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ABSTRACT

The college level teacher is a critical variable in the shift toward acceptance of new technologies. Despite the recognized need for teachers to use and teach new technologies, and National Council for Accreditation of Teacher Education's new accreditation standards, there remains a large percentage of teachers unprepared to cope with technology in classrooms. The data analyzed in this study were generated by a dean's task force of the Association of Colleges and Schools of Education in State Universities and Land Grant Colleges and Affiliated Private Universities (ACSESULGC/APU). Thirty-four cases were reported by 23 state and independent universities geographically representative and varied in size and complexity. The data analysis focused on strategies for technology-related college faculty development, including training, support, infrastructure, and funding. The study examined differential rates of change among colleges of education, the essential keys to successful strategies, and the relative importance of infrastructure, budget, leadership, and special incentives. Findings indicated that the essential key to success was leadership, and that providing appropriate and meaningful incentives was crucial. Recognition from department leaders, deans, or other university officials, release time, and monetary compensation are some of the incentives that are considered effective. (Contains 16 references.) (ND)

Meeting Technology Challenges in Teacher Education: Responses from Schools and Colleges of Education

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The college level teachers is a critical variable in the shift toward acceptance of new technologies. Despite the recognized need for teacher to use and teach new technologies, and NCATE's new accreditation standards, there remains a large percentage of teachers unprepared to cope with technology in classrooms. While leading edge users of cyberspace are adjusting from a PC-centric environment to a netware-centric and digital environment, at the college level, we are still introducing word processing. Reengineering pedagogy in teacher education represents a profound paradigm shift which is well advance in our economy and our culture. We in teacher education have to overtake our colleagues in the other professional schools on campus as well as the corporate world.

The data analyzed in this study were generated by a dean's task force of ACSESULGC/APU. Thirty-four cases were reported by twenty-three state and independent universities, geographically representative and varied in size and complexity. The data analysis focused on "successful strategies for technology-related faculty development" and included training, support, infrastructure, and funding.

The article speaks to differential rates of change among colleges of education, the essential keys to successful strategies and the relative importance of infrastructure, budget, leadership and special incentives. We are reminded of Dewey's observation that all "knowledge is external", all "knowing is internal". Knowing is the process. The computer has become a powerful adjunct to the human mind and the "knowing" process.

Colleges of education are under scrutiny not only by a university that is reengineering itself, but also by a larger society sorely disappointed by a public school system that is not performing to its expectations. If we fail to infuse and reform our curriculum and pedagogy with the most appropriate tools, we will put at risk the future of colleges of education.

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Teacher educators and state policy makers are increasingly aware of the need to prepare teachers for schools with sufficient knowledge and skill to use new technologies. Recently, the National Council for Accreditation of Teacher Education (NCATE) announced new and more demanding standards for the use of technology in schools and colleges of education. Beginning October 1995, accredited schools and colleges of education (referred to as "colleges" hereafter) must meet NCATE's new standards for technology in teacher education to become or remain accredited (Wise, 1995). Some of the areas in the NCATE accreditation standards include expectations for an understanding of the structure, skills, core concepts, ideas, values, facts, methods of inquiry and uses of technology for the subject teacher candidates plan to teach, and for studying the impact of technological and societal changes on schools. Standards call for faculty to be knowledgeable about current practice related to the use of technology and integration in teaching and scholarship, and for sufficient resources committed to facilities and equipment to support computing, educational communications, and education and instructional technology at least at the level of other units in the institution. The standards specifically expect faculty and teacher candidates to have training in and access to education-related electronic information, video resources, computer hardware, software, related technologies, and other similar resources.

Despite this recognized need, a large percentage of teachers remain unprepared in the use of basic technology. While leading edge users of cyberspace adjust to the change from a PC-centric environment to a netware-centric and digital environment, at the college level, we are still introducing word processing or sometimes nothing at all. Integrating technology into instruction and assessment has not been a high priority in many schools of education. Research findings repeatedly demonstrate that beginning teachers' framework for interpreting what goes on in a classroom is heavily influenced by their own educational experience (Barron and Goldman, 1994;

McDowell, 1993; Rust, 1994). As Larry Cuban (1986) described it, "Teaching is one of the few occupations where practically everyone learns firsthand about the job while sitting a few yards away, as students, year after year. We have absorbed lessons on how to teach as we have watched our teachers."

