

Issues and Trends in Instructional Technology:
Slow Growth as Economy Recovers

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This is the seventh in a series of reviews of issues and trends begun in 1998. The year since the previous review was written (Molenda, 2004) has seen an improvement in the national economy in the United States after several years of recession. State tax revenues in the first quarter of 2004 increased dramatically over the year before (Jenny, 2004), signaling an easing of the budgetary crises faced by many states. Increased government and corporate revenues are expected to trickle down to improve the ability of schools, colleges, and businesses to acquire new technological hardware and software.

Schools, colleges, and businesses also continue to expand their information and communications technology (ICT) infrastructure by upgrading to broadband capacity and by building wireless networks to complement their wired networks. The year 2004 could be considered the watershed year in which instructor access to networks became truly pervasive in schools and colleges. Does pervasive access mean pervasive instructional use? Hardly. Indeed, the story of this year's review is the examination of how and why the various ICT delivery systems were being used or ignored in the corporate, higher education, and K-12 school sectors.

As in previous reviews (Molenda & Sullivan 2002, 2003; Molenda, 2004) this review traces developments in three of the largest sectors in which ICT is employed—corporate training and development, higher education, and K-12 education. In addition to the economic forces just mentioned, there are, of course, internal dynamics within each organization influencing whether and how instructional technologies are used. This review will show how the adoption and use of ICT within these sectors has progressed in light of the changing circumstances of the past year.

Overall Developments

“Pervasiveness” emerges as a major theme in this year’s review. In schools and colleges, not only is everyone constantly within range of computer networks, but computing also pervades all functions of these institutions, from teaching-learning to administration to residential life. In schools, testing is becoming more dependent on technology as is instruction; in a number of school districts virtual schools are coming to be as important to the mission as traditional schools.

“Convergence” is a second theme that cuts across sectors and across technologies. Analog media such as slides and video are now incorporated inside digital delivery systems, as, for example, streaming video on the Web. Functions that were once available only in separate devices—telephone, radio, television, calculating, text messaging—are now converging into a single handheld instrument. Likewise, instructional methods that were once considered separate—face-to-face classroom, video, Web-based—are converging into hybrid or blended learning formats.

Let’s see how these themes play out in each sector, one at a time.

Corporate Training and Development

Although business was beginning to expand in 2004, the national economy in the previous two years was still in recession. In that period there was a startling decline in the sheer number of small and medium-sized businesses. For the first time in a generation, the total corporate spending for training actually declined for two years in a row—2002 and 2003. The purchase of off-the-shelf training materials suffered the largest decline of all sectors of spending on corporate education (Galvin, 2003).

Issue 1: Use of Technology-Based Media for Delivery of Instruction

Classroom instruction vs. computer-based. We have been tracking the results of the annual survey of corporate training conducted by *Training* magazine since 1997, so it is possible to track longitudinally the trends in the use of various media and methods over this seven year period.

Despite many earlier predictions to the contrary, face-to-face classroom instruction is still the most universally applied format of training, being used “always” or “often” at 91 percent of companies (Galvin, 2003, p. 31). As is shown in Figure 1, the proportion of organizations using classroom training has hovered around the 90 percent range since 1997, with no noticeable trend. Note that the data from 1997 to 2000 are not directly comparable to those from 2001 and after. In the former period, the question was asked simply, “do you use this method or not?” while in the latter period the question was phrased as “do you use this method always, often, seldom, or never?”

[Insert Figure 1 here.]

In terms of the percentage of *time spent in training*, instructor-led face-to-face classroom instruction occupied 69 percent of all training time in 2003, a decline of five percent from the previous year. Another ten percent of time was spent in classrooms with remote instructors, an increase of three percent since the previous year. Participation in computer-based learning occupied 16 percent of time, an increase of four percent over the previous year (Galvin 2003, p. 22).

The proportion of time spent in technology-based training has been increasing slowly for several years, now showing a trend that has not been consistent in previous years. Since the proportion of time spent in face-to-face instruction has hovered around the 70 percent level for many years and yet the number of organizations making major

use of Internet-based delivery and other technology-based delivery has grown dramatically over this period, one could conclude that technology-based training is *replacing* traditional classroom instruction to a small degree, but is *supplementing* it to a very high degree.

Traditional media. Print materials—manuals and workbooks—remain high in popularity, being used “often” or “always” at 79 percent of all businesses (Galvin, 2003, p. 30). As is shown in Figure 2, the use of print materials has remained around the 80 percent range since 1997, with a small tick downward in the past year¹.

[Insert Figure 2 here.]

The popularity of print materials suggests that independent self-study might be a rather commonly used method of instruction. Actually, self-study as a method was not included as an option in the *Training* surveys until 2002, where “self-study non-computer” was used always or often at 25 percent of businesses, falling to 23 percent in 2003. The other category, “self-study Web-based,” was used always or often at 36 percent of responding companies in 2002, rising to 44 percent in 2003 (Galvin 2003, p. 31). This suggests a trend away from print-based and toward Web-based self-study.

Videotapes are used always or often at 52 percent of responding organizations (Galvin 2003, p. 30). As is shown in Figure 3, this figure has declined substantially from the previous year.

¹ Note that the data from 1997 to 2000 are not directly comparable to those from 2001 and after. In the former period, the question was asked simply, “do you use this method or not?” while in the latter period the question was phrased as “do you use this method always, often, seldom, or never?”

[Insert Figure 3 here.]

Compared to videotapes, it has been less common for audiotapes to be used as the primary delivery system for pre-recorded training modules or courses. Consequently, it is understandable that the reported usage of audiocassettes dropped markedly when the question was changed in the 2001 *Training* survey from “do you use...?” to “how often do you use...?” As shown in Figure 4, only seven percent of companies used audiocassettes “always” or “often” in 2002 and that figure declined to four percent in 2003, whereas in previous years the reported usage rate was in the 40 percent range. Some of the drop may also be accounted for by a change in media format; it may be that when audio materials are used they are now more likely to be stored and used in some digital format rather than in tape format.

[Insert Figure 4]

The use of slides and overhead transparencies has not been tracked consistently over the years, but these media formats seem to be receding slowly, as they are replaced by computer-based display media.

The use of games and simulations that are not computer-based has declined a bit, being used “often” or “always” at 25 percent of companies (Galvin 2003, p. 31). As is shown in Figure 5, the reported adoption of non-computer-based games and simulations has been in the 30 percent range since 1997, with no consistent trend downward until the past year.

[Insert Figure 5 here.]

Telecommunications media. A small proportion of organizations use broadcast or satellite television to disseminate training programs to multiple sites. Some 20 percent

of respondents reported using broadcast or satellite television in the period of 1998-2000. When the *Training* survey changed the question to measure *frequency* of use, it was found that only five to ten percent of companies were using this delivery method “always” or “often” in 2001 and 2002, rising slightly to 12 percent in 2003 (Galvin, 2003, p. 30), as shown in Figure 6.

[Insert Figure 6 here.]

Two-way videoconferences distributed over satellite, cable, or Web are used always or often for training at 22 percent of all organizations (Galvin, 2003, p. 30), as shown in Figure 7. This indicates an increase over each of the past three years. However, two-way videoconferences are not used for a large proportion of training time except in the military services. They tend to be used as supplements to other forms of training or for special purposes, such as the introduction of new products or the rollout of new tools at organizations with widely scattered locations.

[Insert Figure 7 here.]

Computer-based media. Computer-based delivery systems have played a gradually expanding role in training over the past decade. In the early 1990s, this meant modules delivered via floppy disk or local network (LAN). Since then computer-based material is more likely encountered by means of CD-ROM or DVD modules or, more likely, by connecting to the Internet or organizational intranet. In the 2003 *Training* survey 45 percent of companies report using instruction in digital storage media “often” or “always,” as shown in Figure 8, a small increase over the previous year. However, 63 percent used Internet or intranet delivery, as shown in Figure 9, a major increase over the

previous year (Galvin 2003, p. 30). Although both ways of delivering computer-based training seem to be increasing in popularity, the big growth is in the Web-based area.

[Insert Figure 8.]

[Insert Figure 9.]

Games and simulations are often seen as ideal pedagogical methods for learning to make decisions about complex business problems, for practice under realistic conditions, or for repetitive drills on facts or concepts to be memorized. By using the computer to present the problems and select appropriate responses, more sophisticated programs can be run faster and less expensively. Considering these potential advantages, it is perhaps surprising to see that computer-based games and simulations are used “always” or “often” within only about ten percent of responding organizations (Galvin 2003, p. 31), as shown in Figure 10. Non-computer-based games and simulations are used about three times as often.

[Insert Figure 10 here.]

More advanced applications, put under the rubric of “virtual reality,” have been tracked by the *Training* survey since 1997. There has been little growth reported in this cutting-edge area. Virtual reality programs are used “always” or “often” in only about three percent of organizations (Galvin, 2003, p. 31), as shown in Figure 11.

