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ABSTRACT

This keynote address seeks to establish a definition for "instructional technology" that does not emphasize computer hardware and software but instead focuses on human skills, resource management, problem solving, and educational settings. Also discussed are ways in which technology like electronic mail and the world wide web has penetrated institutions of higher learning and has caused shifts in learning and instructional paradigms. Barriers to faculty use of instructional technology range from a lack of administrative commitment to poorly equipped classrooms and disproportionate access. So many barriers exist, in fact, that much of what faculty has accomplished with technology has happened in spite of, rather than because of, the campus environment. This paper concludes that faculty have the right to: (1) a reward system that places a high value on teaching and innovative teaching methods in addition to research activities; (2) an institutional climate that encourages the use of technology; (3) an institutional commitment to technology in university planning documents and budget appropriations; (4) an administration that sets the pace via its own use of technology; (5) a campuswide instructional technology support infrastructure; (6) easy access to technology-based display systems in the classroom, to course development resources, and to consultation and production support services; and (7) training programs related to classroom technology applications. This kind of milieu is crucial because students and employers expect universities to produce a workforce versed in the technologies of our information-rich society. (Contains 22 references and 30 a list of additional resources.) (BEW)

Instructional Technology and Higher Education: Rewards, Rights, and Responsibilities

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Keynote Address
Southern Regional Faculty and Instructional Development Consortium
February 5, 1996 - Baton Rouge, Louisiana

> *"The history of modern education is littered with the trash of technology left behind by unrealistic purchases, naive users, and vendors working on a quota system."* (Polley, 1977)

Perhaps Polley has exaggerated just a bit, but we can say with some certainty that instructional technology has had a less than distinguished history in higher education. We have seen some success stories, to be sure, but for one reason or another new instructional technologies just never seem to live up to their potential. This morning, I'd like to offer some reasons why, and then suggest some ways in which we as instructional and faculty developers can help expand and improve the use of technology on our campuses.

Definitions

Some of you may have noticed that my title here this morning is "Instructional Technology and Higher Education" and not "Information Technology and Higher Education." There is a reason for that, and I'd like to start with a couple of definitions so we're all on common ground regarding the differences between the two. I think you may find them enlightening.

> *[Instructional technology] is a complex, integrated process involving people, procedures, ideas, devices and organization, for analyzing problems and devising, implementing, evaluating and managing solutions to those problems involved in all aspects of human learning.* (AECT, 1977)

The Association for Educational Communications and Technology published a new, more concise, definition in 1994, but I actually like the earlier 1977 definition it replaced much better. In fact, I like every single phrase here.

...a complex, integrated process...

...involving people, procedures, ideas, devices, and organization...

...for analyzing problems...

...and devising, implementing, evaluating, and managing solutions to those problems...

... involved in all aspects of human learning.

If you were expecting references to microchips and flashing lights, you may be a little surprised by the terminology here. Those definitions that emphasize the hardware and software aspects of our business do the image of our profession a grave disservice, because instructional technology is much, much more than that.

> *Instructional Technology is the Development (Research, Design, Production, Evaluation, Support-Supply, Utilization) of Instructional Systems Components (Messages, People, Materials, Devices, Techniques, Settings) and the Management of that development (Organization, Personnel) in a systematic manner with the goal of solving educational problems.* (Silber, 1970)

This definition came from Ken Silber, who chaired the AECT committee that developed the 1977 definition, so the two look somewhat alike. The Silber definition is quite useful because it identifies the components of an instructional system, and by extension, the basic concerns of instructional technology -- messages, people, materials, devices, techniques, and settings. Thus, our domain as instructional technologists includes not only the hardware and software, but also classrooms and labs, faculty teaching skills and student achievement, course organization and delivery, and even the subject matter itself. Instructional technologists could have responsibilities in any or all of these areas as they relate to instructional support and improvement on your campuses.

Just for the sake of comparison, let's look at a couple of definitions of information technology.

> *Information technology is the application of electronic and other technologies, e.g., computers, communications satellites, fibre optics, videorecording, etc., to help produce, store, retrieve and distribute analogic or digital information.* (UNESCO, 1992)

> *Information technology is the acquisition, processing, storage, and dissemination of vocal, pictorial, textual, and numerical information by a microelectronics-based combination of computing and telecommunications.* (Brisebois, 1991).