Much of the attention that has been given to restructuring U.S. schools has been devoted to issues of school organization and governance (Elmore, 1992; Evertson, 1992; Hallinger, 1992). Increased attention to restructuring at the classroom level in teaching and learning processes is more likely to bring about improvement in student learning outcomes (Elmore, 1992; Fishman & Duffy, 1992). Appropriate application of technology has the potential to be the key to enhanced productivity and improved learning outcomes at the university level, in the schools, as well demonstrated in other sectors of our economy. Educators at large have reached consensus that schools of education should be held accountable for providing teacher candidates with a working knowledge of computers and related technologies and of how they can be effectively used in classroom instruction, planning, and evaluation (Wise, 1995; Barker, 1993).

Feigenbaum and McCorduck in their book The Fifth Generation (1984) wrote: "The computer is the knowledge worker's tool, as the planting and harvesting machines are to the farmer and the heavy industrial machines are to the manufacturing workers." Teacher preparation is undergoing fundamental restructuring at most colleges of education across the nation. One important aspect of the reengineering is to change the traditional way instruction is organized by integrating technologies. Colleges of education must keep up with the demands for teachers skilled in integrating technology into instruction by seeking out tools that have been tested to be effective. There are profound consequences in what we do. Thus, in presenting several models which are successful in implementing technology in the colleges of education, the author of this study does not imply the necessity of replicating one or more of these efforts. Instead, this study should lead readers to conclude that there is an urgent need for institutions of teacher education to find an effective model and move rigorously to equip themselves with the necessary skills for reengineering pedagogy in teacher education. This is a profound paradigm change. The change is well begun in our economy and in our culture, but we in teacher education are still at an early point. We have to overtake many of our colleague colleges, and in some cases, even our students. We must think of this change as a bridge to survival for colleges of education in the 21st century. It is important that leaders of colleges of education, both faculty and administrators, understand that a process is underway, the rewards of which will lead to better pedagogy and graduation of more adequately prepared teachers for our public schools.

Data Collection

The primary data for this study were collected by the Association of Colleges and Schools of Education in State Universities and Land Grant Colleges and Affiliated Private Universities (ACSESULGC/APU).[1] Initially, the data were collected to compile a case book to share information on technology-related faculty development efforts among colleges of education. The data collection methodology involved soliciting from ACSESULGC/APU deans and directors nominations of colleges where excellent training for faculty was thought provided, and inviting the nominated colleges to submit structured information about their programs. Thirty-four cases were submitted, which represented 23 colleges of education in the United States. The ACSESULGC/APU Faculty Development Task Force then reviewed the submissions and selected

[1]The data was collected in 1994-1995 by ACSESULGC/APU Faculty Development Task Force. The author acknowledges her debt to Dr. Richard B. Flynn, chair of the Task Force, for permission to use the data.

thirteen cases to be included in a case book. Using the same data set, this study has included all 34 cases in the analysis process.

Data Analysis

Data were solicited from the selected institutions under the title of "Successful Strategies for Technology-Related Faculty Development". Categories included Brief Description of the Faculty Development Effort, Goals of the Effort, Delivery Methods, Target Audience, Timeline for the Effort, Coordination of the Effort Provided by..., Resource Requirements, and Progress. The case book was published in 1995. Among thirty-four submissions, thirteen cases were presented in a straight forward style with little modification.

Using the information of all thirty-four submissions, this study has analyzed the technology infusion in the reporting colleges of education, with an emphasis on faculty development efforts. The data analysis resulted in several perspectives on technology infusion, such as incentives, planning, sources of funding, and technology infrastructure. The findings were synthesized and summarized, and presented in four broad categories: Technology Training, Structural Support, Technology Infrastructure, and Funding. The presentation of the findings was intended to be illustrative rather than definitive.

