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ABSTRACT

Thirty-nine papers on the place of technology in education are collected in this volume of conference proceedings. Several themes run through the collection, appearing in different combinations in different papers. Among the major topics discussed are the applications of computer technology to different aspects of instruction and school administration; the uses of broadcast and cable television and radio and of video technology in on-campus and off-campus instruction; and the formation of consortia of educational institutions to share the costs and benefits associated with courseware development and dissemination. Other major issues considered include the nature of the changes that technology will bring about in traditional and nontraditional education; the role of the government in developing educational technology; the concepts affecting the development of effective courseware; and the effects of educators' attitudes on the adoption of new equipment and methods. The majority of the papers consist of informed opinions or generalized analyses of the status of educational technology, while others describe specific programs or suggest techniques for implementing and applying technology. (PGD)

TECHNOLOGY AND EDUCATION

POLICY IMPLEMENTATION EVALUATION

(Proceedings of the National Conference on Technology and Education—January 26-28, 1981)

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Congressional Perspectives on Information Technology

Congressman George E. Brown, Jr.
Committee on Science and Technology
Washington, D.C.

I am pleased to discuss a subject of considerable interest to me, both personally and as a senior member of the Committee on Science and Technology of The House of Representatives.

There has been a long-standing involvement of the Science and Technology Committee in efforts to improve the flow of scientific and technical information and in the application of information technology to education. I will spare you the ancient history and only summarize the more recent activity for you.

In 1977 we held extensive hearings on Computers and the Learning Society. These hearings served an important educational function for both the Congress and the public, raising in a high-visibility forum some fundamental question about the development and use of computer-aided instruction. Partly as a result of these hearings, Congressman Scheuer, a senior member of the Committee, introduced a bill, H.R. 4326, calling for the creation of a National Commission to study the scientific and technical implications of information technology in education. The Science, Research, Technology Subcommittee held hearings in October of 1979, to gather testimony on H.R. 4326 and more generally on the educational implications of such "new" information technologies as videodiscs, teletext, and cable and satellite broadcast television, as well as computers.

These hearings made it clear to us that much had changed in the two years following our 1977 hearings. Not only had technology development and application progressed rapidly, but there had also been an important institutional change—the establishment of a cabinet-level Department of Education and the resulting reorganization of much of the federal educational bureaucracy. (Of course, it now appears that this new department may succumb to infant mortality—but that's another story.)

As a result of our October 1979 hearings, we saw a need to bring together educators, developers of information technology and the associated courseware, and policymakers, in a forum to share ideas and to begin charting a course for what seems certain to be an increasing use of information technology in the educational future. In April of 1980, the SRT Subcommittee joined with the Subcommittee on Select Education in two days of hearings, a workshop for 150 participants, and a technology demonstration. The testimony of those two days left little doubt that rapid technological advance will continue, creating exciting possibilities in education and elsewhere. The witnesses and participants also made it clear that public planning in this area will need to take a broad view of what constitutes "information technology," and that this technology will have educational impacts going well beyond our traditional educational settings.

The April hearings helped to catalyze a number of activities. The Subcommittees forwarded a copy of the recommendations of the discussion groups to the Secretary of Education, with the request that the Department identify initiatives falling within its preview and indicate proposed actions in these areas. Partly in response to this request, the Secretary appointed a task force on educational technology charged with analyzing the Department's current efforts in support of educational technology and identifying promising areas for future efforts, including any additional legislative authority that might be needed. I prefer not to venture any predictions of the uses the incoming Administration may make of the task force report.

On another front, the Subcommittees requested that the Office of Technology Assessment undertake a study of information technology in education, including an assessment of current levels of activity and projections of future use and its impacts on educational and social institutions. This study, an 18-month effort, was approved by the Technology Assessment Board and is now under way.

The Subcommittees responsible for the April program are in the final stages of preparing conclusions and recommendations to the Congress and the Executive Branch. I cannot yet share these with you, but I would like to share some of my personal views and concerns regarding the future of information technology, in education and elsewhere.

I don't think anyone needs convincing that the Information Revolution is upon us. By one estimate, approximately half of our work force is now engaged in information-related occupations, broadly defined. It is already clear that the productivity and innovative capacity of American industry, which is an important concern of the SRT Subcommittee and a focus of much of our activity, depends in a critical way on the generation, processing, and transmission of information. In the home or workplace of 1990 and 2000, information technologies will have uses ranging from routine services such as electronic mail and banking to sophisticated industrial applications of computer-aided design and robotics.

We cannot allow developments of this importance to take place willy-nilly, without addressing some careful thought to what kind of society we seek to build and what tools are appropriate in building it. Information is an important national resource, and its impact on our lives has become so great that we need to begin some serious planning of how best to use this resource to advance our national goals.

Some of you are aware that I introduced a bill in the last Congress, H.R. 8395, aimed at stimulating this kind of planning. The bill establishes an independent Institute for Information Policy and Research in the Executive Branch. I believe that the independence of the Institute would allow it a broad and integrated perspective on such issues as institutional structure and regulatory policy, a perspective rarely attainable within the bureaucratic constraints of the dispersed agencies, now dealing with information issues. I view the Institute as a transitional mechanism to facilitate our nation's evolution into an Information Society. It would serve as a focal point for information *policy research and analysis* and would provide a forum for consideration of the information interests of government, business, and education.

The ways in which information technology is used—or not used—in our educational processes will have a great deal to do with how well we as a society are able to cope with the Information Explosion. T' , issue of compatibility of technology and humanism, and I use the term to encompass all systems of moral values, is significant. That issue should be of concern to all of us, since information technology raises some particularly disturbing questions about these values.

When technological innovations are widely adopted, it is usually because they offer a demonstrated, or at least anticipated, enhancement of productivity. Information technology is no exception to this rule. By offering students both conceptual and practical preparation in information technology, we can help them to function more effectively in the technology-rich environment of ten or twenty years hence. But in so preparing them, we need to keep in mind the *end goal* of increasing productivity—a more humane, just, and equitable society for all. We need to make a special effort to see that the benefits of these new technologies are shared by all in our society, and that we do not end up reinforcing current patterns of inequality. We need to develop in our citizens the cognitive and social abilities that will enable them to adjust to and thrive in an environment characterized by rapid change. And, not least, we need to enhance the intrinsic value and sheer creative pleasure of learning.

I doubt that any two would agree on the precise characteristics of an educational system that could accomplish all that I have just described, let alone how to create it. It is very likely, however, that most or even all of you will accord an important role to information technology in your respective educational utopias.

But—it is an inescapable fact that, as of today, information technology is less pervasive in formal education than in virtually any other social arena. To get to Utopia from here, we need to understand why this is true.

In my view the main reason is that teachers, administrators, and parents have not been convinced that information technology can increase learner productivity or enhance educational quality at an acceptable cost. In our April hearings, this failure was consistently attributed mainly to the lack of good courseware. It is true that the application of information technology to education has largely been a technology-driven process, in the sense that educational needs have not been a major impetus in hardware or software development. I think there is reason to believe that equipment vendors and publishers are starting to take educational needs seriously and are on the verge of major initiatives in courseware development and promotion. The nature and quality of these initiatives will have considerable bearing on the future of information technology in education, and it is of the greatest importance that educators have early and continued involvement in these efforts. The development of technology must be guided, and its applications shaped, to make it work toward that end goal of a more humane and equitable society.

If education is ever to take full advantage of information technology, I think it's important to understand that fundamental technological advances, almost by definition, have the capability to change the way we think about the world. Taking advantage of the magic of information technology forces us to think about new ways to organize and transmit knowledge. Real improvements in educational quality are not likely to result from using shiny new technology to do the same old things just a little better. The power of videodiscs, for example, will be wasted if we simply use them as surrogates for printed textbooks. I see great educational potential in imaginative uses of telecommunications networks to "wire" together schools, libraries, and governmental and industrial centers and to make distant data bases, as well as distant new and important environments, accessible to home users. With the construction of sophisticated "knowledge bases," computers will be able to query a student—perhaps in natural language—to ascertain his level of knowledge and to guide his explorations, complete with advanced graphics, at an appropriate level.

There are challenges aplenty in this vision of the future—for researchers in cognitive sciences, for courseware developers and educational administrators, and for policymakers in local, state, and national government. I applaud your dedication to this important task and urge you to keep up the fight. As for the federal government, one of the witnesses at our April hearings suggested that the federal government should either help in the application of information technology to education, or else get out of the way. It is not yet clear to me whether the new Administration makes a distinction between these alternatives—but, as for the Contress, I continue to believe that we can help.

Developing Technology to Enhance the Educational Process

Allan E. Hershfield
National University Consortium
College Park, Maryland

Several thousand years ago, there was an island in the Mediterranean on which the people had reached a very high level of civilization. One of the unusual characteristics of this society was that it had no formal system of education. Parents "educated" their children in an informal way, passing along the wisdom and history of their society in the course of day-to-day activities.

Like many other city states of that time, this island state had a large central market that was both a commercial and social gathering place. One day, a number of the adults who came to the market regularly noticed a fairly large group of children had assembled around a young man named "Thok," and were listening avidly to everything Thok had to say. They witnessed the children ask Thok questions and were most impressed by the wisdom of Thok's answers to these questions, and by the question he, in turn, posed to the children.

After talking among themselves, these adults agreed Thok was so smart, and possessed so much wisdom, all the children in their country should be exposed to his brilliance. They approached Thok, and told him they would all chip in to pay him a daily fee if he would share his wisdom with all the children in the society—the children to be assembled in the market place Monday through Friday from 9 a.m. to 5 p.m. Thok agreed and began to meet with the children daily. As the adults continued to go about their business in the market place, some of them listened with some care to Thok's discussion with the youngsters, and they discovered that Thok had a great many things to say that would benefit adults. So, they went to him and asked him if he would meet with the adults in the same way he was meeting with the children. Thok agreed, and the adults began to meet with Thok in the market place from 7 p.m. to 9:30 p.m. fives nights a week. (The market was, afterall, full of children during the daytime hours.)

This arrangement was most successful, and went on undisturbed for many years. As Thok got older, his voice began to weaken, and one night, as he was speaking to the adults, a voice from the rear of the market place shouted, "Speak louder, we can't hear you back here." Thok's voice was weak and he couldn't speak louder, but he was quick witted. He walked over to a nearby palm tree, took off a long, flat leaf, rolled it up to form a megaphone-like amplifier, and continued his presentation using the leaf. This innovation worked very well. The rolled leaf amplified Thok's voice and he was able to continue has teaching.

This innovation, the use of the rolled leaf as an amplifier, became routine and no one thought anything about it until one day, the island received a visitor—a teacher from a neighboring city state. This visiting scholar watched Thok speaking with the children in the daytime and the adults at night, and noted the leaf. In his society, no one used a leaf to teach, and so he began to ask the question, "Can the leaf teach." Being an inquisitive soul, and after gaining the full cooperation of the adults and the children of the society, he submitted a grant proposal to one of the country's largest, and wealthiest olive merchants. The proposal laid out an ambitious research project intended to answer the question, "Can the leaf teach?" The merchant was taken with the question and funded the research project.

The visiting scholar then divided the children, who assembled in the market during the day, into two groups. He did the same thing with the adults who assembled in the market place at night to hear Thok. Then, Thok addressed each group separately. During the day, and one group hear him through the leaf and the other listened to him without the leaf, and the experiment was repeated at night. After using an abacus, and conducting a lengthy multi-factoral analysis, the visiting scholar concluded there were no significant differences between Thok and the leaf.

The moral of this story is that most of the people interested in instructional technology have focused their attention on the leaf, and not on Thok and the students. If we are going to make effective use of technology for educational purposes, we must move away with this simplistic faith in technology, and understand how to help Thok learn to use technology to improve the education delivered to students. To do this, we must come to understand the past and make realistic plans for the future.

Understanding Past—Realistic Future Plans

Breathless technologists and futurists have been predicting a technological revolution in education, at all levels, ever since motion pictures appeared more than eighty years ago. When radio broadcasting developed in the 1920s, it too was supposed to bring about basic changes in our educational systems. Then, teaching machines, television and computers were seen by many as technological innovations that would bring about fundamental changes in the teaching-learning process.

Having received my own formal elementary, secondary and college education from the 1930s through the 1960s, in a number of different schools and systems, I can state categorically that, apart from an occasional Encyclopaedia Brittanica film, my contemporaries and I saw no evidence of this so-called revolution. The educational process through which we went was very much like the process most young people experience, today. Although, I daresay, it may have been somewhat more rigorous.

Undaunted by the gross inaccuracy of previous predictions of technologically driven change in elementary, secondary, and higher education, contemporary oracles are now forecasting video cassettes, video-discs, lasers, communications satellites and two-way cable systems will, at last, bring us to the educational millenium.

In spite of the extraordinary impact all of these technological innovations have had (and are likely to have in the future) on American society in general, they have had little influence on what happens in the average American classroom—be it in an elementary or secondary school or on a university campus. If we looked in on the average American classroom, today, we would find one teacher of professor standing in front of a group of students, presenting materials. At the elementary and secondary school levels, we might also find the teacher posing questions, and accepting responses from students with up-raised hands. Thus, the educational process in the average classroom has changed little since before the invention of movable type in 1448. Until books could be reproduced speedily and inexpensively, the only way a teacher could communicate knowledge to large numbers of students rather quickly was to stand in front of them and read his or her own hand-written notes. The students could then make their own notes for later study. When Johann Gutenberg began printing books, more than 400 years ago, he made this type of instruction obsolete. Yet, this approach to education is still the dominant mode of classroom instruction, and the classroom is the place in which most formal education takes place in the United States.

Thus, we have a single model of the way formal education takes place, and the administration of our schools and universities, with a few minor exceptions, is based on this model, as are state and federal policies related to education. Educational approaches that depart from this model have little chance of success because they don't fit the preconceived notions of faculty, administrators, students, legislators, and staff personnel in departments of education, statewide educational coordinating bodies, and the federal government.

Current Model

Before describing some of the impediments, systemic and otherwise, that block of effective use of instructional technology in American education, it might be useful to sketch out some of the assumptions implicit in our current model of education about what a professor or teacher does in preparing to teach a class and in actually teaching it.

Generally, educators do essentially the same thing no matter the level at which they teach: They plan the course; present the material and make outside work assignments; stimulate and motivate the students; assess how much the students have learned, report the information on how much the students have learned to a central record keeper and to the students, and most important, they provide an example to the students of the way authority figures behave towards students and towards one another. Most of the teacher's time for a given course is devoted to planning and preparing the course and presenting material to students. It is, therefore, important to think about what we really expect of a good teacher who performs these tasks extremely well.

First of all, the teacher should have mastery of the subject matter he or she is supposed to teach. While the level of required mastery will vary according to the level of instruction, there is no doubt our model teacher should be able to select from all the information he or she knows, that material which is most appropriate for the type of students he or she will be teaching. Since knowledge changes rapidly in so many fields, this means the teacher must keep up with the latest discoveries in his or her subject area, and must revise his or her course to take into account these changes, every time the course is taught.

Second, the superb teacher must determine how best to structure and deliver the course so the students will learn not only the material, but also learn how to solve problems and how to be creative and use their imaginations.

Effective teaching, then is a complex series of activities involving many very different skills. Our traditional model of education assumes all teachers have all these skills and use them to near perfection. Yet, if each of us were to reflect back on our own experiences in elementary and secondary school and in colleges and universities, I suspect most of us would be hard put to remember more than one teacher who stimulated and motivated us, as well as helping us learn the latest knowledge in his or her subject area.

From personal experience, I can say when a student has the great good fortune to come in contact with one such teacher during the course of his or her education, that teacher usually makes a permanent, positive impact on a student's life. In twenty years of schooling, I have been lucky enough to have two such teachers—both of whom taught at the university level. While I am extraordinarily grateful for having had the opportunity to sit at the feet, so to speak, of two such great teachers, I ask myself what about the other approximately 113 teachers who instructed me from grammar school through two master's degrees and a Ph.D.? Very few of them possessed all the skills our traditional model of education assumes each teacher to have.

The Promise of Instructional Technology

The great promise of instructional technology is that it, at last, offers an opportunity to develop models of education far different from the current dominant one, and in so doing, make major improvements in the quality and effectiveness of education. We may also be able to use technology to improve educational efficiency. *There is, however, nothing inherent in the nature of instructional technology that guarantees these outcomes.* Instructional television, for example, is used frequently to do nothing more than transmit what happens in the classroom. When that is done, the televised lesson usually combines the worst aspects of the classroom experience with the worst aspects of television, without the benefits of either form of instruction.

The perplexing issue with which all of us interested in improving education must deal is, given the existence of new communication and instructional technology, why haven't we been able to use these technologies to make major improvements in our traditional educational processes?

Why hasn't the mere existence of innovations in communication and instructional technology brought about the same kinds of sweeping changes in the educational process that the invention of the steam engine and its precursor inventions wrought when the Industrial Revolution swept across England and then, much of the rest of the world? Critics, searching for the answer to this question, frequently point their fingers at teachers and faculty members, charging them with unwarranted conservatism, downright recalcitrance, and being the major obstacle to technological innovation in education.

While no description of impediments to the use of technology would be complete without an explanation of the fundamental basis for general faculty conservatism, let me sketch out some of the systemic characteristics and other types of barriers that make it most impossible for even those few faculty members who might wish to use instructional technology to do so effectively.

Comparing the Course Development Processes

A good way to begin is to compare the course development process in the traditional institution of higher education with the procedures used to create courses (instructional software) that make full use of instructional technology.

The course development process in a traditional college or university is basically labor intensive, involving a single faculty member in the development of a particular course. Usually, no major capital investment is required—except that originally needed for buildings, laboratories, libraries, etc. Apart from an occasional summer grant to support a faculty member while he or she develops a new course, there are no major costs associated with such an activity. Most new courses are developed *as they are taught*—while the faculty member is teaching other courses, engaged in research, advising students, participating in committee work and carrying on whatever public service activities can be fitted into a busy schedule. Faculty are, in effect, being paid a single sum of money to develop and to deliver a course.

Unlike the traditional course creation process just described, courses developed to use technology effectively often involve recording an entire course or much of the material in advance, in one or more forms—films, videotapes, computer programs, programmed texts, audio-tapes, slides, carefully-structured printed materials, etc. The development process for this type of course is different from the one just described, and is not consistent with common institutional practice, state policy, faculty and administrative values and behavior, and the traditional model of education.

Imagine the reception a group of foreign language faculty members from three different universities in one state would receive from their department chairpersons, their deans, or vice chancellors, or the head of the state's postsecondary commission or chair of the legislature's finance committee, if they made the following request:

> After careful study and thought, we believe we can make a major improvement in the teaching of French by developing a technologically-based program to be used at our universities, and other universities in the state which might wish to buy or rent our materials for on-campus use, or for off-campus, adult education. We plan to begin by developing an introductory French course for first-year students. Here is what we need to create this course.
>
> We (all three of us) need a full year of released time at learning theorist, and instructional technologist, two graduate assistants and a full-time secretary, all at a total cost of $124,000. Our group, functioning as a course development team, will develop and test an introductory French course. When we have completed this development work, we will need another $150,000 to produce color video cassettes, audio cassettes, computer-based programmed texts and examinations, controlled vocabulary reading materials and a diagnostic entry examination to be administered to all entering students. We will also need $10,000 to hire as consultants the three senior experts in this field in the United States, as well as several of our colleagues from other universities in this state. When the course had been completed and is ready for delivery, our three universities will each have to spend $50,000 to deliver this course. Moreover, because the students will be spending a great deal of time working independently with the materials produced for this course, and less time listening to us live in the classroom, our number of student contact hours will be reduced substantially, but because this course will be used to teach many more students than we could have taught in the traditional mode, we should have reduced course loads. If these materials are sold or used outside of

our universities, we should receive residual payments similar to those paid to film and television performers. Finally, we'll need to provide $15,000 per year for possible annual revision of a portion of the materials.

Although this approach to course development may seem over blown, it is very similar (although not identical) to the development process used by the British Open University to develop superb, internationally acclaimed courses that are used by adults who cannot attend a college or university, on campus as full-time students. The development of one of these British Open University courses costs more than $500,000.

The example just presented demonstrates only one of many ways of creating course materials to make effective use of instructional technology. Other somewhat less complex and expensive approaches can be used with good results. This example is particularly useful, however, because it provides such a stark contrast to the traditional model of course development.

Barriers

Now, let me describe some of the barriers that make it all but impossible to use a sophisticated course development process similar to the one just described to improve the effectiveness and efficiency of higher education.

Current administrative practice makes it impossible to consider funding course development in the high technology mode. Funds are allocated to departments, and the largest proportion of the budget, 70 to 80 percent, is used to pay salaries. Ideas which do not fit this "bits and pieces" resource allocation system are excluded from consideration.

The full-scale, technologically-based course development process is heavily capital intensive—with very large amounts of resources being required to develop a single course or unit. Capital is needed to produce and test the software: to set up and operate a system to deliver the course, and to provide funds to update the twenty-percent of the software on an annual basis.

Few, if any, American states, colleges or universities have any regular mechanism for funding course development activities of this nature on a large scale. Development of this type, to the extent that it does occur, almost always takes place as an unusual exception to existing practice.

The only way such heavy capital investments can be justified is for the course or its various components to be used by very large numbers of students—many more than a single faculty member would normally teach during one academic term. Let us pursue this point further by analyzing the situation of one of the three faculty members mentioned in our earlier example.

Assume a faculty member normally teaches three different three-credit courses per term, and the average enrollment in each course is 30 students. Using current administrative terminology, the faculty member would have "generated 270 student credit-hours—ninety for each course (3 credit hours × 30 students @ 90 student credit hours × 3 courses @ 270)." If the faculty member's salary were $26,000 per year, for a nine-month contract, and the academic year had two semesters, the direct cost of instruction in the traditional mode is almost $39 per student credit hour ($26,000 ✓ 2 semesters—$13,000 per semester ✓ 270 student credit hours—$48.15).

Looking at the high technology model, the costs mentioned above come to:

Capital	$344,000	for software development and equipment
Recurring annual costs	$ 15,000	updating and delivery of software

This does not include the faculty member's salary that is treated below. Since the average faculty member would seldom teach three sections of the same course during one semester, let us assume two of the three sections he or she teaches are of the same course, and this is the one which will be produced using the technological approach to development. In two sections of this course, with 30 students each, the faculty member will generate 180 student credit hours. The cost for his or her salary, apportioned by student credit hours, is still $48.15. If the technologically-based course were to be used only once to teach two sections of the class, the additional costs per student credit hour generated would be $1,855.55. The faculty member's salary added to that would bring overall cost to $1,903.70 per student credit hour generated. If we assume the course will be used five years, without major modifications, (the $15,000 budget for recurring costs is for minor modifications) to teach two sections per semester, or four sections per academic year, the faculty member would generate 1,800 student credit hours, and the annual capital cost would be $78,800 derived as follows:

One Time Capital Cost	Four-Year* Revision Cost at $15,000 per yr.	Total Annual Capital Cost 5 yr.
$334,000	+ $60,000 = 394,000 −	5 yrs. @ $78,800

* No revision required during the first year.

The cost of course development would be $218.88 per student credit hour. Adding the cost of the faculty member's salary, we arrive at a cost of almost $267.03 per student credit-hour generated, if the course developed is used only to teach those students the individual faculty member would have taught anyway. The cost for this form of delivery would be more than 5.5 times that of instruction in the traditional mode.

The course would have to be used to teach 3,416 students over a five-year period, rather than the 600 who would normally be taught, to get the cost per student credit hour down to $38.44, not counting the added cost of the faculty member's salary. This analysis makes it clear that the full *scale use of technology cannot result in the more efficient delivery of educational services within a few universities and colleges unless technology unless technology is used to displace faculty members.* This poses a fundamental dilemma.

The Dilemma of Development

If one were the president of a large manufacturing firm, interested in increasing the productivity of the manufacturing operation, he or she could call upon the research and development section to develop or acquire new, and more efficient machines or processes. Once these were available, management would make the decision to install them in the factory (assuming there were no legal obstacles such as union contracts); the workers would be instructed on how to operate the new machines; they would begin to operate them; and the company would benefit from increased productivity, and in most instances, so would the workers.

Unlike the factory, it is the University's "workers," the faculty, who must develop the software to be used on the computer, the television set, the teaching machine, etc. Thus, even those few individual faculty members who might be willing to try to develop new, more effective and efficient approaches to delivering educational services, would stop very quickly once they perceived they were being asked to invent the means by which to put themselves and many of their colleagues out of a job.

Many individuals who push for the wider use of instructional technology seldom take into account student attitudes toward such developments. In an urban-industrial society, increasingly depersonalized by the use of technology in almost every phase of life, *university students are not likely to be pleased with an approach to instruction they perceive will afford them less face-to-face contact with their professors.* Indeed, there is some anecdotal evidence to suggest substantial numbers of older adults may enroll in extension courses primarily to be with other people and to have an opportunity to interact with the professor.

Faculty, too, generally react negatively to what they perceive to be the depersonalization of the educational process that may result from the increased use of instructional technology.

There are those both within and outside of our institutions of higher education who appear to be breathless enthusiasts for mediated instruction as an end in itself. Such individuals take on a variety of forms—all of which with good reason, tend to alienate the faculty.

Absence of Technology Objectivity

It is difficult to find, within most American universities and colleges, trained instructional technologists who can deal with a wide variety of technological and non-technological approaches to education with equal competence, professionalism and ease. One tends to find experts in instructional television, computer-based instruction, and audio-visual equipment such as film and overhead projectors, etc. Each of these individuals is a devotee of his or her particular form of technology, andrecommends it vigorously to resolve every pedagogical problem. "Experts" such as these often lose sight of students as the beneficiaries of the educational process.

Moreover, faculty, administrators and students have all too often been frustrated by the failure or inadequacy of both the equipment and the software provided by these "experts," and this too contributes to the reinforcement of negative attitudes towards the use of technology.

A second, but no less vexing, aspect of the instructional technology panacea is frequently demonstrated by a politician, state agency official, or self-styled-expert who sometimes exhibits a bid case of "mediaitis." This illness takes at least two forms. A symptom of Type A Mediaitis is a suggestion that gobs of money could be saved if only "we would put one faculty member on television, somewhere in the state, and broadcast that faculty member's sterling lectures to thousands of expectant and eager students." Type B Mediaitis is somewhat different. In this form of the illness, an expert spends a great deal of time expounding upon the need for a particular type of technologically-based delivery system, e.g., broadcast, closed circuit TV, satellite, videodisc, etc.

Faculty Conservatism

Having described many of the systemic barriers to the use of technology to improve educational effectiveness and efficiency, it now seems wise to attempt to understand the basis for the university and college faculty's general conservatism towards new approaches to instruction—both technological and non-technological.

Because the selection of instructional techniques is almost always a matter of free choice by each individual faculty member, new approaches to instruction will only be adopted widely if each faculty member is made aware of a particular innovation, becomes interested in it, tries it, evaluates the results of this trial, and if pleased with the results, adopts the approach more or less permanently. Very few university and college faculty members go through this process of adopting new approaches to instruction because their training and experience do not move them in this direction.

This is the case because there is a single more or less pervasive model of excellence in higher education—the prestigious research university. Faculty members who are successful in such institutions emphasize certain activities and patterns of behavior which are antithetical to seeking out and using information on new approaches to instruction. These patterns of faculty behavior are also not consistent with the requirement that the development of high technology education software is, of necessity, a *team* effort requiring the close, collegial cooperation of a variety of professionals.

As graduate students, most doctoral candidates focus their attention on becoming competent in one or more sub-fields of an academic discipline and on acquiring the skills needed to do research within that sub-field. They also learn, from their faculty mentors, that the primary function of university faculty members is to push forward the boundaries of knowledge in their chosen speciality by doing original research—the results of which will contribute to the development of a body of theory and which will be publishable in the most respected scholarly journals in their discipline. A closely related function is that of communicating the knowledge they acquire to graduate and undergraduate students.

The emphasis, then, is on highly *individualistic,* creative, intellectual work focused on problems defined by an academic discipline. Judgments of the quality and quantity of a faculty member's published work are made largely on the basis of evaluations made by specialists in his or her disciplinary sub-fields, many of whom are at other institutions of higher education. These judgments and those of his or her departmental colleagues are of primary importance in decisions on promotion and tenure, and to a lesser extent, annual salary increases based on merit. A faculty member's performance will be judged by the extent to which he or she conforms successfully to the behavior pattern described above. Departures form that pattern will be punished by negative evaluations.

The reward structure in prestigious research universities reinforces the highly individualistic, creative intellectual behavior patterns learned in graduate school.

The pattern of faculty behavior just described is dominant in most research universities. It is, indeed, one of the primary reasons for the preeminent status of our most prestigious universities. Faculty at these institutions have made extraordinary contributions to the growth and development of human knowledge, and these contributions have been stimulated by the system just described.

