Why Do Educators Embrace High-Cost Technologies?

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Abstract

Web-based instruction (WBI) is a comprehensive set of instructional materials available through a browser over the Internet, an intranet, or extranet. WBI can provide content in hypertext, audio, video files, and other multimedia formats, and include such resources as chat, threaded discussion, e-mail, and hyperlinks. Many institutions of higher education (IHE) choose expensive distance education options rather than WBI, although WBI is much less expensive and equally effective. The reasons for selecting a more expensive alternative are related to the world view of college instructors about the teaching-learning process, traditional functions of the university, and an evolutionary process of technology acquisition. Administrators should carefully weigh the costs of development against the outcomes to contain costs of distance education delivery.

Introduction

Many recent articles in professional publications and the popular press have reported on the growth of distance education courses in higher education. There has been very little attention to how decisions are made to develop distance courses or the underlying pressures on administrators who are confronted with critical decisions about course development and implementation. Saba (1999) described a "dynamic model of distance education" said to depict the progression of technological adoption by institutions of higher education (IHE); the model is summarized as follows:

- Scenario 1: A faculty member re-purposes an existing course for online delivery, which involves a textbook and e-mail communication.
- Scenario 2: A faculty member decides to re-purpose an existing course and deliver it via videoconferencing using graphic production software, video editing, PowerPoint, and perhaps e-mail and the Web.
- Scenario 3: A department decides to put a series of courses, comprising a certificate program, online. Faculty adopts a commercial course development tool.

Somewhat contrary to Saba's position, most educators have a utilitarian view of technology with the following progression depicted in evolutionary phases:

1. An instructor achieves some level of basic computer literacy.

2. The instructor uses computers for personal productivity.
3. Venturing into instruction, the instructor uses technology to enhance lecture presentation.
4. E-mail is used more widely to interact with colleagues and students, along with Internet searches.
5. The instructor decides to re-purpose a course as an imitation of the conventional class requiring live, real-time interaction.

The typical faculty member re-purposes an existing course only after first experimenting with technology in the traditional classroom. Instructional technology in the college classroom is used almost exclusively to augment the classroom lecture. The first instructional application attempted by a professor is usually a PowerPoint presentation, a progression that is almost routine, resulting in a demand for expensive classrooms equipped with computers, peripherals, and projection systems to replace overhead projectors and the chalk board. The first attempts at distance education are commonly not far removed from the lecture method. It does not occur to many instructors that a student can learn anything unless there are lectures. How can there be quality if the professor is not talking? The major obstacle in gaining acceptance for WBI is the altered role of the instructor in distance education (Holmberg, 1989; Sammons, 1989), unless it is a telecourse that keeps the lecture in tact. A telecourse or videoconference enables the professor to capture what is done in the classroom in some electronic format. A synchronous model of distance education is appealing because it more closely matches the typical professor's world view.

The Quality of College Teaching

Professors consider teaching to be an interactive social process (Sammons, 1989), although they do most of the talking in the classroom. However, most universities are sufficiently concerned about instruction that they have created "centers" for teaching excellence to boost instructional quality through faculty development. Felder (1994) focused on the problem:

> College teaching is probably the only skilled profession that requires no prior training and provides none on the job: most professors begin and end their careers without as much as five seconds of instruction on how to teach. It is also the only skilled profession that does not use competence in its practice as the primary basis for advancement.

Embraced as the *sine qua non* of learning, the lecture method is the predominant form of college teaching (Knapper & Cropley, 1991). Negative results of the lecture have been reported for long-term retention, transfer, and learner motivation (Blight, 1972; Kulik & Kulik, 1979; McKeachie, Pintrich, Yi-Guang, & Smith, 1986; Johnson, Johnson, & Smith, 1991). The lecture is criticized for passive learning and poor critical thinking skills. In the average lecture the instructor speaks about 5,000 words, causing students and investigators to question its effectiveness as an instructional method (Johnstone & Su, 1994). Oblinger (1995) made the following observations about college teaching:

- Approximately 80% of teaching is in the form of lecture.
- Significant interaction is lacking in most lectures. In classes under 40 students, four or five students dominate the interactions. In classes over 40 students, the number of students who interact is even smaller.
- In a fifty-minute lecture period, questions and interaction comprise less than five minutes.
- Only 19% of students ask a teacher for advice after class.
- Only one-third of students leave the lecture with most of the information "units" recorded.