Representation of the Institutions

One thing in common among the twenty-three schools and colleges of education represented in this study is that they were all perceived to be quite advanced in providing excellent faculty training in the use of technology by ACSESULGC/APU deans and directors. Otherwise, these institutions are quite diverse. The majority are public institutions. Two are independent institutions (Baylor University and Vanderbilt University). Land grant universities have the largest representation. By general classification, most examples are comprehensive research universities (e.g., Penn State University, University of Maryland at College Park, University of Texas at Austin) or comprehensive universities (e.g., Northern Arizona University, San Diego State University, University of North Texas). Geographically, they represent diverse regions of the United States. The names of the reporting institutions are listed below:

Baylor University - School of Education
Bowling Green State University - College of Education and Allied Professions
Indiana University - School of Education
North Carolina State University - College of Education and Psychology
North Dakota State University - College of Human Development and Education
Northern Arizona University - The College of Excellence in Education
Ohio University - College of Education
Vanderbilt University - Peabody College of Education
Penn State University - College of Education
San Diego State University - College of Education
Texas A & M University - College of Education
University of Arizona - College of Education
University of Florida - College of Education
University of Georgia - College of Education
University of Maryland at College Park - College of Education
University of Nebraska at Omaha - College of Education
University of Nebraska-Lincoln - Teacher's College
University of North Texas - College of Education
The University of Tennessee-Knoxville - College of Education
University of Texas at Austin - College of Education
University of Utah - College of Education
University of Virginia - School of Education
West Virginia University - College of Education

Findings

Technology Training

The need for technology training is evident. Institutions all over the world are reengineering to achieve greater effectiveness through technology. Looking at colleges of education where the use of technology is prevalent, much of the effort is devoted to training. The need for technology training is imperative, but the recognition has been slow. Elaborate hardware and software can be found sitting obsolete in labs, or on shelves, never to be used for the purpose the purchase intended. The notion that to purchase the equipment is all that is necessary to bring technology into the classroom is one of the most prevalent reasons why technology is NOT in the classroom. The success examples in this study seemed to have followed from a strategy of developing technology skills and interests in faculty while building necessary technology infrastructure.

Time and Duration. In most colleges, faculty training was an on-going effort. During the regular terms, the formal training sessions usually lasted one or two hours for a short session, or one to one-and-a-half day for a focused session. In summer, some colleges offered single or multiple day sessions, or even week-long sessions. For instance, the School of Education at Baylor University offered two-week training sessions for all faculty between the end of spring and the beginning of summer. Faculty chose to participate in one or both weeks. Flexibility for faculty training was an important variable of success.

Time and duration for technology training activities were often tailored to faculty timeframe and schedule to accommodate maximum participation. At the Teacher's College of University of Nebraska-Lincoln (UNL), faculty members attended three-day workshops, half-day meetings, one-hour workshops, and monthly technology meetings for interested faculty. Individual assistance from a technology trainer was available to faculty twenty-hours per week. The most successful format in the UNL's experience was a 20 hour training commitment from faculty over a 2 ½ day period. These sessions were held twice a year during May and January.

Delivery Methods. Technology related faculty development activities took various forms. In most colleges in this study, a combination of one-on-one tutoring, small group sessions for specific topics, large group sessions for general applications, demonstrations by vendors for new products, and hands-on sessions to develop skills was reported. Many activities took place in informal settings. For instance, in addition to its formal technology training activities, the School of Education at Indiana University held brown bag sessions for faculty to exchange information, maintained a trouble support line to answer questions, and regularly distributed technology publications. The College of Education of University of Nebraska at Omaha (UNO) used brown bag occasions to introduce software on the network. In some cases, same day field trips were arranged so that enthusiastic faculty members could visit off-campus models of educational technology in use. Such activities were helpful, enabling faculty to create visions of technology implementation, and providing opportunity for exchanging real and vicarious experiences. It appeared that most faculty and students found it easier to understand applications of technology integration their eyes could see in operation.

Inviting guest speakers to present to the faculty was another effective format for faculty development in the uses of technology in an educational setting. Usually, the speakers were faculty members who had developed technology courses, or were prominent users in the field of educational technology. Speakers from business, engineering, medicine, and other technology-based schools on campus can be very effective. Although no quantifiable data were reported regarding guest speakers, the College of Education at San Diego State University reported successful practices of such activities. UNO's College of Education formed Special Interest Groups (SIG) in technology uses, and organized annual technology fairs to bring faculty, students, and business together.