Another major aspect of individualistic faculty behavior and institutional practice is that a single faculty member usually teaches a single course. This is neither the most efficient nor most effective way to develop packages of mediated materials which will be used widely. With respect to the use of mediated materials, it usually leads to "the not-invented-here syndrome" often expressed by an individual faculty member not involved in the development of the mediated materials as "those materials are not of sufficiently high quality to meet the educational needs of my students." (Translation: "That isn't the way I would do it, therefore, it doesn't meet my quality standards.")

If one cannot expect a technological revolution in higher education to begin at prestigious universities, is it then possible that other, different types of American institutions of higher education will make the changes necessary to move in new directions? With the possible exception of some community colleges, the prospects for this sort of change are not good. The reason for this is that even though there are relatively few prestigious research universities, **there is a single model of excellence, in the minds of most faculty members and administrators, and many of them exhibit all the patterns of faculty behavior found in the research institutions—without producing the quantity, or quality of publications produced by their counterparts at Harvard, Yale, Stanford, Berkeley, Wisconsin, Michigan, etc.*

These less prestigious American institutions are, the ones which might be expected to adopt more effective and efficient approaches to instruction and learning. Most of them have not done so, however, and

* All faculty members, regardless of the type of institution in which they teach, must be actively engaged in the pursuit of knowledge. This is the only way they can be sure they are providing current, accurate information to their students. This does not, however, mean they must be involved in "state of the art" research in their discipline.

will not do so until alternative models of excellence emerge and are awarded societal recognition. Unless and until that happens most of these colleges and universities will continue to emulate the research institutions in behavior and values, if not in high quality scholarly output.

The suggestions which follow are intended to help these colleges and universities wishing to use the high technology mode of instruction overcome many of the foregoing barriers.

Policies and Practices Intended to Facilitate the Use of Instructional Technology

A number of changes in institutional policies and procedures can activate faculty to become involved in the development and use of instructional technology and at the same time, protect their jobs, and reward them for their efforts. Here are some general statements which might be included in a policy designed to attain the goal:

1. The faculty, students and administration of ______ University commit themselves to develop and use instructional technology whenever there is sound reason to believe such technology can improve the effectiveness and the efficiency of education. Since the content and the pedagogical objectives of all courses do not necessarily lend themselves to a technological treatment, major development efforts will be undertaken only after discussion by the parties involved and general agreement that such efforts should be undertaken.
2. No faculty member currently employed will be displaced by instructional technology.
3. Within the framework of #2 above, technological approaches to education will be used to:
   a. Extend the capacity of faculty to serve larger numbers of students more effectively; and
   b. Where possible and appropriate, to substitute for faculty members who are planning on leaving the institution voluntarily; to fill vacancies created by death; and to begin new programs or courses for which new faculty would normally be employed.
4. Productivity gains derived from the development and use of instructional technology, if any, will be shared with:
   a. The faculty members who participate in course development and delivery;
   b. The academic department of schools to which the faculty mentioned in "a" are assigned; and
   c. The main funding source for the institution (e.g., the state, for public colleges or universities, and the trustees of independent institutions).
5. The faculty and the administration will, together, develop an

institutional policy on ownership and use of mediated materials, the development of which have been completed with substantial institutional resources. This policy will define and protect both the institution's and the faculty member's rights and obligations. Among these are:

a. The institution's right to recoup funds committed to development, in the event there is a substantial external market for the material produced;
b. The faculty member's right to additional remuneration from external distribution, after the institution's capital investment is recouped;
c. The conditions under which the materials may be used by the institution in the event the faculty member terminates his or her employment;
d. The faculty member's right to ensure the continued accuracy and utility of the materials by the regular provision of institutional resources for annual revision of a specified percentage of the material (ten to twenty percent);

6. The extent, character and quality of a faculty member's contributions to the development of mediated materials will be given substantial weight in the tenure, promotion and merit review process; and
7. New means will be developed for assessing the efficiency of instructional techniques making heavy use of instructional technology.

While any one who has ever taught in a classroom would have grave doubts about the utility of the number of student contact hours* as a valid measure of anything, it is clear such commonly used measures can be major impediments to faculty members who might wish to develop and use high quality instructional software. To do so could reduce markedly their number of student contact hours.

Obtaining Development Capital and Measuring Efficiency

State and national government officials and individuals in the private sector, interested in stimulating the use of instructional technology, must create some regular funding mechanism to provide the capital necessary to develop and deliver instructional software, and they must be willing to re-examine and discard those measures of efficiency that prevent faculty and administrators from developing and using technologically-based approaches to instruction.

* Many American public universities are required to report the number of student contact hours (the measure of students × the number of credits for each course) to state governments. This statistic is used as a measure of efficiency.

Encouraging Wider Use of Instructional Technology and Avoiding "The Not-Invented-Here Syndrome"

Individual faculty members generally have different areas of expertise within the same discipline, and one is likely to get a mediated course or unit in which the content is accurate and current if different faculty members handle that part of a course in which they have the greatest expertise. A second reason for actively involving as many faculty as possible in the development of a single course is that by doing so, one greatly increases the probability each of the faculty members will approve the use of the course. This should increase markedly the number of students who will use the course. Another way to expand even further the numbers of students and institutions using a course, is to leave out certain segments or sections of the course, but to suggest some ways that faculty in other institutions and departments might prepare materials for these segments—thus personalizing the course and increasing the probability these faculty and departments will use it. Using this "blank space" technique is one way of mitigating "the not-invented-here syndrome," and encouraging creative and individualistic faculty to give their own personal touch to software developed elsewhere.

To get an individualistic faculty member to become a full participant in a group of professionals working on a common project, one probably has to make it possible for that faculty member to work with the group on a full-time basis, long enough to complete work on the group project. Doing this should remove the faculty member from his or her workday university world and the system which reinforces individualistic behavior. An explicit orientation may also help the faculty member understand the differences between the normal pattern of faculty behavior and that required to develop packages of mediated materials successfully.

Such an orientation might explain that the effective development and use of instructional technology is basically a team effort which requires careful planning and the close cooperation of highly skilled professionals in several fields. First and foremost among these is, of course, the faculty member. The faculty member is the content expert responsible for ensuring that the course goals are realistic in terms of the entry level knowledge of the students; that the content is appropriate to both the students' entry knowledge level and the goals of the course, and that the content is both current and accurate.

While the faculty member must be treated as the first among equals, someone must be put in charge who has a firm understanding of the entire process, and can activate cooperative effort and who can resolve disputes in a creative and non-destructive manner. Whichever member of the team can best carry out this sophisticated leadership function, should be put in charge of the project. In any event, the faculty member must have the final word on content.

An orientation program during which the points just stated are made would help the faculty member adjust quickly to the new circumstances. This adjustment would be facilitated further if cooperative efforts were reinforced by group processes and financial rewards.

Both students and faculty must come to understand the advantages they can derive from the effective use of instructional technology; what the limits of this technology are; and when it should not be used.

The high technology, capital intensive, mode of course development described earlier can best be used for those courses and parts of courses in which the content is relatively stable, and the teaching-learning objectives are fairly clear. Basic, introductory courses in almost any discipline other than performance courses in theater arts, music and art are generally appropriate for this type of development work.

In these types of courses, the professor's role should be changed, by use of the high technology mode, to that of a tutor in comparatively small group, face-to-face interaction, rather than a presenter of material to hundreds of students assembled in massive lecture sections. The advantages of this type of faculty and graduate assistant role change should be obvious to both students and faculty.

The high technology mode probably should not be used for those courses or parts of courses in which the content is changing rapidly, or in which students and faculty are studying or doing research on problems for which there are no known answers. These would include some junior and senior courses and a good many graduate seminars. One could, however, probably make a very good case for the high technology development of introductory research methods and statistics courses normally required in many graduate programs in the physical, biological, and social sciences, and the full range of courses in many professional masters programs.

CONCLUSION

Although some university-level instruction may not be suited to the development of sophisticated packages of mediated materials, American educators are making little effort to use instructional technology effectively, in their *regular programs,* in those areas that show great promise. The problems I've described are not insurmountable. They can and will be overcome, given initiative, imagination, commitment and cooperation on the part of the faculty, administration, students and those governmental institutions that supervise and provide funding for education.

The technology to improve both educational effectiveness and efficiency is now available. If educators do not reorient themselves quickly to take advantage of this technology, private industry and new types of non-profit educational organizations will do so.

Educational Technology— The Congressional Perspective

Fred W. Weingarten
Office of Technology Assessment
Washington, D.C.

INTRODUCTION

Even in the most stable political times, a person would be presumptuous, indeed, to attempt to present a *Congressional* perspective on any topic. Who could speak for more than five hundred highly independent men and women? And these are anything but stable times on the Hill. The Federal role in many areas of domestic life is likely to be reassessed, and, in the view of many observers, education will receive its share of attention.

Sensing that use of information technology in education is going to present new opportunities and problems for Federal policy makers, Congress has requested that the Office of Technology Assessment (OTA) prepare for it a report on information technology and education. This assessment has just started. A report on its initial directions might give some sense of how Congress may choose to look at education policy in light of new information technologies, and that task is the one I will undertake this morning.

The Office of Technology Assessment

The Office of Technology Assessment is an agency of the Congress. It is responsible to both houses of Congress and is directed by a Technology Assessment Board consisting of three members from each party, from each chamber. Its role is to examine the long term effects of policy decisions regarding technological issues.

OTA studies generally last from several months to a few years, in contrast to the generally shorter, more tightly focussed studies conducted by the Congressional Research Service or the General Accounting Office. The agency does not make policy recommendations to Congress, but rather tries to project as objectively as possible the available decisions and their social, economic and political effects. Each study must be requested by at least one full committee and approved by the Technology Assessment Board.

The Study—Purpose

Hear what has been said so far:

- The Federal Government has nothing to do with education—it's a local issue.
- The Defense Department spends an estimated twelve billion dollars on manpower training.
- The Federal Government has never done anything with the express intent of aiding education per se—but to achieve other social goals.
- The Federal Government pays over ten percent of the budgets of local school districts.

These are just a few of the comments I have collected in the first few months of the study, and they illustrate the paradoxes in U.S. attitudes toward a Federal education policy that makes a study such as this so complex and undertaking.

It is clearly possible that the new information technology holds great promise for traditional education. This same technology, coupled with our evolution into an "Information Society," is also changing the very meaning of education, the mechanisms for providing it, and the nature of societal demands for it.

The purpose of this study is to examine these technological trends, assess what they have to offer the educational process, determine how they are likely to be used, and explore how the Federal Government might respond. Hopefully, the study will answer the following questions. Are there policies that will encourage the use of information technology, are there legislative or regulatory barriers, and are there potential problems stemming from educational use of information technology that may call for legislative remedy?

Communicating this assessment to Congress is complicated by the problem that educational policy is not made solely by Committees with the word "Education" in their titles. The Armed Services Committees must worry about manpower, the Civil Service Committees about the competence of Government workers, the Commerce Committees are concerned with copyright and the Science and Technology Committees are concerned with communication policy and R&D. This type of cross-cutting issue is, theoretically, a particular specialty of OTA. In reality, it is hard to focus and communicate such a study.

Study Goals

The study has four major goals:

Assess Existing Federal Interest and Roles: The Federal Government, even though not directly responsible for the schools of this nation, has many programs that affect them and many interests in the quality of education in the United States. What are reasonable objectives for the Federal Government that may shape policy strategies?

Determine Opportunities and Barriers for Use in the Schools: Many experts think that the new developments in information technology hold great promise for the schools. The problems facing the schools have been cataloged in many places. They include the following:

- A *declining support* from taxpayers as the percentage of the taxpaying population with children in school drops and as the support of the middle class for public education declines.
- Increasing pressure from the Government and the Courts to provide *equal access* to education for all types of students, racial minorities, non-English-speaking groups, the handicapped, and other such groups. In addition pressures to serve more varied student groups in the traditional sectors of education, new demands for education by women, by the elderly, and by those trying to adapt to a changing job market, are also creating new demands on the education establishment.
- The *increase in labor costs* as experienced in all service sectors. Productivity increases often depend upon the substitution of capital for labor. Those activities that have not traditionally been subject to productivity improvements are squeezed by the inflationary pressures of labor costs increasing faster than the overall inflation rate.
- The need to *train more productive and technologically sophisticated citizens*, to help the U.S. economy and to provide more effective citizens in an information society.

Faced with these pressures, it is only natural that education decision-makers would ask whether the new advances in information technology could contribute to solving their problems. Can information technology improve the quality of education? Can it improve access to education on the parts of those for whom it is difficult because of physical restrictions or geographical separation? Can it provide better productivity offering an improved product at lower cost? At the least, this report should be able to summarize for The Congress what is known about the potential benefits and costs of information technology.

Assuming that a set of policy options might be intended to encourage the use of information technology, it is also important to describe the barriers that exist to such use. Many have been proposed in the literature and to me in preliminary conversations with experts. Among them, the need for teacher training might be pointed out, along with the lack of sufficient support in the way of training and service, the existence of overly restrictive purchasing policies, and ignorance at the higher administrative levels of the school bureaucracy.

A number of problems that could be characterized as *societal*, or Constitutional, in nature need to be examined. Many experts have expressed concern about the long term effects on learners, particularly children, of replacing the classroom experience by television or computers. As another example, the use of information technology may greatly increase the amount of record-keeping on students. More records of traditional types of information such as test scores or other types of classroom performance will be stored in machine readable form for long periods of time. In addition, new types of information concerning thinking processes, psychological diagnoses, and so on may be collected and retained. What will be the privacy rights of students under these circumstances, and what will be the responsibilities of the schools in handling this data. An analogy may be seen in the area of medical record-keeping, in which hospitals and doctors have been deluged with a plethora of new legislation and regulation at both the state and Federal levels.

Another issue will be equity. As information services become a major industry, information is becoming a significant marketable commodity. An important question will concern the degree to which access to some basic threshold of information literacy is a basic right of U.S. citizenry. One scenario would hold that the benefits (if they exist) stemming from the use of information technology in education may accrue only to the private providers and, perhaps, to the well-off public school districts. This trend would leave the poorer schools, those serving the poor of society, in the lurch. Should such a scenario come to pass, the schools could serve to increase rather than to narrow the bridge between groups in this society, to provide barriers rather than bridges.

A final example is the problem of Federalism. The schools, as the quote at the start of this paper suggests, have traditionally been regarded as the preserve of local government. One of the general observations that have been made about high technology is that it tends to centralize, to place a value on the large operations, as opposed to the small. True, this tendency is the subject of endless argument about whether this imperative is necessary, but one can observe that most automated systems to date seem to centralize control. Any Federal policy toward use of information technology must take into consideration the possibility that more national control and less local choice over the content and style of education will result. This centralization may not be only on the part of the Government, but reflect the influence of large publishers, broadcasters, program producers, and the like. Choice of curricular material may simply be restricted.

The Changing Role of Education

Evidence mounts that in the future information society education will be provided by a much wider spectrum of agents. Historians of education such as Lawrence Cremin have point out that education has, for a long time, been provided in a number of environments other than schools. These other providers may be in a position to exploit the technology, more quickly and effectively than can traditional schools. The following examples come to mind:

- The investment by industry in training and employee education is not well-known, but estimates range from $40 billion to $100 billion. We do know that the number is large and growing rapidly, surely faster than the budget of the schools. More important than size, the type of education offered by employers is also changing, moving toward topics, such as writing skills, that have traditionally been considered the preserve of the education establishment.
- The recent White House Conference on the Library spent much time discussing the importance of the library in an information society as a purveyor of knowledge rather than an archive, a role that, again, borders closely on that of the schools.
- Many museums, particularly the relatively new science and technology museums and the even newer children's museums, are developing public services that are clearly educational in nature.
- Public broadcasting, radio and television, whose recent emphasis on cultural programming may be under strong challenge in light of new cable and broadcast satellite technologies, may return more closely to their original interest in education. Several proposals have been floating around that show revived interest in a nationwide, broadcast-based educational service.
- In the microcomputer market, manufacturers are starting to attack the home consumer market directly with educational devices such as "Speak and Spell" and software packages for personal computers such as the Apple and the TRS 80 that are starting to appear in the home. Videodisks, if a large consumer market develops, could stimulate a similar trend.
- These trends affect Federal policy in a number of ways. In the first place, they may offer opportunities, provided the markets can be guided or encouraged to develop.

However, these developments may also cause difficult policy problems for The Congress. The public schools may be under even greater stresses than they are today, if an economic, more effective, and more convenient alternative source of education is available to the middle class. To the extent that the alternative is available to those who can afford it, the role of the public schools as the educational system of the last resort becomes vital. And the Federal Government may be called upon to provide the funds to support that role.

Federal Policy

The principal aim of this part of the study will be to determine what Congress may wish to achieve, and to decide what policy levers exist to accomplish those goals.

The assessment will develop a limited number of policy scenarios that appear to be feasible and responsive to the various problems discussed above. Among them, expanded in detail, with substantial fine structure to be added, might be the following:

- A *laissez-faire* policy that keeps a strict distance between the Federal Government and developments in education, save for a few efforts to remove unintended barriers to the developing educational use of information technology.
- Some form of a *Voucher System* may be adopted that removes Federal support of the schools directly, but that recognizes the developing choices of educational style and provider.
- The Federal Government could *directly subsidize* the schools in order to sustain a free public education system and to enable schools to obtain the new technology they used.
- The Government could directly fund the creation of educational materials, curriculum, television programs, and so on, that would be available to all users.
- Agencies such as NSF could greatly expand support for research and development on information technology for education. These efforts could include dissemination programs to help schools get access to the knowledge developed by the projects.

Approach

The Assessment will consist of three stages. The first, nearly complete, is a *study planning phase*. Second, there will be *data collection and analysis*, and, finally, a *policy assessment* will be done.

An advisory panel of distinguished experts in the field of education is being assembled and will meet shortly to kick-off the data collection and analysis effort. This work will be conducted by in-house research staff and outside contractors and consultants.

SUMMARY

I will close by saying that the success of an assessment such as this will depend greatly on the quality of help that is provided by the interested communities. From experience with other projects at OTA, I can state with certainty that the report will probably not fully satisfy anyone. It must present the full possible spectrum of actions for Congress, and represent the interests of all stakeholders. However, it is the active involvement of those stakeholders that assures that their interests are fairly and completely represented.

Technology and the Changing Economics of Education

Robert H. McCabe
President, Miami-Dade Community College
Miami, Florida

INTRODUCTION

After years of faltering progress, it is now reasonable to forecast substantial growth in the use of technology in postsecondary education. Colleges and universities will change dramatically in the decade ahead. A series of factors, incuding operational economics, will stimulate greater use of communications technology. As a basis for discussing changes in the use of technology, it is important to take a brief look at the changing clientele and services, public attitudes towards higher education, and some considerations in financing.

By the end of this decade, the successful postsecondary institutions will be very different from the present. For one thing, there will be more older students. For a number of years state legislatures have been awaiting the widely forecast declines in higher education enrollment. All were aware that there are 20 percent fewer eight-year olds than eighteen-year olds in America today, and that high school enrollments were already declining. Yet, the decline has not materialized. The reason is that growing numbers of older Americans are beginning college careers, or returning for continued educational servies on a lifelong basis. For the first time in the fall of 1980, there were fewer first-time-in college students who came directly from high school than those who did not—a considerable and important change. More individuals are coming back on a continuing basis to upgrade their skills often simply to keep their present jobs. In many fields continued education is being required to maintain certification or licensure. The paramedical fields are a very good example. The average American has three careers during the worklife, and many students return to college to facilitate change in career. Many others return for personal development. This is particularly important to the substantial number of Americans who have jobs that are not personally fulfilling.

Another major change will be the continued diversification in every attribute. The older students have more life experience and necessarily more varied competencies, knowledge, and attitudes. There are more part-time students; more from previously under-served minorities; and, most importantly, more with less academic skill. We are now in the thirteenth consecutive year of decline in academic skill for American high school graduates as measured by standardized tests. If one uses 1975 norms on standardized academic tests with 1980 high school graduates, the median score is tenth grade/sixth month. This decline in skills has profound impact on colleges, especially community colleges. It has brought public concern for the quality of our work, and with it growing demand for standardized testing, competency-based programs, and increased use of assessment and standardized measurement. This in turn is requiring a more directive approach to the educational program, and the need for increased information concerning progress for students and staff.

Less Academic Skills

Students are coming with less academic skill, and colleges are being asked to upgrade expectations and raise standards. Thus, colleges are faced with a critical dilemma which will be very difficult to resolve, but some things are clear. For one, the application of a standard amount of educational services will not bring a student who is considerably behind academically to the expected standards. Further, the tremendous diversity among students will require time variable and individualized programs. The programs must be more directive, with considerable control of student flow. Only through the use of communications technology will these necessary changes take place. I see no prospect that appropriations to colleges will be increased sufficiently to achieve these ends through the use of additional personnel. Even if funds were provided, it is doubtful that the necessary changes in program could be achieved without utilization of the capabilities of the improved communications technology.

Cable

There are so many important changes in communications technology, that for this presentation I will select only a few on which to comment. There will be many new ways to deliver television to the home, but most important for education are the growing cable networks. Unlike open circuit broadcasts, cable delivery can present specialized fare for low volume listenership. Even the public television open circuit broadcasters worry about the impact on programs before and after educational programs which draw small audiences. Audiences that are practical for delivery from the standpoint of the educational institution are often viewed negatively by open circuit broadcasters. Cable operators have an entirely different view. Thus, the spread of cable systems may resolve the serious broadcast access problems of the colleges.

Video

The growth in videotape recorders and the advent of videodisc players, of course, have important implications for education. At this time in Miami there are seven videotape purchase and exchange operations within a ten minute drive of my home, and prices for exchange are dropping rapidly. Already more than 4,500,000 homes have videotape recorders. With the beginning of sales of videodisc players, some educational discs are being offered for as little as $5.95, and disc players have fascinating flexibility, particularly for information, storage, and random access. With regard to equipment, it is important to us in education to follow the home market development, as the volume sales will reduce prices to the minimum, and in the long run it would be well to think of the equipment in individuals' homes as part of our educational delivery system.

Computers

On the computer front there are two developments that are of special interest. One is the tremendous gain in power of microcomputers. The impact is well illustrated with the Miami-Dade Community College RSVP system, a combination of CMI/CAI systems which is operated on a $2 million main frame configuration. We are currently working with other institutions to redevelop this system with limited compromises on scale, and added capabilities. The new system will requie an $8,000 microcomputer configuration. This will not only make the system more available in Miami-Dade, but will make it practical for the smallest institution. This is a major economic breakthrough, not only because of the reduction in the cost of the hardware, but, even more importantly, the potential for reduction of per-student cost for software. The number of students who will benefit from a software package (course) both dictates the financial feasibility of the development of the software and the level of that development. If many institutions have similar equipment, the number of potential users increases, and more dollars can be allocated for the software development—and quality software is costly. The very large institutions have always been able to develop some course software, while small institutions have had limited capability. Now small institutions will be able to afford to acquire quality computer-based courses for their students from the large institutions, and the large institutions can have software for a larger spread of their curriculum, as they can draw from so many sources. This should result in a boom in development of high quality computer-supported learning programs. When we reach the point of volume utilization that will permit modest charges per student to amortize development costs, institutions with very few students and small facilities will be able to access broadly diversified learning programs. From the standpoint of economics, what is created in effect is a situation similar to a very large lecture section with supporting faculty services.

"Games"

The other development in computers that interests me is what I call "Christman games" computers—the very small processers that utilize the television receiver as a screen, operate interactive games, and sell for less than $200. I an intrigued by the possibility that such a microprocesser, particularly the type that utilize cassettes, could be in typical homes by the end of the decade. The possibilities of combining such a processer, a videodisc player, and a television receiver are fascinating. With this configuration, colleges could easily deliver quite sophisticated branching programming with interactive learning arrangements, particularly where drill is essential. From the standpoint of economics, it is important that the equipment is in the home. Not only because of the cost of acquisition, but also from the standpoint of maintenance of equipment. The discs themselves are very inexpensive to reproduce, although high volume is necessary. If this part of the work occurred at home, there would be no investment in plant or equipment for that part of the individual's educational program. There is investment only in software development and/or purchase. The discs, which are quite durable, and the cassettes, which are very inexpensive, could be checked out to students.

Another important application of the use of videodiscs, cassettes, or telecasts relates to the growing need for recertification and the learning of new skills and information to maintain current positions. While in urban areas it might be practical to configure sufficient individuals to operate standard classes, these services must be delivered on a location variable basis. Many individuals live in areas where there are not enough persons with the same need to operate a standard class arrangement; thus, only methods using video appear to be practical. Further, the developments in many fields today are so rapid, and in some occupations the number of specialists so few, that it will be necessary to develop such programs for use throughout the country, or at least throughout a state. It would be impactical for each institution to attempt such programs independently.

Impact of Student Financial Aid

One change which has taken place during the past five years and has important future impact is in the area of student financial aid. Beginning with the post World War II G.I. Bill, the federal government has used financial aid to students as a principal vehicle for expanding access to postsecondary education. It has left the financing of operations to state and private sources. In recent years the expansion of the Basic Educational Opportunity Grants (now the Pell Grants) and other financial aid increases in many institutions resulted in a majority of the full-time students receiving financial aid. Thus, most of the students are being paid to go to college. This has brought with it a growing concern that the people who receive this aid benefit demonstrably from the services, and make progress toward achieving the objectives for which the grants are given. Without question this further contributes to the need for more measurement and more information about student progress for the institutions, the government, and the student. The institution's approach to students must be more directive. This type of feedback and control cannot be achieved without the use of communications technology, and there is clear evidence that much headway is being made. There are at least five national guidance sytems utilizing interactive computer applications, and many institutions are developing other applications to take greater control of the student flow process.

Monitoring Student Progress

Progress based on the concepts that students can take any courses that they want at any time, have a right to fail; should get credit for any courses—developmental or not, are dead. At Miami-Dade Community College the student's progress through the institution is now monitored from point of entry to exit. There is assessment, placement, competency requirements to move into college level courses, restrictions on load as early as seven credits attempted, required intervention courses as early as fifteen credits, individualized letters to all 45,000 students after six weeks of each term concerning their progress in each course, and computerized information at the end of every term concerning progress toward graduation and towards meeting the requirements of the institution to which they are planning to transfer. All of this is at increased cost to the institution, but is an absolutely necessary part of the cost of a student's education, and only affordable because of the use of communications technology.

The key in the economics of education is massing. Simply put, if large numbers of people want to do the same thing (take the same course), it is easy to develop traditional classroom delivery methods that meet economic expectations. A well run student scheduling and registration procedure should be able to handle class size for large enrollment courses almost like an assembly line filling milk bottles to the proper level. But, where the numbers of persons taking a single course is small, class size control is lost and costs rise. Where the number of persons with the same goal begin with considerably varied skills traditional methods break down, and individualization through the use of personnel is clearly beyond our financial capability.

There are a number of things that can and should be done that involve technology, and that are economically feasible. However, one should never forget most students, especially older students, are anxious to have a personal interactive experience, and the number of students who work well completely without such interaction is relatively small. One of the purposes of the controlled student flow system at Miami-Dade Community College is to reduce the student diversity in the broad spectrum of courses, so that there is reduced diversity in academic skills in the classes. In that way, faculty can deal more effectively using traditional methods. In this case, technology, is utilized to make traditional practices more economically feasible and more effective.

Individualization

When a learning program utilizes technology so that a faculty member does not deal with students in a class group, individualization, rather than being more expensive, becomes less expensive. A result is produced that economically is similar to large group instruction. The new technologies provide tremendous capability for individualization that seem not only desirable, but absolutely essential if we are to deal with our much more diverse student body, and preserve the opportunities for students to interact with faculty and staff.

Sharing Developmental Costs

One important key, and perhaps the most difficult hurdle for academic institutions, is cooperation. Technically, the improved capability of microcomputers and the new developments in video have made the sharing of materials among institutions very feasible. To reduce the cost per student for development, it is absolutely essential to share the development cost, and good software is expensive. None of us, regardless of size, can expect to develop all of our own—it is simply not economically possible. The technical developments that have made sharing practical, and the experience of the cooperation of a number of institutions over the past decade have provided important steps in the right direction. In terms of academic attitudes, there is still a way to go. Faculty like to do their own thing in their own way—it is part of the academic tradition. While progress is being made toward necessary collaboration, it is also important to provide for manipulation of software so that faculty in each institution, and, if possible, each faculty member in an institution, have some way to make the materials their own. Yet, there is no escaping the need for faculty to work in collaboration if educational services are to be delivered in the most efficient and effective way for the future.