These are very global kinds of definitions that emphasize the acquisition and storage and handling of information, but they don't say anything about the instructional setting in which that information is used, or about the information itself and how it is planned and organized and developed to maximize its educational effectiveness, using procedures grounded in learning and communications theory. Nor do these definitions address how information media are used within the instructional context or the degree to which they influence learning outcomes. These are very important distinctions when comparing information and instructional technology, because such concerns are at the very core of what instructional technology is and the roles that instructional technologists play. When information technology is brought to bear on the teaching and learning processes of the institution, it is instructional technology, and I wish people would call it that.

Roles of Instructional Technology

So what good is this stuff, and why do we need it? Lewis and Wall (1988) have listed the historical roles of instructional technology:

- To accomplish tasks that faculty cannot do by themselves, such as helping students experience times, places, people, and events that might not otherwise be possible in the class.
- To accomplish tasks better than they can by themselves, such as using a video camera mounted on a microscope.
- To perform routine teaching tasks that instructors can do but prefer not to, for example computer-based drill and practice exercises.
- To prepare students for the world of work, training them how to use technologies they'll experience on the job after they graduate.
- And to reach, via distance learning, those students who cannot attend classes on campus for various reasons.

These are pretty conventional ways of thinking about the use of technology in the college classroom, but if we really want to get the full benefits of newer, emerging technologies, we need to go beyond the conventional applications. We are hearing a lot these days about the transition from a teacher-centered instructional paradigm to a learner-centered paradigm, and a rather significant transformation from the ways in which we've traditionally approached college teaching. Robert Barr and John Tagg discussed the contrasts between the two at some length in the November 1995 issue of Change (Barr & Tagg, 1995). Selected differences may be found in Figure 1.

Diana Oblinger of IBM has also drawn some comparisons between the lecture-recitation model of education and a more learner-centered, transformed approach (Oblinger, 1994). See Figure 2.

I think we can see from these figures that individual learning technologies such as multimedia and the Internet are particularly well suited for use in a learner-centered instructional paradigm. Steve Gilbert has pointed out that the old technologies such as videotapes and overhead transparencies were for the most part simply incorporated into the conventional lecture-style format. The newer, more individualized, interactive technologies, on the other hand, allow us to make much more substantive changes in the structure of a course (Gilbert, 1994).

For example, electronic mail allows students to discuss assignments or course material outside of class. A professor on our campus maintains a listserv for one of his Meteorology courses. Last fall, one of his students posted a question to the list that he couldn't answer, so he forwarded it to a colleague at the University of Illinois. Within six hours after the student posted the message, she had an answer, sent to the list by the world's leading authority on that particular topic. This is a powerful use of a relatively simple technology. The newsletter **Internet Index** provides the tongue-in-cheek estimate that if present growth rates are

Instruction Paradigm	Learning Paradigm
Mission and Purposes	
Provide/deliver instruction	Produce learning
Transfer knowledge from faculty to students	Elicit student discovery and construction of knowledge
Offer courses and programs	Create powerful learning environments
Improve the quality of instruction	Improve the quality of learning
Criteria for Success	
Curriculum development, expansion	Learning technologies development, expansion
Quantity and quality of resources	Quantity and quality of outcomes
Teaching/Learning Structures	
Time held constant, learning varies	Learning held constant, time varies
50-minute lecture, 3-unit course	Learning environments
One teacher, one classroom	Whatever learning experience works
Covering material	Specified learning results
Degree equals accumulated credit hours	Degree equals demonstrated knowledge and skills
Learning Theory	
Learning is teacher-center and controlled	Learning is student-centered and controlled
"Live" teacher, "live" students required	"Active" learner required, but not "live" teacher
Classroom and learning are competitive and individualistic	Learning environments are cooperative, collaborative, and supportive
Nature of Roles	
Faculty are primarily lecturers	Faculty are primarily designers of learning methods and environments
Faculty and students act independently and in isolation	Faculty and students work in teams with each other and other staff

Figure 1. Comparing educational paradigms (adapted from Barr & Tagg, 1995)

continued, everyone on earth will have access to the Internet by the year 2004. (See http://www.openmarket.com/diversions/internet-index/95-09.html) While we know that won't happen, the point is that the Internet allows a class to expand its discussions to virtually unlimited dimensions, with participants involving the leading experts in the field joining in from anywhere in the world.