The College of Excellence in Education of Northern Arizona University reported a unique approach in delivering its technology development efforts. In what was called "jigsaw development", one interested faculty member was selected from each of the five academic programs to form a committee. Each member of the committee made the commitment to learn one aspect of multimedia and teach others in the group. The person who had learned interactive video would teach others about interactive video, while the person who had learned HyperCard would teach HyperCard applications. The result of this individual effort was that the College developed in-house expertise for specific subjects and became more able to assist its own.

A coaching approach places someone with technology expertise, a faculty member, a graduate assistant, or a staff person, in a position to be available to consult and assist faculty one-on-one. Often a graduate student is able to take on such tasks, as reported by the College of Education of San Diego State University. Graduate students in Instructional Technology were paired with non-technical faculty to develop projects or technology skills. Graduate students at the University of Tennessee-Knoxville College of Education and the University of Virginia School of Education were successfully used in coaching various technology applications.

Another important way to build technology expertise in colleges was faculty "working together." Impressive evidence existed in the case of the Peabody College of Education at Vanderbilt University. Where projects were identified, a group of faculty was put together to work as a team. When a strong sense of purpose and common goals were communicated, faculty seemed to develop a shared vision. This unity of purpose paid real dividends. According to the Peabody report, important projects often started at the initiative of one or a small number of faculty. Assistance and recognition from administration came later, but was essential to the maintenance of momentum and acceptance by the faculty as a whole.

Incentives. Some of this author's earlier research found that faculty considered release time, recognition from the administration and colleagues, instructional needs, and assistance from technical experts as the most important factors in learning to use technology. Monetary incentives were relatively less important (Lan, 1993). Release time was found to be critical. The common use of released time (reduction of teaching load by one course or more) was found to be a prime motivation to faculty to integrate technology into new courses. In the cases reported to ACSESULGC/APU, there were usually specified tasks to be accomplished during the release time granted.

A number of colleges provided monetary compensation for faculty pursuing technology projects. This practice usually followed faculty participation in summer workshops, and/or in training-intensive, multiple-day sessions. For example, the College of Education of University of Nebraska at Omaha offered faculty members $250 for participating in a week-long session and $500 for two weeks. At University of Tennessee-Knoxville, the College established a Dean's Incentive Fund to encourage faculty to create multimedia instruction. The fund provided technically qualified graduate assistants to help faculty in multimedia development and to serve as mentors to faculty. Financial support was also provided to purchase software and special equipment. An additional stipend of $1,000 was provided to participating faculty when they implemented the new multimedia course.

The monetary incentive was often project-based. At University of Utah, the College of Education funded up to $5,000 to a series of technology infusion projects. The money was used for salary support, hardware and software purchases, and student labor and programming.

It was not uncommon to see colleges provide faculty members with monetary incentives for participating in technology-related activities. However, this analysis concluded that technology development efforts were often spontaneous and voluntary. Faculty who were early in the use of technology in their teaching seldom received external support. Their own enthusiasm for new technology as instructional methodology was the driving force. But it is abundantly clear that the transformation of a department or a college requires both the leadership of "path-finder" faculty who are self-motivated, and the top-down direction of leadership as well as financial support from deans and chairs. Leadership from senior colleagues was also found to be very important. In institutions where technology had become the accepted norm, it was the convergence of forces from all sides that made a technology culture possible.

Some other incentive strategies reported in the study included salary and benefits, travel, hardware/software, and help from a graduate assistant. Graduate assistants' support seemed to be quite important in several cases reported in the study. As mentioned earlier, graduate assistants were often used to mentor faculty in the use of technology. Younger faculty and graduate assistants often had more exposure to technology and were less intimidated by the computer and other equipment. In working together on technology projects, faculty and students were learning together, from each other, and producing instructional products that were closer to the needs of the classroom.

Audience. Colleges of education in this study focused technology-related development efforts on the needs of the faculty. Some cast the net wider to include staff persons and graduate students. At Texas A & M University and the University of Nebraska at Omaha, the colleges combined the training activities for faculty with local school teachers. At Texas A & M University, it was reported that during 1992-1993, 432 teachers and 82 faculty participated in staff development activities related to technology applications in the classroom. Through external funding, the College of Education at the University of Nebraska at Omaha coordinated two "TEAM"s (Technology in Education Advancement Model) to provide in-depth, hands-on technology training over an extended period of time to educators from local schools and from the College.