SUMMARY

One advantage in the introduction of technology into the institutions in this decade is that it appears certain that the resistance among faculty will decline, for use of technology is no longer unusual. The growth in the use of computers and video in every field, and the daily interaction with technology in the lives of students and faculty will make it seem strange in the future if the institutions do not use communciations technology.

The future growth in the use of technology in higher education is certain. It holds great hope for us in community colleges to finally match our long held aspiration to help each student succeed through realistic, affordable, and effective educational programs.

Changing Organizational Structures to Capitalize on Technology

Joseph I. Lipson
National Science Foundation
Washington, D.C.

Most observers agree that educational technology has not lived up to its promise. Many reasons for this have been proposed. I would like to explore the possiblity that an important reason is the following:

> We have tried to implement new technologies with a school organization that evolved in response to an older technology—the technology of the classroom, the blackboard and the textbook. The effective use of educational technology will require the evolution or design of new organizational structures.

If this is true, it implies that schools should be re-organized to help people to be productive with the new information technologies such as the computer, the videodisc, and the communications network. By organizational structure I mean simple, mundane things such as who reports to whom, how the budget is allocated, how the budget is organized, who must sign-off before various decisions or purchases are made, the names given to organizational units, unit descriptions and goals, job descriptions, how people are hired, who can ask whom to carry out a task, and who must approve requests for work by a given unit or person.

Related ideas are that as educational technology becomes more complex and changes more rapidly, 1). our organizational structure must become more adaptable, less rigid, and 2). we must invest more of our effort in the design and maintenance of the organization that helps us to use this technology.[3, 4]

The Challenge of Innovation

Why is it that established organizations such as the hotels, the railroads, the steel industry, the auto industry, and schools have so much difficulty responding to the opportunities of new technologies? Why is it that innovations are so difficult to institutionalize? Perhaps the story is something like this: Large established organizations have a life of their own. They are stable and successful. Presumably they are successful because their organizational structure was, during their time of growth, well-suited to the tools of their operation. Their organizational structure was appropriate. They were well-organized to enable people to be productive with the technology then available.

Their very success and stability is what gets long-lived organizations into difficulty. When a ball is at the bottom of a bowl or an object is held in place by a set of springs, a small disturbance brings forces into play that return the ball to the bottom of the bowl or return the spring-held object to its original position. Similarly, when a stable organization is disturbed by an innovation, forces come into play to resist the innovation and to return the situation to normal. The status quo is the condition of stable equilibrium. All departures from the status quo are resisted.

In a personal conversation, Rob Spaulding used the analogy of resistance to infection. If we think of the school or school system as an organism, an innovation is analogous to an infection. The school system immediately responds to maintain its character and its integrity, to resist the infection of change. Each individual in the system thinks that s/he is acting autonomously and intelligently, not realizing the myriad ways that the organizational structure and procedures are encouraging him/her to act so as to reject the innovation. There is some evidence that awareness of the forces operating on us helps us to resist them, to be more discriminating in our actions and decisions; and if our consciousness is raised with regard to the subtle ways our organizations influence us, we may learn to modify our traditional reactions.

I have seen the following happen several times: An individual professor will become interested in using some form of educational technology. For a while s/he is able to resist the forces that encourage a return to the status quo. If energy in the form of resources (e.g., money, released time) is allocated to the innovation, then for a while a tenuous stability can be created. Of all the innovations that are tried, a few may even be compatible with the existing structure and such innovations may survive and be institutionalized (e.g., the research institute, the use of the Xerox machine). However, the more common course of events is that eventually the professor gets tired, leaves or is simply forced to give up the innovation and the system. The school returns to the status quo.

At the microscopic level of detailed human interactions, many causes are observed and offered as reasons for the failure of an innovation: The faculty member feels that his/her efforts are not adequately considered in the promotion/tenure process. Not enough help is provided. A federal grant runs out and there are no replacement resources made available, and so on.[6] However, after observing the process of attempted and failed or limited institutionalization several times, I have come to the hypothesis that the problem lies deeper than the surface events imply and that the solution must deal with the deeper relationships between organizational structure and the way we use the tools available to us.

Put another way, we need social and organizational inventions to enable us to effectively use new hardware and software inventions. As Dobrov[3, 4] states,

> "... without technology, society is disarmed; without technical knowledge and people who can manipulate it, technology is stillborn; without social organization enabling technological systems to be rationally used and developed, those systems are of little use and can even be harmful."

The Existing Technology

If one looks at most schools and colleges, one sees that our curriculum and the activities that we assign to students are largely limited and controlled by our reliance and commitment to word and symbol oriented technologies. These technologies are the classroom, pencil and paper, the blackboard, and the textbook—in contrast to the field trip or laboratory, and the TV/computer screen or direct observation. The existing technologies are used because a.) words and symbols are so important to the educational process and b.) they are relatively cheap. The result is that student activities with objects, photographic images, and equipment are not well represented in the curriculum. As a further result we have the recurring complaint that students can repeat word and symbol strings but that they do not have the skill needed for actually doing things. This distinction is characterized as the difference between knowing what and knowing how, the difference between declarative and procedural knowledge. Examples of the difference are a.) being able to describe the operation of an auto engine vs. being able to design, build, or repair an engine and b.) being able to state mathematical rules or theorems vs. being able to solve problems with those rules. (Note. Another technology that has seriously influenced education is the multiple choice test. There is evidence that students who are preparing for a multiple choice test engage in different kinds of study activities than those who are preparing for essay or problem tests. In general, the anticipated form of assessment [e.g., having to make an oral presentation, having to teach a class while being observed, having to carry out an experiment or construct a work of art] modifies the activities students use to prepare. The conclusion is that a technology that allows a wider range of assessment procedures to be carried out economically and reliably will modify the learning experiences of students. The computer is such a technology.)

Departments and Classroom Teachers

The organizational structure that has evolved to effectively use the existing technologies is a realtively flat one (i.e., a group of peers reporting to a department chairperson) that tends to focus on the teacher in the classroom as the basic operational unit with the subject-based department as the basic organizational unit. Services, administration, budgeting practices, promotion and tenure, etc., all tend to support the classroom teachers in their standard role of developing knowledge using words and symbols. I know that many teachers would disagree with this and express dissatisfaction with the degree of support they get. I would propose that their dissatisfaction with anything except direct support of their role in front of the class is one of the forces that tends to maintain the current structure. Teachers resist any new organizational arrangement that drains resources from traditional classroom activity. In my view, this is correct as long as the principal sources of productive work in the school is the teacher-led class. The question is, can we invent new technology-based arrangements that, with different combinations of roles, tasks, reporting lines, schedules, etc. are more productive and more satisfying to both faculty and students? There are interesting examples in medical education and in the case of the British Open University that suggest but do not prove or conclusively demonstrate that this may be possible.

The Failed Technologies

The motion picture, television, radio, the LP record, the electric typewriter, the audio-cassette player, the video-cassette player, and kits of laboratory materials have not had a significant impact upon the nature of the curriculum and the quality of formal school education. In order for them to have had a greater effect many inter-related steps to modify the organizational system would have had to be taken: new purchasing regulations, new federal, state, and local arrangements to support curriculum development, new organizational support units, new in-service and pre-service training programs, new budget formulation procedures, etc. would have had to be developed.

For example, because of its new organizational structure, the British Open University has the largest publishing operation in the United Kingdom and the documents they print are widely used throughout the higher education system. In this case an organization modification was required to enable higher education to serve the distant, isolated learner; and a result has been the creation of a huge organizational subsystem to exploit the existing print technology. A similar story holds for their TV production. However, even the British O.U. has difficulties in using new media because of the fact that they have a matrix organization of course teams combined with academic departments of the Open University. The academic departments seem to be the culprits that create a resistance to innovation and may even be a force for reversion to a campus system with classes, etc.

The New Technologies

The compuer, telecommunications networks, and image devices such as the videodisc offer a wide range of instructional options.[1, 2, 5] Even on a straight economic basis the continuing reduction in the cost of computing combined with the increasing cost of printed materials suggests that electronic publishing will compete directly with printing within the decade of the 80's (Evans, 1979). The question is, can we reorganize our educational system—at all levels—to make effective use of these new information technologies?

At the national level, can we coordinate the resource allocation and decision procedures to have needed equipment standards, information and dissemination networks, and courseware development?

At the local and state levels, can we create support units such as the science teacher support centers that Doug Lapp has designed and implemented in Virginia? Can we develop new training programs for teachers to use the new technologies and for authors who are needed to create the new materials?

At the school level, can we create new organizational arrangements that move away from the cottage industry format of the classroom and that allocate resources to the purchase, maintenance, and improvement of educational technology systems? And can we do these things in a cost effective way that makes the schooling experience more interesting for both faculty and students?

The Likely Scenario

If the above questions are to have a positive response, their urgency needs to be recognized at every level of the system. Decisions are driven by emotions, and until the problem of educational technology has emotional and political force, little is likely to happen. One of our tasks is to find the arguments, images, anecdotes and demonstrations that give the issue the needed force. Some of our best arguments will be given during this conference and also are listed in existing documents.[2, 8] My expectation is that the new technologies will begin to take root outside of the formal system through home learning, through industrial training programs, through medical training programs, and through military training programs. When they are sufficiently established outside of the colleges and public schools, some schools and colleges will respond to the challenge and try new organizational schemes to use the technologies and some new schools and colleges will be created specifically to make use of the new technologies. Oral Roberts University is a possible example of the latter case. The use of technology is built into the structure of Oral Roberts; and the contracts of all faculty require that they learn about educational technologies, contribute as authors, and use the technologies.

Knowledge and skill are so critical to a modern society that eventually inter-national pressure will require the organizational changes needed. Forethought and planning can make the transition easier, can minimize the pain of change; but the change is inevitable. Failure to make the investment of human talent and ingenuity will cause much greater misery and dislocation at some future time. To paraphrase Ann Landers, unless we take the steps to renew the quality of our schools, we will become a fourth-rate nation without a shot being fired. I propose that the intelligent and humane use of educational technology is a necessary part of any program of improvement.

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Public Telecommunications Policies and Education's Options

Frank W. Norwood
Joint Council on Educational Telecommunications
Washington, D.C.

INTRODUCTION

Of the numberless public policy decisions which impact on schools and colleges, few are farther from the educator's focus of attention than those which shape communications policy. The school superintendent or the university chancellor may know that the Federal Communications Commission grants licenses to commercial and noncommercial radio and television stations, but it is not likely to occur to either that that has much to do with education or with education's use of technology. What may happen in Geneva, Switzerland, at the International Telecommunications Union's World Administrative Radio Conference, or how the work of CCIR Study Group 10/11B or a Joint Government/Industry Committee might open or close education's doors to a future full of satellites, computerized data bases, interactive cable television systems and the like are questions not even formulated.

With or without the participation of educators, decisions are made. With or without their knowledege of the war, the battles for communications policy advantage go on. And their results impact schools and colleges—and the options for off-campus learners as surely and as severely as if the superintendent and the chancellor understood the demonstrable fact that other parties are deciding their future for them.

Historical Perspective

The JCET is concerned with this interaction of communications policy and educational policy because it was born in response to a policy making crisis. In 1950, the Federal Communications Commission struggled with a dilemma. The post-war public successs of the infant television medium had demonstrated that the demand by potential broadcasters and eager viewers for the new medium would require more stations than could be accommodated in the twelve Very High Frequency (VHF) channels that had been allocated to television broadcasting before World War II. Rather than a rich man's toy, limited to well-to-do urban areas, television promised to be a medium of news and entertainment for all.

The Commission's problem was that of finding a way to create enough new channels for television broadcasting to make possible a variety of services for substantially all of the American public. Adding additional channels in the VHF spectrum was not possible. Other services already occupied those frequencies. The next available spectrum was in the untested Ultra High Frequencies (UHF) for which no television hardware had yet been developed, or even tested. To seek out the technical solutions to the problem, the FCC in 1948 called a halt to the construction of all new TV stations for what was to be a period of six months. But difficult technical problems sometimes refuse to conform to bureaucratic schedules. The six month "freeze" lasted four years.

For the one-hundred-nine "pre-freeze" stations which had television all to themselves from 1948-1952, it was a period of financial bonanza beyond the wildest dreams of avarice. For the educational community it was a fortuitous opportunity.

The very speed at which television was making a central place for itself in American life convinced a handful of alert educational leaders that something must be done to exploit TV's power for more than mass entertainment and the sale of consumer products, or the opportunity would be lost forever. After the passage of the 1934 Communications Act, the Congress had held an inquiry to determine whether 25 percent of the frequencies for AM radio broadcasting should be reserved for education, but the educational interests failed to press the case, and private sector broadcasters assured all concerned that school and college interests would always find a warm welcome and plenty of free air time from the commercial stations.

The following decade saw the number of noncommercial radio stations shrink from more than 300 to about thirty, and leaders like Arthur Adams, then president of the American Council on Education, were determined that the promise of television would not be lost.

The Joint Committee on Educational Television included the ACE, the National Association of State Universities and Land-Grant Colleges, the Association of State Universities, the National Education Association, the American Association of School Administrators, the Council of Chief State School Officers, and the National Association of Educational Broadcasters. Its mission was simple and direct: to persuade the Federal Communications Commission that when the freeze was ended, some of the channels should be set aside for education. When the Commission issued its Sixth Report and Order in 1952, the Table of Allocations which matched channels with cities and towns across the nation marked reserved for noncommercial TV, some 242 assignments—some in the VHF band, the rest in the new UHF spectrum.

National Educational Television, the Corporation for Public Broadcasting, the Public Broadcasting Service, Masterpiece Theatre, even Pledge Week, were then still years in the future, but that future could never have arrived without timely action in 1950. Television's appearance on the American scene was so arresting, and the history of educational radio such a stern warning that the need for educators' participation in communications policy making was sharp and clear. If the FCC's extended freeze had not provided the JCET with the time to make the case for educational television, the opportunity might well have passed without notice in academe.

Contemporary Significance

Now, as what has become "Public Television" begins to look at multiple services, including a separate instructionally-oriented PTV-3, and multiple channels of distribution for such programming the significance of the communications policies urged by education thirty years ago becomes all the more apparent.

To an educational leadership besieged by pressing and immediate problems of increasing inflation and falling budgets, demands for conformity to new regulations and for making good on old promises, issues of communications policy,which may have their benefits far in the future, are easily pushed aside to deal with problems whose impacts will be felt tomorrow. But those who bear the mantle of leadership can hardly disdain the responsibilities of the statesmanship.

The growth curve of technology and electronic communications has risen sharply since 1950 and the protection of education's long term interests in communications cannot be left to an ad hoc group of Minutemen who can put down their lecture notes or annual conference plans and leap into the breach whenever a crisis in communications policy making occurs. That sober recognition came in the moment of victory in 1952, when the FCC did, indeed, reserve channels for educational television. The Joint Committee on Educational Television reconstituted itself as the Joint Council on Educational Television (later changing its title in recognition of the fact that the coming technology battles would be fought on a wider front than TV).

Satellites and cable television are technologies which, in 1950 were still beyond the purview of most educators and of most communications specialists. Sometimes it is not possible to await for the arrival of the technology, for a chance to "try it on for size," before developing communications policies. Policy decisions can prevent or promote the birth of new communications technology. Direct broadcasting satellites are a case in point.

From the viewpoint of the scientist and engineer, the eventual possibility of satellites capable of broadcasting television directly to individual homes has been obvious for twenty years. What was lacking was the requisite technology. There is a complementary relationship between the size and power of the satellite and the size and sensitivity of the associated receiving stations on earth. In the 'Sixties, our limited launch capability meant that the first satellites were small and weak, their earth stations very large and very expensive. But by the end of the decade, the know-how to build satellites powerful enough to beam programming directly to small, low-cost earth stations had been achieved.

In 1969, the Indian Space Research Organization and the U.S. National Aeronautics and Space Administration signed a Memorandum of Understanding, providing that the hardware for a direct television broadcasting experiment to 2,000 village schools in India would be included on ATS-6, an experimental NASA satellite scheduled for launch in the early 'Seventies. American educational interests, wanting to explore the possibility of similar experimentation at home found existing communications policy a major roadblock.

By international agreement, satellite transmissions are restricted to certain frequency bands where they will no interfere with existing terrestrial services. By special arrangement, the Indian SITE (Satellite Instructional Television Experiement) would take place in the UHF band. There are no UHF television broadcast stations operating in the Indian subcontinent. But here, in North America, the UHF band is in use in this country, Canada and Mexico, so UHF satellite broadcasting was ruled out—even on an experimental basis.

An Alternate Route

An "alternate route" was technically possible: the use of higher microwave frequencies in the band 2500-2690 MHz. Those frequencies are also in use, but by schools and colleges for the Instructional Television 1 ixed Service. Engineering calculations indicated that, under the proper constraints, satellite broadcasting could take place without interference to existing ITFS systems.

NASA was convinced, and the Department of Health, Education and Welfare was prepared to fund satellite experimentation--but existing international agreements on frequency allocation made no provision for space services in the 2500 MHz band. (Since radio waves know nothing about political borders, the allocation of pieces of spectrum to specific services is coordinated by the International Telecommunications Union, a UN agency whose agreements have the force of international treaties.)

Preparations had already begun for the ITU World Administrative Radio Conference on Space Telecommunications to be held in 1971. Unfortunately, the U.S. positions and proposals were already well developed... and they did not include satellite broadcasting in the ITFS band. Despite NASA's willingness to cooperate with educators in the U.S. as well as India. inclusion of an ATS-6 experiment at variance with proposed communications policy was hardly possible.

Education's fight often begins at home. Policy proposals for a World Administrative Radio Conference are developed by the Department of State with inputs from other parts of the Federal sector funneled through the Interdepartmental Radio Advisory Committee (IRAC). Participation by nongovernmental interests, public and private, go through the Federal Communications Commission, which typically established a Joint Government/Industry Committee (JC/IC). The Department of HEW's Office of Telecommunications Policy (now disbanded) and NASA worked through IRAC; the Corporation for Public Broadcasting and the JCET attempted to persuade the JC/IC and the Commission that a last minute turn-around in the U.S.'s agenda for the Space Telecommunications WARC was possible and desirable.

Influencing Policy

To influence technology policy, it is necessary to understand the technology. The first task was to convince the seven Federal Communications Commissioners that their own staff was wrong in its insistence that the educators were wrong in asserting that satellite broadcasting could take place without interfering with terrestrial ITFS systems. Fortunately, the necessary technical studies had been done within the aerospace industry. Commissioner H. Rex Lee and his staff studied the evidence and he became the educators' invaluable ally.

The result of the last minute FCC turn around was that the U.S. went to the World Administrative Radio Conference on Space Telecommunications proposing co-allocation of the 2500 MHz band to the Broadcasting Satellite Service. Thanks in no small measure to the presence of HEW's Dr. Albert L. Horley on the U.S. delegation, the proposal carried at the Geneva meeting, and the barriers of domestic and international communications policy were removed.

The immediate result was that the way was cleared for American satellite broadcasting experiments on NASA's ATS-6. Those experiments in the Rocky Mountains, Alaska, and the Appalachian states demonstrated for the first time that television transmission from space to small and inexpensive receivers, capable of operation by non-technical personnel could bring services to hitherto inaccessible educational and health care institutions. The Alaska and Appalachia experiments laid the groundwork for today's operational services. In Alaska, RCA's Satcom II satellite now provides telephone service to every Alaskan village, with a special line for emergency medical traffic. Many villages also get television by satellite, including programs for the schools, and the University of Alaska has extensive plans for extending its services by satellite. From the early ATS-6 experiments undertaken by the Appalachian Regional Commission has come the Appalachian Community Service Network, which is providing a daytime schedule of educational and instructional programming for all ages through the use of satellite and cable technology.

Our experimental use of the 2500 MHz band for satellite broadcasting was not followed up in this country. The Alaska and Appalachian operational systems use commercial satellites in the 3700-4200 MHz band. But the WARC allocation is world wide, and the Indian Space Research Organization will use the 2500 MHz band for its operational follow-on to the Site project (the Insat I satellites are already under construction), and the planned Arabsat includes educational television in the same band.

Implications

The connections between communications policy and education sometimes have their implications for the priorities and budgets of other agencies. Those who planned the ATS-6 experiments at 2500 MHz expected that ATS-6 would be followed by ATS-7, a still more advanced satellite which could have had satellite broadcasting for health and education as its primary mission. When, early in 1972, NASA trimmed its budget by gutting applications R&D, ATS-7, and the Applications Technology Satellites that were to follow it, were canceled.

A second opportunity for educational broadcasting from space presented itself in the Communications Technology Satellite, a joint U.S.-Canadian venture pioneering in yet another frequency band, 12 GHz. Still more powerful, CTS provided opportunities for more than two dozen experiments in health, education, and public service communications in this country and in Canada. But when CTS reached the end of its useful life, the U.S. experimenters once again found themselves without a satellite with which their earth stations were compatible. For the Canadian experimenters, things were different.

NASA is concerned with the needs of the public service community and the process of technology transfer, and has supported the Public Service Satellite Consortium, the Appalachian Community Service Network, and the Joint Council, but its prime responsibility is the development of new technology: Develop and demonstrate satellite broadcasting in the 2500 MHz band. Move on and do the same at the next "frequency frontier," 12 GHz. Now, NASA is looking toward the development of space communications in the 30/20 GHz band, with inviting possibilities for service to rural areas. NASA will welcome experiments in public service communications, but cannot be expected to take responsibility for seeking them out.

Canadian Organization

Canadian space communications, however, are under the direction of the cabinet-level Department of Communications which has a broader mandate. Having demonstrated on CTS the technical feasibility of satellite direct broadcasting to the villages of Canada's Far North, the Department of Communications sought a means by which an operational service could grow from such experimental beginnings. Canada's operational satellites are owned by a government-carrier partnership called Telesat Canada. The Department of Communications asked Telesat to include four 12 GHz channels on its Anik B satellite, offering to lease the channels for a minimum of four years, thus assuring Telesat a return on its investment.

The United States lacks an equivalent Federal mechanism for considering and advancing communications technology and policy according to some concept of the public interest which goes beyond mere technology development. Carter's Presidential Directive 47 charged both NASA and the National Telecommunications and Information Administration with responsibility for promoting communications in support of public services, but the division of responsibility is not clear... nor is the future of the NTIA.

U.S. Executive Branch Participation

The history of Executive Branch concern with communications policy is less than encouraging. Until the end of the Johnson administration, the Office of Telecommunications Management concerned itself only with the government's (ie, Defense, Coast Guard, Forest Service) use of the spectrum allocated to government uses (although the White House, itself, gave strong support to the Public Broadcasting Act). A presidential Task Force on Communications Policy recommended the establishment of a White House Office of Telecommunications Policy to formulate policy and to speak for the President. That recommendation came to fruition in the Nixion years, but OTP's threats to public broadcasters and to media critics of the White House gave it an unhealthy political odor.

The National Telecommunications and Information Administration was successor to the Nixion OTP and the creation of an early Carter promise to reduce government agencies, starting in the Executive Branch. The Executive Branch was reduced by moving OTP administratively, although not physically, into the Commerce Department. What, if any, shifts, changes, or deletions can be expected from the new Reagan administration remains to be seen. If education would protect its stake in the need for a communications policy focus, it must do what it can to be heard on the subject.

Court Actions

Sometimes, communications policy made by the Federal Communications Commissions can be unmade by the courts. As access to the broadcast television band for education required action in 1950, two decades later it was necessary to press education's case for access to cable television. The Commission's 1971 cable television rules recognized the important role the CATV could play in providing more than improved reception of local and distant television stations. The technology of cable is by its very nature local, and channels can be provided to serve a community or even a neighborhood. The Commission's 1971 rules put CATV operators on notice that all new systems serving more than 3500 homes should be capable of at least twenty channels and that dedicated channels would have to be provided for government, education, public access, and for lease to commercial interests.

A 1979 court challenge overturned the FCC's access channel requirements on the grounds that they go beyond the Commission's powers in the Communications Act. Not challenged, however, is the right of local governments when granting cable franchises, to incorporate free channels for education as a contractual condition. The rush for franchises in each of America's major cities is on, and in many other communities, franchises granted in the 1960's are up for renewal. If school administrators and university presidents are going to protect their future options to bring classes to homes and offices via cable, they will have to become informed participants in the battles at the local level.

And not only there. After several unsuccessful attempts to rewrite the Communications Act of 1934, the new session of Congress will see yet another proposal from the Senate Subcommittee on Communications. The starting point is expected to be last session's S. 2827, whose provisions on access channels were unclear, but thought by some to undercut even the city fathers' right to insist on cable channels for public services.

The Communication Policies Battles

Unfortunately, the battles for communications policies favorable to education are more constant than sporadic, and as the example of cable television demonstrates, eternal vigilance is the price of communications. Last Spring, the Commission issued a complex of inquiries and proposed rule makings which threaten education's long-standing frequency reservations for the Instructional Television Fixed Service. Having worked to open these 2500 MHz frequencies for satellite broadcasting for education only a few years ago, we are now in danger of losing them for multichannel instructional television on the ground. The basic issue is that the Commission finds itself with a pressing demand for more channels for the technically similar Multipoint Distribution Service, currently enjoying a boom as a means of distributing pay television, and Commission staff is proposing to meet that demand by allowing commercial services into the ITFS band, a de facto end to reserving these frequencies for schools, colleges, and health care agncies.

On other fronts, the issues, are not so clear cut. The Commission has instituted steps to foster the birth of a whole new class of television broadcasting stations of limited power. While the Commission's TV Table of Allocations (in which education got its reserved channels) specifies *a priori* which channels are available in which cities and towns, these new low power stations would be approved wherever it could be shown by the applicant that no interference to existing stations would be approved wherever it could be shown by the applicant that no interference to existing stations would result. How many such new "mini-stations" could be created in any given city or town, or in the U.S. as a whole, is impossible to predict. By the FCC's own estimate, perhaps thousands of low power stations will be born.

Low Power TV

For education, opportunities are broadened. Low power TV stations can be constructed for as little as $50,000 and minimal studio equipment (not meeting conventional broadcast standards) can be used for local programming. In fact, there is no requirement that the mini-station have facilities for local programs. As has been done in Alaska on an experimental basis, a small community can have its own PBS affiliate, rebroadcasting programs from the satellite. Small colleges—even schools—can get into educational and public television at suprisingly modest costs.

Such mini-stations will be permitted to do nothing but local programming or do no local programming at all. They can be commercial or noncommercial. They can carry pay TV. The Commission's proposed rules would give preference to minority applicants and to those who propose noncommercial services, but the "land rush" is already on. Local stations (including PTV stations) are prohibited from applying for low power operations in their own coverage areas. but the rules which limit any licensee to seven conventional TV stations do not apply to low power, and while educators and minority groups contemplate the possible opportunities ahead, eager entrepreneurs are beseiging the Commission with applications: one, for example, proposes to own more than one hundred across the nation, a network of country and western television.

The questions are complex. Since there is no easy way to estimate how many low power stations can be accommodated, it is impossible to assess whether this spate of commercial interest is or is not closing education's future access. The 1950 strategy of asking for frequency reservations is simply inapplicable.

And watch the heavens! While our 1970 efforts secured us a band for satellite broadcasting at 2500 MHz (and reserved in this country by the FCC for educational and public service use), the near term possibilities for an operational satellite in that band seem remote.

Direct-To-Home Broadcasting

In the meantime, direct-to-home satellite broadcasting is being proposed as a commercial venture by the Satellite Television Corp., a subsidiary of the Comsat.

Proposed is a three-channel pay television service, but as STC notes, the economics of DBS are such that the medium can be "to assemble an audience for programs which would not be economically viable undertakings for conventional TV broadcasters." Comsat surveyed more than 1300 community leaders and members of the general public and found evidence of a latent audience for—in addition to movies, sports, and Broadway shows—educational, college, medical and scientific courses; historical, biographical and natural science documentaries; and news, news analysis, news magazines, editorials and business and financial news.

Channel A of STC's proposed service would include movies, pop concerts, theater specials and family entertainment. Channel B, classic films, children's TV, variety, arts and culture and public affairs. Channel C would offer adult education, sports, and special interest programs.

The question of authorizing a direct broadcasting satellite service puts before the Federal Communications Commission a long list of difficult policy questions. The international agreements arrived at at the 1971 World Administrative Radio Conference clear away some—but not all—of the international issues. While frequencies for satellite broadcasting were established on a world-wide basis in 1971, the specifics of how those frequencies are to be used in the Americas is the agenda for a Regional Radio Conference in 1983.

What the Federal Communications Commission must now decide are such questions as: Should any American action wait on the RARC? What is the potential impact of satellite broadcasting on the viability of local television broadcasters? Would approval of a commercial DBS system presage or preclude the development of noncommercial direct broadcasting from satellites . . . and how would a noncommercial DBS service be paid for?

Summary

Which answers to those questions and a dozen more will build communications policies which preserve the greatest number of degrees of freedom for education's future needs?