[Insert Figure 11 here.]

Taken together, information and communications technology (ICT) delivery now accounts for roughly a quarter of the time spent in training. This represents an unusually large jump in one year and the acceleration of what had been a rather weak trend.

Consistent with this trend, the traditional audiovisual media used in face-to-face instruction show a pattern of slow decline, although video materials continue to be very widely used.

Issue 2: Constraints on Acceptance and Use of Technology

The largest constraint to the expansion of e-learning is the global business cycle, in a downward drift since 2001, but showing signs of recovery in 2004. E-learning initiatives require substantial front-end investments in hardware and software as well as in development time and talent. E-learning remains a tempting prospect for improving return-on-investment (ROI) in training. However, there does not seem to be a simple recipe for substituting “cheap” e-learning for “expensive” face-to-face instruction. E-learning obviously works equally well for instruction that is merely knowledge transmission. But for more advanced skills or skills in the affective and motor domains, more sophisticated pedagogical methods are necessary, both for face-to-face and for ICT-based instruction. For advanced skills, the secret still lies in involving learners in engaging, challenging problems and guiding their budding abilities to solve those problems. To the extent that e-learning can provide such an interactive learning environment, it will succeed and find an eager market.

Unfortunately, e-learning courses often suffer a high dropout rate, indicating both that trainees often enter with insufficient reason for staying and that the instructional methods they encounter fail to hold them. A text-heavy, didactic approach is commonly found in e-learning courses, which contrasts sharply with the problem-based, inductive approach advocated for adult learners seeking usable skills.

Issue 3: Challenges to Existing Paradigms

Blended learning. In everyday parlance, trainers have tended to classify learning events into discrete categories: face-to-face classroom instruction, online learning, self-directed study, action learning, and so on. In fact, though, corporate training programs increasingly consist of hybrids; for example, face-to-face classroom meetings interspersed with Web-based team projects; satellite video conferences followed by small-group discussions at remote sites; on-the-job action learning plus mentoring via e-mail. Combining conventional and online methods has come to be recognized as a “third path,” referred to as blended learning. The advantages of combining formats are obvious. Online activities offer self-pacing, standardization of information dissemination, and rapid deployment of new material; while face-to-face learning allows practice with feedback, team building, networking, and the other functions that are tied to people’s emotional responses. There is a growing consensus that the future belongs to blended approaches. The strong foothold of this new paradigm is indicated in the findings of the Training magazine Industry Report for 2003 (Galvin 2003), discussed earlier. The survey shows face-to-face instruction still dominating the time spent in training *at the same time* as e-learning formats are taking off in terms of more and more frequent use. How can both modes be flourishing? By being used as complements to each other—blended learning.

Since 2002 the *Training* survey has included self-study as a separate instructional mode. As shown in Figures 12 and 13, the use of non-computer-based self study declined between 2002 and 2003, but the use of Web-based self-study grew from 36 to 44 percent, making it one of the most widely used learning modes. This is a concrete

indicator of the trend toward blending Web-based materials with other methods, such as live classroom training.

In addition to combining different types of instructional media and methods, blended solutions also tend to include non-instructional cognitive supports, such as online help systems or printed job aids. Thus the line between instructional and non-instructional interventions is becoming blurred, as is the line between conventional and digital instruction.

Performance improvement. The profession formerly known as Training has been in a prolonged state of identity crisis, driven primarily by economic pressures that have forced corporations to be increasingly conscious of the costs and benefits of all their processes. Top level managers are willing to pay only for operations that actually yield results, which conventional training often does not. There is not yet a clear consensus on a name or conceptual framework for the new profession. However, one of the leading contenders is the concept of performance improvement (PI), which grew out of the instructional technology field (Molenda & Pershing, 2004). The gist of PI is that the ultimate purpose of training is to enhance performance in the workplace, which can best be accomplished by combining instruction with other interventions, such as incentives, job redesign, and job aids.

In the most recent examination of the future of the training profession, Galagan (2003) observes that “performance improvement is both time-tested and newly appealing to organizations fed up with training programs that don’t change anything that matters (p. 30).” Respondents to a survey associated with Galagan’s article favored “workplace learning and *performance*” as a new name over “training and development” and “human

resources development (p. 29).” The time may finally have arrived for a paradigm shift in the field formerly known as training.

Higher Education

As in the corporate sector, the use of instructional technology in the higher education domain is affected by external economic forces as well as internal socio-cultural influences. The downturn of the national economy beginning in 2000 and continuing through 2003 led to severe shortfalls in state tax revenues, which led to tightening of budgets at most state-supported universities, which in turn forced cutbacks in planned upgrades or expansions of academic computing. Although the business cycle began improving in 2004, those improvements had not begun to ripple into college and university budgets.

Economic forces have not favored instructional technology thus far. Investment in new technology tends to be driven by payoffs, particularly economic payoffs. Organizations implement technology with the hope that it will increase their benefits or decrease their costs. In the case of higher education, information technology has begun to pay off in terms of administrative costs and improvement of student services at a more affordable cost. But information technology has not proven to be a cost-reducer on the educational side of operations. Indeed, as long as universities are organized as they are (teacher-centered decision-making, professors as independent operators, decentralized academic fiefdoms), there is little possibility to reduce instructional costs. So, instructional technology advocates are left with the claim that benefits increase: greater numbers of students reached, students more satisfied, faculty more content and/or

productive, and the like. This benefits argument is not as potent as the economic one, so the provision of technology support tends to be lower than in other parts of the administration.

The tempo of change in instructional practice, including what tools will be used, is driven much more by the dynamics of socio-cultural forces within colleges and universities themselves: by whom instructional decisions are made, whose interests are primary, and how rewards are allocated. In American colleges and universities, these forces are generally conservative of traditional practices and values, thus putting a brake on major change in teaching-learning arrangements.

Issue 1: Use of Technology-Based Media for Delivery of Instruction

Classroom media: Traditional audiovisual media. Many college and university instructors still prefer to use analog media—audio and video cassettes, overhead transparencies, 2x2-inch slides, and the like—for many reasons including legibility, reliability, familiarity, and a large installed base of materials. Administrators, on the other hand, tend to prefer digital media. They are seeking standardization to allow compatibility within and across departments. Standardization would allow updating and expanding of existing materials without having to start all over, as is the case with analog media. As in the corporate sector, the dream is an enterprise-wide database for all the institution's instructional media.

Since digital media are viewed as the way of the future, there is little research on the extent to which analog media are still used. However, an informal survey of university media service centers indicates such usage is still common, for example:

- Overhead projectors—virtually every classroom is equipped with a projector, and instructors still use them, although no usage statistics are kept. Many instructors, especially younger ones, use PowerPoint™ presentations instead of or in addition to overheads.² However, attempts to remove the overheads and substitute document cameras meet faculty resistance. The authors have witnessed this themselves. When a new Education building was furnished the dean insisted on equipping the largest classroom only for digital media, prohibiting electrical outlets in the front of the room just to be sure that overheads could not be used. The faculty dragged in overhead projectors and found extension cords to reach the side outlets.
- Slide projectors—circulation of projectors is declining, but projectors tend to be built into classrooms and labs in departments that make heavy use of slides, such as biology, veterinary medicine, optometry, fine arts, classics, and drama. These fields rely on visual images, and high resolution is often a priority. It is difficult to match the sharpness of optical images with digital projection. In addition, such departments often have large collections of slides, including of historic subjects, which simply can't be replaced by newer digital media.
- 16mm films are still used, mainly in film-studies classes, but a small number of instructional films are used in other classes.

² Although this has not been documented with formal research, there is growing anecdotal evidence of student malaise with PowerPoint™ over-use. Some of the malaise is attributable to the monotonous series of bulleted lists that are all too easy to create with the PowerPoint™ software.

- Video recordings in VHS format are still widely used, with thousands of bookings annually at universities with large central collections. Circulation has been steady for about ten years. As VHS video recordings have become less expensive, many individuals and departments own their own copies; showings of these do not appear on campus circulation records.
- DVD recordings are growing in popularity, slowly replacing the VHS format, although their total circulation figures are only a quarter of those of VHS videos at the present time. Many of the VHS titles that are now used by faculty are not available in DVD format; further, libraries and media centers cannot afford to replace their already large collections of VHS recordings. Consequently, VHS will continue to be used for many years to come.

As noted, VHS, overhead, and slide formats are going to continue to be significant vehicles for instructional presentations for the foreseeable future. We can foresee a coming hardware crisis, as slide and VHS equipment ceases to be available in the marketplace. Campus media service centers are going to be hard pressed to provide the equipment needed to keep showing the software on which the faculty rely.

Classroom media: computer-based digital media. In our 2002 annual review (Molenda & Sullivan, 2002) we reported that the pace of faculty adoption of computer-based media appeared to be slowing. According to the annual surveys of the Campus Computing Project between 1997 and 2000, faculty adoption of certain computer-based teaching applications—such as course Web pages and use of Internet resources—grew each year during that period. However the percentage increase was *smaller* each succeeding year, indicating plateauing of the adoption rate.