Only one school, the Peabody College of Vanderbilt, mentioned training for administrators. There were no specifics given regarding the training.[2]

Structural Support

Structural support in these case studies included coordination and planning as elements of the leadership responsibility. Coordination was found to be crucial in any large-scale adaptation to technology. It is axiomatic in management that there can be little coordination without some subordination. Thus, university leadership for technology must be seen not only as committed, but also as legitimate. Technology implementation will need to advance in accordance with the mission and the strategic plan of the university and its colleges. The substantial reengineering implicit in reeducating non-technical faculties to sophisticated technologies is a management responsibility as well as an intellectual obligation of the faculty. Each needs to recognize the imperatives of the other. The planning process is one of the ways in which the mission of the institution is clarified and the importance of the necessary changes (technology) are legitimized.

Coordination. Coordination of technology infusion in this study often took one of three forces: 1) Someone at dean's level, often an associate dean, 2) director of the school or colleges technology unit (learning resource center, center for learning technologies, educational technology services, academic computing center, and so forth), or 3) a technology committee or task force representative of various program areas, and other administrative and technical units.

As suggested above, the involvement of higher administration, especially the dean's office, was vital. The direction by the dean not only stressed the importance of technology and dean's commitment to it, but also implied a commitment of the necessary resources. An example was

[2]The survey did not intend to collect data on administrator training.

reported by the Teacher's College at University of Nebraska-Lincoln, where faculty were formally invited by the dean to participate in in-depth skill development workshops.

Once the leadership structure was clear, and faculty acknowledged the need for change, it was usually necessary to provide some staff augmentation. Necessary technical staff could include network administrator, media specialist, instructional designer, training or multimedia development specialist, and technician who could set up and maintain equipment. Additional faculty competent in supervision and teaching of the appropriate technologies were required unless already on staff. Faculty skills were necessary to effect changes, especially in the teaching of technology and in the persuasion of greater faculty involvement. At the University of Nebraska at Omaha, faculty recruitment in the College has been partially based on technology skills. Where some fully qualified faculty were already present, additional technical staff or graduate assistants were added to support faculty retooling efforts.

Planning. Colleges of education planning for technology implementation usually grew out of a university strategic commitment. However, planning for the specifics and tactics of change were more likely to be a school or college process. Most cases in this study have reported the development of a technology implementation plan. There was a considerable range in the detail and sophistication of college plans. Moreover, evidence of progress in the implementation of college plans was varied. For instance, at the time of the survey, the School of Education of Baylor University was already in the second year of its second five-year plan, where other schools or colleges were at various stages of a first plan. Plans were often set for three to five years. Technology implementation goals were established and priorities were set in accordance with faculty needs and were responsive to faculty requests. However, university guidelines influenced budget and format. Technology standards were developed as part of the implementation plan.

Some technology plans included technology courses for students and specific curriculum, as mentioned in the case of the College of Education and Psychology of North Carolina State University.

It is important to remember that for most colleges, technology implementation is an on-going effort. The content of the implementation plan requires constant review and revision as dictated by the advances in hardware, software, and pedagogy.

Technology Infrastructure

Settings do shape behavior and outcomes. The technology infrastructure provides a physical setting that allows the use of technology. One of the conclusions of this analysis was that a well planned technology infrastructure will maximize the use of technology, while the absence of infrastructure will make technology development difficult or impossible.

Faculty Computers. In planning technology infrastructure, location and costs need to be considered together with increasing productivity, strengthening administration, and improving communications and learning processes. Obviously, those colleges with adequate budgets were able to provide better infrastructures. But leadership and innovative faculty efforts often overcame the constraints of marginal funding. Nonetheless, all colleges in the study provided faculty with computers in offices, and most with network access.

Classrooms. In a small number of colleges in the study, faculty were provided with equipment for computer-based presentations in all classrooms with at least some with network connection (Baylor University, Indiana University, the University of Maryland at College Park, the University of Utah). Most of the colleges in this study reported such capabilities in some classrooms.