The march of communications technology is inexorable—and at double time to boot. Each new development will create its own imperative for new communications policies. The members of the education community have only two choices: they can participate or they can leave the decisions to others.

What they cannot do is escape their consequences.

Investing in Computer Technology: Criteria and Procedures for System Selection

Fred T. Hofstetter
University of Delaware
Newark, Delaware

INTRODUCTION

Matching needs with available technology poses a constant challenge for educational decision-makers. Seven years ago the University of Delaware began what has become a major institutional effort aimed at determining to what extent the needs of higher education can be met by computer-based educational techniques. Essential to the success of this effort was the identification of what available computer-based educational system offered the most capability. As the result of a careful assessment of the characteristics which that system should have and a nationwide search involving both visits to existing computer-based educational projects and consultation with experts in the field, the *PLATO* system was selected.

Since 1974 the University of Delaware has made a considerable investment in its *PLATO* capabilities, having installed its own central system in 1978, and having since upgraded it on an annual basis to meet the needs of its growing user community. Over one hundred faculty members are developing computer-based learning materials in thirty subject areas and testing them with students using the two hundred terminals connected to the Delaware PLATO system. The progress made toward determining the extent to which PLATO can meet the needs of higher education at Delaware is described in *The Fifth Summative Report of the Delaware PLATO Project* which concludes with an eleven-part classification of the benefits of computing in higher education.[2]

It was well known in 1974 that rapid changes were occuring in the computer field, and it would appear on the surface that the University took a substantial risk in investing in a large central system like *PLATO*. Indeed, recognized authorities publicly stated in the mid-1970's that

PLATO was a dinosaur that would never make it into the 1980's. Just the opposite has happened; *PLATO* has emerged in the 1980's in a new microcomputer format which combines the power, communications, and record-keeping features of a central system with the microcomputer's ability to run off-line, to acquire real-time scientific data, and to interface with new microprocessor-based peripheral devices like videodiscs. Through comparative study of the capabilities of available educational computers and through careful analysis of trends in microelectronics and of vendor commitments to making use of microelectronic advances, the decision to install PLATO at Delaware was not as risky as it may have seemed. It is the purpose of this paper to present the system selection criteria used at Delaware and to describe the procedures followed in making a selection based on those criteria.

System Selection Criteria

Table 1 shows how the system selection criteria used at Delaware considered support for instructional strategies, requirements of the student learning station, features for instructors and authors, general operational characteristics, dissemination networks, and future viability. Each of these system selection criteria is discussed in turn as follows.

Support for Instructional Strategies

There are a variety of instructional strategies which can be used in designing educational computer programs. Some educational computer sytems are quite limited in their support of instructional strategies. *TICCIT*, for example, is designed around a preselected strategy of objectives, examples, practice problems, and tests;[3] for some applications this strategy may be appropriate, but there are many others which *TICCIT* cannot do. It is important for a University system to support the gamut of instructional strategies which include tutorials, drills, simulations, games, problem solving, testing, and computer-managed instruction.

Requirements of the Student Learning Station

Careful attention must be paid to both the quantity and the quality of the features of the student learning station. Not only is the learning station the only part of the system which the student sees, but it also greatly affects how instructional materials are prepared. Resolution is an important consideration because it affects how much text can be displayed at one time as well as how many points can be used in making graphics. Sugarman[5] has indicated that a resolution of 512 dots across by 512 dots down is certainly adequate, and that a resolution of 320 by 240 may also be adequate. At this lower resolution which is typical of systems using ordinary TV displays, 16 lines of 40 characters each would fill the screen whereas at the higher resolution 32 lines of 64 characters can be used.

Table 1: System Selection Criteria

1) Support for Instructional Strategies
   - tutorial
   - drill-and-practice
   - simulation
   - gaming
   - problem solving
   - testing
   - computer-managed instruction
2) Requirements of the Student Learning Station
   - high-resolution graphics
   - programmable character sets
   - animation
   - touch input or light pen
   - student control keys
   - instantaneous response time
   - support of peripheral devices
3) Features for Instructors and Authors
   - program libraries
   - indexes and routers
   - student record keeping
   - communication options
   - programming aids
4) General Operational Characteristics
   - reliability
   - maintainability
   - accessability
   - ease-of-use
   - security
   - documentation
5) Dissemination Networks
   - international program distribution
   - communication links
   - user groups
6) Future Viability
   - corporate commitment to CBE
   - flexibility of system design
   - planned use of microelectronics

In order that the system is not restricted to those characters and symbols which appear on the typewriter keyboard, there should be auxiliary memories where new characters can be defined. System response time should be instantaneous so that students never have to wait, and the system should also be fast enough to move characters around on the screen. Control keys like NEXT, BACK, HELP, EASIER, HARDER, and ANSWER should be available so that instructors can give students some say as to the sequencing of lesson material. And the learning station should have connectors whereby peripheral devices can be attached.

Features for Instructors and Authors

Often neglected in system selection are the features which make it both easy and less time-consuming for instructors and authors to prepare lesson materials and to manage student records. It is widely recognized that the greatest cost in computer-based education is the design, programming, and evaluation of instructional materials. Important criteria in system selection are therefore the availability and the quality of pre-existing materials organized into lesson libraries, indexing systems whereby instructors can select and structure courses around these materials, on-line programming aids whereby authors can quickly get help when they have technical questions, communication options whereby instructors, authors, and students can share information regarding lesson development, and student record keeping which allows instructors to collect data on student achievement and progress in a lesson. Regarding student record keeping it is important for the system not only to make available standard, pre-programmed ways of keeping student data, but also to allow the instructors to design their own ways of collecting and summarizing student records.

General Operational Characteristics

Educational computing services must be reliable. Down-time must never exceed five percent of scheduled hours in any one month, and annual up-time should average at least ninety-seven percent. Mean time to failure should not average less than six days. Maintenance support must be readily available so that equipment problems can be solved promptly when they occur.

Students, instructors, and authors need to be able to schedule terminal time when they need it. Especially if a centralized approach utilizing one large computer is adopted, care must be taken to insure than various user groups do not compete for the same resources. There must be a way of allocating memory and processing time so that no single group can usurp resources belonging to another. Educational computers must be easy to use. Human engineering, the effort made by computer vendors to make their equipment easy to use, is an important consideration in system selection.

There must be an adequate system of passwords, security codes, and file safeguards in order to insure that information cannot be obtained by persons who are not allowed access to it. The system must prevent access to persons trying to use accounts, user numbers, and sign-ons which are not their own. All users need system documentation that is complete, up-to-date, and correct. Indexes and libraries of published programs reflect the extent to which a given system can be used, and they make it possible to project the amount of programming which may have to be done locally. The number, extent, power, and ease of use of available programming languages are important system selection criteria, as are staff training programs offered by vendors in how to use available software packages and programming languages.

Dissemination Networks

One of the greatest national problems encountered in education today is dissemination. For a variety of complex reasons there is a resistance to using materials developed eleswhere. It is important for vendors of educational computers to make available dissemination networks whereby materials can be published, exchanged, reviewed, and shared. Electronic links among major development sites facilitate the preparation of materials that are suitable for inter-institutional use, as do peer review mechanisms and user groups.

Future Availability

Evidence of long-range corporate plans and commitments to the systematic development of curricular materials is just as important in selecting a system as is the evidence that the hardware can be upgraded to remain compatible with technological advances. Flexibility is a key term. Educational programs which allow instructors to select local terminologies and to adjust levels of difficulty and sequencing of material for different groups of students will be more widely applicable than those in which instructional variables cannot be changed. Hardware must be designed for the future. Rapid changes in microelectronics have made it necessary for computer hardware to be both modular and redefinable. Upward compatability and expandability are vitally important to its long-range viability.

Procedures Followed in System Selection

Educational uses of computers are becoming increasingly widespread, and documentation of their effectiveness is growing more complete. Many institutions have made system selections and are happy with their decisions, others are re-evaluating their selections, and still others are selecting a system for the first time. Regardless of the past history of computing at an institution, it is important for system selection to be done in an open manner following objective procedures which will hopefully lead to an informed decision. Table 2 lists twelve steps followed in selecting a system at Delaware. The manner in which each of these steps contributes to the selection process is discussed in turn.

Table 2: Twelve Steps Followed in Selecting a System

1. Form system selection committee
2. Reach agreement on system selection criteria
3. Compile list of available systems
4. Acquire literature on available systems
5. Compare systems based on selection criteria
6. Determine which systems are frontrunners
7. Visit projects using frontrunners
8. Consult directors of projects using frontrunners
9. Make preliminary selection of suitable systems
10. Get pricing information for suitable systems
11. Consult impartial experts on system selection
12. Make final decision regarding system selection

Form System Selection Committee

It is mportant for the system selection committee to be representative of various groups in an institution. Administrators, professional staff, trainers, and faculty members should be included. At Delaware the system selection committee was a subcommittee of the faculty senate. The faculty played an important role in the Delaware PLATO Project.[1]

Reach Agreement on System Selection Criteria

The system selection committee should carefully assess the needs for educational computing and compile a list of the features needed to meet those needs. Care should be taken not to let preconceived notions of committee members who might be advocates of particular systems to influence how these criteria are written. At Delaware only one member of the system selection committee had seen a PLATO terminal before the criteria were written.

Compile List of Available Systems

The first step toward determining if there is a system which meets the needs of the institution is to compile a list of available systems. Local computing faculty and professional staff members can be asked to name the systems of which they are aware, and publications like *Computer World*, *Byte*, and the *AEDS Bulletin* can be scanned for the names of systems used elsewhere. If the system selection committee does not feel confident that its list of available systems is complete, outside consultants can also be asked to look it over and point out any omissions.

Acquire Literature on Available Systems

One quick way of accomplishing this step is to write to system vendors, informing them that the institution is planning to make a substantial investment in educational computing, and asking them to send all available literature describing the hardware, software, performance characteristics, and educational effectiveness of their products. However, there are additional sources of information in professional publications which vendors do not usually supply. Zinn has described these sources of information and has provided mailing addresses whereby materials can be ordered.[6]

Compare System Based on Selection Criteria

At this stage it is helpful to make a table listing at the left side the system selection criteria and across the top the names of the systems under consideration. Ratings of how well the criteria are met by the respective systems can then be entered on the table resulting in a composite view from which systems can be compared. McClain and Thomas have developed such a table for microcomputers.[4] At Delaware, considerable attention was given to the realtive strengths and weaknesses of available programming languages, and a separate chart was made up just for this one aspect of system selection.

Determine Which Systems are Frontrunners

As a result of the previous step a few systems should emerge as obvious frontrunners, meaning that they meet the system selection criteria better than most of the available systems. These frontrunners then become the focus of attention for the remaining steps toward making a final systems selection.

Visit Projects Using Frontrunners

The ability to travel to sites where the frontrunners are being used is very important at this stage. It is one thing to read about the claims which vendors make in promotional literature, and it is often quite another to see how a system actually operates in a real instructional environment. Important information regarding the physical set-up of the site can also be gathered at this point and used later when arranging for local space acquisition and modification.

Consult Directors of Projects Using Frontrunners

Directors of existing projects can be extremely helpful in providing information and advice regarding the operation and organization of educational computing. Each system has its own idiosyncracies which affect project management, and persons who are experienced in directing projects can help new projects avoid problems that they encountered in the past. Advice given by Dr. Donald Bitzer, the inventor of the PLATO system at the University of Illinois, and by his associate director, Dr. Frank Propst, profoundly influenced the organization of the delaware PLATO Project.

Make Preliminary Selection of Suitable System(s)

By this time it should become apparent whether any existing systems fit the criteria well enough to be seriously considered as candidates for a final selection. Ideally there would be more than one system so that vendors could bid against each other in a competitive situation. At Delaware there was only one system judged to be suitable.

Get Pricing Information for Suitable Systems

Cost should not be considered until this step is taken. One might argue that if the consideration of cost is delayed until now, institutions might not be able to afford the candidates for final system selection. However, neither can institutions afford to have their needs dictated by cost. A need exists whether or not a computer-based solution to that need is affordable. If cost is included earlier as a system selection criteria, then a second-class alternative may seem to be appropriate when a first-class system should have been used. Related to this concern is the marked downward trend in the cost of computer hardware. Cheap systems are being continually replaced by newer models while advances in microelectronics are allowing expensive systems to lower their costs. An institution which values the investment which its faculty and staff must make in program development and implementation will carefully consider longevity as well as cost in making a final system selection. If more than one vendor can supply a system to meet institutional needs, then competitive bidding will help keep costs down. In any case vendors should be asked to make educational discounts.

Consult Impartial Experts on System Selection

Even if there is only one vendor under consideration at this point, advice from impartial outside consultants will tend either to reinforce or to refute the thinking of the system selection committee. Before the final decision to use PLATO was made at Delaware, the Educational Testing Service was consulted because it had been awarded an NSF contract to evaluate both PLATO and TICCIT and could render an unbiased opinion as to whether or not it was reasonable to expect that the University of Delaware could achieve its educational computing goals using the PLATO system.

Make Final Decision Regarding System Selection

If all the steps outlined above have been carefully followed, the final decision will be well documented for any higher committees and administrators who may be required to review it before funding the project. One might ask how long it takes to arrive at this final decision point; at Delaware it took six months.

CONCLUSION

With the growing interest in an importance of computers in our society, all educational institutions will need to consider both wah what criteria to use and what procedures to follow in selecting computer systems. Whether institutions are doing this for the first time or have experience from previous hardware acquisitions, it is important to consider the objectivity of the procedures and the effect which the selection criteria will have upon the quality of education. The criteria and procedures presented in this paper are not the only ones that can be used. They are ones which were used at the University of Delaware in 1974, and no one at Delaware has regretted the rigor with which they were followed.

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New Public Broadcasting Programs and Services

Dee Brock
Public Broadcasting Service
Washington D.C.

INTRODUCTION

Among the many things public television and education hold in common is a loyal following of doomsayers—a cadre of critics clucking away in print and speech that we have not fulfilled our promises to the nation, that we have become obsolete, that we are inefficient, that we will, should be, perhaps even have been, abandoned or replaced by technological, societal, or demographical changes. On that score, as one of my favorite authors Mark Twain aptly put it, and one of my favorite public broadcasters Larry Grossman aptly preempted it, I am happy to say on behalf of both public television and education, that reports of our death are greatly exaggerated.

Certainly, we cannot ignore that we face trying times. The economy has taken its toll. New scientific discoveries, societal changes, and advancing technologies challenge traditional concepts and traditional procedures. We face government retrenchment at both local and federal levels. Luckily for all of us, we can not only survive these pressures, but we can thrive on them.

Far from seeing the eighties as a period for gloom and doom, I see the decade as offering at last the opportunity for public television and higher education to forge a powerful partnership, a partnership long desired, collectively sought, progressively approached since the advent of television in the 1940's. Of course, it is accurate to say that television has not fulfilled its educational potential. But, one should add the word *yet*, and one should also look at new initiatives in education undertaken by the Public Broadcasting Service (PBS); for the future looks bright.

Programming Services

In June, 1979, by a large majority vote, the member stations of the Public Broadcasting Service voted to establish three programming services. Thus, PTV-1 to provide programming for the large general audience during the evening hours; PTV-2 to provide targeted audience programming, and PTV-3 to provide educational programming were formed. The PBS planning team spend more than a year in extensive consultation with broadcasters and educators in designing the Educationa; Telecommunications Programming Service. As of September 2, that unit is a fully staffed and functioning part of PBS.

Within PTV-3 there are three departments. The Children's and Youth Programming Service is concerned with the schedule of programming for children and young people at home. It offers such well-known series as SESAME STREET, ONCE UPON A CLASSIC, UP AND COMING. A second department is responsible for instructional programming for in-school use, kindergarten through high school. Faced with a real shortage of new programming, these Departments are actively seeking new sources of funding, and untapped, high quality domestic and foreign products, as well as encouraging and stimulating new program development. There is a serious effort to make all series as flexible as possible so that they can be used effectively in and out of classroms through development of print components for children, teachers, and parents and through good scheduling.

The third area, the one with which I am working, is the Adult Learning Department. It is the first PBS programming service devoted entirely to adult learning, and it embraces the ambitious goal of providing "a full range of educational and instructional programs and program related services for . . . adult audiences for at home and in school use." Perhaps because it is my field of interest—or perhaps because it is true—it seems that it is in higher education that the critics are most disappointed about the use of television for education. As one wag put it, television still "looms small on the landscape of higher education." Yet even in higher education, it is important to remember that if the instrumental television cup is half empty, it is also half full. And I am happy to report, the level is definitely rising.

College Level Programming

The last decade was one of exceptionally vigorous growth of college level programming. Although the beginning of the seventies saw only what Newton Minow characterized as the grey professor with the grey lecture on a grey screen, by mid-decade these were giving way to exciting and effective college credit television courses. By the end of the seventies, there were over fifty telecourses, produced by individual colleges, public television stations, or college consortia, that were marketed to other higher education institutions across the country.

According to the Corporation for Public Broadcasting's "Higher Education Utilization Study," there were almost a half million students enrolled in college credit courses in 1978-79. Though most of these were enrolled in on-campus courses via closed-circuit television, almost

200,000 were distant learners, that is students taking courses at home, at work places, or in learning centers. Obviously, that number is a very small percentage of the number of students enrolled in colleges and universities in 1978-79. However, the numbers represent significant growth from the first of the decade, and the demographic make-up of these students is also significant. Many of them are the "new students," the older, part-time students from which higher education must draw if it is to maintain or increase enrollments in the next decades.

And the numbers of the enrollees in television courses are growing, as success stories in several parts of the country demonstrate. For example, in Kentucky, the State Departmentof Education and Kentucky Educational Television backed a statewide effort to offer college credit instruction via television. The number of enrollees has climbed steadily during the first two years of operation. In Texas, the community colleges serving Dallas County and Tarrant County began in 1977 to use the same public televsion station to present college credit instruction. Together they now regularly enroll over 17,000 students a year. The Tri-State Consortium, recently reorganized as the Eastern Educational Consortium, has grown to represent fifty colleges in the Northeast (two year, four year, public, and private institutions), and the enrollments for television courses have increased as dramatically as the numbers of institutions in the organization. And there are other such examples. However, though there are a few areas where television is successfully used for adult learning, there are even more places where television is not used for adult learning at all or is not used very successfully. Now, at last, to enhance those efforts already under way and to provide service where there is none, here is PTV-3, the first PBS national programming service for adult learning.

Adult Learning Programming

The details of the PTV-3/Adult Learning Programming Service were announced at a national teleconference February 26. Over 120 public broadcasting stations participated in the conference on that day. Others taped the teleconference for later use with the postsecondary institutions in their communities. Althouth we do not yet know how many colleges we reached, we do know that stations requested about 3,500 packets of information to send along with invitations to their local institutions, and we know that over 2,000 public television and higher education representatives were tuned in to hear the details of the plan I am going to share with you now.

The basic principles underlying the plan have been announced and published several times, but they still bear repeating. First, there is a need for a national delivery system of top quality educational and instructional television courses and series directed at adult learners with all of the accompanying economies of scale and potential for excellence that national delivery can provide. Second the choice and the use of these programs must remain under the control of local broadcasters and educational institutions. Together, they must decide which of the available programming they wish to use and when and how. Just as individual PBS member stations must be the final judge as to which programs fit their missions and their schedules, so local colleges and universities must decide which programs fit their curricula, and they must grant college credit if college credit is to be granted. Thus, a strong working relationship between local stations and the institutions within their communities is imperative. The aim of PTV-3 is to help establish such new local partnerships where none exist and to enhance the effectiveness of existing partnerships where they are already functioning.

The PTV-3 Adult Learning Programming Service will take a multi-faceted approach to adult learning. It will offer college credit courses; non-credit, life-long learning series; and career training and professional development courses. The first PTV-3/Adult Learning schedule will concentrate on credit courses. These courses were chosen after months of screenings and formal and informal consultation with the leadership of educational associations, college and university administrators and faculty, college consortia, and a specially convened PTV-3/Adult Learning Advisory Council of ten distinguished educators and broadcasters.

College Credit Courses

There are, of course, several kinds of college credit television courses. The most common type, produced by colleges and used primarily on campuses, is the televised lecture, either live or taped, which transmits, virtually intact, a classroom presentation. It may or may not include elements in addition to those used in the original classroom version, such as on-campus use, PTV-3 will not be distributing this type of television course.

Telecourses

Another kind of college credit course using television is called a telecourse. In this case, the television programs are productions prepared for open circuit distribution with general audience viewing in mind. However,the television series would not have been produced had it not been part of the telecourse. The complete telecourse is an integrated learning system. In addition to the television programs, it includes other components, such as a textbook, a text bank, a student study guide, an administrator's guide, a faculty manual, and other materials as needed. PTV-3 will distribute the best of this kind of college credit course—that is, telecourses that include television programs which have open circuit, broadcast quality technical and production standards sound academic content, and the most effective instructional design.

Headlining the schedule will be UNDERSTANDING HUMAN BEHAVIOR, produced by Coast Telecourses, in partnership with several other producing institutions: Dallas County Community College District; Miami-Dade Community College District; the State Department of Education in Florida; Chicago City Colleges; the Southern California Consortium for Community College Television; and the University of Mid-America. A new telecourse featuring the best-selling psychology textbook by Dr. James McConnell, UNDERSTANDING HUMAN BEHAVIOR, is being field-tested by the producing partners and selected institutions this spring. It will make its national debut on PTV-3.

The other telecourses in the PTV-3 schedule are AMERICAN GOVERNMENT SURVEY (produced by Dallas County Community College District, Coast Community College, Chicago City Colleges, and Tarrant County Junior College), a thirty-segment overview of the governmental system of the United States; THE AMERICAN STORY: THE BEGINNING TO 1877 (produced by Dallas County Community College District), an American history survey; CONTEMPORARY HEALTH ISSUES (produced by the Southern California Consortium for Community College Television), an examination of the critical health questions facing today's society; HUMANITIES THROUGH THE ARTS (produced by Coast Community College and City Colleges of Chicago), a survey of film, drama, music, literature, painting, sculpture, and architecture, featuring Maya Angelou as narrator; INTERACTION (produced by Maryland Instructional Television/Maryland Department of Education), an in-service course for all school instructional personnel, or a graduate course in teacher education; IT'S EVERYBODY'S BUSINESS (produced by Dallas County Community College District), an introduction to the complex range of operations which constitute the contemporary United States' business scene.

Wraparounds

Still another kind of college credit course is called a wraparound. This kind of television course begins with a television series such as THE ASCENT OF MAN, which would have been produced and broadcast regardless of whether it was to become a part of a college credit course or not. Ancillary materials prepared during or after the production of the series integrate the television programs into a learning system. The wraparound is currently the most commonly known and widely used type of college credit course on public television, and of course, PTV-3 will use wraparounds in its distribution schedule. In fact, one of the important functions of the Adult Learning Department will be to coordinate the development of the instructional materials with the production of the television programs for prime-time PBS series that have potential for adult learning so that these series can be effectively utilized from their first airing.

The fall, 1981, schedule includes two wraparounds: COSMOS, which garnered a higher viewership than any previous PBS weekly show and now has a full set of integrated instructional materials, and THE SHAKESPEARE PLAYS, featuring six plays from the past two seasons, selected by Dr. John Andrews of the Folger Shakespeare Library. These plays will be assembled with appropriate print materials to provide a survey of Shakespeare's work The series will include two tragedies, (Julius Caesar and Hamlet); two comedies (Measure for Measure and Twelfth Night); and two histories (Richard II and Henry IV, Part I).

The first schedule of Adult Learning Programming will begin transmission via satellite to participating PBS stations on August 29. Each telecourse program wil be fed on Saturday from 9:00 a.m. ET to 4:00 p.m. ET with the first three hours of the schedule repeated from 4:00 p.m. ET to 7:00 p.m. ET to provide for Pacific and Mountain time zones. All of the telecourse programs will have a daytime, weekday repeat. THE SHAKESPEARE PLAYS will be broadcast by participating stations on every other Sunday afternoon beginning September 6. COSMOS will be part of the PBS prime-time schedule beginning (on an evening to be announced) the week of September 27.

To participate in the service, colleges and universities will pay a small license fee for each telecourse, plus student enrollment fees. (There are no PBS fees for wraparound courses.) In return, they will receive the right to use the courses for credit or non-credit; a full set of administrator and faculty materials; and permission to tape off-air or acquire in advance a full set of videocassettes of the television programs. These cassettes may be used for the entire license period for makeup and review, or even as the primary delivery for enrolled telecourse students. Participating colleges and public television stations will work together to inform the community about the service, to schedule programs and to serve students.

The full details of the PTV-3/Adult Learning Programming Service are available now: how you can preview and evaluate programs; what your rights, responsibilities, and costs are in this plan; where you can seek help in setting-up or improving an adult learning television outreach; and what you should do next. For this and other information, you can write to me at PBS-PTV-3/Adult Learning Programming Department, 475 L'Enfant Plaza, Washington, D.C. 20024, or call me at (202) 488-5361.

Annenberg Gift to CPB

The prognosis for the development of superior programming for an adult learning service was greatly enhanced by Ambassador Walter Annenberg's generous and substantial gift of $150,000,000 to the

Corporation for Public Broadcasting (CPB). This fund, to be given at ten million dollars a year for fifteen years will be used to support the creaton of high quality college level television and radio programs and other materials for distribution through existing and developing communications systems. Recognizing the long history of development of adult learning through telecommunications, the fund was established to develop programs and projects (in collaboration with other organizations and with higher education institutions) which would result in courses to be offered generally, but not exclusively, for baccalaureate degree credit. The administration of this gift, to be called the Project, with a capital P, will be housed within CPB. A director appointed by CPB and an Advisory Council—consisting of two representatives from PBS, two from National Public Radio, two from CPB, and two from the Annenberg School of Communications, and perhaps two more members at large—will administer the fund. The goals of the Project are to create one or more significant collections of new, innovative, high quality college level materials and to demonstrate the use of communications systems for addressing unique higher education problems. The primary target audiences are those persons who demonstrate an interest in college level education, but because of lack of time, or resources, or other reasons are unable to pursue that education. The fund was formally presented and accepted the morning of February 26; thus, Lawrence Grossman, President of PBS, was able to announce this magnificent gift to education and public television personnel all over the country at the beginning of the Adult Learning Teleconference.

Other Services

In addition to programming, the PTV-3 Adult Learning Department will provide a number of related services. Included are two more teleconferences this spring. A teleconference on March 31 will deal with implementation strategies for telecourses. Dr. John Flanagan, Associate Dean for Non-Traditional Programs at Eastern Kentucky University, and Dr. Terence Kelly, Vice-President for Education at Miami-Dade Community College, both administrators of successful television outreach programs for their institutions, will be featured guests, along with Stephen Pence, Adjunct Professor at Eastern Kentucky University, and Elizabeth Koster, Professor of Nursing at Bergen Community College, both enthusiastic teachers of telecourses. A packet of materials about implementation will accompany the video presentation.

On April 29, PTV-3, in cooperation with the Public Information and Advertising Departments of PBS and practicing experts in promotion and marketing, will present a teleconference on promotion. This meeting will pull together the public information staffs and other interested personnel of colleges and universities with those of the local public television station to address the problems of informing communities and recruiting students. PTV-3 will provide press kits, including stories that can be localized about the service and the courses within the schedule; photographs; appropriate art work and copy for brochures, newspaper advertising and direct mail pieces so that the local institutions can easily adapt them by adding only their names, addresses, and other pertinent local information. On-air promotion for public television stations and public service announcements for commercial radio and television stations will also be available to participants. All of these materials will be integrated into a presentation that will suggest several viable approaches to planning and implementing effective promotion campaigns for adult learning via television.

The PTV-3/Adult Learning Programming Service is already well along in planning for its second semester in spring of 1982 and its second academic year 1982-83. Among its goals are earlier announcements of schedules to provide a longer lead time—nine to twelve months in year two—for colleges and universities; development of new programs and services; and a more systematic feedback system involving all of the participating institutions and stations. We want to get advice from all of our PTV-3 participants about the courses to select; the courses to encourage in development; the days and hours courses should be transmitted; the services needed to make the Adult Learning Programming Service effective; and other curricular, instructional, and broadcasting issues.

Public Subscriber Network

Though PTV-3/Adult Learning is a functioning department within PBS, still another PBS national initiative in education is on the drawing boards. Called first the Grand Alliance, but now named the Public Subscriber Network, this initiative is a part of the PBS plan for a subscriber or pay-cable service. The plan was conceived as a partnership between PBS and the cultural and performing arts institutions and groups in the country, and the focus of the evening schedule will be on first class cultural and performing art programs. However, the daytime schedule will be devoted to education. The shape of that educational programming is taking form now. It seems likely that it will be highly targeted to appeal to the same audience paying for the evening service, but will also be particularly useful to its institutional members, which will include such entities as school districts, colleges, universities, professional associations, businesses, hospitals, and industry. Though it is too early to say exactly what the daytime components will be, perhaps one strip of programming will be devoted to the needs of academically talented children and youth; another block of programming might provide advanced professional development for scientists, executives, and professionals; still another might schedule master classes by the world's greatest scholars. These potentials and others are in research now.