The World-Wide Web in particular opens up a staggering array of resources. An company called Internet Solutions maintains a counter that estimates the number of active Web sites at the moment you access the counter. (See http://www.netree.com/netbin/internetstats) As of about 2 p.m. on Thursday, January 25, 1996, the number read 361,748. Those aren't

Current	Transformed
Lecturing	Coaching
Taking attendance	Logging on
Distribution requirements	Connected learning
Credit hours	Performance standards
Competing	Collaborating
Multiple choice	Portfolio assessment
Library collections	Network connections
Passive learning	Active learning
Textbooks	Customized materials

Figure 2. Some types of transformation being sought in academic programs (adapted from Oblinger, 1994).

individual pages, those are sites. Individual pages number somewhere in the 16 million range, and according to **Internet Index**, more than 18 million different people used the World Wide Web during the past three months. College courses that have at least part of their course materials and activities on the Web probably number well up into the thousands. The last time I counted, the World Lecture Hall Web site at the University of Texas (see http://www.utexas.edu/world/lecture/index.html) provided links to 530 courses in 72 different disciplines, and these are likely a small percentage of the total. The sheer volume of information out there in virtually every subject area, and the ease with which it can be accessed, can have profound implications for curricular content and the basic structure of course activities.

Even something as mundane as word processing is causing us to rethink the ways in which we use student written assignments as learning tools.. Steve Ehrmann describes how word processing allows professors to assign projects developed in stages, with multiple drafts at each stage. This type of activity was much harder to justify back when everything had to be typed. Assignments like these promote active learning through complex projects, rethinking of assumptions and positions, and collaboration with other students in the development of a finished product (Ehrmann, 1995). Technology has thus revolutionized a type of assignment that has been around for ages.

Kozma and Johnston (1991) examined over 700 multimedia software packages submitted to the EDUCOM/NCRIPTAL Higher Education Software Awards competition over a four-year period, and they identified seven different ways in which new interactive technologies are transforming the ways in which students learn.

From reception to engagement. Students are moving from being passive receptors of information to active participants in the construction of knowledge.

From the classroom to the real world. Kozma and Johnston cited a videodisk simulation in which law students learn how to manage a case, from client interviews to courtroom defense.

From text to multiple representation. Through technology, students are learning to express, understand, and use ideas in a variety of symbol systems.

From coverage to mastery. This builds on one of the historic functions of technology and provides drill and practice activities.

From isolation to interconnection. According to Kozma and Johnston, technology allows us to shift our perception of learning as an individual act done in isolation toward learning as a collaborative activity.

From products to processes. Technology provides students with new insights into the processes that create knowledge, because they are able to use the same tools as scholars, and in the same ways.

From mechanics to understanding in the laboratory. Kozma and Johnston point out that the scientific lab is one of the most expensive instructional areas of the university. New technologies provide highly effective simulations of lab experiments at a greatly reduced cost.

The bottom line here is that technology offers many rewards for the faculty and students who use it.

Statistics on IT Penetration

The problem, of course, is that the majority of faculty and students still don't use instructional technology, or if they do, it's at a minimal level. This past summer, the Corporation for Public Broadcasting released the results of its latest national survey on the use of communications technologies in higher education (CPB, 1995). Video was found to be fairly widespread, with 43 percent of faculty at doctoral universities using video at least once an academic term, up to 71 percent at community colleges. (See Figure 3.) They also found that 11 percent of faculty at doctoral institutions, and 21 percent of community college faculty, use multimedia materials in their classroom presentations, numbers that I feel are rather unbelievably high percentages. The use of multimedia materials for self-paced instruction was considerably lower and is probably a bit more realistic.

	Doctorate-Granting	Comprehensive	Two-Year
Video	43%	56%	71%
Multimedia in classroom	11	14	21
Multimedia in learning lab	08	07	16

Figure 3. Percent of faculty using selected technologies at least once per academic term. Source: CPB (1995).

Actually, these figures contrast rather significantly with the data obtained by Kenneth Green in his 1994 national survey of desktop computing in higher education. Green (1995) found that only 4 percent of faculty were using multimedia as learning tools. Other findings

ranged from 4 percent using CD-ROMs to 8 percent using electronic mail for instructional purposes, 9 percent computer simulations, and 11 percent commercial software. In fact, I've seen some other estimates that interactive technologies are used to a significant degree in no more than five percent of all college and university courses in the U.S (e.g., Willut, cited in Geoghegan, 1994).