Unfortunately, the Campus Computing Project has not continued to measure these indices and has focused on other topics in information technology. This lack of attention may be an indication of a slackening interest in classroom media within the academic computing community. In fact, in the 2004 EDUCAUSE survey, e-learning, distributed learning, and course management systems have slipped from near the top to near the bottom of the list of concerns of information technology professionals (Spicer and others, 2004). In any event, there are no national data comparable to those of the Campus Computing Project. However, it is possible to get a picture of how usage of digital media has evolved by piecing together a sampling of internal university reports. Four reports were found (Indiana University-Bloomington, University of Wisconsin System, Wright State University, and City College of San Francisco), which can be summarized in Figures 14 and 15.

[Insert Figure 14 here.]

[Insert Figure 15 here.]

Generalizing from these selected cases, we can project that around 90 percent of all faculty exchange e-mail with students; some 60 percent use class listservs; about one-half assign the use of Web resources; upward of 40 percent show digital presentations; about 20 percent provide online discussion forums; and between 10 and 30 percent provide online simulations or lab experiments.

Figure 15, showing comparative data from 1998 and 2002, also reinforces our earlier hypothesis that the curve of adoption has slowed in recent years, as the growth rates were higher in the years before 1998. This is mentioned specifically in the City College of San Francisco (CCSF) report:

...there were significant gains in use and interest between 1997 and 1999, but the ensuing two years showed a much flatter trajectory...There has been no increased interest in using listservs or presentation software...the use and interest in computer lab assignments and computer lab classes remained virtually unchanged. (*Research & Planning Briefs*, 2003)

A number of other interpretations may be drawn from these findings. First, these findings indicate that faculty incorporation of computer media in their teaching can be viewed as a wide spectrum of adoption decisions, not a single yes/no decision. Second, consistent with earlier national survey findings, a decade after the Web became widely available to students and faculty, barely half the faculty are incorporating Web resources into their courses.

Third, it can be inferred that uses requiring a greater change from familiar practice will be incorporated less readily. Most faculty already use e-mail as a matter of daily routine, so it's not surprising that some 90 percent extend this use to their teaching. Setting up and using distribution lists requires a bit more time and effort, so use of listservs drops to the 60 percent range, and so on with the other applications shown in Figures 14 and 15. At the other end of the spectrum is the use of online simulations and lab experiments, which require considerable investment of time and special expertise, hence attracting a much lower rate of adoption.

Finally, one could hypothesize that there is an inverse correlation between adoption and likelihood of making a major impact on learning improvement. The most popular uses entail reading or viewing informational presentations while the least popular require active engagement, negotiating understanding, and seeking patterns in complex

problem-solving spaces. Small improvements in instruction come easily; major advances require greater investment of time and resources, and possibly structural change.

Course management systems. Software systems specifically designed to manage course content and course activities have become a mainstay at most colleges and universities. By 2002 over three-quarters of all colleges and universities had adopted a standard course management system (CMS) (Campus Computing Project, 2002), and by 2004 such systems could be considered to be ubiquitous. One brand, Blackboard, dominates the market. Its success in capturing this market enabled Blackboard, Inc. to become a publicly traded stock in mid-2004. Although Blackboard has become the de facto standard for CMS, a number of universities—including Indiana, Michigan, Stanford, and MIT—are working to establish an “open source” standard to compete with the proprietary one. Their Sakai Project has the goal of enabling faculty and developers at all universities to create instructional materials that are transportable within and among universities.

The existence of a CMS motivates faculty to create content to make use of this delivery system. Having created ingenious learning activities, they want to be able to reuse them each semester and to adapt them over time. Eventually they may wish to share lessons or parts of lessons with others. These “reusable learning objects” can only be shared if they are created using standards and methods common to other users. Although very few faculty are consciously aware of or interested in “reusable learning objects,” they find themselves becoming creators and users of them. Thus, what has been a topic of theoretical and technical concern for a decade—without much practical payoff

in higher education—is becoming a topic of urgent importance (Metros & Bennett, 2004).

Distance education. Around the time of the dot-com collapse the most highly touted American university distance education (DE) initiatives had already crashed in flames, and in 2004 the major British effort, UK eUniversities Worldwide or UKeU, was dismantled. As further indication of the fading of the land-rush mentality, in EDUCAUSE’s annual survey of top issues facing administrators, for “issues with a high potential for becoming significant in the coming year,” distance education dropped from first place in 2001 to off-the-chart in 2004 (Spicer and DeBlois, 2004). Nevertheless, many more modest distance education ventures continue to grow steadily.

Of all residential four-year colleges and universities and two-year community colleges, over two-thirds now operate distance education programs (over 90 percent for major public universities). Among these dual-mode institutions, DE enrollments grew by an average of over 25 percent from 2003 to 2004, according to Primary Research Group (2004). A significant finding of this survey is that the audience for such programs seems to be shifting. DE programs initially targeted such “non-traditional” niche groups as single mothers, employed adults, people with disabilities, and those living in remote areas. By 2004 these programs were becoming more fully integrated into the universities’ traditional programs and now draw many students who are already enrolled in regular on-campus courses of study.

Among dual mode institutions, an operational model that appears promising is the consortium approach—having a common portal, sharing course development and marketing costs, but facilitating enrollment at any one of the participating schools. Over

thirty states have formed such distance learning consortia, and some have experienced growth far above the average for individual institutions. For example, in 2003-2004 New York State's SUNY Online had over 70,000 enrollments, an increase of 32 percent over the prior year; UMassOnline enrolled 15,000, also up 32 percent. Illinois's Virtual Campus had over 125,000 enrollments, in increase of 54 percent.

One factor impelling universities to develop online programs is the pressure from proprietary institutions such as University of Phoenix Online and Jones International University, which have achieved enrollments larger than any individual universities, and have demonstrated that online-only universities can be profitable, a goal that is still elusive for most dual-mode institutions.

Issue 2: Constraints on Acceptance and Use of Technology

Administrative Issues--Funding. The financial picture of higher education was summarized by the executive director of the Western Interstate Commission for Higher Education (WICHE): "American higher education is confronting a perfect storm of more limited public resources, increasing demand, and an increasingly difficult-to-serve customer base of poor and minority students" (Symonds, 2003, p. 74). This financial climate of falling state government revenues, leading to falling state university budgets has led to more and more severe cuts to academic computing budgets. In 2003, 41 percent of all institutions reported cuts (higher for public universities), up from 33 percent in 2002 and 18 percent the year before that (The Campus Computing Project, 2003).

In this time of tight budgets, administrators find themselves in an "arms race" with other colleges and universities, requiring increased investments in services such as

wireless access. This is true even of the elite liberal-arts colleges. All of the top liberal-arts colleges are fully wired and racing to keep up with amenities offered by the competition (Smallen, 2004). Students have these digital amenities at home and expect to find them at college. Nearly 80 percent of all campuses have wireless LANs (up from 30 percent in 2000). Only a small proportion of these cover the whole campus; on the average about one-quarter of the campus has wireless access (Campus Computing Project, 2003).

“Going wireless” is just one of the current funding challenges. Institutions continue to struggle with the battle of bandwidth, attempting to keep up with the enormous traffic loads caused by student downloading of music and video. More rigorous enforcement of copyright claims, downloading quotas, and user charges are all being pursued by universities in an effort to manage this problem.

With lowered incomes and rising infrastructure demands, it is not surprising that for the past two years in a row “funding information technology” has been the number one issue of concern among information technology administrators (Spicer & DeBlois, 2004). This climate obviously imposes constraints on resources available for the sorts of faculty development and technical support needed to promote deeper and wider use of technology in the teaching-learning enterprise.

Administrative Issues--Productivity. Closely related to the funding issue is that of achieving productivity improvements. Ultimately, any investment must be judged according to its contribution to productivity, and that includes the adoption of instructional technologies. There are several ways of measuring productivity, several ways of comparing decreased costs and/or increased benefits. So far, instructional

technology innovations have not garnered a track record of either clearly lower cost or clearly increased student learning. One possibility is promoting the notion of indirect benefits, such as increased student satisfaction. That is, one could argue that better discussion opportunities, enhanced feedback, and easier access to updated grades improve the student's educational experience. This benefits the institution by increasing student retention and improving the whole educational climate.

However, there are projects, notably the Pew Program in Course Redesign, that have compiled an impressive track record of using technology to redesign courses that are both less expensive and more effective. The features that account for the success of these remarkable courses are familiar to instructional technologists: whole course redesign, active learning instructional methods, computer-based learning resources, a mastery learning framework, on-demand help, and alternative staffing (Twigg, 2003). These course design models could help turn the productivity argument from a constraint to an advantage.