SUMMARY

Television has been an increasingly powerful force in our society since the fifties. Its power in business, in politics, and in all phases of communication is certainly far advanced. But television has not yet emerged as the powerful force it can and should be in education. Clearly, the arrival of PTV-3 and the coming of the Public Subscriber Network demonstrate that it is time for the good friendship between public broadcasting and education to become stronger and deeper, to grow into not so much a marriage, as a partnership. This partnership will be forged from our combined efforts to achieve our highest goals, for we have long had mutual needs, common interest, and shared values. And from this powerful partnership should come the most exciting educational experiences of the eighties.

Computers/Software—More for Less

Dorothy K. Deringer
National Science Foundation
Washington, D.C.

INTRODUCTION

Computing has profoundly influenced our society; science, government, business and even our household appliances and our children's toys have been affected. Indeed, computing is one of those rare commodities within our society for which the cost continues to decline. Or stated in another way, the increase in cost-effectiveness over time has been exponential. The rule that cost-effectiveness doubles every two years has held up for the last decade and current projections indicate that it will continue to hold for still another decade.[1] the character of the computer industry is *"More is Less."*

In a recent report, *Technology in Science Education: The Next 10 Years,* J.C.R. Licklider of MIT says "the world is rapidly moving into the Information Age" and information technology is flourishing everywhere but in the field of education. He concludes that "education is not only missing a great opportunity, *it is failing to discharge a responsibility."*

However, in spite of the fact that the computer pervades all segments of our society and the toy industry has "gone electronic" with computer based toys, "Less is not Always More" especially in public education.

What is the role of the education establishment in preparing our students to live and work in this new world and how are we fulfilling this role? How should the education establishment use the new technologies to improve our performance as so many other professions have done? Many of you at this conference are asking yourselves this question. Some of us have already decided and wish to learn more about the best ways of doing it. I expect that many of us here will talk about not only the promises but also the dangers which exist in an increasingly technologically-based educational system.

Some recent reports have delineated many problems and issues in the use of information technology in education. These reports come from the executive branch of the federal government, the Congress and the field.

NSF and Information Technology

The National Science Foundation's mission for maintaining the health of science education in the United States leads to our involvement in this topic in a variety of ways (For NSF, the word "science" includes research and education in science, mathematics and engineering). NSF's legislation, the NSF Organic Act (P.L 81-507), gives NSF a special mandate to foster computer technology for research and education. Section 3(a) (4) authorized the Foundation "to foster and support the development and use of the computer and other scientific methods and technologies primarily for research and education in the sciences." Under this mandate, NSF has invested well over 50 million dollars over the last 10 years in technology for science education.

The national concern for the decline in U.S. productivity and the recent reports of the heavy emphasis of science and technology in the Soviet curriculum for elementary and high school students led the President to request a report on the health of American science education and its ability to prepare students to function in a technological world.

The report, *Science and Engineering Education for the 80's and Beyond*[3] prepared by the Secretary of Education and the Acting Director of the National Science Foundation, shows that we will have a prolonged shortage of engineers and computer scientists. More interestingly, we are fast becoming a nation of technological illiterates. The gap between those few who study science and technology and the many who don't is great and ever growing such that it portends significant problems for our society over the long run.

The report recommends computer literacy courses as one of many possible actions, greater support for university departments of engineering and computer science to purchase research equipment so that faculty can conduct state of the art research in these areas, and it recommends that the educational profession use the technology itself to improve performance. It urges NSF to encourage the development of software for classroom computers and for the Department of Education to encourage schools to use it. Schools are urged to use video technology, classroom television and other technologies in educating students.

The Congress

The Congress as well has been concerned about the use of information technology in education. During the most recent hearings, Congressman George Brown (D, Cal.) in his opening remarks stated that the objectives of the seminars were "to enhance the awareness of the Congress, the executive branch, and the private and public sectors of the potential educational benefits of new information and telecommunications technologies and . . . the possible social and economic impacts resulting from the widespread use of these technologies in the educational process."[4]

After witnesses spoke, six panels met to discuss the problems and make recommendations.

A report synthesizing the recommendations will be available later this year. Congressional staff members indicate that two central issues are emerging in the use of information technology for education at all levels and in all environments—the need for trained personnel and for high-quality courseware and software.

The House Committee itself has taken an innovative step in the use of technology to share the material of these hearings. For the first time, a videotaped report of the hearings—actually three 1 hour tapes and one half our tape—will be available from Congressman Brown's office. These tapes have also been shown on the House closed-circuit television system. Colleagues of mine who have seen these tapes give them high marks for articulating the problems and issues in discussing the use of information technology in education.

The Field

In December 1980, a conference on National Goals for Computer Literacy[5] was conducted by the Human Resources Research Organization (HumRRO) and the Minnesota Educational Computing Consortium (MECC). Over 85 experts in computing and education participated. Though there were some widely differing viewpoints expressed the group identified the need for:

- a national commitment to a computer literate society;
- talent development;
- software, courseware and curriculum guidelines;
- equipment availability;
- a total effort in the school, the home and the workplace; and
- further research, development and policy studies.

The conference participants also pointed out that the availability of the computer could result in two distinct classes in our society: those who have the ability to use computers and those who do not. Those who do not have the ability will be technological illiterates in the technologically sophisticated society of the 80's and beyond. This will most likely further widen the gap between the rich and the poor, and serious social, political and economic consequences could result.

Clearly there are many fine policy statements and recommendations from the executive branch, the Congress, and the field. All of these and other reports reveal a consistency in views of different groups and organizations on the important problems and issues.

And now, I believe, that the people of the United States not only see the increasing importance of computing and technology, they are attempting to use it and teach about it. The question is no longer should the computer be part of instruction, but how should it be used and studied best? Enrollments of students in computer science and engineering courses in higher education are increasing faster than our institutions are able to provide well trained professors to teach them. Schools are acquiring micro-computers for their classrooms through planned purchasing programs, state-wide purchasing agreements and PTA bake sales.

But our strategies for using these computers and training teachers are varied. People are searching for sound approaches, as we are here, but there are no agreed upon solutions. The change in the last five years is that the number of people searching for solutions has increased enormously.

The National Science Foundation Projects in Computing

All of these studies mentioned above are useful if you are trying to convince advisory committees, school boards, parents, and other decision makers that information technology should play a vital role in our schools.

When one actually takes the step to use technology, however, one finds a variety of different approaches to the use of courseware and software in the education of students, teachers and citizens. The needs for large quantities of high quality courseware and software and for trained people are identified by policy makers, but there are many different and high quality approaches to fulfilling these needs.

NSF's approach is to support a variety of different projects which are examples and models of the uses of computing in science education. Then you can pick and choose among these approaches and decide for yourselves what is best for your local educational needs and objectives. These federally supported examples provide benefits to many at a much lower cost than if each institution financed its own research and development.

I would like to tell you about several of our projects which are trying to anticipate the educational needs of the late 80's in science, mathematics and engineering education. They are characterized by diversity of subject matter, levels, strategies, focus and environment.

The National Science Foundation concentrates on computing because to be able to do science and engineering in the 80's and beyond one has to know something about computing.

We see three different approaches to the computer in science education:

1. The computer as a tool of science;
2. The computer as an object of study; and
3. The computer as a deliverer of instruction.

For the last of these—the delivery of instruction—there is still reluctance on the part of many institutions to change. Dr. Joseph Lipson of NSF in an earlier talk has outlined some reasons for this reluctance.

To know about the computer as a tool of science and an object of study, however, is becoming a requirement for a well-educated individual. I believe that it is in these areas which the computer is best received and used in pre-college and higher education. It is, by far, the area in which the Foundation has the largest investment.

The Computer as a Tool of Science

Materials in which the computer is used as a tool are being developed for a variety of different science and engineering topics. All of these applications are focused on bringing research strategies and techniques in the discipline to undergraduate and graduate classrooms.

- Are you interested in improving the education of our meteorologists? Sophisticated computer graphics systems such as the one at the University of Wisconsin/Madison are used by professional and research meteorologists to analyze and predict weather systems. Dr. Donald Johnson is preparing a version of these color graphics systems, accompanied by teaching materials, and designed for use within atmospheric sciences classrooms and laboratories.[6]
- How about improving the analytical skills of undergraduate biology students? A package of programs incorporating techniques from research in biology will be designed for use in the first two undergraduate years of biology laboratory for data analysis and simulation by Dr. James Spain at Michigan Technological University.[7]
- One strategy used by political scientists and economists to predict the state of the world in the 80's and beyond is a world computer model which incorporates political, economic and other scientific data. A simplified version is being constructed for use within the classroom by Dr. Barry Hughes at the University of Denver.

Computer Literacy: Strategies for all Ages

If learning how to use the computer and about its use in our society—becoming computer-literate—is an important goal for your faculty and students, consider these different projects in different environments with different philosophies.

- If you're involved in elementary schools, curriculum kits for introducing computing into science and mathematics courses taught in grades K–8 are being produced by the Human Resources Research Organization (HumRRO) in Alexandria, Virginia;
- At the middle and high school level, a project at the Minnesota Educational Computing Consortium directed by Dr. Ronald Anderson is producing materials which will be integrated in mathematics, science, and social sciences classes;
- How about out-of-school learning? Professor Seymour Papert at MIT will use the opportunity afforded by a summer camp to explore the mathematics learned by early adolescent youngsters

within a computer culture;

- If you believe the library should be the center for change in our information-based society, look at the project conducted by People's Computer Company at the public library, recreation center and local business locations. This project will give the 27,000 residents of Menlo Park, California an opportunity to have a direct experience with a microcomputer.

Computer Development and Revision

One of our recent efforts which has generated strong interest among mathematicians, educators and the public involves pre-college mathematics education using computers. During Fiscal Year 1980 twenty projects were supported, nine in cooperation with the National Institute of Education under the NSF/NIE Improvement of Mathematics Education using Information Technology effort. These twenty projects illustrate a diversity of approaches at different age levels.[8]

- If you are looking for materials for gifted young children, games, inquiry learning sequences and puzzles will be programmed under the direction of Dr. Ann Piestrup of Advanced Learning Technology to help gifted second and third graders learn geometry and logic. Children will use a variety of input/output media—joy sticks, graphics tablets, color graphics and speech;
- It you envision a classroom with both calculators and computers, you might consider the techniques used by Dr. John Miller at the Lawrence Hall of Science. Calculators and computers will be combined in the mathematics classroom in a project to teach 4th, 5th and 6th grade teachers and parents about the potential of calculators in elementary mathematics instruction;
- If you consider the networking of teachers and classrooms an intriguing technique for improving the interest and motivation of both teachers and students, consider this project directed by Dr. Diane Resek at San Francisco State. A network of micro computers will be used to link middle school students and teachers learning mathematics through games, simulations and information storage and retrieval techniques;
- Looking for a technique to involve talented but non-science oriented students in computing and mathematics? Tenth grade students (talented but non-science oriented) will use the computer in their roles as mathematics tutors for underachieving sixth grade students. Dr. Marc Swadener at the University of Denver anticipates that the mathematics and problem-solving skills of both groups will improve as well as their enrollment in math and science classes.
- Do your students think that math and science are too abstract? At the All Indian Pueblo Council in Albuquerque, NM, Pueblo story

telling techniques with color graphics will be used to teach Indian students about energy use in the Pueblo culture.

- When your teachers express the desire to use the computer as a "dynamic blackboard," consider a project at Georgia Tech directed by Dr. Les Karlovitz and one at Carroll College by Dr. Gerald Isaacs. In both of these projects, teacher tools for illustrating and describing mathematical principles and problems in the classroom are being developed.
- How about a math lab? A mathematics laboratory akin to a high school physics or chemistry lab will be created by John Staib at Drexel University.
- If your school serves adults who need to learn or refresh their high school mathematics, the mathematics clinic at Virginia Commonwealth University will help adults learn high school algebra and trigonometry graphing through computer graphics.

Ten to fifteen more prototype projects in mathematics and computing will be supported in Fiscal 1981.

CONCLUSION

In conclusion, technology is flourishing everywhere but in education. The President's report says that in the long range this situation is going to Have a significant negative impact. As we search for trained people to run our technological society, we will find fewer and fewer of them. Predictions are that we will soon find a technologically illiterate society. If we are to meet the challenges of an information society we must ensure that we have a literate populace.

NSF has funded programs to stimulate the development of ideas and systems to assist those who are interested in using technology in the classroom. Much more is needed.

If we are to integrate the use of technology in all of our nation's classrooms (not just in pilot projects and prototypes), we need to develop national strategies to stimulate the large-scale development of high-quality educational courseware, software and materials and to facilitate the acquisition of appropriate hardware.

If the courseware, software, materials, and hardware are to be created and used effectively in our nation's classrooms, we need a nation of trained people—faculty, teachers and administrators, who are prepared to use technology wisely.

If we are to capitalize on the strengths but avoid the dangers of these information technologies, we need continued research and development activities to determine long-term benefits and dangers.

And finally, if we are to remain a technologically sophisticated nation, we need to establish national policies, goals and strategies to ensure that our educational system can produce students who can participate in such a society.

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Matching Educational Needs with Available Technology: What is Happening in the Rest of the World

Clifford H. Block
U.S. Agency for International Development
Washington, D.C.

INTRODUCTION

As I prepare this paper in Washington this afternoon, my thoughts turn to some of the places on this earth where educational technology is today being used to make a difference—places where it is playing a central role in the educational process. It is early morning in the South Pacific, and students of Fiji, Tonga, Western Samoa and eight other islands scattered over hundreds of thousands of square miles are preparing to take a university course in tropical disease control, thanks to audio links provided to each island by a NASA satellite 23,000 miles in orbit above the earth. Further to the West, in the Republic of Korea, in a few hours 250,000 primary and junior high school students will attend schools where learning is organized in a sophisticated system based on mastery learning concepts, delivered by programmed instruction, radio, television, and teacher-led exercises, while thousands of Korean adults will be earning a high school degree through Korea's High School of the Air. A little later, in Thailand, students will be studying primary school mathematics provided by radio to their classrooms, and they will be learning it well. In the Ivory Coast of Africa tomorrow morning 580,000 students throughout the interior of that country will be studying through classroom television in almost every subject. In England, of course, that nation's largest university will be operating using the postal system and the facilities of the BBC to bring higher education of estimable quality to 65,000 students; meanwhile, in our own hemisphere a similar system is providing relief to Venezuela's bulging university classrooms, while even in strife-filled El Salvador education is being provided for most of that country's junior high school students through classroom television.

So, we in this country are part of a fabric of experimentation and commitment to new ways to provide the best educational opportunity that can be afforded to our children and to ourselves, no matter the material, political and cultural differences among us. There is some merit to the thought that we can learn together from some of these experiences—as well as provide a boost our collective morale, as innovation wends its rocky way through the very testing trials of reality.

World Trends

I would like to give you some sense of the trends in educational technology throughout the world, at least as I see them from my vantage point, where my job is to select promising approaches and concepts worldwide and to work with specific developing countries to generate applications to their problems. It is tempting—very tempting—to speculate about the new world that we see coming into reality in the next few years: whole libraries available on a handful of videodiscs; students of all ages learning at home through micro—computers linked by phone with vast educational data bases; instant access by satellite to an unlimited variety of televised information. But I, like many of the other contributors believe we have learned that those fundamental changes will come to realization, in most cases, only in a gradual and often evolutionary way—rather than by some instantaneous sea change. Educational institutions, and those within them who learn, and teach, and administer, need time and experience to incorporate these new ways of learning into their individual, social and economic patterns of behavior. The organizational changes to which many of this book's papers have referred will take some time, some fits and starts, and many adaptive processes in order to become viable. So instead of speculating about what could come to pass, I would like to examine currently existing trends in the rest of the world; it is these existing trends which are most likely to condition the educational alternatives of the near future.

I see four basic trends that now have a firm basis. The best established is that embodied by the concept of the open university—that is, "*teaching at a distance*," for motivated adults. The second is an increasing use of broadcasting to meet basic educational needs within primary and secondary schools, particularly the emerging rediscovery of *radio as a powerful in-school educational medium,* when appropriately programmed. The third is the now familiar world-wide use of *television for early childhood education,* as pioneered by the Children's Television Workshop in its Sesame Street and Electric Company efforts. And finally, serving as the intellectual underpinning of many of educational technology's success stories in the world's educational marketplace is the slow but steady growth of *instructional systems design*, used as a formal methodology for developing the content of instruction. *TEACHING AT A DISTANCE: THE OPEN UNIVERSITY*

Elsewhere in the world, as in our own country, innovations succeed when they are able to combine effective instructional methods with delivery systems that are cheap, reliable and simple for the users to operate. Even then, they persist only when such innovations become incorporated into institutions that themselves are strong—institutions which are viable because they serve important social needs.

The Open University

The Open University movement fits all these criteria. The British Government of the late 1960's and '70's was deeply, politically committed to expanded higher educational opportunity beyond the selective and indeed elitist university system extant in the United Kingdom. By using television, radio, and the post, the production skill of the BBC, the instructional design skill of its superb educational technology group, and the content expertise of a first-rate faculty, the British Open University has grown to more than 65,000 students, by all odds the largest university in Britain and one of the larger ones in the World. Its graduates have acquitted themselves so well, and their intellectual standards are so high, that an Open University degree means a good deal even in status-conscious Britain. The model has quickly become transplanted to other nations where university entrance is difficult to achieve. The Bavarian Open University now enrolls thousands of German students; the model has been extended to Venezuela, to Pakistan, to at least a dozen other countries including, of course, the United States. We can expect some of the particulars to change from place to place and to evolve—in Britain, for example, the use of the audio cassette is increasingly viewed as having advantages for some purposes over both television and radio, and is rapidly becoming a major element in the media mix. In the South Pacific—where mailing cassettes or documents means in many instances taking them over dangerous reefs by longboats—broadcast techniques are predominate, and there is now serious experimentation with slow-scan television.

But the basic elements of the Open University model remain the same—working adults study in their own homes, or in some countries in community centers, using some form of audio or visual instruction; their performance is monitored and guided through correspondence, telephone or some other means; and in most cases, instructional systems design techniques frame the development of instruction content. These systems generally work well. They are economically attractive because students can still be employed, and they fill a tremendous need for services to new populations.

In some developing countries, these systems are being used also to extend the societal usefulness of the university. In the South Pacific, for exemple, with a little help through A.I.D., university faculty in such fields as agronomy, public health, and economic policy are providing specialyzed in-service courses to development workers throughout the region—to nurse-midwives, to agricultural extension agents, to planners—through satellite radio. In the process, incidentally, these faculty are being profoundly influenced in their regular academic teaching by their two-way communication with those who are facing real-world problems on the job. So I expect these open universities to continue to function, to grow, and to become even more sophisticated educationally. Because they are now permanent and important institutions in their countries or regions, they can take on that task of continued, steady, instructional improvement, through new instructional techniques and better testing—one of the great promises of educational technology that has so rarely been fulfilled.

Instructional Broadcasting: The Re-Discovery of Radio

Let me turn now to basic education and the expanding role of instructional broadcasting, increasingly by radio in the developing world. By basic education I mean the fundamental language and numeracy skills one is supposed to acquire in primary and junior secondary school. Here the developing nations are facing even greater burdens then we are, because of their rapid population growth. Although school enrollments have risen dramatically in the last two decades, in many African countries fewer than half the children are in school; in India a majority of school-age children fail to complete the fifth grade; and in Brazil just a few years ago fully half the school children in the country were in first grade classrooms, many of them repeating the first grade because of failure, or simply the absence of schools with higher grade levels available. In India last month, a noted Indian educator observed to me that if India were to keep up educationally with its entirely predictable, indeed quite certain, population growth over the next twenty years, a new school would have to be built every ten minutes. In addition, of course, trained teachers would need to be recruited to live in the difficult conditions of village India, and to be paid by a very poor nation.

With conditions like these, some countries have been working seriously at using the educational technologies to carry a major part of the instructional burden. To planners in some countries it seems almost inevitable, and the only practical hope of coping with the population explosion, let alone improving educational quality and capitalizing on the vast human potential in Third World nations. We at A.I.D. have had the privilege of working with several such countries as they seek out basic educational alternatives. In at least a few of these countries there has been the recognition that fairly fundamental organizational change will be a requisite to meeting their needs. Starting a dozen years ago, television was the chosen medium, and it is those systems which are now the most mature. When they were developed, the use of instructional design methods was rarely used in educational broadcasting; Seseme Street and the Open University had yet to emerge as successful hybrids of these two approaches to educational technology. Thus, the quality of these systems might have been limited, to some degree, by their early birth. But they have had considerable achievements: in El Salvador, for example, a doubling of junior high school enrollment without diminishing quality (in fact, with significant learning gains) was made possible through double sessions supported by classroom television, television closely integrated with daily teachers' guided and intensive teacher retraining. At the same time, the curriculum was entirely overhauled. The system continues. In the Ivory Coast, something of an educational miracle has taken place. From 1970 to 1977, primary school enrollment expanded from under 80,000 (almost entirely in the cities) to 560,000; again daily television lessons in every key classroom subject have made this expansion possible, while teachers have been gradually trained, in part by television programs for that purpose.

But television-based systems are perceived as too costly by many. Therefore, we at A.I.D. and later others, such as UNESCO and the World Bank, began some years ago to work with selected developing countries to develop radio as a key medium for distributing much of the core of instruction. Because radio has been around a long time, it was initially very difficult to interest educational planners in using it in a significant way. Our strategy has been to try to make it so effective educationally that people would have to sit up and take notice. In this enterprise we have had the great advantage of having the leadership of Professor Patrick Suppes of Stanford and his very able colleagues, Barbara Searle, Jamesine Friend, and Klaus Galda, to carry out the initial efforts.

The first result of this new commitment to radio education has been the creation of a complete, daily, radio-based curriculum for all of primary school mathematics, widely usable in schools where teachers themselves are inadequate in mathematics teaching. This curriculum, tested in daily broadcasting over several years, has shown learning gains over traditional rural schools ranging from 20 percent to 35 percent per year. The method was first developed and tested in Nicaragua; it is now showing equal success in the very different culture of Thailand, and is being examined for possible adoption by several other nations throughout the world. Its power derives, incidentally, from adapting many of the instructional principles associated with computer-assisted instruction to the mass medium of radio. The programs, for example, are filled with elicitations of active responses by the children—working out sums with bottle caps on their desks, shouting out answers, singing mathematical songs. The schedule of repetition of drills in particular skills, such as two-digit multiplication or three-digit subtraction, is determined by fine-tuned principles of distributed practice, based in part on students' performance. And feedback on performance is rapid, frequent and non-perjorative. All this, plus some creative radio formats that are culturally sensitive and warm-hearted, has created a system that is a delight, welcomed in the classroom as a lively guest each day, and that succeeds educationally.

When one sees this system operating in otherwise dreary and sleepy rural classrooms, it is a joy to see the electric aliveness it can bring—much of it deriving from the delight that is inherent in active learning. If one ever wanted to puncture the myth of passivity associated with instructional broadcasting, these are the classes to see.

Many of these same techniques are now being used by A.I.D. to develop a curriculum in the language arts by radio, initially in Kenya. We soon will be testing elsewhere a complete primary school system for remote rural schools, where family members of community volunteers can play many of the roles of the teacher—the classroom organizer, the nurturer, the interest-stimulator, while the radio lessons provide a core of instruction. So, while just out of its infancy—or perhaps its second childhood—instructional radio is being rediscovered throughout the world, with significant new uses now emerging in such countries as the Philippines, India, Korea, and several Latin American countries.

I must also mention some of the extraordinary uses to which radio is being put to reach adults with both basic education and practical information. In almost every Latin American country, radio schools daily teach tens of thousands of largely illiterate or semi-illiterate farmers the basics of education, as well as a wealth of practical information on health, agriculture and family economics. There are now 34 such systems, most of them initiated by the Catholic Church; one of them, in Colombia, has a regular newspaper for new literates, the "Campesino," with a circulation of 600,000!

The U.S. has assisted a number of these efforts and, again through A.I.D., is helping develop new techniques for making radio a full-scale information and educational service for rural people. We are assisting projects which are teaching basic nutritional skills to families by radio, providing daily detailed agricultural information, and teaching mothers themselves to deal even with severe health problems being faced by their infant children. So radio is increasingly educating, informing, training and even saving lives in the developing world, using techniques entertaining enough to attract listeners and useful enough to retain them.

Television for Pre-School Education

The third trend I alluded to earlier, the adoption of Sesame Street-types of television programs for the pre-school instruction, is so well known I need not dwell upon it. More than thirty countries are using Sesame Street or the Electric Company. Even more importantly, the Children's Television Workshop has done a great service by engaging in co-productions with countries as diverse as Mexico, Germany, and Saudi Arabia (a total of 6) and so has left these nations with basic skills on which to build future activities themselves. Since pre-school education is generating increased interest in many nations—as a way to improve school success and to overcome intellectually deadening environments in many of the poorest households—the use of this model will, I am confident, continue to thrive, especially as television becomes more widespread.

Instructional Systems Design

Now, a word on the fourth trend, the one that underlies, I think the success of most of the others—the growing acceptance of instructional systems design as the framework for developing instructional content, no matter what the medium. Here, I think, we can take pride in this peculiarly American intellectual export that is beginning to take root and flower, and that is of enormous importance to the future of education. The systems design approach to empirically based instruction. which grew out of programmed instruction, basic psychological research on learning, and the use of computers, is in a way the essence of American pragmatism, as at every point in developing a lesson—or a system—it says, "Go see what is really being learned; if it doesn't work, try it again until it does work." I cannot emphasize enough how radically different that underlying attitude is from the methods still extant in so many places—"copy-recite, repeat the knowledge exactly as it is in my head, or fail;" an approach, incidentally, that seems to work reasonable well for the few, and seldom works well for the many.

As we have begun to combine these methods of instructional systems design with the wide access provided by the mass media, substantial movement has begun to occur. One of the most impressive achievements in this area, incidentally, has been in the Republic of Korea. Eight years ago, with the help of U.S. A.I.D. and experts from the Florida State University, led by Professor Robert Morgan, Korea set in motion a complete overhaul of its school system, a reform based on instructional design concepts, especially on mastery learning, and on the use of radio, television and programmed texts. Here, great attention has been paid also to changing classroom and school system organization. It is an extraordinarily ambitious effort, and one of the few where the instructional technologists have been put in charge of the reform of an entire school system. Last year a near-final test of the system in 200 schools showed major learning gains; the model system now has begun its national scale adoption.

Satellite Communications

Finally, I must briefly mention the revolution that satellite communications promises and that is at its beginning overseas, as it is in this country. After years of worldwide speculation about the possible use of satellites to enhance education in the developing world, India in 1975-76 used a NASA experimental satellite, ATS-6, to bring community educational television to almost 2,400 remote villages throughout India. It broadcast science lessons: it reaches hundreds of thousands of adults with health and agricultural information, news, and cultural programming; and it provided in-service training to 48,000 rural school teachers. This was the same satellite that in the U.S. spawned that now-blossoming Appalachian Community Service Network and a variety of educational and health uses in Alaska, and that also served the Rocky Mountain states. In India, too, the experience encouraged the nation to develop an operational system; in 1982 India will have its own satellite (U.S.-made and launched, by the way, and fully paid for by India) which among other things will bring educational broadcasts in ten languages into schools throughout rural India. China has declared its intention to do the same (although just recently delayed by budgetary constraints), in an effort to rapidly overcome the deficits in basic and technical education produced by the Cultural Revolution.

The power of newly available satellite communication systems derives from two factors—their ability to reach rural people economically, and their capacity to aggregate learners in any specialized field, without regard to distant. These capacities will find many applications.

The United States is associated with developing these new opportunities through the new A.I.D. Rural Satellite Program, which will provide both radio broadcasting and community telephones to rural areas in several countries, in an effort to show that educational and two-way communications can, in fact, be a catalyst to social and economic development in the rural areas of the world—where, after all, majority of the people on this planet live. We are working in developing this program with Peru, Senegal, several Caribbean nations, and soon, we expect, with the Philippines and several additional countries. Among other things, we expect to making some dramatic new uses of another "old" technology, the telephone, a "feedback" medium of great flexibility, as well as a means of access to many sources of information.

Briefly, these projects will use small earth stations to bring radio and telephone communications to rural towns. We will be assisting local agencies such as agricultural extension and health provider systems to learn how to utilize these media to improve their effectiveness, and we will be evaluating very carefully their cost, revenues, and effects.