[NOTE: Green's 1995 survey, reported shortly after this paper was completed, found significant increases in faculty use of instructional technology. See the January 26, 1996 issue of the Chronicle of Higher Education, p. A-17.)

Barriers to IT Use

So why is this? Why don't more faculty use instructional technology? If you look, you can probably find about 5,000 references on the barriers that faculty face, but let me review a few of them.

Faculty conservatism and a commitment to traditional means of teaching. This is no surprise, I'm sure. The situation is changing, but the change is occurring slowly.

A reward system that penalizes faculty for concentrating on teaching instead of research. We've found on our campus, for example, that the faculty who are generally the most receptive toward technology are the associate professors, because they don't have to worry about getting tenure. Kenneth King pointed out that "junior faculty work on instructional innovation at their peril" (King, 1990, p. 297).

Lack of commitment to technology at the highest echelons of the administration. In Green's 1993 national desktop computing survey (Green, 1994), he found that chief academic officers have no involvement with instructional technology at about a third of our institutions, and at the university level the figure was more like 50 percent. According to Green and Gilbert (1995), many senior administrators still seem to view the technology infrastructure as a "black hole" for money that is an easy target for budget cuts when funding gets tight.

Dominance of the "bean counter" mentality and a preoccupation with productivity and cost savings. We see this a lot in the literature these days, and Bob Heterick of EDUCOM had a great line on it. He said, "We must find our way out of the tar pit of justifying technology applications because they demonstrate tangible cost savings and into the integration of technology because it significantly improves the learning process" (Heterick, 1991, p. 12).

Poorly-equipped classrooms that have nothing more sophisticated than overhead projectors, and many don't even have those. The presentation hardware and software industry in this country rang up $31 billion in sales in 1993, but for some reason relatively little of that showed up in our classrooms. Most of it, of course, stayed in the commercial sector, and you have to wonder if they know something we don't.

The lack of financial plans that provide for the annual purchase, maintenance, and support of technology. Just about everyone's strategic plan calls for increased technology use, but not very many of our institutions have figured out how to pay for it.

Cries of lack of evidence that technology actually works. I'm really getting tired of this one. We've got tons of evidence that technology works, when it is used appropriately for a given learning situation. Just about every college campus has closets full of technology that didn't work, but the reasons it didn't work didn't have anything to do with the technology. More than likely it was the unrealistic purchases and naive users that Polley described, the absence of ongoing funding base, or the lack of an adequate support infrastructure, or all of the above. Let's not keep blaming technology for our own failures.

Faculty frustration with unreliable or difficult to use equipment. A few bad experiences are guaranteed to turn people off. This problem is easily overcome through carefully considered purchases, faculty training, clear directions, and the presence of a quick, responsive support infrastructure.

Disproportionate access. Especially if your campus has decentralized support services, you know all about that. Decentralization inevitably leads to "haves" and "have-nots" on your campuses and about the most inefficient management and use of technology I can imagine. It's a dumb policy that saves money only through depriving faculty and students.

The rapid pace of change and the speed in which expensive new technologies become obsolete. This pace is diametrically the opposite of the normal rate of change in higher education. M. M. Chambers, the Illinois State professor who published the two-year trend analysis of state funding for higher education, once said that implementing change in higher education was like trying to move a cemetery. Evans and Lippman, who published a classic study entitled **Resistance to Innovation in Higher Education** in 1967, declared, "The greatest resistance to change will be found in those institutions whose traditional primary function has been the perpetuation of a society's folkways, mores, and values, such as religious and educational institutions" (cited in Beal, 1981, p. 3).

Lack of faculty knowledge about technology and available resources.

Lack of time, and so forth.

In general, what we've gotten accomplished with technology in higher education has happened in spite of the campus environment, instead of because of it, and that's a pretty sad legacy. Education must be about the only industry in America where we even talk about "barriers" to employee use of technology. Can you imagine the stock brokers at Paine Webber, or the white collar crowd at Boeing or Prudential or 3M being denied or discouraged from using technology because senior management and the organizational climate have put up "barriers"? Industry moves into technology because technology helps employees to do their jobs better and create better products and services, thereby making their companies more competitive in the marketplace. Sooner or later, we're going to have to embrace that concept in higher education as well. How competitive would a travel agency be that still uses the telephone instead of computer reservation systems? Yet far too many of our classrooms haven't yet even reached the telephone stage.