The synchronous model of distance education is closely related to a professor's regular habits, experiences, and expectations. An asynchronous course, and WBI in particular, eliminates direct

lecture transmission and requires instructors to develop different ways of engaging, supporting, and evaluating students. For many faculty who are unaccustomed to developing instructional units with objectives, correlated learning activities, and who lack much expertise with technology, it is difficult to imagine a course where the professor is facilitator and students have greater responsibility and active role in the teaching-learning process. Knowledge is not passively received, not by the lectures of professors or the simple act of reading, but through active cognitive actions of the student. Therefore, the requirements of the course and actions of the students, whether online or traditional, play a more important part in learning than the method of delivering information to students. There are, however, differing costs for the methods of delivery.

Synchronous and Asynchronous Delivery Systems

Synchronous Delivery

The technologies used in synchronous delivery include two-way interactive video telecourses, one-way video with two-way audio, audioconferencing, and audiographic conferencing, and may include electronic white boards, radio, television, IITS, closed-circuit, satellite. Not only are the production systems more complex and expensive, but the number of potential students is limited by the real-time requirement for class attendance. In effect, this is a variation of traditional classroom instruction rather than a replacement. In most respects, the classroom structure and routines are similar to a conventional classroom, with the instructor treating persons at remote sites as if they are members of a large class in a lecture hall. In fact, other than using presentation graphics, instructors do not act much differently than in a conventional classroom. Students on-site or at a remote site are expected to listen, take notes, and answer questions.

It is common to also employ telephone, fax, surface mail, and e-mail for transferring assignments and completed work. Remote sites typically require the presence of a monitor and/or a technician. As a result, the expense increases because of the necessity of equipment at all sites and additional costs such as uplinking, salaries of non-instructional personnel, and so forth. Costs at the "home" site are significant too because of the need for development facilities and personnel to handle television production. Even less costly systems, such as videoconferencing, are still expensive by comparison to asynchronous web-based courses.

Asynchronous Delivery

In the asynchronous method of distance education the instructor and students are not required to have real-time contact on a regular basis, because instruction is not time and location dependent. There is no need to have full-motion video for an entire class, especially if computer software and learning activities are designed for students to preclude the need for lecture. Students in an asynchronous course access university and Internet resources and interact asynchronously via e-mail and threaded discussion, but can also use chat if there is a desire and need for synchronous activity. In an asynchronous model there are no class sessions, although there may be occasional or scheduled online meetings for specific purposes. Students study independently and in virtual groups, electronically. As conceived in this model, virtually all contact is by means of computer technology. Streaming video/audio, file sharing, downloading, chats, and e-mail are used for access to "lectures," assignments, transfer of reports, other on-line resources, and communication. Technical support is not required at each location. Unlike the synchronous models where related equipment is often required at each remote site and paid for by the institution, most technology for WBI is commonly available, affordable and costs at remote sites are born by the student, most of whom are likely to have computers and Internet connections anyway.

Asynchronous WBI is much less expensive, but it is equally effective as synchronous models and

traditional classroom instruction. However, professors and critics regard WBI to be inferior to synchronous models of distance education, mainly because the instructor cannot deliver a traditional lecture. All courses have similar elements, whether they are traditional, synchronous or asynchronous. However, distance education is held to standards that do not necessarily exist in traditional classrooms. This table shows common elements in traditional, synchronous, and asynchronous classes and how they are typically managed:

Course Element	Traditional Classroom Options	Synchronous Course Options	Asynchronous Course Options
Syllabus	Handout	Mailed	Online
Course Calendar	Contained in Syllabus	Mailed	Online
Grade Reporting	Returned or posted	Mailed	E-mail attachment
Examinations	Paper-pencil, bubble sheets, portfolios	Paper-pencil, bubble sheets, portfolios	CGI forms, portfolios, e-mail correspondence, CGI with instant scoring
Office Hours	Set time and location	Set time and location	Set time or at student's convenience by e-mail
Communications	Before/after class, phone calls, office hours, conferences	Fax, e-mail, 800 number, occasional phone call	E-mail, videoconference, chat, threaded discussion
Handouts	Copies distributed in class	Mailed	Online, download
Resources	Library, labs	Library, mailed or CD-ROM	Web page, downloads, links, interactive components
Lecture Presentation	Didactic, question and answer	Real time (video, conferencing) videotape, compressed video, CD-ROM	Hypertext, streaming audio and video, chat

Efficacy of Distance Education

It is presumed that conventional instruction by the professoriat is the ideal, so any alternative must bear scrutiny. Despite criticism (Hoague, 1998) that distance education lacks sound educational practice and theory, research shows that distance education programs produce learning outcomes equal to face-to-face instruction (e.g., Russell, 1999; Moore & Thompson, 1990; Beare, 1989). Russell (1999) reviewed 355 research reports spanning a half century between 1947 and 1999, ranging from radio to various electronic variations, and reported that the experimental group was equivalent to the traditional group in nearly each instance. The evidence is overwhelming that distance education, regardless of the medium, is equivalent to traditional

instruction. Such results are difficult for many to accept. A new wrinkle is the suggestion that the subsequent performance of distance education students should be examined in other classes (Dominguez & Ridley, 1999), the presumption being that students who do well in distance courses may be suspect and their performance may not hold up in other courses.

The International Data Corporation predicts there will be 2.23 million distance learners by 2002, up from 1 million today. Concerns about the quality of distance education or, any particular course, should be no different than concerns about the quality of any individual course, textbook or instructor in conventional college instruction. The medium is not the problem. Quality is the responsibility of the professor online or in front of a lecture hall.

Cost Effectiveness

How much does a distance education course cost? Asking this question is like asking a builder, "How much will it cost for you to build me a house?" The answer is likely to be the same that Boettcher (1999) gives for costs in distance education, "It all depends." It depends on which method of delivery is used. Saba (1999) claims that commercial software companies invest an average of $500,000 to develop new courses or re-purpose print-based material for online courses; he also estimates that it requires a minimum of 500 students over a period of 18 months to break even with the investment cost in course development. It is apparent he is not talking about WBI. The least expensive applications are just as effective as those requiring expensive pre-production, production, post-production, and management support.

To determine a break-even point an administrator can calculate development costs and plot the projected income necessary to recover costs [i.e., **cost -** the sum of ***fixed*** and ***variable*** expenses, and **price** (per unit/enrollment)]. A general formula for calculating break-even revenue is:

$$\frac{\textbf{Fixed Costs}}{\textbf{1 - (Variable cost per unit/Selling Price per unit)}} = \textbf{Revenue to Break-Even}$$

IHEs often do not account for many fixed items in a budget on a daily or hourly basis, such as office equipment, utilities, office space, and so forth. Variable costs are often easier to track such as hourly wages paid to specialists, contracting for online delivery, new software or equipment for production, and so forth. Factors that contribute to variable costs can be identified in this table (rented and/or owned):

Factor	Synchronous	Asynchronous Web-Based Course
Infrastructure	IHE must own or rent television production studios, transmission (e.g. fiber, satellite, microwave), and related equipment)	Access to the Internet
Technology	Numerous cameras, editing decks, special equipment, uplinking	Workstations and server

Personnel	Designers, video/camera operators, editors, support personnel, consultants	Designers, instructors, webmaster
Support/Maintenance	Multiple sources of potential problems needing repair and upkeep at IHE and remote sites	Little need at IHE and none at remote site; server may be used for other purposes & and costs can be amortized
Transmission	T-1, fiber-optic, satellite, microwave	Internet
Administrative Support/Overhead	High (i.e., registration, advisement, maintenance schedules, middle management, facilities management	Low (i.e., registration, advisement online; server maintenance, few facilities)
Enrollment Projections	Fewer students (restricted to specific time and location requirements)	More students (unrestricted by time and location demands or time zone restrictions)