At Peabody College of Vanderbilt University and the College of Education at University of Texas at Austin, (assumably in other colleges as well,) portable multimedia equipment, such as a computer and other accessories setting up on a rolling carts, were used to provide flexibility to meet faculty instructional needs in all classrooms. The development of distance education capabilities is a growing trend and was reported to be in place at a number of colleges.

Off-campus Use. For off campus instruction or presentation, lap-top computers and LCD panels were available in some schools as well as camcorder and VCR (reported by College of Education of University of Maryland at College Park and Teacher's College of University of Nebraska - Lincoln, assumably other campuses as well).

Learning Resource Center. The use of a learning resource center (LRC) or a computer lab where faculty and students could have access to computers for general applications (word processor, spreadsheet, database, library search, Internet, e-mail, etc.) was common. A typical example was the School of Education of Baylor University, where the computer lab was furnished with 40 workstations and more than two hundred software programs. Sometimes, computers in LRCs were available in dual platforms (PC and Macintosh), and other media development devices were also available. Some schools established separate labs for multimedia applications.

Faculty Lab. Computer labs or other designated places were established for faculty to learn and experiment with technology in several colleges (the School of Education of Indiana University, the College of Education and Psychology of North Carolina State University, the College of Education of University of North Texas). Such facilities usually made available hardware and software not otherwise available in offices. Technical assistance was also provided.

This study confirms that planning for technology infrastructure sometimes involves substantial remodeling and construction. Often, the concerns were centered on the functionality (what is needed in the implementation of technology?), and the accessibility (how can the greatest access be provided to all users?). Faculty needs and preferences were factored into facility planning. There was also evidence that budget constraints were impediments to ideal solutions at most institutions.

Funding

Without the commitment of resources, faculty development activities and the necessary development of technology infrastructure are slow to take place. However, it is clear that innovative institutions have been able to achieve a great deal of success in the face of meager resources. Funding strategies include not only the traditional university budgeting process, but support from the external resources as well.

Internal Funds. Internal funds came from institutional revenues including student fees. The College of Education of Texas A & M, through internal and external funding, budgeted $365,000 annually as the minimum resource for technology in its strategic plan, and every academic department on campus established a technology account and a replacement schedule. At San Diego State University, the College of Education allocated $30,000 yearly for faculty technology development activities in addition to equipment costs. Many of the reporting institutions had fixed annual university budgets for technology development in the colleges.

External Funds. External funds include grants from Federal, state, regional or governmental entities, private foundations and corporations. Several colleges were successful in attracting grants from outside sources. At the Peabody College of Education at Vanderbilt University, a number of major course development projects were entirely or partially grant funded: Apple Corporation funded the Christopher Columbus Project (developing technology-based course modules), a similar project funded by the Sears, Roebuck Corporation, and the IBM

Corporation funded a project entitled "Increasing Pre- and In-service Teacher Skills in the Application of Multimedia Technology in Classrooms". The College of Human Development and Education of North Dakota State University obtained grants for technology from the Bush Foundation, AmeriTech, GTE, as well as State Department of Education. The College of Education at Penn State University estimated outside funding reached $100,000 yearly. The College of Education and Allied Professions (EDAP) at Bowling Green State University used a number of strategies to fund its technology development. In addition to grants from government, private foundations, and corporations, fund-raising activities were held biannually through a telephone based campaign assisted by students. The campaign was proven to be very successful, providing ongoing support for the College's technology implementation plan. Bowling Green State University also reported alumni sponsorship as key support for technology implementation.

Uses of Funds. It was common for internal and external funds to be used by faculty to develop courses which incorporated technology into classroom instruction; to provide release time for faculty engaged in technology projects; as summer stipends; as compensations for support personnel (graduate assistants, lab staff, or extra load for faculty with expertise); and in some cases, to train trainers. Also, funds were used to meet the hardware and software needs for projects. However, most colleges have budget specifically for hardware and software purchase and upgrading.

Discussion

This analysis demonstrated that the process of technology integration in colleges of education has been very uneven and always challenging. The evolutionary change from non-technical to somewhat more technical has been measured at differential rates among the colleges of education across the nation. The data provided by the institutions of this study demonstrated growth and advancement in the use of technology beyond many colleges of education in the United States. The most advanced in the study represent real success stories. Some institutions not included may have even better outcomes. However, even where adequate financial resources were made available, the rate of change was sometimes less than spectacular. Where resources were meager, so was the technology infusion.