Faculty acceptance. As discussed earlier, instructors have a tendency toward conservatism in selecting teaching methods. The burgeoning of course management systems (CMS) and administrative promotion of these systems has triggered an interesting payoff for improved teaching. Most large universities now support a primary CMS and have pressed individual instructors to at least post their syllabus and some course materials on the system. As it is now playing out, this simple adoption seems to serve as a wedge that expands to encompass more and larger changes. Professors report that they tend to use the CMS more and more extensively because they gradually see more potential uses of its features. It begins with the content presentation tools, and for

some it ends there. Many users go on to make use of the discussion forums, quiz tools, and gradebook. Usage of the features of the CMS has a cascading effect (Morgan, 2003).

On the other hand, other professors, a minority, stop or even regress in their CMS adoption. They often resent the time required to load and reload course materials. Some find the CMS structure to be inflexible and inadaptible to their preferred teaching approach (Morgan, 2003).

Issue 3: Challenges to Existing Paradigms

Ubiquitous Computer Networking. Quantitative changes sometimes become qualitative changes. Over the past twenty years the surging growth of the Internet, the relentless wiring of campus networks, and more recently the overlay of wireless networks has made virtually every higher education institution a “network of networks.” This process has progressed to the point that the everyday functioning of colleges is *dependent* on the functioning of its networks. Students, faculty, and staff can no longer do their work without the campus network. This dependency signals a qualitative change: the institution has been transformed, intentionally or not (Stunden, 2004).

This transformation of the communication system has made possible the unbundling of the rights and responsibilities of the faculty, emphasizing the roles of course manager and coach and making possible the outsourcing of roles such as lesson designer-producer and information dispenser. There becomes a technological imperative to carry out the unbundling, to find the cheapest labor source for each of the constituent roles. The same is true for students (who may be affiliated with two or more colleges at a time), other staff, and administrators. People’s long-held, comfortable roles are changing.

At a deeper level, technological transformation is challenging the very meaning of a college. Cyber-universities like University of Phoenix Online and Jones International University bring into question the notion of having a campus...and even of having a faculty. Institutions will have to examine deeply what their values and mission are, and they may find themselves evolving into a more diverse set of institutions than we have now. Rather than a unitary model of what a college is, there will be multiple models. The landscape could look quite different in the next generation.

K-12 Education

It would be impossible to tell the story of technology integration in K-12 education during the past year without putting it into the context of President George W. Bush's "No Child Left Behind" (NCLB) initiative, since this law has been the signature element of the federal government's education agenda since its signing in 2002 and therefore the lens through which most K-12 developments must be viewed, including the use of technology. State and local funding for technology, already stressed by tax revenue declines, was further stressed by the diversion of funds to testing programs.

Issue 1: Use of Technology-Based Media for Delivery of Instruction

Computer-Based Assessment. As it happens, the focus of technology-based media in K-12 education during the past year has not been on the use of computers for instruction, but rather on the use of computers as a tool for the *assessment* of instruction. This shift in view of technology use, a direct result of the NCLB legislation, was highly controversial and became a campaign issue for the 2004 presidential election. One of the key issues in the controversy over the legislation was the major emphasis on test scores

and testing processes to measure whether schools achieved “Adequate Yearly Progress” in student achievement as required by NCLB (Austin, April 8, 2004).

As might have been expected, one solution proposed to address the problems of testing for Adequate Yearly Progress was computer-based assessment and recordkeeping. The emphasis on the computer as a tool of assessment and accountability was shown by the titling of *Education Week*'s annual Technology Counts report as “Pencils Down: Technology’s Answer to Testing” (Education Week, May 8, 2003). This special issue included articles that explored the drivers and restrainers for computerized testing (Olson, 2003), the problems and promise of computer adaptive testing for K-12 schools (Trotter, 2003), students’ use of online test-preparation materials for Advanced Placement tests and college-entrance exams (Borja, 2003), the role of computers in testing children with disabilities (Goldstein, 2003) and in classroom assessment (Galley, 2003), as well as the economic boon of computer-based assessment to for-profit companies that have a presence in the marketplace of education (Walsh, 2003).

Schools’ needs for large-scale, high stakes testing stimulated a vibrant commercial market. Mergers and acquisitions between K-12 education companies were up from 27 in 2002 to 34 in 2003 (Education Week, April 14, 2004). In order to procure “eduTest,” a computer-based assessment system, Plato Learning acquired Lightspan in one of the major deals of 2003. Plato Learning also acquired NetSchools Corporation, a curriculum standards management company, in 2003.

Like its for-profit counterparts, the National Center for Education Statistics (NCES) also explored the potential of computers for testing and measurement during this period. The NCES engaged in the Technology-Based Assessment (TBA) Project, the

primary purpose of which was to explore how the use of computers would “enhance the quality and efficiency of educational assessments” for the National Assessment of Educational Progress (NAEP) (National Center for Education Statistics, 2004). Also known as “the Nation’s Report Card,” NAEP is a nationally representative assessment that has been administered periodically since 1969 to measure student performance in reading, mathematics, science, writing, history, civics, geography and the arts. During 2003-2004, the NCES engaged in a three-phase process of pilot testing, pre-testing and field-testing several components of the TBA including assessments for math, writing and problem solving.

The need for and consequences of accountability as defined in the NCLB legislation were hotly debated in the professional and popular literature, with a supportive position taken by Chester E. Finn Jr. and William J. Bennett in an opinion piece in the Wall Street Journal titled “No standards without freedom” (2003, December 23), which identified one key value of the accountability movement as its provision of “private alternatives to failing public schools” (p. A14). A rejoinder by Alfie Kohn ran in the Kappan (2004) titled “Test Today, Privatize Tomorrow: Using Accountability to ‘Reform’ Public Schools to Death,” which claimed that the high-stakes testing initiative at the heart of NCLB has already begun to undermine public education.

Traditional audiovisual media. There are few sources of current information on a national level regarding the usage of non-computer media in the schools. NICEM, which operates a national database of audio and video materials, continues in operation after more than 35 years. It has a catalog of over 440,000 titles and adds 20,000 new titles a year. So, clearly, audiovisual materials continue to be produced and used in classrooms.

While the interests of federal-level politicians and policy makers were focused on issues of accountability and the role that computers may take in addressing accountability, the primary source of funding for media/technology centers came from local and state governments, and funding from those sources has decreased during the past two years (NAMTC, 2003).

The predominant media formats in the collections of members of the National Association of Media & Technology Centers (NAMTC) continue to be analog, particularly videocassettes. Their collections include (from greatest to least) videocassettes, multimedia, curriculum materials, professional books, digital video disks and CD-ROMs. However, purchases of some types of digital media during the past two years outpaced purchases of most types of analog media. While videocassettes still represent the greatest expenditure, expenditures for this analog medium were closely followed by expenditures for several types of digital media including internet resources, DVDs, and multimedia.

Computer-based media. The constraints on local education spending due to the sluggish national economy were reflected in school administrators' estimates of expected spending for 2002-2003 (Market Data Retrieval, 2003). Projected technology spending for hardware, software, and staff development dropped 25 percent in one year, to \$89 per student. To compare, projected technology spending was \$118 per student in 2001-2002.

Four measures of leading-edge technologies in schools showed significant growth during 2003, including the presence of DVD drives, laptops, wireless networks, and high-speed Internet access (MDR, 2003). The presence of DVD drives in schools increased 67 percent in one year, with half of all U.S. public schools having DVD drives in the school.

The number of schools using high-speed internet connections such as T1, T3, or cable modem increased from 75 percent to 80 percent of all public schools.

Schools, like universities, are going wireless. The percentage of schools with wireless networks nearly doubled, from 15 to 27 percent. Additionally, 43 percent of schools reported having some wireless laptop computers, up seven percent from the previous year, with the actual number of laptops in those schools averaging about 22 (Park and Staesina, 2004). The proliferation of laptops has been hampered by the downturn in state education budgets. Early in the decade there was a boomlet in state programs to provide every student with a laptop, but that movement has stagnated with the budget crunch.

The oft-cited student-per-Internet-connected computer was 4.3:1, much improved from 5.6:1 the previous year (Education Week, 2004). Along the way, however, the federal E-Rate program, begun in 1996 to fund computer infrastructure in poor and rural schools, has come under increasing scrutiny for its susceptibility to fraud. Many computer suppliers have sold schools equipment they did not need, overcharged them, and then even inflated the bills submitted to the government authority even further. In June 2004 the U.S. House of Representatives was engaged in an investigation of fraudulent practices in the E-Rate program, with major cases erupting in Puerto Rico, Milwaukee, New York, and other cities. In the largest fraud case, NEC Business Network Solutions pleaded guilty and agreed to pay \$21 million in fines and restitution. At least one school information technology director has been convicted of collusion in such fraud (Richtel and Rivlin, 2004). Professional organizations, including the International

Society for Technology in Education (ISTE) and the Consortium for School Networking (CoSN) were obliged to undertake public relations efforts to save the E-Rate program.