Without actually plugging in numbers, it is apparent that development costs of synchronous courses are higher because of variable costs, especially if the course requires television pre-production, production, and post-production costs, extra technical personnel, extra development personnel, TV or satellite time, duplication services, surface mail, faxes, phone calls. There is simply a lot more equipment and/or rental costs and personnel necessary. It also takes longer to recover costs because the number of potential students is restricted in a synchronous course, limited by the number of remote sites that can be used and by time and location requirements that constrains availability to only those students who are able to attend at particular times and locations.

Some costs, such as faculty time, can be considered a redistribution rather than additional costs. Changing a faculty member's role temporarily to develop courses for WBI may raise costs for the short-term, because of the need for someone else to teach certain existing courses in the faculty member's absence, but these costs can be recovered in the long-term as the professor returns to normal duties.

It is possible to have more students in an asynchronous course, because time and time zone restrictions are not imposed. If an IHE decides to out-source many of its functions in distance education, careful analysis of these options must be made, including faculty satisfaction and relationships with external, commercial personnel in addition to costs. Involving external commercial consultants, personnel, and servers creates an entirely new source of potential problems, conflicts, and cost factors. In many institutions the academic programs are required to funnel their distance education offerings through a special center, such as continuing education, which has the effect of complicating administration and drives up costs. As distance education becomes more widespread, faculty and administrators will find it more convenient and less expensive to offer their WBI courses directly. Future battles to contain costs and maintain control of academic courses offered over the Internet may be fought by deans and department heads who see no need for a separate administrative structure to handle WBI courses, reasoning that they may operate as part of existing academic units.

Conclusions

WBI has little or no need for special equipment, studios, support personnel, or real-time transmission of lectures originating from campus. E-mail, threaded discussion, and file sharing provide convenient ways to collaborate and exchange information. Presentation of course content can be done by means of "streaming video and audio," which may be accessed in real-time, and hypertext and computer files can be downloaded. Compared to the technology, infrastructure, and support necessary for most synchronous systems, the cost differences are enormous. In their own way, synchronous courses can add to the cost of education. The National Commission on the Cost of Higher Education (1998) reported that between 1981 and 1995, tuition at 4-year public colleges and universities increased 234%. If WBI is used as the distance education model of choice, there should be a net cost savings and no loss in "quality" for lack of a lecture.

If development costs for a web-based course are less than a synchronous course, and if student outcomes are essentially the same, the IHE administrator needs to consider developing web-based courses and avoid more expensive synchronous endeavors. As Russell (1999) says:

> Web-based training presents live content, as fresh as the moment and modified at will, in a structure allowing self-directed, self-paced instruction in any topic. WBT is media-rich training fully capable of evaluation, adaptation, and remediation, all independent of computer platform.
>
> Web-based training is an ideal vehicle for delivering training to individuals anywhere in the world at any time. Advances in computer network technology and improvements in bandwidth will usher in capabilities for unlimited multimedia access. Web browsers that support 3-D virtual reality, animation, interactions, chat and conferencing, and real-time audio and video will offer unparalleled training opportunities. With the tools at hand today, we can craft highly effective WBT to meet the training needs of a diverse population.

In the long term the WWW can be the most efficient and least costly method of distance education delivery. Administrators might want to consider two questions posed by Russell (1997):

- Why do professional educators embrace high-cost technologies when low-cost technologies work as well?
- Why do administration and faculty - despite research results - perceive that distance education technologies, especially those without interaction, are inferior?

If the assumptions and observations above are correct, these questions can be answered in terms of faculty attitudes, expectations, and experiences that form the culture of the university. Faculty who use distance education gradually become more accepting with time and experience, but the preference for conventional instruction remains high (Taylor & White, 1991). As long as faculty are incapable of viewing instruction from any other perspective than lecture, WBI will struggle for acceptance, or perhaps it will compete effectively with those institutions that reject it.

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