Professor's Bill of Rights Regarding Instructional Technology

Every college and university faculty member, regardless of rank, is entitled to use technology in his or her teaching, to find it easily accessible, to be trained in how to use it effectively, to have ready access to a qualified support staff, and to use technology without any form of penalty. Instructional technology is an entitlement. We're talking here about the basic tools of the trade of the teaching profession, as essential to college teaching and learning as computers are to those travel agents and ball gloves are to baseball players. So, I'd like to propose a Bill of Rights related to instructional technology, that applies to every member of the teaching faculty. Faculty, even those at research universities, are entitled to:

I. A reward system that places a high value on teaching and the use of innovative teaching methods.

I list this one first because I feel that the reward system is the number one reason why we have so little technology use in the classroom. We give a lot of lip service to the importance of undergraduate education, but the reality is that research and scholarship carry so much weight in the tenure and promotion process that faculty simply can't afford to spend much time on their teaching. This topic has been beaten to death, and I don't want to prolong its agony, except to say that we're never going to come close to realizing the potential of technology until we change this paradigm.

II. A positive, nurturing institutional climate that encourages the use of technology.

Faculty have a right to work and teach in an organizational climate that supports and encourages the use of technology. Positive attitudes toward technology need to extend from the senior administration down through deans, department heads, and faculty colleagues, including the secretary and other support staff. We shouldn't find stigmas attached to using technology or other innovative forms of teaching, but we do.

III. A clear institutional commitment to technology in university planning documents and budget appropriations.

This starts with an understanding of the fundamental roles of technology in the reshaping of the curriculum and the transformation toward a learner-centered instructional paradigm. Throughout the institution, we should see a recognition of the value of technology for its contributions to the teaching-learning process. The commitment to technology should be evident in institutional strategic plans, departmental and college academic development plans, and in long-range plans for the integration and funding of technology.

IV. An administration that sets the pace and provides leadership via its own use of technology.

What a powerful example it could be for our faculty to see the president or provost using technology comfortably during the fall convocation, or in a report to the regents or a presentation to the Alumni Club in Atlanta. Some of our senior administrators are extremely fluent with technology, but a very large number are former faculty members who entered academe during the 60s and 70s, and never used anything more sophisticated than an overhead

or slide projector in their own teaching, and therefore never developed a personal interest in or commitment to technology (Wunsch, 1992). Unfortunately, this is the perspective that many of them have taken into the administration building and may influence their funding decisions related to instructional technology, not to mention their own use thereof.

V. A campuswide instructional technology support infrastructure organized within the academic mainstream.

I am very concerned about the current trend toward placing instructional technology support services within an information technology organization. As we saw in the definitions, information technology is a very broad concept that ranges from the library's online catalog and the processing of the payroll to the campus telephone and data networks and your secretary's word processor. With such a broad spectrum of functions under the information technology umbrella, it is easy for the instructional support mission to get lost and relegated to a lower priority, especially if the person in charge is more concerned with bits and bytes than with student learning achievement.

I'm a firm believer that campus support units should be organized by mission or function and not by the tools they use. Academic computing and the campus media center have much more in common with the office of faculty development, for example, than they do with ADP or the folks who manage the campus phone system.

I also feel that the reporting senior for academic support services should be that administrator with the greatest degree of accountability for the quality of the instructional programs they support, the person with the strongest vested interest in seeing them function effectively. Of course, that would be the chief academic officer. However, chief academic officers across the country have an average of something like 12 million people reporting to them, so an assistant or associate in charge of academic support might be a better choice.

VI. A campuswide instructional technology infrastructure led by an individual with a thorough understanding of college teaching processes and whose own highest personal priority is the effective support and enhancement of academic programs.

The faculty has a right to have priorities established and budget decisions within its academic support services made by someone who knows what goes on inside a classroom, someone with a thorough knowledge of teaching and learning processes and the integration of technology within these processes, somebody whose own professional interests are focused on academic support. Unfortunately, that's not always what the faculty gets.