Emerging digital technologies. Handheld personal computers, referred to as pocket PCs or personal digital assistants (PDA) have progressed beyond the experimental stage to significant use in the classroom. Nationally, about eight percent of schools provide PDAs for teachers and four percent provide them for students (Park and Staresina, 2004). Handhelds have been adopted on a large scale in a number of school districts and are finding “niche” purposes that they serve well. For teachers, they are especially useful for lesson preparation and classroom management, for example, taking attendance. For students, handhelds are used as digital readers and graphing calculators, for word processing and spreadsheet creation, and for specific instructional activities, such as concept mapping (ISTE, 2004).

Video games, the high technology application that children know best, are still far from being adapted to constructive educational use. The potential is well established, but creation of appropriate software is still an extremely expensive proposition, too expensive for commercial producers to undertake in view of the small size of the market. Indeed, overall sales of educational PC software have actually been dropping in recent years. With development costs so high and potential sales so low, truly educational video games are still a distant prospect.

Teacher computer use. What do teachers *do* with the computer hardware and software to which they have access at work? In recent years Internet communication and search functions have been used at a slowly increasing rate, with the most common uses continuing to be gathering information for lesson plans, communication with colleagues,

administrative record keeping, and communicating with parents (U.S. Department of Education Policy and Program Studies Service, 2003).

Directly instructional uses are less common. While about one-half of all teachers (55 percent) report that they use computers for instructional purposes at least once a week (69 percent of elementary teachers and 43 percent of secondary teachers), those uses tend to be rather marginal. The two most popular activities assigned to students are to improve their computer skills” and “to have free-time, as a reward.” Next most popular are drill-and-practice exercises and doing word processing. More innovative activities tend to be assigned by only a small fraction of computer-using teachers, as indicated in Figure 16.

[INSERT FIGURE 16 HERE.]

Student computer use. In fact, K-12 students primarily access and use technology *at home* rather than at school. Seventy percent of students in grades 7-12 and 57 percent of students in grades 4-6 who participated in a NetDay survey conducted in late October 2003 reported that their home was the primary access point for using technology to complete schoolwork.

Students typically learn about new technology and internet resources primarily from friends, parents, and through personal online exploration, rather than from a class or a teacher recommendation. The Internet tools that students use most frequently are e-mail, search engines, instant messenger, and online games. Seventy-nine percent of students in grades 7-12 have their own e-mail address and 70 percent have instant messenger accounts. Almost half (45 five percent) of students in grades 4-6 have an e-mail account, while 29 percent of students in grades K-3 have an e-mail account (NetDay, 2003).

When at school, students in grades 4-12 use computers predominately in a computer lab (64 percent). Students in grades 4-12 most commonly use computers at school to find information, visit class or school websites and to take tests. Students in grades K-3 use technology to play learning games, create pictures, and practice spelling and reading, and these younger students primarily access technology in their own classrooms (NetDay, 2003).

Computer access is the overarching obstacle to using technology more at school, according to students who participated in the NetDay survey. Lack of time during the school day, slow internet access time, school filters and firewalls, not enough computers in the school, and having computers that are not functional were the most frequently reported obstacles by students in grades 7-12 (NetDay, 2003).

Equity in access. The percent of Technology Literacy Challenge Funds (TLCF) that were apportioned to high-poverty school districts declined significantly between 1997 and 2000, with the poorest half receiving 80 percent of funds in 1997, but by 2000 the percentage of funds apportioned to this group had dropped by 30 percent to the point at which funding was equal to their proportion of the population (U.S. Department of Education Policy and Program Studies Service, 2003).

During the 2003-2004 school year, most school districts faced stagnant or declining technology budgets, contributing to a growing gap between “have” and “have not” schools. On the other hand, the money gap is not completely synonymous with a gap in services. A recent survey of school technology decision-makers reveals that visionary leadership and local community support can influence how those funds are

expended. Through careful prioritizing, some schools have been able to channel funds into activities that have helped improve teaching and learning (CoSN, 2004).

Another study showed that teachers in high-poverty schools appear to use computers differently than teachers in other schools, creating another equity gap related to technology use. Seventy percent of teachers in high-poverty schools use technology to teach basic skills and facts through drills, tutorials, and learning games, compared to 54 percent of teachers in other schools (U.S. Department of Education Policy and Program Studies Service, 2003).

Issue 2: Constraints on Acceptance and Use of Technology

Professional Development. Given that computers and the Internet are almost universally available in schools, one might assume that the challenge of technology integration is to build capacity to use these technologies for instructional purposes. Because a major key to increasing capacity is to build the technology skills of teachers, the NCLB Act of 2001 requires states to allocate 25 percent of federal technology dollars to professional development. However, only 15 percent of schools' technology budgets were spent on staff development in 2003 (Education Week, 2003).

The greatest professional development need identified by teachers is for the integration of technology into instruction. Virtually all teachers say that they would be willing to engage in additional professional development on the topic of educational technology, but what they mean is learning how to integrate technology into instruction (80 percent), not just learning basic computer skills (37 percent) (U.S. Department of Education Policy and Program Studies Service, 2003).

In lieu of or in addition to professional development, teachers are using other strategies to learn about technology (see Figure 17): 95 percent report that they teach themselves to use computers; 88 percent learn from other teachers at school; 78 percent learn from family and friends; and 50 percent learn from their students. In an indication that children of the Information Age are now reaching adulthood, 13 percent of teachers say they have learned technology use from their own K-12 schooling (U.S. Department of Education Policy and Program Studies Service, 2003).

[INSERT FIGURE 17 HERE.]

Barriers to Use of Technology. Time continues to be the greatest barrier to teachers' integration of technology into instructional and professional activities. Lack of time to develop activities is a constraint reported by 68 percent of teachers. Issues of access also create barriers to computer use: teachers report not having enough computers (47 percent), lack of student access to computers outside of school (46 percent), and lack of access to appropriate materials (37 percent) (U.S. Department of Education Policy and Program Studies Service, 2003).

[INSERT FIGURE 18 HERE.]

Technology support. The lack of technical support for computers is one additional barrier to teachers' integration of computers into their professional and classroom activities. While virtually all teachers report that technology support of some sort is available to help them with computer integration, only half report that their needs for technical support are met fairly or extremely well (U.S. Department of Education Policy and Program Studies Service, 2003). A full-time technology coordinator is present in only 16 percent of schools; a full-time teacher who also has the title of technology

coordinator is present in 21 percent of schools; a district-level coordinator only is available to 17 percent of schools; and the library/media specialist serves as technology coordinator for 14 percent of schools. In all other cases, the level of technology support is informal or ad hoc (Education Week, 2003).

Issue 3: Challenges to Existing Paradigms

Virtual Schools. The number of states that allow virtual charter schools tripled between 2002 and 2004. In 2002, twelve states had established online high school programs {Trotter, 2002 #58, p. 16}. A year later over 40,000 students attended approximately 2,400 publicly-funded virtual schools and virtual charter schools in 37 states (Fording, 2004). “From a federal standpoint, virtual schools and distance learning is one of the top technology issues we are focused on,” according to one federal official (Fording, 2004, p. 2). Some school districts are creating virtual schools in order to compete with for-profit competitors, since many states mandate that state funding follows students when they transfer to a charter school, thus siphoning millions of dollars out of the public schools. Public school administrators are also discovering that online classes serve several sub-groups of students who have traditionally posed a challenge to regular schooling—students with emotional and behavioral disorders or health problems, students who drop out or are expelled, and pregnant or parenting students.

While the number of states allowing virtual charters schools has grown during the past two years, the number of questions and concerns about these types of schools has also grown. There are concerns about the isolation of students who take online classes, the lack of activity involved in virtual classes, lack of access to these classes for all students, and the policy barriers to distance learning given the historical locally-

controlled nature of K-12 schools (Fording, 2004). School leaders have expressed numerous questions about virtual learning environments, including the development of content, policies and management issues, technology support as well as support for teachers and parents.

The two most fundamental concerns about virtual schools are the same concerns expressed about traditional schools, issues of cost and quality. Initial reports regarding both of these measures do not reflect favorably upon virtual schools. Test results from the states of Pennsylvania and Ohio for 2003 show that virtual school students scored below state averages on a majority of proficiency tests, did not meet state standards, and did not match the achievement levels of their peers attending traditional schools (Gartner, 2004a).

Regarding comparative costs, virtual schools do not appear to be much cheaper to operate than traditional schools, even though virtual schools do not require expenditures for the physical infrastructure required by traditional schools (Gartner, 2004b). Despite having a ratio of between 40 and 50 students to one teacher, the for-profit virtual school Connections Academy has lost money in Florida. A vice-president of for-profit K12 Virtual Academy estimates that states need to allocate approximately \$5,000 per student to adequately support virtual schools and at that level of funding, “the profit is in the curriculum” (p. 1). Legislators and education departments in several states, including Florida, Ohio, Idaho and Pennsylvania have questioned the amounts that for-profit companies charge to operate schools and want more oversight authority regarding how funding for virtual schools is spent by these for-profit companies (Gartner, 2004b).