So, in this panorama I hope you've gathered that some important seeds of productive change are sprouting in education around the world. New, more educationally powerful, uses of old media such as radio and telephones are emerging, and instructional methods based on learning effectiveness are beginning to make difference. Some new institutions, such as Britain's Open University and Korea's Educational Development Institute, have arisen to give some permanence to these new systems.

SUMMARY

There is still a very, very long way to go, however, to effect fundamental improvements in the basic educational opportunities available to most of the world's people. In attempting to go that long way, I look to a lively interchange with the many in the United States who are aiming at some of the same objectives, and I also hope that the people of this nation will continue to support this effort through the A.I.D. program. We in this country have a special professional contribution to make to this effort because of our well-rooted pragmatism and our leadership in the new learning technologies. In turn we can perhaps be inspired by the efforts of other countries to ourselves take bolder and more rapid steps to overcome our own difficulties. We are now realistic enough about our own educational constraints that we can have the very genuine satisfaction of learning together during this next decade, a decade which should be exciting and which, together, we can make satisfying.

Securing Teacher Acceptance of Technology

Doris K. Lidtke
Towson State University
Baltimore, Maryland

INTRODUCTION

When addressing the topic of securing teacher acceptance of technology in schools, a great number of educators today are talking about bringing computers and computing into the schools and this means *change*. Bringing computers into schools some years ago might have been considered a minor change and could have affected only a few teachers, particularly the mathematics teachers, some business teachers, and those few teachers using Computer Aided Instruction (*CIA*), since *CIA* was too expensive for most schools. Today, however, there is a new problem. Computers pervade all aspects of our lives. Everyone in our society needs to know about computers in order to function in the society. Joseph Lipson in a 1979 report for the National Science Foundation (*NSF*) said, "Failure of the Federal Government to move swiftly to facilitate educational uses of the new technologies will endanger the economic and, eventually, the military security of the country. If our democratic institutions are to remain stable, we must welcome, rather than fear or ignore, the imperatives of technological change. It is unlikely that we can do this without firmly weaving advanced information technologies into the fabric of our educational system."[1]

He continued by saying we need a major program to train specialists in this area—computer specialists and people with artistic and instructional design talent. And herein lies one of our major problems, there are not and will not in the foreseeable future be sufficient trained personnel for the schools unless some near miracle occurs.[2]

Further Lipson said, "We find evidence that only with an informed public, can the nation hope to move into a computer age with the speed and sense of purpose required. The adoption of a new technology is incredibly complex. At almost every stage there is strong intereaction with public attitudes and public understanding. Investments, markets, legislative positions, enrollment in courses, and selection of careers will all vary with public awareness and knowledge."[3]

Beyond consideration of these problems, the acquisition of hardware, software and courseware for use in the schools must be addressed. "The dramatic change in capability, and the cost of information and image machines will touch every aspect of our personal lives and health as a society. And science education . . . will face a unique challenge in responding to the opportunity. New knowledge and skills can be taught through new forms of learning experience. Concepts and procedures can be more effectively taught to a wide range of students."[4]

The returns are great if a real commitment is made. The teachers' commitment is important, but is only one part. For "the acceptance by teachers of an educational program is a necessary precondition for its success."[5] However, "a school district must have a strong commitment from the Board of Education and the administration in order to provide the policies and resources needed to establish goals and implement systematic curriculum change."[6] Does this commitment exist to allow teachers to incorporate the needed technological change?

Aspects to Consider

There are several aspects that must be examined with regard to teacher acceptance of technology in the schools. It seems appropriate to consider the reasons that teachers may not accept technology, the reasons that will persuade teachers to use technology, and finally to look at the methods and means that may minimize those factors which inhibit the use of technology and those that maximize the acceptance of such technology. Before examining these factors a brief look at history seems appropriate.

Historically there has been only minimal acceptance of technology and innovation in schools. There has actually been only incremental change when the long term is considered. Today there is still a great deal of teacher explanation [lecture presentation], student listening, students doing assignments and reading from textbooks, and students writing examinations about the material presented to them.[7] That is, there is great reliance on lecture, text, and test. This is not to say that there has not been considerable emphasis at times on the use of media other than blackboard, chalk, and textbooks, but these older materials remain dominant in the majority of classrooms. Dr. Andrew Molnar cites a 1975 National Science Board report stating, "that over half of all science and social studies and two-thirds of all mathematics classes use a single textbook and many teachers use no supplementary aids other than the chalkboard."[8] The question is why is this so? Why are television teaching, programmed learning materials, films, direct-dial access systems, and language laboratories not more dominant? There is no single answer. Some of the explanations for the failure to use these technologies in schools include: little concrete evidence of the effectiveness of the use of these media, teacher resistance to change, lack of training in the use of equipment, the lack of adequate hardware, software and courseware, the need to change teaching style to use the technology, and the fact that extra time and preparation are required to use these technologies. Acceptance, on the other hand, occurs when the teacher feels that the technology is effective with students, the teacher has adequate training to effectively and efficiently use the technology, there is adequate hardware, software and courseware, and the technology fits the teaching style of the teacher.

Almost parenthetically it seems appropriate to mention that one of the technologies that has succeeded is the language laboratory. Here the special feature seems to be the active rather than passive involvement of the learner.[9] This and the experience of most teachers seems to agree that active involvement of the learner in the learning process is more effective than passive involvement.

Classroom Effectiveness

The primary factor most teachers consider in relation to the use of technology in the classroom is its effectiveness in the teaching-learning environment. Nearly all technology will require an investment of time and effort on the part of the teacher, if they are to use it in their classroom. Unless the teacher is thorougly convinced that this is worthwhile for students, the teacher will not be motivated to expend time and/or effort in preparing for the use of the technology.

Today, the technology that seems paramount in the minds of most educators is computers, more particularly microcomputers, and microcomputers with videodisks. In terms of schools this is a very recent development. Computers were unheard of in the schools in 1950. Indeed, there were only 15 computers in the United States in 1950[10] and in 1951 the first commercial computer, a UNIVAC, was delivered to the Census Bureau.[11] It was 1954 before a commercial computer was delivered to other than a governmental agency. But computer technology developed rapidly and by the late fifties there were already many "second generation" computers.[12] These computers were more reliable, faster and less expensive. At that time many schools acquired their first computers, business and industry recognized the need for computer specialists, and the general interest in this new technology spurred the development of courses in programming and the use of the computer. A few experimental programs were developed in the late fifties and a scattering of credit and non-credit courses appeared at various educational levels. The problems of the emerging new discipline were apparent from the beginning—equipment, teaching staff, texts and curricula.[13]

On the secondary level a pilot program in Livermore, California in 1957-58 was one of the earliest reported courses.[14] This successful program led to the introduction of a regular course in computer programming in 1958. Designed for mathematics and science students, the purpose was enlightenment and enrichment of their programs. Local business and industry provided computer facilities, materials, and instructors. It should be noted that this was one of the few areas of the country where firms had computers at this early date and where they were willing to donate so generously of their time, facilities and personnel. This cooperation between school and industry was present in the early states of many programs.[15]

Until the mid-sixties progress was slow. In 1963 the *PIP Newsletter* listed all the courses and programs known to the Project on Information Processing, a committee of the National Science Teachers Association. The report showed that only a scattering of courses were being offered. There was evidence of a lack of equipment and of trained personnel for teaching. The lists of available texts and visual aids revealed a dearth of suitable materials. Many non-credit courses were offered by business and professional associations[16] for the enrichment of the regular high school program. Significantly, two distinct varieties of programs were reported, the one with a mathematical scientific orientation and the other with a business orientation. Hard facts as to the number of secondary schools teaching data processing are not available, but one estimate is that in 1966 one-fifth of all high schools had access to data processing equipment for instructional purposes, though most of the equipment was unit record equipment.[17] Another report at that time indicated that nationwide about 400 secondary schools were using computers for programming scientific problems.[18] Throughout the sixties the problems were still equipment, teachers, texts, and curricula. But some schools were finding solutions.[19] Time-Sharing services provided the equipment at a price many could afford. Some teachers obtained training at local colleges or attended summer institutes sponsored by the National Science Foundation. Some texts were appearing, though not always of good quality, and the results of experimental and early course offerings of a few schools provided the basis for curriculum development.

The situation as the seventies began is well summarized by Warren Stenberg of the University of Minnesota:

> Computer science courses have not as yet played a major role in computer use at the secondary scene but they now seem to be coming up fast ... [Even tough] no standard curriculum has yet been developed ... [and] textbooks are not generally used.[20]

Courses in data processing "are still in the category of pipe dreams since the teaching personnel just does not exist."[21]

Computer Acceptance

But events in the seventies changed this picture. Today there is a sudden increase in the number of schools across the nation which are beginning to use computers or are considering the use of computers in the classroom. There are two major forces behind this movement. First, computers are, with the advent of the microcomputer, relatively inexpensive. Second, the computer has become such a pervasive factor in our daily lives that nearly every citizen must have some knowledge of computers to function in the society. This means that schools must educate students to function in a society where they will interact, directly or indirectly, with computers.

Surveys of teachers indicate that most teachers believe that all students should learn about the computer. Not all teachers are convinced that they should use computers in their own classrooms, and some of those who are not interested in using computers indicate that they are unaware of the possible uses of the computer in the classroom.[22]

Other factors which cause teachers to be reluctant to use computers include earlier claims that the computer will replace the teacher, their own lack of knowledge about computers, the feeling that computers will deliver a less personalized education for the student, a lack of understanding of the advantages and modes of use of computers in the classroom, being ill-at-ease when using computers, and having seen examples of problems with the use of computers in various school administration applications.

For those teachers who are convinced that computers are an important part of the classroom, there may remain some reluctance to use computers. This reluctance comes from anxiety in dealing with equipment, a feeling of loss of control of the teaching-learning situation, inadequate hardware, software, courseware, and support, or because of the considerable time and effort required to obtain adequate training, to remain current in the field and to use computers in appropriate ways in the classroom.

Training Needed

What will persuade teachers to use computers?

First appropriate training is essential. Through pre-service, in-service and professional development the leaders in education need to see that teachers understand that the computer is to be viewed not as a replacement of the teacher, but rather as a sophisticated tool to be used by the teacher to allow the teacher to do a better job in the classroom. This means that teachers must realize the potential of the computer in the classroom, that the computer can be used in many modes, as a tutor to provide information and drill and practice, as a tool in courses that require a calculator or information retrieval device, and as a machine to be instructed. Teachers should be given ample opportunity to see computers used in all these ways and to see how they may effectively be used in their own classroom. Seeing examples of quality uses of computers should allay misgivings and motivate teachers to consider using computers in their own classrooms.

Support

Second, adequate hardware, software and support must be assured. At the present time many schools face tight budgets and this naturally means strict limitations on funds for hardware, software and support. There are areas which are trying innovative programs for the use of computers through sharing of facilities, one school using the microcomputer for a few weeks and then passing it on to another school. This is certainly preferable to no computer at all, but it is far from adequate. In fact for most uses one computer for a classroom is inadequate. While research supports the use of one microcompuer or terminal by a pair of students at one time,[23] in a classroom of twenty to thirty students, one computer means that the teacher cannot help the students using the computer and neglect the vast majority of the students in the room. Ideally, a computer for every four students is suggested. A single laboratory in the school, where students may go to use the computer, might be a good solution. The teacher could accompany the students and various classes could be scheduled to use the laboratory, or the laboratory might function in much the same way as the library. Even now it is being suggested at Carnegie Mellon University that each student should have his/her own microcomputer.[24] This is certainly a long way off for public secondary schools, but gives some idea of the thinking of some professional educators about the importance of computers for students.

Software is beginning to be developed for use in schools. At the present time much of the software that is being used has been developed by the teachers who are using it, or has been given to them by friends and acquaintances, or swapped through user's groups. A current project of the North West Regional Laboratory in Portland, Oregon, headedby Dr. Judith Edwards and funded by NSF, is evaluating and cataloging software for use in schools. Other materials, primarily for use in higher education, are available through CONDUIT at the University of Iowa. Several microcomputer vendors are also active in assisting in the exchange of software among their users. While there is not at the present time an abundance of software, positive steps are being taken in the development and dessimination of quality software. This is an area which needs continued attention.

There must, at least for the present, be a realization that the classroom teacher requires support in the use of computer or computers in the classroom. Many teachers, especially in the initial stages, are unfamiliar with computers and find such small problems as hooking up and adjusting the color monitor or TV, tightening up a connection, and checking out the machine for proper functioning, to be overwhelming. For some time after the initial introduction into the classroom the teacher needs someone to whom to turn in case of a malfunction, someone to be a resource when questions arise in the use of software and for lesson planning. This seems essential if the transition into the classroom is to be smooth. One "expert" in the school building who has the time, expertise, and assignment to assist other teachers seems to alleviate many problems.

Third, teachers must be given time for training to use a computer with ease in the classroom, time is also needed to remain current in this rapidly changing field. The amount and type of training that an individual teacher needs will vary considerably, depending on the previous training of the teacher and the mode and extent to which the computer is to be used in the classroom. For those teachers who will use only prewritten software, the training need not be extensive. However, for teachers who are teaching computer literacy and computer programming much more training will be necessary and frequent updating will be necessary since the field is so dynamic.

Encouraging Usage

What can administrators and educational leaders do to encourage the use of computers in classrooms?

There are no simple answers to bringing computers into the classroom. Indeed it has been a long process and it will not occur immediately. However, it is crucial that the process of bringing computers into the classroom be addressed in this decade. Dr. Andrew Molnar of NSF sees this as a critical issue for schools. Change cannot be mandated, but leaders can persuade. This is an appropriate time because the public is aware of the importance of computers, parents are seeking, in many cases, for computers to be introduced into schools. News magazines, such as TIME, indicate that the USA is falling behind Japan in technology, particularly in computerized robots. Many leaders point to the need for better science training, which means training in the use of computers. With this stimulus, it is time to develop a plan of action which should include:

1. Provide teachers with an opportunity to learn about appropriate uses of computers in the classroom.
2. Provide pre-service and in-service training for teachers.
3. Provide adequate, not token, equipment for the classroom.
4. Provide software packages for use in classrooms.
5. Provide auxiliary teaching resources—films, texts, lesson plans, and curriculum guides.
6. Provide a specialist to consult with classroom teachers concerning hardware, software and classroom usage of the computer.
7. Reward good teaching with computers.
8. Provide examples of teachers doing superior teaching with computers.

Though this lists seems long, and some items involve considerable expense, we must consider the cost of not providing these items for our teachers and students. Because "the computer has, today had an impact on the lives of each and every one of us; already, most of our financial affairs and many of our social affairs are subtly controlled or structured by the computer, and the future promises only more of the same,"[25] we must see that every student has a "basic understanding of the computer . . . a critical component of the knowledge of any educated man or woman."[26]

We must realize that the status of computer literacy among the students in our schools today is woefully low. Dr. Ronald E. Anderson of the Minnesota Educational Computing Consortium (MECC) reported in December 1980 at the National Computer Literacy Goals for 1985 Conference in Reston, Virginia that:

> In brief, the best data we have suggest that few students in either senior or junior high school have opportunities for computer experience; few have algorithmic problem-solving skills; and many lack an awareness of the role and value of computers. Since these findings are true for 17 year old students, most of whom were in 11th grade, we would speculate. that many students are graduating from high school and perhaps from college without a minimal level of computer literacy.
>
> What is equally disturbing is the evidence in the data that what little literacy exists in the nation's students is unequally distributed across social groups. Computer experience is much less common among minorities, women, and those living in the Southeastern U.S. or rural areas. Not only is computer experience less common among these groups but there is good evidence that computer knowledge and skills are lower as well.[26]

All students must become computer literate. We must see to it that computer education is equitable and that we do not develop a group that is information and computation rich and a group that is information and computation poor. For information and computational ability are power and these belong to all.

Learning from the Successes

Finally, it is instructive to look at some examples of computers in schools and to try to determine how they came about and why they succeeded. There are many examples that should be considered and here only a few are mentioned. One of the earliest known programs in a pulic school was in Livermore, California in 1957. Here parents wanted their children to learn about computers and programming. Some of the parents and local professionals taught the course and the programs were taken to local facilities to be run. There are many similar examples of parents teaching a course or courses, providing access to equipment and giving excellent support to the classroom teacher. A program of this type can work in the initial phases, but eventually it must become a regular part of the curriculum and be handled bya regular teacher.

One of the important examples of an entire state taking the initiative in bringing computing into the schools is in Minnesota. The Minnesota Educational Computing Consortium has been very successful in this respect. They began by using a system of time-shared computers with terminals in the schools and now are also using microcomputers. They provide teacher training, software, group purchase of hardware, curriculum guidelines and support. State and local school systems in other areas can gain considerable expertise from publications of MECC. You will be able to learn more about this in the next session when Dr. John Haugo, Director of MECC, talks in the session "Managing Technological Change in the Schools."

The impressive work in the Philadelphia Public Schools under the direction of Ms. Sylvia Charp is an excellent example on a local level. People from around the world visit this project and emulate many of the fine parts of this program

Many of the secondary schools in New England owe much of their success to Dartmouth College which not only made computer resources available to these schools through their time-sharing system, but Dartmouth also trained teachers and encouraged the development and exchange of software.

The early and successful programs in computing in Oregon owe much to Dr. David Moursund who obtained NSF grants to fund summer training sessions for secondary school teachers at the University of Oregon. An outgrowth of this was the establishment of the Oregon Council on Computer Education and the Publication *The Oregon Computing Teacher* which has recently become *The Computing Teacher* and is distributed nationally.

SUMMARY

These are but a few of the projects that have had an effect on the local or state schools, but they are important and we can learn much from them. In every case there was at least one very dedicated individual who gave guidance to the project, there was training of teachers, there was involvement in acquiring of hardware, there was development and dissemination of software, and there was ongoing support for the teacher in the classroom. These are the essential ingredients to encourage teachers to use computers effectively in their classrooms.

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Effectiveness of Technology in the Schools— Public and Taxpayers Response

Catherine E. Morgan
Educational Consultant
Kensington, Maryland

INTRODUCTION

Tradition is defined as "the passing down of elements of a culture from generation to generation" of "a mode of thought or behavior followed by a people continuously from generation to generation" or "a set of such customs viewed as a coherent body of precedents influencing the present." These definitions provide justifications for what is taught and how it is taught. Any field or method which has the aura of tradition needs no justification for inclusion in the school program. As an example of tradition, consider that although metric measurements and decimal notations are almost universally used, we continue to spend an inordinate amount of time on common fractions and English measurements in the elementary schools. These traditional emphases appear to need little or no justification and are, in fact, difficult to drop from the curriculum.

On the other hand, innovation means "something new or different." Where does non-traditional technology fit into the schools? Television and compuers represent innovative instructional subjects and tools which are not accepted readily by educators or the public. Interestingly enough, these two media are of recent vintage but are well accepted as media for entertainment and business. Television has been part of most of our entertainment lives since the late 1940s. Computers have infringed on our business and economic lives since the late 50s and now are making their way into our homes.

However, in education, the use of computers and television requires that it be "sold" to a variety of constituencies. These groups include: (1) the decision-makers— the superintendents, members of Boards of Education, curriculum specialists; (2) the implementors—principals and teachers; (3) the public—parent and non-parent taxpayers; and (4) the clientele—the students.

Uses of Computers in Education

Let's begin by examining where computers are used in education and how they got into the schools.

For Administration

In almost every public school, as well as the college and university, a computer was leased or purchased for business applications, such as payroll and accounting. In that capacity, the computer is firmly entrenched in our educational institutions.

As a Subject of Instruction

A second area is that in which the computer is the actual subject of instruction. Vocational data processing in high schools began in the 1960s and was justified as job preparation. Most of the equipment was called unit record equipment and young men and women learned such skills as key punching and sorting. At the same time, colleges and universities began teaching computer science and their graduates had no difficulty getting employment in a rapidly growing field.

During and since that period of time, certian public schools and particularly certain teachers began to recognize the need for all students to acquire a new literacy—computer literacy. The subject teachers, who were most likely to be interested, were mathematics teachers. Here is where the idea that improved problem solving skills results when students are taught to program the computer. I recall believing this to be a fact and stating it unequivocally at a board of education meeting in 1973. My gut feel still is that it is true but we couldn t prove it and no one else to date has proved it, despite many past and on-going studies. I'm grateful that we no longer need to prove it. Universal computer knowledge is a legitimate goal in itself. School systems should develop policies under which they support computer experience for *all* students. The computer is here to stay; our children will use computers in their work and in their homes. They need to know how to access information from a variety of data bases; how to read documentation and run computer programs; and how to make judgments and decisions about computer uses. Many of our students will need to know how to program a computer. All will need to know how to exploit and control their uses.

Fortunately, technology has changed the economics of acquiring computer equipment for literacy and programming. The microcomputers available for several hundred dollars can be used by many students to learn a programming language and acquire the necessary degree of computer literacy to function in the modern world. The languages are part of the machines and the students write their own programs in the available language to solve problems. Their programs can be stored on inexpensive reusable cassette tapes. If a school system now is doing little or nothing with computers, this area should be its first thrust.

As a Source of Instruction

The most controversial area for the student use of computers is when it is the source of the instruction. Since the early 1960s, educators have been experimenting with the use of the computer as a direct aid to instruction: computer-assisted instruction. In this mode, the computer takes on all or part of the teacher's role. Instructional programs may provide the actual teaching dialogue. The student interacts with the machine in a primitive tutor/student relationship. More commonly, the machine supports the normal classroom instruction by providing drill and practice, remedial instruction or a simulation. This latter mode may be used when a classroom laboratory experience may be too lengthy, too expensive or too dangerous.

Advocates of computer-assisted instruction stress that the need exists to individualize instruction and make student and teacher time more productive. A student who only needs ten practice problems before progressing to a new level will get only ten while a classmate may need 50 or more before attaining the same proficiency. A student who cannot factor a polynomial would not progress to solving quadratic equations which require factoring. Nationally known experts made statements assessing that computer instruction for remediation would go far toward overcoming educational deficiencies and inequalities. Computer equipment and supporting instructional materials were purchased with monies for disadvantaged students. The city of Chicago bought hundreds of computer terminals to be used by deprived students using Title I funds.

Now let's look at the economics of this type of instruction. In the past and, even today with large computers and teleprocessing, the equipment and supports needed for computer-assisted instruction represented add-on cost of $108 per year per student for drill and practice in arithmetic. school system decision-makers were familiar. Justifiably, these people want to know: Does this new type of instruction make a difference in achievement? Is the difference worth the cost? Are we able to do some things that can not be done without computers? Are there any side-effects? Are the machines dehumanizing? All of these legitimate questions need to be answered.

The costs have decreased at a startling rate. For example, in 1974, in Montgomery County, we provided the Board of Education with an add-on cost of $108 per year per student for drill and practive in arithmetic. This $108 figure gave each student one-half hour of CAI per week during the regular school year. A major portion of that cost was for computer and communciations equipment. The $108 figures was predicated on involving approximately 4,000 children in the program.

Today using the same parameters and assuming that the costs of a fairly elaborate microcomputer at $3,000 plus maintenance over a four-year period, the cost of providing the same half-hour per week over a school year would be less than $18 for equipment. The equipment cost would be constant if there were one or 50 computers. Obviously, if a large number of micros were purchased at the same time, the cost would be reduced.

A more important question to ask about computer-assisted instruction is that of effectiveness. Are there differences in achievement when CAI is employed? Many research reports describing the use of drill and practice CAI programs have shown that student achievement increases significantly. Favorable results were shown in Chicago, Illinois, with Title I children, in Los Nietos, California, with Mexican-American students and in Montgomery County Public Schools, Maryland, with mostly middle class students.

Other examples can be cited, such as those reported by the Pennsylvania State University, an early leader in the field of computer-assisted instruction. The two Professors Cartwright developed a series of courses called CARE, which provided classroom teachers with information on how to accommodate blind, deaf and other handicapped children into the regular classroom. At registration, students were placed randomly into the conventional college lecture course or into the CAI laboratory to work at a computer terminal with an individualized program. The content of the course, Introduction to the Education of Exceptional Children, was identical. Only the mode of instruction differed. The course time under conventional methods was 37.5 hours while the mean time for completion of the CAI program was 25.2 hours. The final examination contained 75 items with the conventional class having a mean of 52.78 with a standard deviation of 4.68 while the CAI group had a mean of 65.89 with a standard deviation of 5.89—the difference was significant at the .001 level. These results represent a 24 percent higher mean grade on the final examination and 35 percent less time required for course completion. Similar studies in the military and in industry show significant differences in training time when all trainees are required to meet a standard level of competency.

In the area of special education, the use of the computer has been particularly intriguing. Students in special education, unique in many respects, require remediation and attention unlike that needed by other students. For example, maintenance of skills by mentally retarded high school age students is difficult and an actual increase in achievement is highly unusual. Yet, for selected students, the computer has been a remarkable motivational and teaching tool. In a Montgomery County, Maryland, study 10 mentally retarded adolescents, with an average IQ of 74, participated in a CAI arithmetic program once a week from January to June, 1972, and made an average gain score of 7.6 months in arithmetic achievement with a standard deviation of .4. In spite of their low mean IQ, their gains which ranged from 3 months to 1.7 years, were analyzed as though they were normal.

Currently, computers are being used with deaf, blind, orthopedically handicapped, learning disabled, mentally retarded and emotionally disturbed children. Enhancements for computers include audio, color, graphics, touch panels, light pens and other devices. These special additions to an already motivational tool increase its versatility, both for teaching special student groups and for the presentation of subjects like music, art and foreign languages.

Is the difference worth the cost? This question is a valid one and should be asked of all programs. For example, in the same year that the $108 add-on figures was cited for CAI, the cost of providing diagnostic-prescriptive tutoring for a single child was approximately $500 yearly. No proof existed that this program made any difference but the time-honored tradition of one-to-one tutoring comes down from the Greeks, and as such needs no justification.

A cost/benefit analysis can be made for industry where the less time required for training places the employee into production earlier. If the training normally occurs at another city, travel and per diem expenses are actual cash savings. However, in public education, the cost/benefits of saving student time is not of immediate value to the school system. In fact, it may raise new complications. What happens is 5 students finish Algebra I in March, 8 in April, 10 in May and 4 the following October?

Similar difficulties exist in public education for costing out effectiveness. What does a month's gain in achievement normally cost? If a student makes a half-year grain during a school year, is his education twice as expensive as that of the child who makes a year's growth? The long range effects of poor school achievement are well-known and may cost taxpayers millions of dollars for maintaining people on welfare and in prisons.

Are there some things that cannot be done without a computer? Management of instruction may be one. This type of program provided the classroom teacher with profiles of the students in many skills and concepts and keeps these records up to date. These reports reflect individual and group needs and strengths assisting the teacher with planning. If records were kept in 25 areas of two subjects, mathematics and reading, the teacher would have 1,250 pieces of information on each child! And when a parent wants to know can Johnny add, measure and solve problems, the teacher has information supported by data.

Another area in which schools can provide new services may be when insufficient enrollment in a course causes it to be cancelled. What about Latin IV for two students? Could students in different schools study Statistics at computer terminals three days a week and meet with a teacher once a week to discuss problems and go over difficult assignments? Will, in the future, students work on most skill areas at computer terminals in their own homes and attend schools much less time than currently? Alvin Tofler suggests this possibility in his latest book.

Are the machines dehumanizing? Not in my experience, In fact, students say, "The computer says the same thing to me that it says to everyone else." Students in Montgomery County wrote personal and endearing notes to "Dear Computer." Studies in Los Nietos, California showed that Mexican-American students made significant gains in self-concept after using computer mathematics programs. Children are not only engrossed in their interactive computer work but they are loath to give the terminals up when their turns are over. There is an old English proverb which states that "when kids stand quiet, they have done some harm." Computer kids don't stand quiet.

The computer situation in public schools has changed radically during the past year or two. Prior to 1978, educational technologists in public schools were begging to retain whatever equipment they had in place. Today large numbers of microcomputers are being purchased and installed in schools; many times into situations in which no one in the systems knows what to do with them. Monies from general funds, year-end surpluses and PTA's are being expended and no planning for their use has been made.

Current National Situation

A recent report published by the Task Force on Computer Assisted Learning Subcommittee in the Secondary/Elementary Schools—Association for Computing Machinery (July 1980), stated that they had surveyed 974 school districts and had a 62.3 percent return. The association determined that the response was balanced as to geographic and urban/rural districts. Analysis indicated that 74 percent of the districts used the computer for instruction with projections to 87 percent by 1985, and 54 percent reported usage in the form of computer-assisted instruction with projections to 74 percent by 1985.

Further the report stated that major impediments to increased use were financial, lack of knowledge about computers and their use in instruction, attitudes of faculty and the need for more and better instructional materials.