I give you as Exhibit A an ad that appeared in the *Chronicle* a couple of weeks ago. A campus in the SUNY system is looking for an Associate Vice President for Computing and Educational Technology, with job functions including responsibility for planning, funding, and development of academic computing, computer-mediated instruction, distance education, academic telecommunications, and computer-mediated, multimedia classroom development. However, of the nine "representative responsibilities" listed, not one makes any kind of reference to the academic support functions, and the qualifications listed make no mention at all of experience in college teaching, instructional support, academic product development, classroom design or equipment, multimedia, distance education, or any other evidence that this

person should have a clue as to what happens in a classroom, or even the slightest bit of interest in or commitment to academics. This is the person expected to guide this campus's academic use of technology into the 21st century. The faculty and students deserve something better.

Two aspects of this case are particularly scary. One is that according to a friend of mine close to the position, the ad was written by the search committee, thereby disclosing its priorities. The other is that we see ads like this in the *Chronicle* about every week.

VII. Easy access to technology-based display systems in the classroom.

Faculty should find instructional equipment, including video, multimedia, and computer systems with network access, easily available in or near the classroom with a minimum of set-up time. The technology must be reliable and simple to operate, and the campus support system should be able to provide rapid response in the case of a breakdown. As we noted above, nothing will turn faculty off to technology faster than cumbersome, unreliable equipment and a non-existent or non-responsive support service, unless it is the complete absence of technology.

Few, if any, institutions have the resources to equip all classrooms in this manner, but enough technology classrooms of various sizes and configurations should be available and distributed across the campus to meet the demand. During the scheduling process, technology intensive courses should be flagged and programmed into those classrooms, and additional classrooms need to be equipped with technology and scheduled on an hourly basis to accommodate those courses in which in-class use of technology is occasional. When I was media director at the University of Hawaii, my center managed five of these hourly classrooms, and during the 1992-93 academic year they were scheduled more than 3,400 times. Each room was in use an average of 7 hours a day during the academic terms.

VIII. Easy access to the resources required for course development.

Every faculty member should have the resources easily accessible to design or redesign courses and develop course materials, either on their own desktops or at a centralized checkout or laboratory location. Authoring software and equipment such as camcorders and digital cameras have become so inexpensive and easy to use that many professors are becoming quite skilled at developing their own course materials. Consultation services should be available as necessary from a trained professional who is skilled not only in instructional development but also in college teaching methods. Implicit here is the concept that the time and effort put into the development of courseware and learning activities employing technology is recognized and credited by the campus reward system.

IX. Easy access to consultation and production support services.

Professors who don't have the time or ability to develop their own course materials are entitled to have campus support services available to them for this purpose. These service units should also be ready to assist faculty who develop their own materials but need help with graphics, video, or authoring components that are beyond their capability. Again, consultation services should be provided by a professional highly trained not only in the technical aspects of technology but also in college teaching and the applications of technology within that context.

X. Training programs related to technology applications in the classroom.

In this case also, training activities should be provided by individuals not only with technical knowledge but also with a fundamental understanding of teaching and learning processes and the integration of technology into those processes. Last spring, our center at Iowa State conducted a survey of our faculty to determine their patterns of technology use and to identify needs for planning purposes. The question that inspired the strongest response by far related to training. Respondents indicated a high demand for training in distance education, the Internet, the use of presentation and multimedia authoring software, and the general integration of technology into college teaching. Faculty have a right to have these kinds of training programs available to them, and we simply can't expect them to use technology effectively if training opportunities aren't provided.

What Can We Do?

So what can we do as instructional and faculty developers to help overcome these barriers and provide the organizational climate to which faculty are entitled? What are our responsibilities?

Some of the choices are obvious. I'm sure that many of you are already working to change the reward systems on your campuses, ugly job that it is. If your campus is thinking about reorganizing academic support services, or if it is writing or re-writing a job description and qualifications for a director of instructional technology, you can take on an advocacy role and help to ensure that the decisions made are in the best interests of the faculty and students and are not based primarily on administrative convenience.

I mentioned productivity in terms of "bean counting." In general, I think that much of the literature on productivity and cost effectiveness regarding instructional technology misses the point, because it seems to be focused on large-scale product development projects that consume tremendous amounts of personnel and material resources, while the vast majority of technology use is on a much smaller scale, costs nothing or very little, and yet provides some terrific learning experiences for students. For example, a biology professor on our campus requires his students to use the World-Wide Web to locate vendors and current prices for the chemicals used in their lab experiments. This is not a productivity matter, it doesn't cost much of anything, and yet it's a wonderful, real-world application of technology. We have to be very careful in talking about productivity and cost savings, lest we try be tempted to think of all instructional technology use in higher education within this context.