Some educators have expressed concerns about the close relationships between the nonprofit school boards that oversee the schools and the for-profit companies that manage school budgets because “none of the states with virtual schools prevent board members from having ties to school-management companies or even from serving in dual roles” (Gartner, 2004b, p. 3). As discussed previously in this chapter, Kohn (2004) expressed a similar concern in his rejoinder to Finn and Bennett about the relationships between education officials and for-profit companies at the federal-level, arguing that the emphasis on assessment by education officials in the Bush administration masked the administration’s goal of privatizing public education. Kohn’s cynicism regarding Bennett’s own motives seems to be justified, given that Bennett (who was the Secretary of Education for George H. W. Bush) founded and is on the Board of Directors of K12, one of the for-profit virtual academies that has been the focus of state legislators’ concerns regarding cost accounting for virtual schools.

Effectiveness of Technology. The emphasis on accountability coupled with tight state budgets has led administrators and policy makers in education back to the question of return on investment for technology expenditures. Meta-analyses of the effects of technology by McCabe & Skinner (2003), by Waxman, Lin and Michko (2003) and by Kulik (2003) all indicate small but positive effects on student achievement of various types of technology, for example, computer-simulated frog dissection, interactive CD-ROM storybooks, computer-based basic skills development and the Plato Learning System.

Though there appears to be some positive effect on learning from the use of computer technologies, this association is tenuous at best, and those who are looking for

evidence of a positive effect between educational technology and student achievement must continue the search. However, some technology proponents are beginning to question whether evidence of this association really matters (McCabe and Skinner, 2003). As these technology advocates note, educational researchers are not looking for positive effects of other technologies such as books and pencils on achievement; there are other benefits of technology integration (such as increased employment opportunities for students with computer skills), and technology can influence teachers and students in ways other than achievement, such as student engagement and school climate.

NCLB and the new National Educational Technology Plan. The NCLB Legislation mandated the development of a new National Educational Technology Plan to “inform and guide policymakers in their efforts to ensure that schools will be able to use technology to support high-quality teaching and learning for all students” (Culp, Honey and Mandinach, 2003). U.S. Department of Education policymakers in the Office of Educational Technology spent a fair amount of time in 2003 working to develop that plan, which is likely to shape the direction of education technology integration efforts at the federal and state levels for some years to come. In a report commissioned to contribute to the development of the new National Educational Technology Plan, Culp, Honey and Mandinach (2003) summarize what they believe should be the focus of educational technology policy in the near future:

... educational technologists have begun to understand with more nuance that technology needs to work in concert with other factors like effective leadership, instructional priorities, and the day-to-day demands of classroom practice. The most recent policy reports begin to address these

needs, and are once again placing technology in the context of broader educational challenges that are of immediate concern to educators and which technology may be well positioned to address, such as the need to make productive use of assessment data; to provide increasingly individualized and flexible but sustained and substantive professional development; and to create administrative efficiencies that support educators in day-to-day work with students and colleagues. These are some of the most promising links between education and technology ...

To summarize, this planning document emphasizes the use of technology to facilitate assessment, professional development, and administrative efficiency. We have already noted in this chapter the increasing role of technology in education assessment. If the Office of Educational Technology takes on the additional priorities of efficiency and professional development in the next National Educational Technology Plan, it appears that the next phase of technology integration in education will focus on administrative support rather than on teaching and learning.

Conclusion

During the period covered in this review, schools, colleges, and businesses were still suffering from the budget exigencies inflicted by the recession of 2000-2003. Corporate training budgets actually contracted two years in a row. In schools and colleges, many information technology operations absorbed budget cuts, although the majority managed to avoid service reductions. Information technology infrastructure continued to expand nevertheless, so that access to networks became virtually ubiquitous.

On the other hand, instructional use of ICT advanced at a decreasing pace, a trend that has been notable for about three years. Use of traditional audiovisual media has been stagnant for a decade, while use of digital media is growing, but slowly—a few percent a year. Growth in instructional use of digital media was a bit faster in the corporate domain, but slower in the higher education domain.

Put together, these trends tell us that pervasive access to information technology infrastructure does guarantee its use in teaching. Infrastructure is a necessary condition for use, but not a sufficient condition. Human factors such as resistance to practices that require new ways of working and the need for specialized training impinge on trainers', teachers', and professors' use of ICT. Because of these human factors, as they play out in training and education, it is inevitable that technology use lags behind technology availability.

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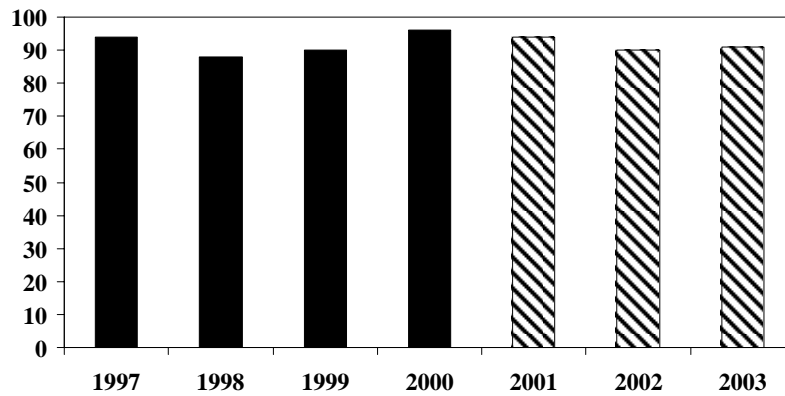


Figure 1. Percentage of organizations using **Live Classroom**
 (In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

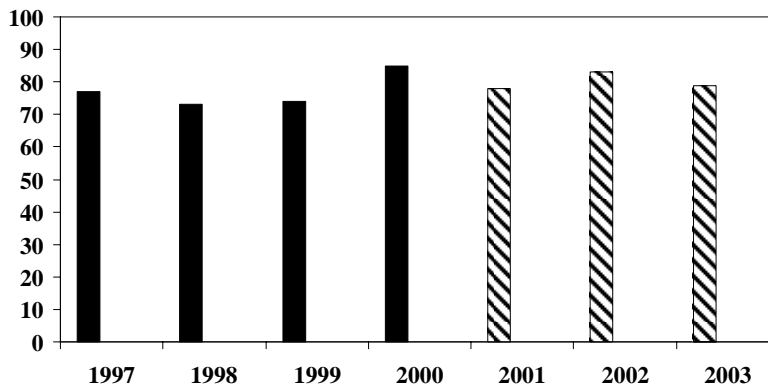


Figure 2. Percentage of organizations using **Workbook/ Manual**
 (In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

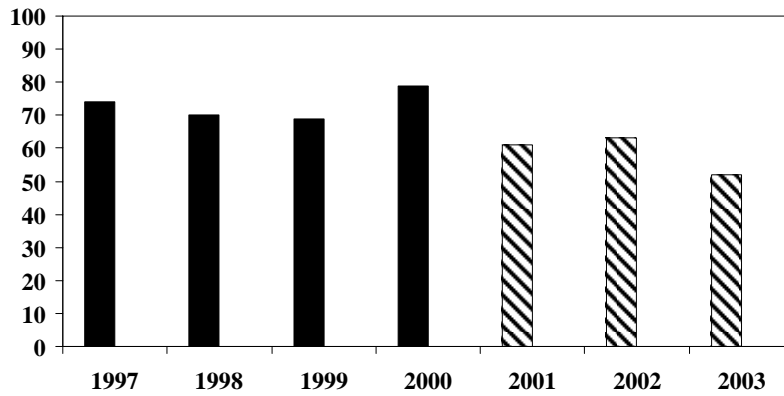


Figure 3. Percentage of organizations using **Videotapes**
(In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

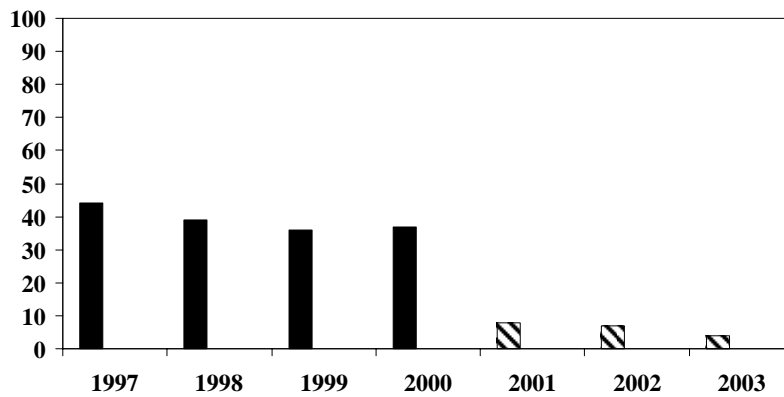


Figure 4. Percentage of organizations using **Audiocassettes**
(In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