Recommendations

If your school system is a novice in the computer field or would like to increase its usage but presently has no plan as to how to proceed, I would recommend the following steps:

1. Key school personnel and board members should become knowledgeable about computers and their uses in instruction. This can be accomplished by attending workshops or seminars which are given by national organizations or by planning for in-house presentations.
2. A careful needs assessment should be undertaken. An analysis of what equipment and expertise exists within the district. This

needs assessment should begin to delineate where the district would like to be by 1985. At the same time, an examination of academic areas in which students are having difficulty should be undertaken. The literature in the computer field should be researched to learn if any areas of deficiency can be addressed by computer-assisted instruction.

3. The school system should formulate a policy relating to instructional uses of computers.
4. The school system should designate an instructional leader to develop short and long-range plans for the implementation of the policy. Care should be given to acquisition of equipment, guidelines for selecting or developing instructional materials, staff development needs and the process for implementation.

One goal of each school system should be computer literacy for all graduating students by 1985.

Let's prepare kids to function in an information rich world remembering the words of Elbert Hubbard when he said, "The object of teaching a child is to enable him to get along without a teacher."

The South Carolina Telecommunications System

Thomas L. Stepp
Deputy Manager
South Carolina Educational Television Network
Columbia, South Carolina

INTRODUCTION

I would like to address the topic of technology in schools, not from a broad, superficial point of view, but rather from the point of view of local impact in local schools.

The reason that this perspective is important (from my experience) is that all of the applications of educational technology which exist are completely moot if individual students and teachers in schools and other educational institutions are not motivated to use the product which those of us who are program distributors provide. We can engage in a lot of planning. We can engage in a lot of sophisticated instructional design. We can spend vast sums of money producing highly attractive radio and television courses. We can provide tape recorders in classrooms to improve the smooth integration of our product into overall instructional plans. But if our products do not suit the educational needs of individual students and teachers they are valueless. The grandest scheme for production and distribution is worthless if it is not utilized.

South Carolina System

In South Carolina we transmit signals hundreds of miles. Our national programs travel 22,300 miles to a satellite half-way point, returning to earth over wide geographic terrain. None of that is of any merit if a one-quarter inch, off-on button on a television screen or radio receiver negates the use of our services by the students for whom they are intended. It is impossible to consider technology in schools without considering the impact of an individual program on an individual student in a specific classroom under the supervision of a dedicated teacher in a school system devoted to principles of improving instruction for all of its students.

I don't want to bore you by describing the South Carolina Educational Telecommunications System. I think perhaps many of you know something about what we do. For those of you who do not, let me briefly state that within South Carolina we—the South Carolina ETV Network—operate 10 television transmitting stations, 6 FM radio stations and an extremely complicated closed circuit, statewide network made up of leased cable, ITFS, state-owned microwave, and the physical delivery of tape. In South Carolina, we apply this technology to all of the educational needs of the State. We produce and distribute programs for preschoolers, for the elementary grades, for secondary schools, for college credit (in fact, offering more courses for college credit than any other institution in the world, more than 60 last year), for post-graduate education (including two dynamically unique programs through which a student can achieve a Masters Degree in either Business Administration or Engineering during evening hours from any geographic location in the State). We extend our college credit to home viewers, in an "open university concept." And, of course, we provide the entire array of public television and radio programming for all of South Carolina.

In cooperation with NOAA, we operate the State's comprehensive twenty-four hour weather and emergency weather services. And I an very, very proud of the efforts we make in providing 12 hours per day of special programming for the visually handicapped broadcast on the subcarriers of our FM radio stations.

Impact

Many times, when discussing my trade in public, I speak from three major points of reference and they generally deal with, first, the impact of electronic telecommunciations on the lives of each of us. The second point is the information explosion and the usefulness of telecommunications delivery in meeting the demands for increased educational opportunities and needs. And, third, both at home and out of the state, I like to talk about the economy of telecommunications as an important and significant new means of providing educational opportunity to all citizens no matter how remote they might be in socioeconomic status or geography from the traditional centers of learning.

I think that you will probably join me in understanding the now traditional concept that the application of man's most powerful communications tool—television—to our daily lives has changed the way we live. My late friend and colleague, Marshall McLuhan, was the proponent of "probes" dating from the early '50s about the flow of electronic communications into our daily lives and the resultant impact on us. We're like fish who are not aware of the water in which they live, in that we live in an electronic ecology and are not always, I think, aware of the impact of that ecology on us day by day. Parents often tell me they are startled to learn that, according to recent Nelson data, children under five watch television 23½ hours a week. I don't know why they're surprised. The same data reflects that they watch television 44 hours a week.

Arthur Clark, creator of 2001 said, "The single greatest industry of the future is going to be education. For every person, education will have to continue throughout life. That will be essential in a world where half the things a man knows at 40 hadn't even been discovered when he was 20; and half the things he knows at 20 are no longer true by the time he is 40." Ninety percent of the scientists who have ever lived are alive today.

Our task in educational communications is to try to make just coping with the information explosion even possible.

Teleconferencing

To put our efforts in perspective, I would like to make a few points about the impact of the South Carolina System in areas other than the public schools before turning directly to the specifics that you have asked me to present today. A major and most exciting development in our operation is that we have moved actively into a significant degree of statewide teleconferencing. We are pioneering in this area, which is going to become increasingly important as state agencies are forced by the pressures of inflation to become more cost conscious. Teleconferencing is a way for groups to meet and receive essential training without expensive travel to a central location. The very best experts on any subject can be brought in to provide information and to conduct meetings. Their audience can be at any of South Carolina's technical education centers, University of South Carolina regional campuses, health care centers, hospitals and many high scholls. Through teleconferences, state agencies have been conducting training, making surveys and meeting other management communciations needs. Viewers in the field talk to experts at the ETV Center in Columbia by way of telephone talkback circuits.

Economics

The State of South Carolina saves per diem, mileage, lodging costs, training costs, lost time from the job, and wear and tear on vehicles by meeting through teleconferences. ETV saves money for the State by moving information to people—electronically—rather than by transporting people—at great cost—to the traditional information centers. This is a major basis of justification of our System to policy makers and decision makers. I do not mean just teleconferencing; I mean the presentation of the advantages of economy and efficiency of telecommunications services. When a comprehensive telecommunciations center exists, the economics of scale of its operation are the most dynamic and forceful reasons by which to explain its importance. It is certainly a mainstay of how we justify our institution to the State of South Carolina.

Now, quickly, I must insert that, yes, it is most important that we speak to the quality of product which we deliver and to the quality of educational opportunities that we provide to students of all ages, in all areas of education.

However, in these harsh economic times it is crucial that we also justify ourselves on the scale of economic efficiency. And that is what we do.

Take teleconferencing, for example. In the last three years ETV has conducted 319 teleconferences for our fellow state agencies, providing specialized training for 74,000 people. The use of our closed circuit network for teleconferences during that period of time has provided services that could have cost the State eight to nine million dollars by traditional methods. That figure is equal to the total three-year leasing cost for the entire closed circuit system, with only a small percentage of the time of the closed circuit being required for the teleconferencing activities which achieve these savings. The remainder of the time is available for, and heavily used for, in-school instruction, higher education, medical education, and many other services.

Let me give you just one specific example of the economic impact of teleconferencing. Prior to each general election the State of South Carolina has some 8,000 poll workers who must undergo mandatory training by the State Election Commission. Prior to the last three elections, these 8,000 workers have received their two days of training through ETV at a savings to the State and to the individuals involved (who are volunteers) in lost time from the job, mileage, lodging per diem and instructor costs of over $1,300,000 per statewide election. That is a total savings of nearly $4 million during a six-year period.

That is language that legislative leaders, school boards, college trustees, governors and citizens understand.

There is no longer any question that it is much more economical to take education to people than to take people to education. Marshall McLuhan, to whom I referred earlier, once said that ". . . when two seemingly disparate situations are placed in opposition, often startling results occur." So it is with the energy crisis and increased telecommunications capacity.

A central argument for the existence of the South Carolina Educational Telecommunications System follows an economic theme. In 1961, shortly after we began serving schools in South Carolina, we taught 3,300 students at a cost per student of $194.85. By 1979, we were serving 1,691,669 course enrollees at a cost of $5.83 per course delivered to a student. Let me repeat the dollar numbers: 1961—$195, 1979—$5.83.

Let's look at that in a slightly different way. Ten years ago the delivery of a television course to a school in South Carolina cost roughtly $10 per course per student. In those ten years, the cost of that delivery of television instruction has dropped to $5.83, a drop of 47.3 percent. At the same time, the average cost of a school textbook in South Carolina increased approximately 300 percent. A $2.59 textbook in 1975 now costs $7.38.

Justify telecommunciations education? Why not use a dollars and cents approach? The entire South Carolina Educational Telecommunications System, which has one out of every seven South Carolinians enrolled in at least one of the 346 courses of instruction offered through our system, costs only 1.2 percent of the State's education budget. And that is the cost of the entire delivery system and programs for public television and radio viewers and listeners, programs for children in school, programs for college credit, for continuing professional education, for technical education, for doctors, lawyers, nurses, the visually handicapped and others.

Scope

For 1.2 percent of the South Carolina education budget, we deliver 176 television lessons in a typical school day. Yes, on our multi-channel system that amounts to over 80 hours per day of instructional television delivery. And, don't forget radio in addition.

Thus, I have no trouble in looking toward the future to predict that telecommunications will play an increasingly major role in education—particularly as adapted, specialized and particularized for local educational needs. Telecommunications improves the quality of instruction. It imparts knowledge skillfully and permits one to learn wherever he is in the educational process. And it permits him to learn equally with others no matter where he is in a geographic sense. Educational telecommunications is like a beam of light. It provides illumination to help us cut through the fog of change that could otherwise obscure the world ahead. Telecommunications allows us to more quickly and ably move from one point to another as we strive to generate creative worth from our intellectual enterprise. Communications technology is an integral part of the process transforming our lives and shaping our destiny.

But in a more overriding sense, it is economics which will compel the use of telecommunciations in education. Our system in South Carolina has shown this clearly. There are many other justifications. But rather than look around for means to justify our existence, I am proud of the fact that, in South Carolina, we have taken a strong stand on the usefulness of television and radio in education and have proceeded to put those dynamic tools to work. In putting them to work we have found that one service stacks naturally on top of another service and additional services compound the efficiency of delivery geometrically. Herein lie vast economies of scale which make use of the system compelling.

Significant Enrollment

No user has to use any program which we provide. Therefore, the statistics concerning the enrollment in our courses are very significant to us in that enrollment is voluntary and engaged in solely at the discretion of the user. Increases in in-school utilization alone are indicative of a great deal of success in what we have accomplished. Innovations in providing new services are equally impressive and, indeed, have begun to become part of our basic justification of the System.

I think we need to be careful, however, that we do not let the need to justify the system control its purpose, direction, or the motivations for its use. The South Carolina System was created to enhance the educational opportunities for every citizen in the State. We are beginning, after 22 years of hard effort, to work our way toward doing that. The capacity required for delivery of our services was virtually unpredictable. Each new service generates another. The number of users we serve is startling, compared to two decades ago.

SUMMARY

Serving these people is the reason we are in existence. Edward R. Murrow once said that "The trouble with television is that it is like a sword rusting in the scabbard during a battle for survival." Frequently, however, I confess that the more pragmatic way to explain the impact of what we do must include both economics as well as philosophy and educational accomplishment.

In South Carolina I sincerely believe that with the support of teachers, superintendents, State education officials, boards of education, colleges, universities, legislatures and governors, we have—through the years—proved that there is a major place and a major role for a significant educational broadcasting system to impact on the educational progress of an entire state.

Higher Education Uses of TV and Radio

Peter J. Dirr
Corporation For Public Broadcasting
Washington, D.C.

INTRODUCTION

For years, colleges and universities have used television and radio for instruction but until recently we had little systematic data on the nature or extent of those uses. Since 1978, the Corporation for Public Broadcasting has been working with the National Center for Education Statistics (NCES) and the national higher education associations to document the extent of use and to explore factors which were thought to affect use.

The information which I will discuss is drawn from two studies conducted by the Corporation in conjunction with NCES and the following education associations: American Association of Community and Junior Colleges, American Association of State Colleges and Universities, Association of American Colleges, Association of American Universities, National Association of State Universities and Land Grant Colleges, National Institute of Independent Colleges and Universities. The information was gathered in two phases: the first, conducted in 1979, was a universe study of all 3,000 colleges and universities in the country but looked only at television and involved only one administrator at each institution; the second, conducted in 1980, included radio/audio as well as television and involved a sample of 120 institutions, 960 faculty members, and 1,920 students. Together, these two studies provide a wealth of information about current uses of television and radio as well as a wide variety of opinion about the factors that most affect those uses.

Institutional Level

More than 70 percent of all institutions of higher education (IHEs) make some use of television: 10 percent use it only for non-instructional purposes such as promotion/recruitment or staff development; 61 percent use it for instruction, including 25 percent which offer courses over television and 36 percent which use it to supplement existing courses.

Looking only at the instructional uses, the greatest portion of the effort is spent for on-campus credit offerings (66 percent), followed by off-campus credit offerings (17 percent), then on-campus non-credit offerings (12 percent). So, while many contend that television is a way to reach students who cannot get to campus, we find that 78 percent of the instructional television effort at colleges is devoted to on-campus uses of the medium.

Tracking the exact number of students enrolled in courses using television is complicated by problems of definition and unavailability of adequate data. However, from the data we have obtained, we are confident in estimating that in 1979, about ½ million students were enrolled in more than 6,000 courses offered over television. While some colleges and universities make extensive instructional use of television, the most common experience is for a college to offer one course per year over television and to enroll 20 students in that course.

Technology for delivering television programming seems to fall into four categories by the extent wo which they are used: more than 90 percent of the institutions reported using self-contained video tape units; approximately 75 percent reported using public and commercial television stations; about 50 percent reported cable and closed circuit systems; and 10 percent reported using satellite distribution and Instructional Television Fixed Service (ITFS).

More than one in four IHEs (28 percent) is a member of a formal consortium offering or producing televised courses. Another 17 percent are members of informal consortia. The services most often provided by the formal consortia include: program previews (77 percent), program exchanges (74 percent), and group buys and/or acquisition of program rights (63 percent). Three out of four members of formal consortia expressed satisfaction with the services provided by the consortia and 86 percent planned to remain members of those consortia for at least the next three years.

The television equipment resources of colleges and universities vary greatly: 94 percent of those that use television have TV cameras but only 58 percent have control rooms or studio facilities. (This seems to indicate that mobile production is more prevalent than fixed studio equipment.) 74 percent of TV users produce their own programs. About half have closed circuit or master antenna systems. Color and black-and-white TV sets are about equally available.

Institutional expenditures for television seems to be increasing or level but not decreasing: funds for equipment and staff have increased over the past 3 years (in 55 percent of the cases) or remained the same (30 percent) and will continue to grow (45 percent) or remain the same (35 percent) over the next 3 years. Projected increases are greater for equipment than for staff.

These studies have identified the major barriers to the use of television for instruction at IHEs as the following:

• Lack of institutional funds and support	70%
• Lack of faculty commitment	55
• Cost and availability of courses	50
• Lack of trained support personnel	45
• Lack of record rights	40
• Poor broadcast times	35
• Insufficient advance notice	30

Data on the use of radio are just beginning to be available. Those data indicate that 53 percent of all IHEs used radio/audio for instructional purposes in 1979. Those colleges and universities offered a total of almost 10,000 courses involving substantial use of radio/audio and enrolled almost ½ million students in those courses.

Eighty-four percent of IHEs which used radio/audio for instruction had on-campus production facilities. Seventy-six percent used available facilities to produce original programming for instruction.

The barriers to the use of radio/audio for instruction are exactly the same as those for television—lack of institutional funds and support, lack of faculty commitment, cost and availability of courses, lack of trained support personnel, lack of record rights, poor broadcast times and insufficient notice. These findings, as well as the use patterns, suggest that radio/audio's use is more like than unlike television's use.

Faculty Level

More than half of all faculty members reported using television for educational purposes either in 1979 (43 percent) or prior to the 1978-79 academic year (22 percent). Those who had used the medium for educational purposes averaged 6 years of use. Most reported having videotape playback units available (85 percent), as well as TV cameras (84 percent), TV receivers (73 percent with color receivers and 71 percent with black-and-white receivers), and control room and studio facilities (62 percent). Most reported using videotape playback units (82 percent) and TV receivers (58 percent color and 48 percent black-and-white).

The delivery system most often used by faculty were: self-contained videotape playback units (73 percent), public television stations (57 percent), commercial television stations (37 percent) and campus closed circuit systems (33 percent).

Funds for the acquisition of television equipment are more likely to come from non-departmental accounts whereas funds for the acquisition of instructional programs is likely to come from departmental accounts.

Eight-five percent of faculty members who used television for educational purposes reported that production facilities were available for their use. Fifty-six percent reported having participated in a production at their institutions.

Twenty-nine percent of those using television for educational purposes had had formal training for such use. Fifty-seven percent reported that they had taken a college course in which television played a substantial role. When those faculty members used television in their own courses, the dominant production modes were lecture/monologue and demonstration techniques.

Even in courses where television was reported to have played a substantial role, only 12 percent of the course hours were televised.

Faculty members reported the following factors as major hindrances to their use of television for instruction:

- Lack of adequate departmental funds 56%
- Programs do not meet academic needs and/or standards 49
- Cost of available courses 39
- Poor broadcast times 35
- Insufficient advance notice 34

It was the opinion of many faculty member respondents, the use of television for educational purposes is not readily accepted by the profession or the institution. They view their course framework as unadaptable to television, maintain that the use of television adds to their work, and feel that the institutional and professional reward structures do not recognize efforts spent in developing and using television course materials. Interestingly, faculty members see none of their major barriers coming from the students.

More than one out of four faculty members (28 percent) reported that they used or assigned radio/audio for educational purposes in 1979; 7 percent of all faculty members reported that they used radio/audio in an average of 2 courses each, enrolling an average of 27 students in each course.

Ninety-two percent of all faculty members reported that radio/audio production facilities were available to them.

The barriers to the use of radio/audio for instruction are exactly the same as those for television: lack of departmental funds, unsuitability of available courses, cost of available courses, poor broadcast times, and insufficient advance notice.

Student Level

Almost all students have used or expect to use television for educational purposes during their college careers; 47 percent, or 5.5 million students used TV as part of their college programs in 1979; another 3.5 million had used TV prior to 1979 and 3.5 million expected to use it within the next three years.

Slightly more than one in four students (28 perent) who used television in 1979 used college-owned equipment, especially videocassette playback units (88 percent) and color TV sets (44 percent) and black-and-white TV sets (39 percent). Most of the use was in traditional college classrooms (70 percent) as opposed to non-college housing (29 percent).

Most students who used television in 1979 reported that such use was voluntary (63 percent), did not constitute a substantial portion of the course (76 percent), and that the courses which used television cost the same as courses which did not (82 percent).

The major barriers to the use of television for instruction as reported by the students were:

• Poor broadcast times	33%
• Inadequate equipment	26
• Insufficient advance notice	23
• Inadequate courses	20

Students did not view the use of television in courses as too burdensome, depersonalizing, or an easy way to get credit. Neither did they see courses with television as being particularly more relevant and informative than other courses. In general, they viewed courses with television as worthwhile and appropriate for their areas of study.

More than one out of three students (35 percent) reported that they had used radio/audio for some of their courses in 1979; 13 percent of all students reported that radio/audio was used for a substantial portion of one or more of their courses.

The major barriers to the use of radio/audio reported by the student respondents were:

• Lack of appropriate radio/audio courses	41%
• Inadequate courses available	20
• Poor radio/audio reception	16
• Poor broadcast times	15
• Insufficient advance notice	14

In all other opinions about the suitability of radio/audio for college instruction, the student responses closely paralleled their opinions on television's suitability.

SUMMARY

These data and the limited analyses already performed on them begin to provide use with an appreciation for the roles of television and radio/audio in college and university instruction. Analyses will continue and the implications of these findings will be carefully examined over the next 12 months. For instance, we already know that differences exist in the ways in which different types of colleges use television for instruction. Further analyses might disclose some of the reasons for those differences. At least they should help to further describe the nature and magnitude of the differences.

Making the Case for Changing Public Policy

Norman E. Watson
Coast Community Colleges
Costa Mesa, California

INTRODUCTION

The community college today, as an institution, is entering a period of extremely rapid and sudden change. During the decade of the 70's, the community college was an institution in *transition*. It was learning to become a "mature" institution, one which had experienced significant growth in numbers, in facilities, and in students served. During the decade of the 80's, the community college will be an institution in *transformation*, moving from the traditionally accepted goals of its early years to a heightened and expanded mission to provide lifelong education.

Some of the critical problems that will face community colleges as they move into a new era will be public policy, state laws, and administrative regulations. In times of rapid change, the old rules and social arrangements can become rigid barriers standing in the way of adaptations and modifications to new environmental conditions.

Technological developments in delivery systems that are taking place today have immense potential for the community colleges in connection with their ability to fulfill the mission of lifelong education. Already, hundreds of community colleges throughout the United States are utilizing broadcasting to offer additional opportunities for learning to the adults they serve. An increasing number are using cable to make learning opportunities more available. And, as the technology develops, tape cassettes, discs, teletext, the satellite, and the computer will see greater use.

In order to fully utilize much of the new technology, traditional ways of dealing with personnel, with reporting procedures, and with funding mechanisms will require close study and scrutiny in order to ascertain the extent to which they assist or obstruct an institution's ability to meet new needs.

Without entering into a long and dusty discourse on the origin and historical development of the community colleges in California, I would like to select by means of chronological timelines, a few examples of legislation, policy, and administrative difficulties which have had to be addressed in allowing institutions to change with the times.

Public Education Regulations

To begin, community colleges in California evolved from the public school, or K-12 segments of education. They started, in fact, as a 13th and 14th grade appendage to the K-12 segment and for many years were tied administratively, legally, and by funding mechanisms to that segment of public education. With such a heritage, many of the regulations that the community college was required to enforce were regulations that were developed over a period of time as appropriate for the K-12 segment but that had little relevance or worth for community colleges.

One such definition which existed in administrative regulations was the definition of "immediate supervision." For attendance accounting purposes, "immediate supervision" was defined as having a certificated instructor physically present with students when learning was taking place. Only those hours of attendance where "immediate supervision" could be certified were eligible for state support. Such a regulation, obviously, was admirably suited to keeping unruly adolescent boys and girls under reasonable control in a standard size box-like classroom, but had serious deficiencies when it came to the use of learning centers, tutorial labs, television, etc.

The first movement away from the strict construction of the term "immediate supervision" was spearheaded by vocational educators in allowing cooperative work experience to be funded by state allocations.

Including Technology

Riding on the coattails of the success of the vocational educators which had necessitated both changes in state law as well as administrative regulations, a number of us in the community colleges set out to broaden further the meaning of "immediate supervision" by permitting the use of modern technology. A task force was formed, a research committee was put in motion, and an advisory committee was activated——all in an attempt to open the door a crack for modern technology. This activity, years of research and study, resulted in a report, signed off by the California Junior College Association, which became a position paper to support legislation modifying one provision of Education Code Section 11251. We created a new term called "Coordinated Instruction Systems" to describe the process being advocated. The paper's purpose was to call attention to the critical need for development of new coordinated instruction systems which combine classroom lecture with modern technology to improve the effectiveness and efficiency of instructional programs in community colleges; and to identify a problem area in the

California Education Code which serves as a deterrent to progress toward that goal."

The paper went on to point out that 'coordinated instruction systems, combining the resources of modern technology with traditional procedures, increase the effectiveness and efficiency of community college instruction. Television instruction, computer-assisted instruction, automated slide-sound tapes, single-concept film loops, and other technical resources serve to strengthen the teaching process."

Ever aware of the watchful eyes of the professional teachers' groups, the paper painstakingly pointed out that "the role of the community college instructor is expanded with coordinated instruction systems to encompass more instructional development, learning management, and evaluation of student progress. Instruction is more flexible with greater opportunity for student success. Educational progress and competency of students are coordinated and evaluated by professional community college instructors." The paper documented research on the effectiveness of such instruction, pointed out that there would be no increase in cost, and concluded that "legislation is needed to provide the same Average Daily Attendance (ADA) apportionment for students earning credit through community college coordinated instruction systems techniques as though traditional programs limited to classroom lecture techniques.

The paper was comprehensive in the coverage of the problems that existing legislation posed, and the necessity for modification of code requirements."Development of adequate coordinated instruction systems in California community colleges will not occur until changes are made in the procedure of ADA apportionment for students enrolled in these kinds of classes. Programs must have an adequate base of financial support within the school budget if they are to exist."

Legislation

Next came the immense task of mobilizing the support of the many diverse educational and professional organizations for the new legislation, finding an author for the bill, presenting testimony at various hearings, and making necessary changes in the legislation in order to obtain the support needed for its passage.

Years of effort, and many work hours of input later, the two following miniscule changes made it possible for the community colleges to move into the Twentieth Century. I will remid you that this occurred as recently as 1970.

1. "One student contact hour is to be counted for each unit of Coordinated Instruction Systems credit in which a community college student is enrolled during any census period."

2. "For purposes of community college Coordinated Instruction System, 'immediate supervision' of instruction should be defined as student participation in approved Coordinated Instruction Systems programs of instruction using such modern technology as television,

computer-assisted instruction, automated slide-tape systems. and programmed learning materials under the coordination and evaluation of certified college instruction."

All was well thus far. However, it then became necessary, in order to protect the new legislation from abuses, to develop a long list of caveats and guarantees which were to be elaborated in Title V, Administrative Regulations. These, in themselves, barely escaped throttling the new code provision with rigid requirements which colleges were compelled to meet. Rather than treating Coordinated Instruction Systems on the same level as lecture courses, the regulations required such things as: prior state approval course by course, a proof of credentialed supervision, a rigid interpretation as to what could be considered as current costs, a restrictive limitation on the amount of state support (only 50 percent of current cost), the elimination of any capital expenditure, and the requirement of detailed evaluation reports to the state for each course offered at the close of each semester.

Is it any wonder, then, that television instruction was extremely slow in taking off in California, even after the new legislation allowed it to be offered in the early 70's. For many districts, and for many administrators, the added paper work and bureaucratic requirements were just too much, added to the already heavy burden of acquiring hardware and software, and of attempting to fend off the attacks of a considerable body of professionals.

But the door was ajar, ever so slightly, and with great effort.

Modification of Regulations

The next hurdle that had to be overcome was the interpretation by the state office that a specified number of hours of television broadcast material would have to equate with each unit of credit offered. Such an interpretation, of course, overlooked all elements of the coordinated instructional system except those which actually went over the air, and did not address, in any fashion at all, the rigor of the materials or the learning objectives, At this stage of the game, the state office was willing to "buy" fifteen one-half hour television programs for one hour of credit, but no less that that, accepting the principle that there was a certain amount of compression in television courses, and that other learning activities took place in some fashion.

The modification of that regulation set the stage for an entire reexamination of Coordinated Instructional Systems. A task force ws set up by the state office in 1976. With the goal that "The Board of Governors shall encourage the development of instructional technologies, varied learning modes, and resources to more adequately meet the diversity of student characteristics and learning styles," the task force was charged with identifying problems, recommending revisions in statutes and/or regulations, and developng a prospectus report.

The task force considered whether the definition should be broadened to include other instructional methodologies than hardware and software whether developmental costs should be reimbursed, whether the 50 percent cost factor should be eliminated, and whether only current costs should be reimbursed.

As a result of the report of the task force, the definition broadened. As a matter of fact, Coordinated Instruction System, with all its good points and bad points, was eliminated from statutes and replaced with a new piece of legislation entitled "independent study."

With the amendment of the law in 1978 setting up "independent study," it was necessary to formulate and adopt a new set of Title 5 regulations for its administration. Once again the battle heated up between those who were attempting to move community colleges into an innovative and changing direction, and those who would hope to prevent the community colleges from doing anything that was not traditional.

The following proposals were made to the Board of Governors as needing to be included in the new regulations:

1. State apportionment would be based on passing grades at the end of the term—a completely different standard from that imposed on any other type of instruction!

2. The number of students assigned to any one instructor should not exceed ten percent more than the average number of students per instructor at the college unless exempted by waiver from the State Chancellor.

3. The number of independent study courses at a college shall not exceed ten percent of the credit courses certified for transfer unless exempted by waiver from the State Chancellor.

Obviously, the adoption of such regulations, in the face of the fact that television courses were accepted for transfer by all state and private colleges in California for full credit, would have been a giant step backward.

Then followed the long series of hearings, the testimony, the written arguments, the counter proposals at the state level in an attempt to prevent the loss of all the ground that had been gained since the original legislation in 1970.

