaction is less spontaneous than traditional classroom discussion, and if instructors in such courses do not extend themselves to build a virtual community, then students may feel isolated and disconnected (Freedman and Lewis, 2002). Second, even in instances where threaded discussions or synchronous online chats actively engage students, some of the robust nature of personal interaction is lost. Under Koch's (2002) theory of media naturalness, evolution and the physical composition and capabilities of the human body suggest that human beings are well-designed for face-to-face communication involving synchronous interaction, co-location, body language, facial expressions, and speech, and that extra cognitive effort is likely to be required when communication lacks these characteristics (Koch, 2002). Faculty teaching in a text-based online environment are likely to be particularly sensitive to this change in communication channels. As Smith et al. have noted (2001), "Some instructors feel as if a lifetime of teaching skills goes by the wayside. They cannot use their presence and their classroom skills to get their point across. Nor can they use their oral skills to improvise on the spot to deal with behavior problems or educational opportunities."

Summary of Problems with Web-Based Education

The common text-based approaches to Web-based education are problematic in four major ways. They require an extended period of labor-intensive course development, without significant economies of scale for subsequent courses developed. They discourage faculty from keeping such courses up-to-date. Finally, their asynchronous nature, coupled with their inability to convey body language, facial expression, speech, or a sense of co-location, results in a learning environment that is at odds with the evolutionary development of human beings as described by Koch (2002). These deficiencies can be addressed through the alternative approach to Web-based education suggested here.

3. AN ALTERNATIVE APPROACH TO WEB-BASED EDUCATION

Mechanics of a More Practical Approach

DePaul University's School of Computer Science, Telecommunications and Information Systems (CTI) has used a relatively uncommon alternative approach (DePaul CTI Distance Learning, 2002) to Web-based education in order to achieve over 500 course

enrollments per term. In 1998, CTI's dean, Helmut Epp, conceived the notion of capturing relevant streams of information in the classroom and then transforming them into a Web-deliverable form, thereby automatically managing a large number of courses with a database driven management system.

CTI's approach is not to create separate stand-alone Web-based classes, but instead to create Web-based sibling sections for traditional classroom sessions by automatically capturing multiple aspects of the classroom environment and posting them on the Web. Forty-eight CTI classrooms have been equipped with fixed microphones and cameras to capture audio and video. In addition, everything that the instructor shows on the classroom projection system is recorded synchronously and automatically with the lecture. This includes, for example, PowerPoint slides, Web sites visited, or program code displayed on the classroom computer as well as anything displayed using the in-class document camera. Material the instructor writes on the electronic whiteboard is also automatically captured electronically through a fourth synchronized stream.

All recordings begin and end based on the scheduled time of the traditional class, and are uploaded automatically to the Web overnight. DePaul CTI has made a formal commitment to students to have all class recordings uploaded to the Web within eight hours of the end of the class session. Students who expect to enjoy a film or television-like event undoubtedly will be disappointed. No attempt is made to edit the material or to create a "production quality" experience. Instead, the goal is simply to capture, as nearly as possible, the actual classroom experience. Students, "watching" the class session on the Internet, have the ability to fast forward or rewind to find particular spots in the class that they want to view, or they can simply watch the entire lecture from start to finish.

While viewing, the video recording of the classroom lecture is always onscreen. Students can switch at will from looking at the classroom projector, typically showing a computer screen or document camera image (Figure 1), to one of two electronic whiteboard images (Figure 2). Figure 3 shows the higher-level interface that allows students to view the syllabus, instructor announcements, assignments or notes posted, individual grades, or threaded discussion group. Software supporting this system was written internally by the school's staff, but alternative course management packages are available through a variety of vendors, including Web-CT, Inc. (http://www.webct.com/) and Blackboard, Inc. (http://www.blackboard.com/).

Figure 1. User interface: viewing a lecture and PowerPoint presentation simultaneously