On the other hand, I think the productivity literature may be useful in helping us redefine our roles in the area of instructional product development. We do need to look at some of these larger scale projects and ask whether the academic benefits really do justify the cost. We may find that we need to shift our focus from the mega-project to the simpler projects that we can do in greater numbers and probably reach more students.

Another thought that I'd like to share with you is based on Moore's technology adoption life cycle model that has the innovators and early adopters at one end and the laggards at the other, with about the middle 65 or 70 percent falling into the mainstream, which is then divided into the early majority and the late majority. Moore (1991) pointed out that some very

significant differences exist between the early adopters and the early majority, creating a very significant gap where the adoption of innovations frequently breaks down. In the case of faculty, the early majority is much more conservative in their approaches to teaching, and while the early adopters are horizontally connected, that is they are much more likely to participate in cross-disciplinary activities, the early majority is more vertically connected. In other words, they tend to operate within their own academic units and are more isolated from outside ideas (Geoghegan, 1994).

Bill Geoghegan of IBM offers some suggestions on how we might overcome this gap. First of all, he points out that we have to recognize the mainstream faculty as a distinct group within the academic community and to respect their differences from the early adopters. Then we sell them on the idea of using instructional technology on their own terms and "under conditions appropriate to mainstream needs and interests." He recommends that we pay special attention to the mainstream's vertical orientation, and he suggests that mainstream faculty can be reached most easily if support personnel working with them have a solid understanding of the culture of the disciplines in which the faculty clients are working.

Geoghegan emphasizes that mainstream faculty need to be provided with compelling evidence that technology offers value, that it provides improved performance in an existing task or enables a task to be accomplished that previously couldn't be addressed. He feels that ease of use is critical, pedagogical flexibility must be provided, and that the risk of failure should be low. And finally, a firm institutional commitment to improving the quality of teaching and learning should be evident, through such measures as recognition of achievements in the improvement of teaching and learning through technology and the availability of a well funded and highly professional instructional technology development and support organization (Geoghegan, 1994).

Conclusions

I have talked a lot this morning about the roles of technology and the potential value of technology in the learning process, but I think we also need to consider the expectations of our primary constituent group, our students. Something like 40 percent of all personal computer sales in this country are to private homes. About 50 million people now have access to the Internet, and companies such as America Online and Compuserve and other Internet service providers are a $2 billion a year industry. Many homes now have camcorders and CD-ROM drives and audio CD players and cable systems that provide a mind-numbing array of programming. Our students are coming out of technology-rich high school environments where they watch satellite-delivered instruction and produce multimedia and communicate with other students around the world on e-mail. When they reach our campuses, many of them are more technologically literate than their professors, and they have some real problems with sitting passively in the classroom and taking notes while somebody "lectures."

Employers, too, expect our students to be ready to move into an information-rich environment after graduation and to take their places in a technology-intensive workplace without the need for extensive additional training.

Obviously, we can do a lot better with the technologies we have now, but in the very near future, we're going to see some dramatic new developments in technology that will have

significant potential as learning tools. Digital videodisk (DVD, is expected to come on the marketplace in 1996. A digital videodisk will hold 4.7 gigabytes of information, enough for about two and a half hours of video, on a disk the size of a CD-ROM, and the player will cost about $500 and will play the CDs we already have. DVD is being introduced as an entertainment medium, but it's only a matter of time until we see it in education.

Many of you remember what a terrific improvement the World Wide Web was over Gopher. New Web applications such as Java and Shockwave are already out there and are taking the Web into a new dimension. Java and Shockwave are bringing multimedia capability to the Internet and offer a tremendous array of possibilities for learning.

I haven't said anything about distance education, but distance ed technologies open up all kinds of opportunities, including the development of virtual universities that may change our whole way of thinking about what a university is and does. In fact, in December the Western Governors' Association announced that they were exploring the idea of a virtual university made available to students through video technologies, CD-ROM, and the Internet (Blumenstyk, 1995).

All in all, it's an exciting time to be involved with technology in higher education, and I for one am glad to have a chance to be a part of it. Thank you again for the invitation to join you this morning.

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