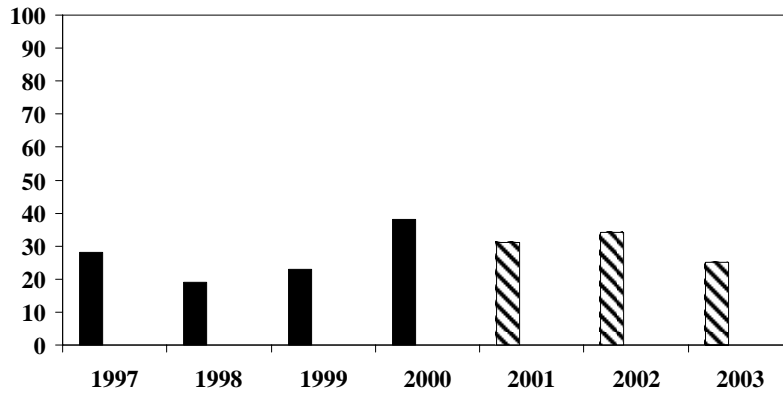


Figure 5. Percentage of organizations using **Games/Simulations, non-computer** (In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

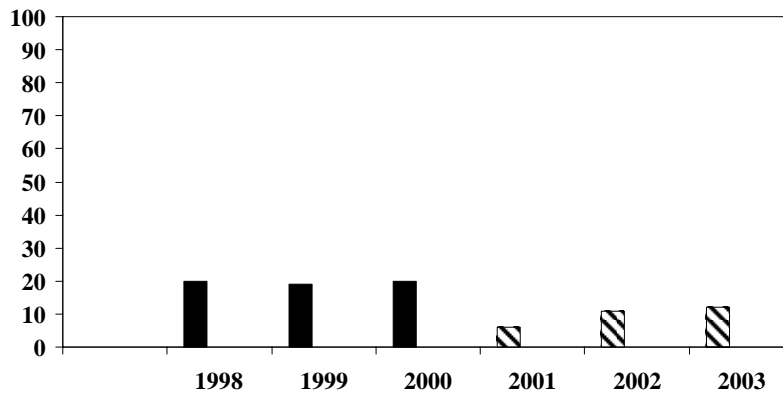


Figure 6. Percentage of organizations using **Broadcast or Satellite TV** (In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

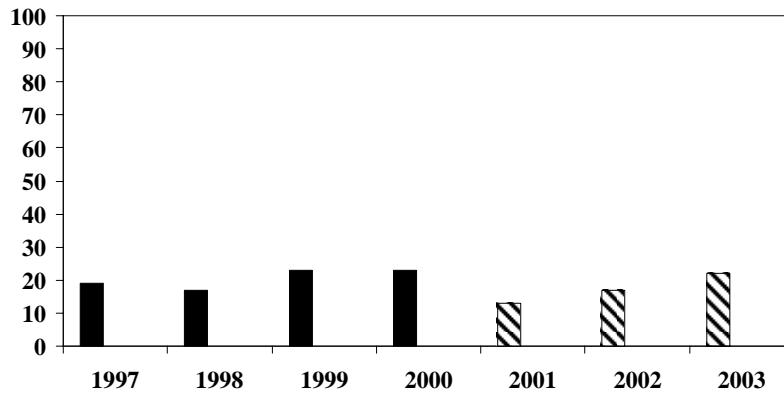


Figure 7. Percentage of organizations using **Videoconferencing** (In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

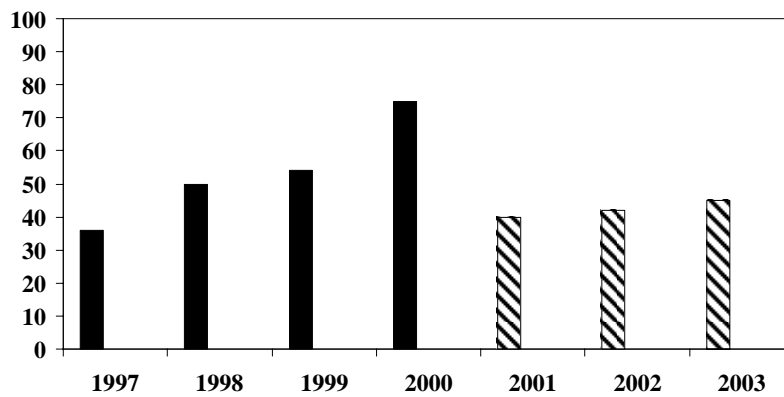


Figure 8. Percentage of organizations using **Digital Storage Media-- Diskette, CD, or DVD** (In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

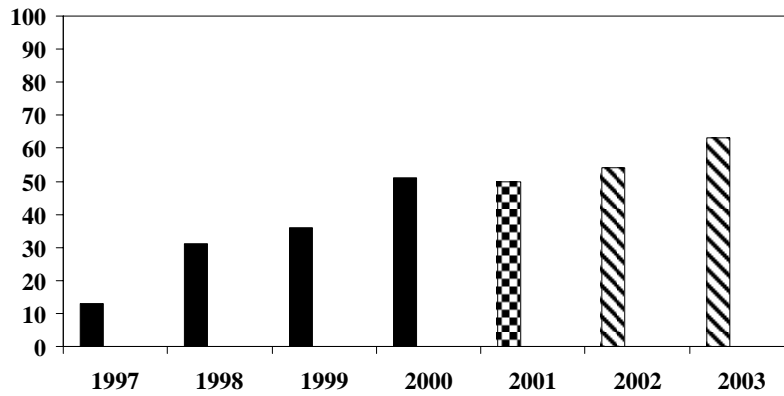


Figure 9. Percentage of organizations using **Internet or Intranet** (In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.
 Note: in 2001 Internet and intranet listed separately; combined total is shown.

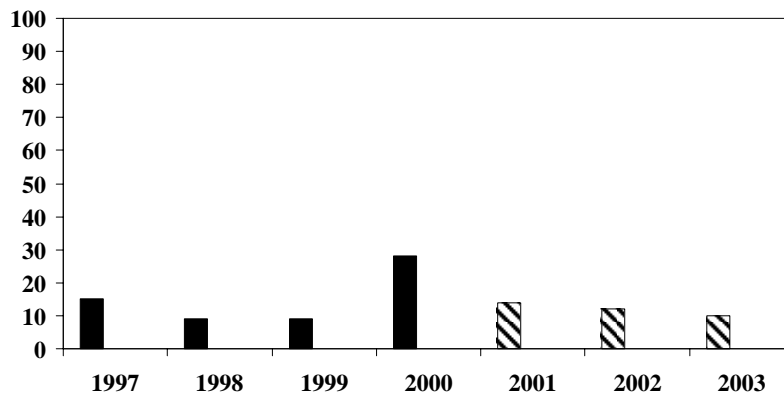


Figure 10. Percentage of organizations using **Games/Simulations, computer-based** (In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

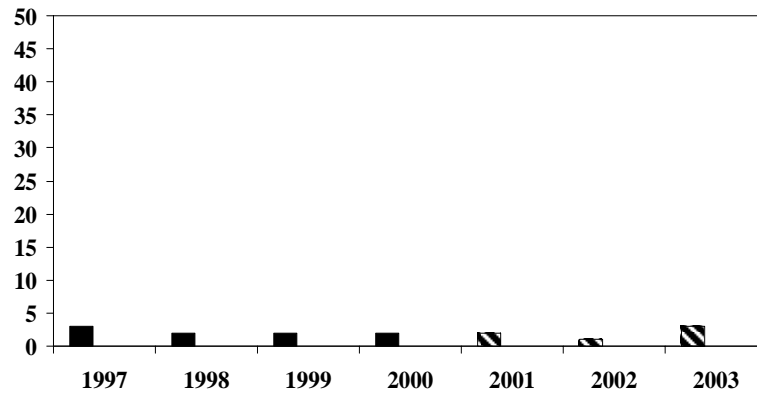


Figure 11. Percentage of organizations using **Virtual Reality** (In 1997-2000, shows those who use “ever.” In 2001-2003, shows those who use “always” or “often.”) Source: Galvin, 2003.

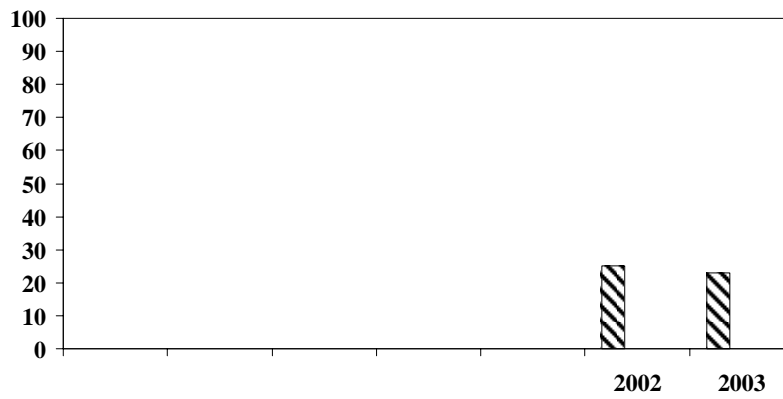


Figure 12. Percentage of organizations using **Self-Study, non-computer** “always” or “often.” Source: Galvin, 2003.