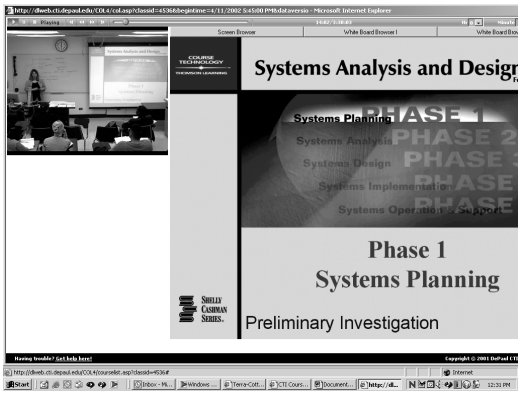


Figure 2. User interface: viewing a lecture and whiteboard simultaneously

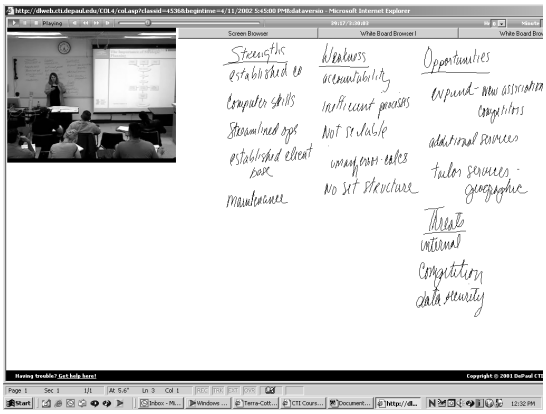
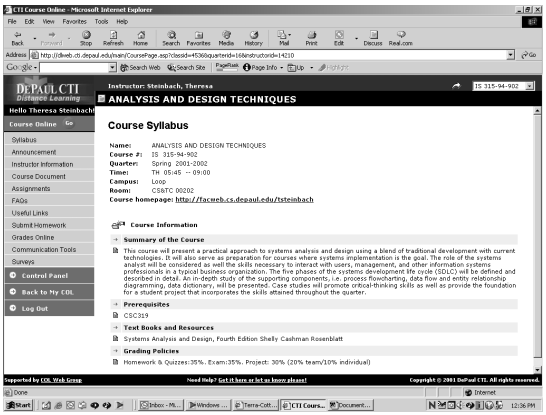


Figure 3. User interface: access to distance learning course



Results

DePaul University's School of Computer Science, Telecommunications and Information Systems (CTI) began offering totally Web-based courses in the spring of 2001 with 245 students in 35 sections. Without any significant advertising, this had grown, by the spring of 2002, to 525 students, primarily working adults at the master's level, in 72 sections. These students, while largely from the regional area, include people across the United States, and from the United Kingdom and British Columbia. Substantial additional enrollment growth is expected, since CTI recently received North Central Association accreditation for three totally distance learning degrees. These degrees are Master of Science degrees in Computer Science, Distributed Systems, and Telecommunications.

The approach to Web-based education described here addresses all of the major shortcomings of traditional Web-based education, as described earlier. The labor-intensive aspect of most Web-based course development is alleviated, if not eliminated. The technology-based approach used in its stead has much higher one-time up front costs, but virtually no variable costs beyond what is paid to faculty per student for those enrolled in the Web-based sections. Course content is kept current, with no additional costs. Further, such currency, rather than being discouraged, is virtually insured. Finally, the potentially impersonal nature of Web-based education is addressed, at least in part, by allowing the student to watch the teacher, interpreting body language, facial expressions, and speech patterns. Such an approach also allows the teacher to leverage more fully the verbal communication skills gained over years of teaching experience.

Although few material changes are needed Web-based teaching requires psychological adjustment in two areas. Teachers new to the Web-based environment report a heightened awareness that every word, gesture, and mannerism is recorded, and feel a lack of interpersonal connection with students whose faces cannot be seen and whose voices cannot be heard. The unobtrusive nature of the recording technology and the otherwise familiar classroom setting combine to make unusual awareness of class recording short-lived. Experienced Web-based teachers use techniques, such as digital photographs of distance learning students and periodic telephone calls, in addition to routine e-mail, to strengthen the teacher-student relationship.

Beyond addressing the deficiencies of traditional Web-based education, the approach described here also provides additional benefits to students in sibling sections held in traditional classrooms. Some of these benefits are simply due to updated technology. All CTI classrooms have up-to-date projecting computer systems and document cameras. Other benefits derive from traditional students' ability to view the lectures that are being recorded for distance learning students. Traditional classroom students who miss a class can view the missed session on the Web. Traditional students who are unexpectedly required by their employers to travel in the midst of a course do not need to drop out. Traditional students whose employers transfer them in the midst of a program can now complete their degree without interruption. Finally, all students, those in the traditional classroom and those in Web-based sibling sections, have the ability to view missed lectures and to review difficult material at will throughout the course.

4. DISCUSSION

Principles for Success

Human and organizational aspects are critical to the successful implementation of Web-based education. As Sharma and Gupta (2001) observed, "While pedagogical issues and technical hurdles can be overcome with planning and research, the most serious issues in Internet based education may well be political obstacles caused by existing organizational culture and infrastructure at an academic institution." While DePaul University's School of Computer Science, Telecommunications and Information Systems (CTI) did not experience cultural or infrastructure roadblocks, it did recognize and address the crucial importance of its human resources. In particular, CTI identified faculty as a critical factor in ensuring the success of its Web-based education initiative. As a result, it worked actively to build faculty interest and involvement, and to alleviate, as much as possible, the additional workload and pressures that Web-based education often bring to faculty.

The single most important factor in CTI's success with Web-based education has been the vision of its dean, Helmut Epp. He conceived the idea. He provided necessary technical resources and support personnel. Ultimately, it was his persistent enthusiasm for the project that achieved faculty buy-in. Dean Epp identified ten key principles for success:

1) **Leverage technology to reduce time that faculty must spend on course development.** Automatic recording of classroom sessions relieves faculty of the responsibility of creating unique lecture notes or overhead slides solely for the use of their distance learning students. A university should also facilitate distribution and receipt of notes, assignments, or other class-related materials to all students by creating a central Web repository accessible by all students registered in the course, whether in the classroom section or the distance learning section.