The essential key to success, even in the age of technology, seems to be leadership. In fact, the human variable appears to be more important than ever. Leading colleagues to a shared vision (recognition of a common goal) is a leadership task requiring the greatest skill, and yet to be achieved *vis-a-vis* the acceptance of technology on campuses. This leadership task belongs to the faculty as much as to deans and chairs. Individual faculty initiatives inspire colleagues and change faculty culture.

To provide incentives that will work is an enormously challenging task for leadership to accomplish. Incentives are sometimes thought to be a myth. It is true that incentives are often rejected or when accepted, have little or no yield. It is easy to see why givers and receivers of incentives have become a bit cynical at some institutions. However, it is well understood that a cardinal principal of psychology is that behavior rewarded is reinforced. Reward is in the eyes of the beholder. If incentives are to be used to encourage faculty to use available technology and integrate that new capability into teaching and research, then an appropriate and meaningful *quid pro quo* must be found. As with all things having to do with intellectual growth and maturity, it is the ego of the inner person (the mind) that must be rewarded first. The intrinsic value associated with learning to do what one does better is incentive enough for the dedicated scholar teacher. The monetary reward may serve as an attention getter since even dedicated scholars and master teachers have to pay the mortgage or rent, and buy groceries and clothing. But recognition from department leaders, the dean of the college, and others in the university hierarchy may prove more effective than money where faculty are fairly compensated. This will be especially likely if there are consequences associated with indifference to the need for reengineering pedagogical skills.

Perhaps the most common initiative for school change has been top-down (Cuban, 1993). While the top-down mandate has apparent efficiency in introducing technology, it is often viewed by faculty as coercive and an invasion of their autonomy, resulting in resistance. To provide structural support, on the other hand, reinforces the message that administrative leadership is committed. Leadership in this, as in all areas of the university, needs to be seen as nurturing and supporting an environment where faculty and students can learn and grow intellectually.

It is useful to remember what we want those going into the field of education to know. Dewey said that all knowledge is external, all knowing is internal. Knowing means to process. We have historically relied upon the mind to process knowledge. The computer has been demonstrated to be a powerful adjunct to the human mind. In less than two decades, technology has become the dominant world force, moving economies and creating knowledge at an unprecedent pace. Computers and related technologies drive space flight, guide the surgeon's hands, make possible genetic research and biotechnology outcomes which a generation ago could have been found only in science fictions. As we prepare for 21st century, we must equip teachers we graduate with the ability to use computer power in the knowledge that they own, as well as to prepare their students for a work world that will demand computer literacy, just as surely as the ability to read and write was required for employment by the leading edge of the "boomer" generation (e.g., at the end of WWII).

Colleges of education are under considerable scrutiny not only by a university that is reengineering itself, but also by a society that is sorely disappointed by a public school system that is not performing to its expectations. As Seymour Sarason (1995) suggested in his lecture, "A Critical Appraisal of Teacher Education," that at the turn of the century, American medicine did something that paid handsome dividends for the society: "Before the Flexner report (1910), most medical schools ... were not affiliated with universities and were not even affiliated with hospitals. ... There are many illnesses that we know little or nothing about." Flexner's report emphasized the importance of knowing these things. The report promised that medicine would do its best to get answers. "They made a virtue of ignorance." Sarason noted the educational community did exactly the reverse. The educational community presented itself to the public as "Send us your children, and we will do the appropriate thing because we know how to do it in the best possible way." He stated, "It wasn't true then and it isn't true now."

The public school system is at risk. Colleges of education have an opportunity now to position themselves for better service to their students and their communities through the use of technology-enhanced pedagogy. If we as educators fail to act to meet the technology challenges in our classrooms, and assist in finding solutions for teachers in the schools, we must be prepared to see even greater numbers of k-12 students deemed obsolete even before they graduate, with the attendant increases in drop-out rates and greater social disfunction. If we fail to infuse and reform our curriculum and pedagogy with the most appropriate tools, we will have placed the future of colleges of education at risk as well.

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