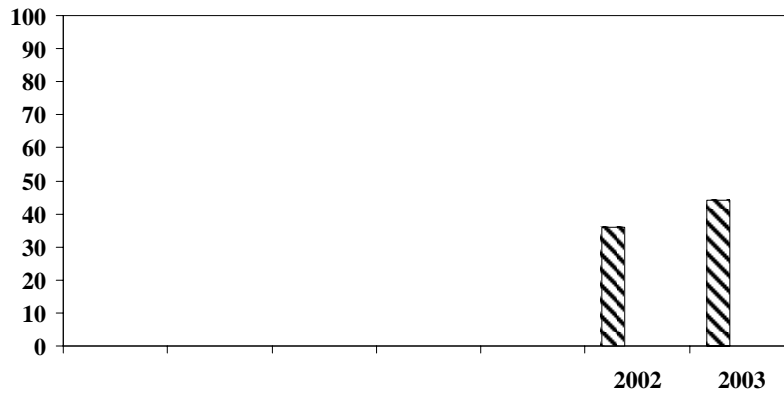


Figure 13. Percentage of organizations using **Self-Study, web-based** “always” or “often.” Source: Galvin, 2003.

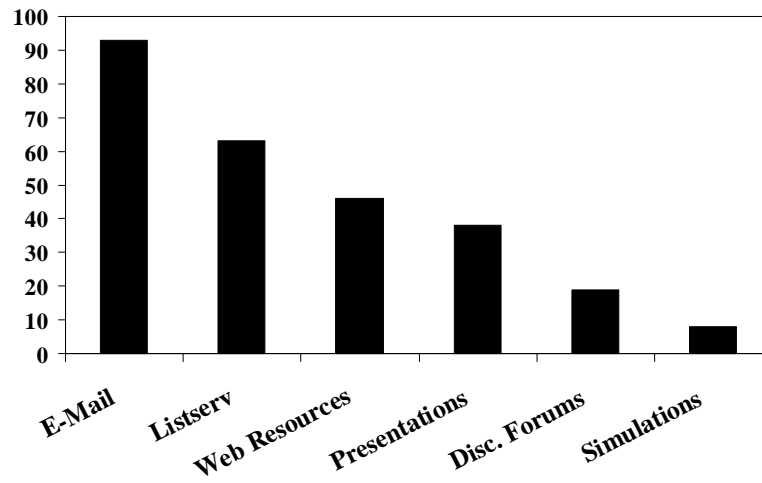


Figure 14. Percentage of faculty using various instructional technology applications. Source: Distributed Education Committee, 2002.

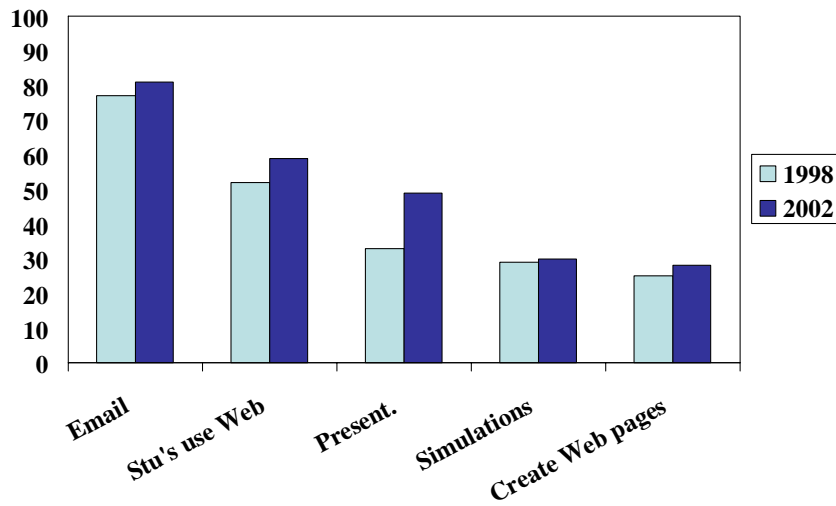


Figure 15. Percentage of faculty using various instructional technology applications. Source: Achieving Excellence Accountability Report, 2003-2004

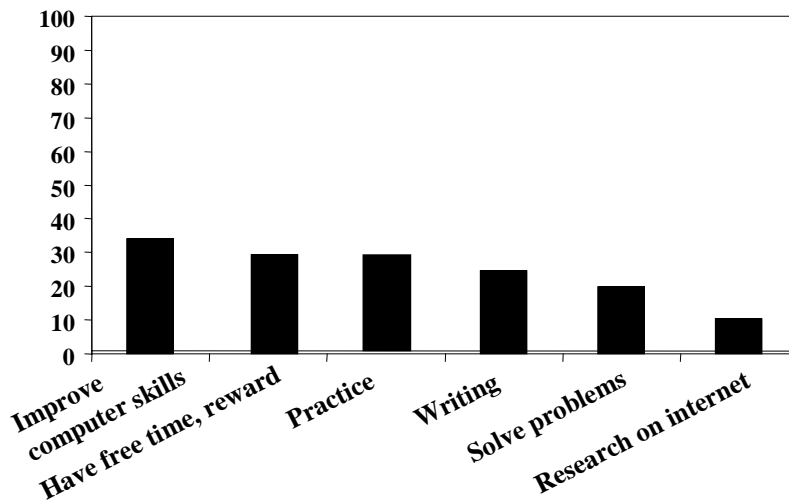


Figure 16. Teacher's frequent use of technology with students for different instructional purposes. Source: U.S Department of Education Policy and Program Studies Service, 2003.

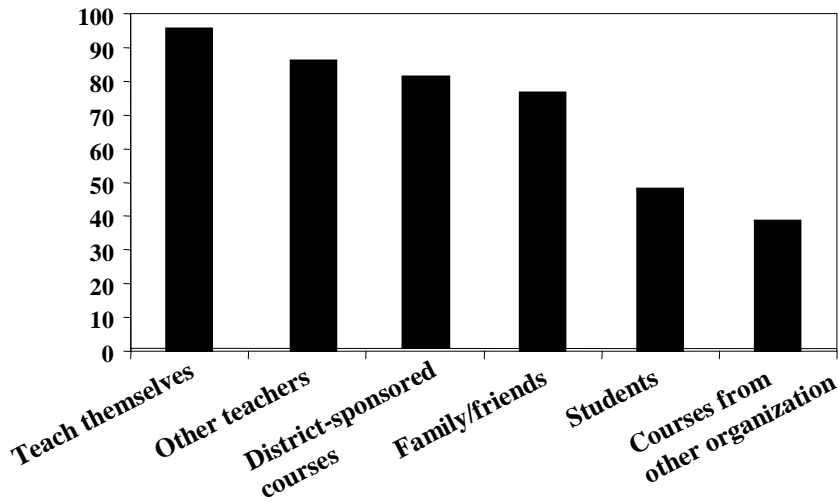


Figure 17. How Teachers Learned to Use Technology.
 Source: U.S Department of Education Policy and Program Studies Service, 2003.

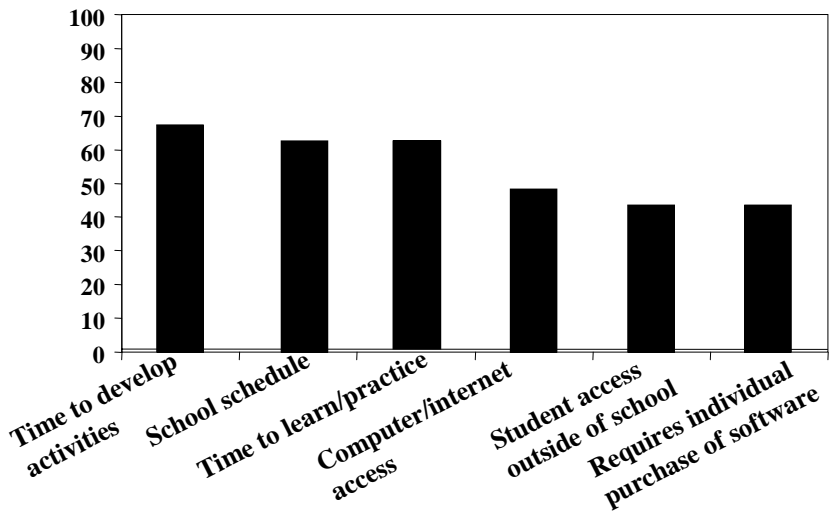


Figure 18. Teachers' reports of barriers to use of educational technology.
 Source: U.S Department of Education Policy and Program Studies Service, 2003.