2) **Provide faculty with the opportunity to experiment with new technology as an enhancement for their traditional classes before asking them to commit to teaching a Web-based section.** Even faculty who are not teaching distance learning sections should have the opportunity to use both the central Web repository and the classroom technology.

3) **Make a commitment to never use classroom recordings to evaluate faculty.** This frees faculty to see technology in the classroom as a tool, rather than as a potential evaluation device. Faculty, nonetheless, should be able to use the technology independently to view their own lecture performance, and to make whatever adaptations they wish.

4) **Pay faculty for Web-based classes on a per-student basis, in addition to traditional pay for traditional classroom sections of the same classes.** This fairly recognizes that additional students require additional time of a faculty member.

5) **Pay more per Web-based student to faculty whose sibling traditional sections have high enrollments.** This recognizes a faculty member's time commitment to all of his or her students, whether traditional or distance learning.

6) **Involve faculty in setting enrollment caps in their Web-based sections.** This helps insure that distance learning does not make unreasonable demands upon a faculty member's time.

7) **Address faculty concerns about intellectual property rights by limiting access to online material to the faculty member's current students, and deleting all recordings and Web-based records when each term ends.** This approach makes distance learning an extension of the classroom. Just as with a traditional classroom, there is no permanent electronic recording of a faculty member's intellectual work product.

8) **Provide a support staff to guarantee working equipment that is transparent to faculty, and to handle the additional overhead of distant students, including scheduling and overseeing exam proctoring for students in Web-based sections, and having staff on-call during every scheduled distance learning recording timeframe.** The goal is to alleviate, whenever possible, any additional burden placed on a faculty member by teaching in a distance learning environment.

9) **Provide students with technical and support services at times and in ways convenient to them.** This added flexibility recognizes the fact that distance learning students seek support services on a different schedule than traditional students.

10) **Set student expectations before enrollment.** While the approach to distance learning discussed here has advantages over correspondence courses in that material is kept current and students can share the traditional classroom experience that experience is still not interactive, and the quality of the Web video is more akin to a home movie than to a professional performance. Potential students should be encouraged to view a sample Web-based session before enrolling. More importantly, potential students need to appreciate the self-discipline required when working relatively independently as a distance learning student, rather than being part of a classroom. The very benefit of flexibility that allows a distance learner to view a class session at virtually any time also may be a potential liability for students who are not experienced self-directed learners. Students who better understand this environment before they enroll are more likely to complete their distance learning courses.

Limitations

The major limitations to the approach to Web-based education described in this paper lie in two areas. First, like most Web-based techniques, automatic recording works best for highly structured, lecture-dependent courses. There is little benefit to having Web-based students watch a video of a classroom that has dissolved into a mass of small group discussions. Courses that rely heavily on small group work and classroom interaction require significant redesign in order to be offered successfully in a Web-based environment. Second, the up-front costs to install the technology described here are significant. In the DePaul University's School of Computer Science, Telecommunications and Information Systems (CTI) experience, this high fixed cost was easily overcome by the virtually nonexistent variable cost per Web-based class added. CTI was able to take advantage of economies of scale, however the approach described here may not be transferable without tailoring. In particular, smaller schools and more tentative implementation efforts that experiment initially on a small scale are likely to require greater customization.

Any university initiating or expanding its Web-based education initiative must of course consider its unique characteristics and overall strategic plan. CTI's unique characteristics made it a good fit for the approach described in this paper. It is the largest computer technology program in the country, enrolling almost 2,000 undergraduates in six different degree programs, and more than 2,300 graduate students in nine different master's degrees, as well as a Ph.D. Helmut Epp, Dean of DePaul University's School of Computer Science, Telecommunications and Information Systems, described some of the thinking that went into the approach that he initiated for Web-based education: "At CTI, we are faced with the added challenge of making sure our DL [distance learning] courses keep up with a large and very diverse, state-of-the-art curriculum that is constantly in flux. Our faculty is made up of excellent teachers who keep up with the latest technology and research. We needed an approach that would enable us to provide a curriculum that is constantly current, that does not require massive updating as our classes move forward, that provides a DL [distance learning] version of virtually every class we offer, and that is scalable and economic (Epp, 2002)."

5. CONCLUSIONS

The use of disposable, automatic, and unedited recordings of traditional classroom sessions provides a viable and far less labor-intensive alternative to more common approaches to Web-based education. Equally important, it enriches the learning environment for

traditional and Web-based students alike. Such an approach enhances Web-based course currency and provides a learning environment that is more in accord with the biological basis for human communication. The approach is particularly appropriate for more structured, lecture-based classes and for large-scale implementations at the graduate level. Its successful implementation at DePaul University's School of Computer Science, Telecommunications and Information Systems (CTI) was dependent upon recognizing and supporting the key role that faculty play in Web-based education. Its success was based in understanding and leveraging the unique strengths and strategic positioning of the university.

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