A new task force was formed and issued the following statement:

> "In general, these regulations would discourage the offering of independent study, specifically CIS courses, in community colleges. They assume that students all learn the same way, in a classroom with a lecture and texts. They would freeze community colleges into one form of instruction and an "average faculty-student ratio. But, in a time of financial limitations, there is a need to encourage flexibility and innovation as well as continue the standards of quality instruction which have distinguished community colleges in this state up to now.
>
> Under the proposed regulation community colleges will, for all practical purposes, find it impossible to continue to offer alternative

> modes of education. The nontraditional student, many of whom are unable to attend a regular academic program, will not be able to earn academic credit. This means that a direct and foreseeable result of the regulation will be discrimination against the nontraditional and often disadvantage student including homebound, seniors, and handicapped student. It is ironic and unfortunate that the Board of Governors would consider cutting back on such programs at the very time that society has recognized the need for such programs."

The Education Policy Committee of the Board of Governors, in turn, requested that proposed regulations be "tightened up" to reduce the potential for abuse and/or misunderstanding. The staff was also requested to put a ceiling on the student-teacher ratio for independent study courses, although no ceiling exists for any other type of course.

The new regulations were adopted, with some softening of the language. The college must certify to a number of requirements with regard to independent study courses. The restrictions on the number of students in the course and the number of courses which may be offered remain in the regulations and we have been forced to request a waiver, as permitted by the regulations, from the State Chancellor.

Conclusions

What conclusions can we draw from the California case studies beyond the obvious one that "it ain't easy to get from here to there"? We can probably come up with three rather important conclusions:

1. Our laws and regulations are beset by countless archaic provisions which now thwart and will continue to impede progress toward meeting new environmental demands.

2. Public policy can be changed and must continue to be modified if the community colleges are to continue to be the innovative, flexible institutions of postsecondary education.

3. External vigilance is essential in order that simple-minded solutions to complex questions do not become part and parcel of our bureacratic inheritance.

Our community colleges, in our fifty states, function in highly differentiated environments. Although we share many common goals and are influenced by broad and pervasive changes in society and by developments in technology, we exist in different structures with varying legislative frameworks. It is essential that we exercise our influence, to the strongest extent possible, in interpreting the *transformation* which must take place in the community college during the coming decades. Local boards, state boards, accrediting commissions, state commissions on higher education, departments of finance, and state legislators must be brought to see what it is the community colleges are attempting to achieve and what must be done in order that they can fulfill their function. In this connection, the Coast Community Colleges are currently attempting, through membership on the Telecommunications Advisory Committee and the California Postsecondary Education Commission, to influence the direction of future public policy. Included as a special category of society's on-going needs for education identified by the Commission are the needs of significant portions of the populations that have special problems or barriers. These include the imprisoned, the physically handicapped, the homebound with dependents, displaced homemakers, and mid-career people pressed to change careers. The Commission states, "Providing reasonable access to education for these groups of adults must be seen as another dimension of public—i.e. societal—needs." California possesses vast resources in the area of telecommunnications to meet the changing societal needs of the state. The community colleges are equipped by inclination and experience to coordinate such activities. It is vital that we give close and continuing attention to evolving public policy.

Faculty Response to the Use of Technology

Dallas K. Beal
President, State University College
Fredonia, New York

INTRODUCTION

I will begin this paper with a qualification that requires expression, one which is a re-statement of the obvious—it is as impossible to reference "a" faculty response to the use of technology as it is to characterize "a" faculty on almost any matter or issue you may care to mention. For example, on my own faculty, a recently retired political science professor reliably cast a single opposing vote on any occasion where unanimity prevailed on the principle of retaining the "purity" of a persistent minority viewpoint as a benchmark characteristic of true faculty loyalty to the academy.

Of course, there *are* faculty responses to the use of technology for instructional purposes as you might well expect; clearly, the literature on the subject documents a range of views not unlike the response to the use of anything else except perhaps the book, or the library. But keep in mind—Lineberry is quoted in Willett's Modernizing the *Little Red School House* as saying, "the antitechnologists of antiquity were convinced that even the book, by downgrading memory, could produce only a race of imbeciles."

The safer and more creditable reference to make about faculty response is that it is best seen by the current instructional methodologies they employ. Our planners should be pleased to know that the evidence in surveys and studies by Stern, Evans, Kozma, Cogan and others clearly warrants the convening of a National Conference on Technology and Education. But for a pitifully few college and university exceptions, the collegiate response to technology fits the discomforting view expressed by C.P. Snow almost twenty years ago (Evans):

> "In a society like ours, academic patterns change more slowly than any others. In my lifetime, in England, they have crystallized rather than loosened. I used to think that it would be about as hard to change say,

the Oxford and Cambridge scholarship examinations as to conduct a major revolution. I now believe that I was over optimistic."

My own belief is that progress is being made—however slowly— and there is reason to believe that the pace of progress will accelerate in the years ahead if the academy wills that it be given high priority.

I would like to touch upon a few of the available research studies which deal with faculty response to innovation; the technology currently available to colleges and universities in the public sector; a set of assumptions which to me set in place the principal guideposts for charting the course of progress; and, I shall conclude with a brief description of a major proposal to spur progress jointly sponsored by AASCU and NASULGC.

Selected Studies

Although the study is along in years (1967), the comprehensive study by Evans and Lippman reported in their book, *Resistance to Innovation in Higher Education* is classic and is really quite relevant and topical. The authors examined an academic community's response to Instructional Television—using a number of variables—and obtained data on the general beliefs and the personality orientation of the faculty of nine colleges and universities which they visited. Among their observations and findings are the following which are pertinent to our discussion at this conference:

To put our work in perspective we are reminded:

"As early as 1965, the textbook committee of a state legislature holding hearings on high school biology texts was confronted by an impressive group of literate citizens who bitterly opposed the teaching of evolution in the public schools. When we consider furthermore, that in our own research case history—one of the respondents, a college professor, remarked that television is the 'invention of the devil,' we might indeed predict that Copernicus would have had a hard time introducing some innovations to our generation as he did in his own time." (Evans)

Evans and Lippman go on the declare, and in my view, quite accurately,

"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."

Indeed, beyond being no surprise to the student of higher education, there is in this resistance to change a needed sense of dependability which society in general must feel and appreciate and which is referred to by the authors when they state:

"Educational institutions would be derelict in their obligation to society if they were totally responsive to fads and fashions of the surrounding community."

What was learned about faculty response to the use of technology? Evans and Lippman report:

"There is little empirical evidence to support the assumption that faculty and administrators—even though they carry the responsibility of imparting both old and new knowledge and are viewed as experts in evaluating new developments—will choose methodological innovations which seem to provide the greatest potential for learning."

They go on to say:

"It is undoubtedly clear by now that the present study proceeded from the assumption that the attitudes which most of our faculty members held toward ITV did not exist in isolation but were often inter-connected in varying degrees with other attitudes, such as those toward teaching machines and teaching methods versus content. They were even inter-connected with the respondent's attitude toward himself and his general philosophy of life."

In the above connection and further from the analysis of attitudes and beliefs of professors it is reported that:

"Forty percent of the professors believed that knowledge of content is a sufficient prerequisite for university teaching, thirty-five percent felt that method is of some importance, and only ten percent felt they were of equal importance." (Evans)

And a very significant and humbling clue to any of us who dares believe he or she is destined to be a significant agent of instructional change, is the discovery that:

"In effect professors were saying, 'The machine cannot provide those ingredients which I, myself, can provide. I am personal and provide discussion; I motivate students, and I am creative.' Therefore:

"The college professor sees himself in the traditional role of standing before a class, delivering a lecture on which his students take notes—notes he expects them to commit to memory, supplemented by readings in their textbooks and some additional work in the library."

Even the more negative responses in this study (Evans) take on at times humorous incongruities such as:

"ITV is a fine instructional medium and should be encouraged for all to improve instruction, but not for *my* subject area," and

"ITV is the best means of teaching in the long run, but *I* would leave college teaching if *I* had to use it."

However, it is interesting to note that there also surfaces in the survey literature, professional types who *are* pro-IV and they can be described and I presume identified on our faculties.

The study by Evans pictures them as being "more adventuresome, flexible, and mobile in thinking and teaching... who see the university as a *social* as well as *academic* community... more free to experiment with new methods and techniques."

And although such categorical typing may be useful early in the development of strategy for innovation and implementation, it is important to keep in mind that:

"Although we have given evidence to show that some professors have consistent attitudes toward innovation in general, we think it quite likely that other professors are very selective about the kind of innovation they are willing to accept." (Evans)

The research findings do not altogether present a bleak picture about the current readiness of faculty to climb aboard technological vehicles which may hold promise for the improvement in and the satisfaction faculty seek to gain from teaching. What seems clear is the evidence that approaches to faculty have not been well designed, showed a lack of concern for readiness, and have too frequently not given sufficient attention to the importance of self-motivation toward tangible rewards provided by the "system." For example:

"To utilize ITV many professors seemed to think that much training, equipment and general re-evaluation of teaching goals and activities would be required . . . evidence seemed to indicate that if a complex innovation can be broken down into palatable bits—at least partial acceptance will be more rapidly affected." And, further:

" . . . evidence suggests that the degree of acceptance of an innovation by professors may partly depend on whether they viewed the innovation as being instituted by the university administration or . . . within their own academic departments as a result of their own planning."

" . . . evidence suggests also a reversion effect occurs most often where reinforcers are not programmed beyond certain minimum limits—reinforcers include salary increments, promotions, and overt administrative approval" and it is:

" . . . highly plausible that an individual's position in the university (rank—job security) bears some relation to receptivity to innovation." (Evans)

A point so often overlooked in the context of effecting change is mentioned by Cogan:

"*Any* plan that seeks to rationalize the process of innovation in our schools will perforce be slowed down by the imperative necessity to train the men and women who will be centrally involved. And that delay will be a blessing if it serves to educate us to understand that the phases of education are long, longer than the phases of a fad, style and local and national politics."

Telling it more stridently, Stern and Keislar in reporting their survey of five thousand references on teacher attitudes conclude:

"The success of any broad-based educational innovation is not simply a result of whether the proper procedures have been technically carried out; rather, if innovation is imposed authoritatively on the teacher, with no attempt to understand and enlist support, it will not succeed."

The above surveyors suggest six categories of guidelines for consideration in the development of a strategy for innovation:

1. Accepting environment—largely an administrative responsibility.
2. Assurance of personal involvement.
3. Acceptance of personal responsibility.
4. Role models.
5. Incentives for change.
6. Preparation.

A more recent experiment dealing with *Faculty Development and the Adoption and Diffusion of Classroom Innovations* by Kozma and funded by FIPSE is reported in the Journal of Higher Education.

In a faculty fellowship project at the University of Michigan the findings showed that the incentive of fellowship grants increased significantly the fellows use of innovations as compared to a random sample. In this same study, the evidence also indicated that those holding fellowships had relatively little success in influencing fellow faculty members to adopt instructional innovations as a result of discussions.

I suppose any examination of research findings should end on a note of caution and in this instance, a bit more pithy than the typical dissertation conclusion which concludes the need for more study.

Willett, Swanson and Nelson say in *Modernizing the Little Red School House* bring into view a rather fascinating comparison between the *feasibility* and the *logic* of change as it applies to the introduction of educational hardware.

"The *feasibility* of change to man-machine systems of education is clearly seen in the dollar savings . . . the *logic* for change is another matter . . . the educational establishment represents an intrenced moving to man-machine systems of education will receive quick moving to man-machine systems of education will receive quick acceptance should be viewed with reservations."

Availability of Technology

Until recently those of us concerned with expanding the use of instructional technology in the public sector of higher education had available as evidence of its availability only isolated reports of commitments by campuses across the country.

In the late 70's, AASCU and NASULGC conducted the first national survey of existing technology available to the faculties in over four hundred member colleges and universities. The results of this survey may be known to some of you; however, its highlights should serve an important documentary purpose of this conference.

The survey covered three major areas: availability and description of present communications technology facilities, the instructional use served by this technology, and the plans for expansion. Responses to the national survey indicate that member institutions of both associations exhibit a strong commitment to the use of communications technology in their educational programs. Many institutions in the study operate television and radio broadcasting stations which are used for educational programming. In fact AASCU and NASULGC institutions constitute approximately one-third of the station membership of the Public Broadcasting System.

Seventy-nine percent of the NASULGC institutions in the survey operated non-commercial broadcasting and fifty-four percent of the AASCU members carried non-commercial radio programming. FM frequencies were licensed by seventy-five percent of the NASULGC and fifty-two percent of the AASCU institutions.

Closed circuit television systems were found to be quite common and in addition, the public colleges and universities in the two associations produced educational programs for the broadcasting stations (NASULGC 71.1 percent and AASCU 33.9 percent). They utilized cable TV to distribute even more programs. NASULGC cable utilizers totalled fifty-two percent and AASCU responders totalled forty percent in the cable TV category.

The survey covered also the provision for faculty utilization of telecommunication facilities for instructional purposes. In excess of ninety percent of the member institutions stated media services were available to faculty and staff and over eighty percent reported the availability of telecommunications facilities to the adult public. Instructional programs include credit and non-credit courses, continuing education units and open learning and external degree programs.

With a view toward expansion, member institutions who operate telecommunications systems in both associations, as well as those who do not, indicated expansion plans especially in the areas of instructional media facilities, radio broadcasting and cable television.

It seems reasonable to conclude from this nationwide survey of public colleges and universities that a surprising array of educational technology is presently available to faculty for their use, and the awareness of the emerging significance of this technology as a means of enhancing and extending outward the teaching boundaries of the campus is of concern and importance to these public institutions. With this advantage clearly in view, there is reason to hope that with proper training and inducement, faculty in increasing numbers will rise to form the critical linkage between the communications technology found to be in place with the needs of students in a variety of educational settings.

Some Working Assumptions—(Six, in Fact)

From the standpoint of a working administrator who has spent some time immersed in the process of learning and thinking about the current state of instructional technology, and who also has endeavored to bring into being a small amount of change, I have drawn assumptions, some of which I hope you will find worthy of consideration and perhaps even helpful.

Assumption Number 1

There remains abroad in the land a legacy of unfilled promises promulgated by hardware advocates who, during the sixties, in particular, convincingly influenced the purchase of vast amounts of instructional equipment with the promise of relieving the then shortage of faculty and at the same time reducing the cost of instruction.

State budget analysts and, indeed, many legislators make painful reference to the millions "wasted" in purchasing educational hardware to equip new buildings during the sixties. The space utilization studies which yearly demonstrate our failure to make sufficient use of large lecture halls and inventoreis of dial access equipment, TV studios and the like are too often silent and also unfortunate testimony against proposed new initiatives at a time when higher education is strapped for funds.

It is my view that any progress we hope to make toward the goal of more effective use of new technology in teaching, even with faculty motivation at a high peak, must be calculated within the existing constraints of continuing inflation, unfriendly budget examiners and public policies which reflect an attitude on the part of decision makers that higher education has had its moment on the stage and now must make way for other pressing societal needs.

Our requirements for new equipment, if met at all, will be drawn from a convincing demonstration of yearly savings through more efficient management and the never ending search for dollars which must flow from gifts and grants.

We can, I believe, overcome the unfortunate legacy of our past stewardship of instructional technology. It is not unrealistic to suggest that the necessity of such a struggle is after all our best insurance that progress will be more sustainable because it will have been so hard won.

Assumption Number 2

Most college faculty have insufficient experience as learners via technology for us to expect them to be advocates of the implementation of available communications technology either as a teaching tool or a more comprehensive teaching methodology.

There is little or no evidence to suggest that graduate students preparing for careers in teaching have been taught other than the lessons of scholarship and research. Whatever teaching methods they adopted came as a result of imitation of their mentors or by trial and error, rather than studied examination of the teaching process. From this direction as a starting point is where we must begin as we introduce also into the current equation faculties which are unionized and who are forced to perceive depressing immobility as a carrer reality.

An exaggeration, perhaps, but our overly sanguine assumptions in the past—which overlooked the critical necessity to begin where faculty are—resulted frequently in the wrongheaded purchase of "hardware methodology" far ahead of any attention to the needs, expectations, abilities and realities of our faculties.

Faculty development initiatives generated largely by faculty themselves, and primed and sustained by administrators who understand the role of "facilitator" hold the promise of bringing about a gradual, perhaps even an assuredly sustainable involvement of faculty in the use of a vast array of new and more available educational technology.

Assumption Number 3

The pervasive and fearful spectre of broad exposure to the risk of failure before the eyes of watchful colleagues is intimidating and a retardant obstacle in the path of the most secure of instructional faculty.

It is the rare faculty member who would speak in other than fearless tones about the educational value of an occasional failure. Usually in this context of failure our reference point is the students whom we instruct. The carryover of this belief into the very diferent and personal risk context of teaching methodology demonstrates clearly a considerably different and largely hesitant faculty response—at the very least those of us interested in building a strategy for change should assume so.

The intramurals of peer evaluation for reappointment, promotion, and retrenchment mechanisms engaged as a result of shortages of funds and reduction in generated student hours in the latter instance surface resistance factors even from faculty who have traditionally believed themselves to be secure in their positions. The perceived exposure to criticism felt by even the best professors sometimes easily sets in motion subtle and curiously department-wide episodes of resistance rather than acts of courage.

Overcoming the anxieties married to potential failure is most successfully accomplished in a general sense by the recognition of its presence. Steps which follow are largely situation specific and are better locally planned and constructed, except for the all-important necessity of confidence building that comes from early if only modest success and followed by deserved recognition.

Assumption Number 4

The sanguine declaration that excellence through resource enrichment is hardly creditable during the current and prolonged era of the equivalent of zero-based budgets, faculty retrenchment, and long-term fiscal exigencies.

The sooner we engage the operational assumption that resource enrichment belongs to a bygone era of educational finance, the better will be the operational design of instructional schemes which make use of instructional innovation.

Priorities will of necessity require reordering. Programs and earlier missions may be called into question and consequently, be repleced by current plans for instructional improvement which require the shifting of resources. Indeed, there may emerge a new "art" of creative management that allows, for a process of *substitution* rather than addition.

We should not fail to recognize that higher education management requires the similar challenge of rethinking and reassessment of attitudes and methodologies as does the instructional process; indeed, it is not presumptuous to recommend such a process as a beginning expectation of any plan designed to change substantially instructional modes of operation.

Assumption Number 5

Promotion, workload considerations, financial, and success incentives are high on the list of reward factors which spur faculty responsiveness.

If we dream of a world of change absent of these compelling factors we dream of a time that will never be. They are, indeed, stituational and often personal, but they persist as perceived and real expectations. They are for the faculty, the tangible outcomes that make the effort worthy. They are for the faculty, outcomes related to ego fulfillment which outdistance institutional goals and expectations. They can be silent killers of change or the very real difference between the success and failure of a strategy. At the very least, faculty must perceive an administration *involved* in and willing to articulate with conviction and to document with creditability, positive action that the university reward system is responsive to faculty willing to make substantive commitments to instructional change.

Assumption Number 6

There is no foreseeable technological substitute for the creative, learner oriented and highly knowledgeable "director" of the learning enterprise—rather, there exists a mounting array of workable instructional tools around which to surround and assist those prepared and motivated to use them.

In earlier times even some thoughtful educationists took the highly questionable leap from the knowledge base directly to the learner via available hardware. Witness, for example, the dismal failure and regression that accompanied the wholesale distribution of the "teaching machine." One is reminded of the earlier experiments in man's fascination with flight, and the do-it-yourself contraptions which were fastened to arms and legs—each in its own way destined to fail because of a lack of knowledgeable application of correct theory and creatively directed into practice.

It is my view that effective utilization and progress in the use of technology will succeed to the extent that the process remains directly in the hands of the teacher with prior knowledge of the subject and compassionately aware of the needs of the learners.

A model of the director of learning set forth by some media professionals places the professor within a centerpiece similar to the role of a nightly newscaster. He or she directs the conduct of the enterprise, selects the content, chooses from an array of sources and resources and is responsible for a format design which is appropriate to the viewing audience or learners as the case may be. Portions may be altogether precast. Other segments are flexibly utilized to meet the changing demands of the situation.

The point to keep in mind is the requirement of a learner-oriented knowledgeable manager of the process to have resources of his choosing available on demand, and appropriately matched to the broadly based needs of students. The achievement of a system that responds to these demands is a complex and demanding challenge and cannot be viewed as any economy measure or a workable substitute for skilled professionals. However, the degree to which it may be more expensive over the longer run than present instruction requires much more study and experience.

The Response of Two Associations (AASCU—NASULGC)

The American Association of State Colleges and Universities and the National Association of State Universities and Land-Grant Colleges have given increasing concern to proposals which may result in the establishment of an on-going system with the potential of dealing effectively with the potential of faculties to exploit instructional enhancement through technology. It is their belief that progress has been retarded and can be attributable to:

(1) the lack of understanding among most faculty of appropriate and pedagogical applications of technology, and
(2) the fear of losing creative control of their classes and course work by using the materials developed by others.

The proposal set forth through the combined efforts of the associations has the potential of involving some seventeen member institutions and over one hundred sixty instructional faculty, academic deans, and instructional support staff. Essential to the success of the proposal is the requirement that *institutions* as well as faculty commit themselves to a continuing involvement in the project throughout its duration through the allocation of a portion of the support costs of the proposal, the remaining costs to be covered by an outside agency.

Following each orientation conference, faculty will be required to formulate their own ideas for applications of technology to academic subjects which *they* teach in their own institutions. Delegations from institutions chosen to participate also will be encouraged to work as a "team" during the training institutes.

As an ultimate outcome and beyond the hoped-for advantages to participating faculty will be the dissemination of what has been learned and achieved to other colleges and universities.

SUMMARY

I chose to end on a bright note of hope for reasons which go well beyond my own involvement in the advancement of instructional improvement. Indeed, the fact of our generally low morale, the doomsayer predictions of the future and our failures in the past can, I believe, be turned to productive use. We have perhaps come of age. We are hard headed, more so than in the past, not so easily led and curiously demanding more accountability of ourselves.

It may very well come to pass that the 80's will bring forth a faculty "response" to technology that surpasses our imagination in part because we are poorer, yet wiser, but due in part also to the understanding and assistance made available to us through reunions made possible by this conference.

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Evaluating the Use of Technology in Education

Kamala Anandam
Director, Computer-Based Instructional Development and Research
and
J. Terence Kelly
Vice President for Education
Miami-Dade Community College
Miami, Florida

INTRODUCTION

There are probably few, if any, assignments more difficult or evasive than evaluating the use of technology in education. The imponderables could fill up pages. Therefore, one must immediately ask: "What do we mean by technology?" "What is a logical classification system for the various technologies that currently exist?" The same types of questions must be asked about the meaning of evaluation. But even beyond the definition stage, one must consider other elements associated with evaluation, such as the philosophy of an institution and the goals of particular instructional programs, in order to determine what is to be evaluated and how it is to be evaluated.

Frustration and aggravation mount when legislators and others who are outside the educational arena ask the question: "Is technology cost effective?" Frankly, we have never understood those terms, and are not sure whether those who ask the question fully comprehend the complexities associated with what appears to be a rather simple and straightforward question. Overall, one might even make an argument that perhaps education by itself is not cost effective, whatever that might mean. However, if a price tag can be computed for ignorance and its impact on society, one might have a different perspective regarding education's cost effectiveness at all levels throughout the country.

This preamble is not intended in any way to suggest that one cannot discuss the topic of evaluating technology or to simply say that there are no answers. Answers can be found, but one must be cautious and understand precisely what it is we are trying to evaluate. Often we think of how educational television was nearly doomed by its uses in the fifties and the sixties. Part of the reason for those early failures centered around some of the misunderstandings of what its capabilities were and what it was attempting to do. In certain instructional settings, it simply was an instrument to increase productivity in terms of faculty-teacher ratios, not necessarily to improve learning. It is not surprising, therefore, that we found huge auditoriums with thousands of students listening to a TV lecture given by one faculty member. If one were evaluating the productivity of its use, it would be rated as a rousing success. However, if students' satisfaction and learning were considered, those early educational TV days might well deserve to be classified as a dismal failure. Thus, for the purpose of this paper at least, let us define the framework within which the present topic will be discussed.

Technology that is used in education can be divided into five major categories: 1) *Print technology* is the most widely used technology though it is not always thought of as one. 2) *Telecommunications* include telephones, radios, and two-way communication systems which are just barely beginning to make their mark in various instructional applications. 3) *Motion picture and video technology* represents a combination of visual, motion, animation, and audio components. 4) *Computer technology* is exploding with unbelievable dimensions into every phase of our lives. 5) *Biological manipulation*, perhaps the most frightening of all, links all the other technologies to modify human behavior.

The single most decisive observation that one can make about technology today as it relates to educational use is that the hardware developments far out-distance the human and software developments, thus making it impossible to capitalize on the hardware capabilities. If one agrees with this premise, which we think can be demonstrated without much difficulty, one can better understand the results of the evaluation of technology in education. For example, the studies on two popular computer interactive systems, *PLATO* and *TICCIT*, did not bear out the high expectations for their effect on student learning; therefore, their use in the community colleges failed to expand.[1] These results occurred because the most important facets—the human and software developments—were not attended to in a manner that would have permitted the entire technological innovation to be fully implemented and fairly evaluated.

Benjamin Bloom[2] discusses two roles of evaluation—formative and summative. Formative evaluation pertains to the process of developing a program, while summation evaluation focuses on the completed program. The former is "the use of systematic evaluation in the process of curriculum construction, teaching and learning for the purpose of improving any of these three processes" (p. 117). Most evaluations with respect to technological innovations failed to include formative evaluation and are thus beset with mixed findings. Rather than be discouraged by this situation, we should relentlessly explore the numerous ways to exploit the capabilities of the technological innovations in order to accomplish our educational goals.

Evaluative studies focus on different objectives—economics, faculty acceptance, number of students reached, their motivation and performance. All of them are valid objectives worthy of independent evaluation, but they will provide meaningful information of practical significance only if they are considered together. In reviewing the research literature on the use of technology in education, we would like to introduce the concept of the three E's—Extensiveness, Effectiveness, and Endurance. Extensiveness refers to how widespread is the use of technology in education; effectiveness refers to improvement in human (faculty and student) satisfaction, student motivation, retention, and learning; and endurance refers to the long-lasting continuation of an innovation.

Extensiveness

What has become of the long assault on higher education by media and technology enthusiasts? Do traditional systems of teaching prevail against all odds? Based on approximately 1,000 in-depth interviews with state commissioners, administrators, faculty, students, and alumni in six states, the question is raised: "Does Education Want What Technology Can Deliver?"[3] This study concluded that what is generally in use (meaning what more than three-quarters of the educational institutions of a particular type are using) is not very much different from what was generally in use in the 50's—chalkboard, a piece of chalk, some books, filmstrips, audio cassettes, projector of some sort, or an occasional computer terminal. Examined from a different perspective, in the late 70's, expenditure for technology constituted 0.3–0.5 percent of total expenditures at the elementary and secondary schools, 0.2–0.4 percent in vocational and 2-year colleges, and 0.5–1.1 percent in 4-year colleges and universities. In other words, the technological innovation that has skyrocketed in industry is rather limited and isolated in education. This is not surprising because technological innovation in education was mostly prompted by what technology could offer rather than what educators wanted. Even though media and technology enthusiasts oversell their products, the capabilities of technology will not in and of themselves create or even prompt changes in our educational activities. It is the people who are going to make a difference.

In terms of extensiveness, printed materials have outscored every other technology. Although they have become second nature to use in education, they also had their day of being rejected and resisted. At the time when the printing press was introduced, people's objections rallied around much the same themes as they do today against computers—loss of human factors, loss of jobs, necessity to learn new skills, discarding of traditionally cherished values, etc. Decades passed before the potentials of the printing press were acknowledged, utilized, and appreciated. The text and the printed word have endured in higher education for so long that no one will dream of questioning its effectiveness. Ironically, the computer technology that is resisted so much today will perhaps see the demise of the printing press, although new print technologies hold far-reaching promises. It has been estimated that by the end of the 80's, computer information transfer will be less expensive than print technology and will allow us to store whole libraries roughly the size of the Library of Congress in a computer.[4] Proponents of video-disc claim that they can do the same or better with their discs.

Telephone and radio, although widespread in their use for personal and commercial purposes, are rarely used in education. There are some isolated trials going on with this technology that require our consideration and exploration. These are the Satellite Tele Education Program (STEP), Roche Laboratories, experiment on teleconferencing, the Cono Educational Network (CEN) in Iowa, and American Issues Radio Forum. Because the application of the telephone and radio in education is rather limited, it is premature to discuss their effectiveness and endurance.

How extensive is the use of television in education? Next to the printing press, television perhaps enjoys an extensiveness of use that is worthy of being evaluated. With the initiation of distance learning (or open learning, as it is sometimes called), we can truly say that television has come of age. A 1980 report prepared for The Station College Executive Project in Adult Learning[5] states that more than 1,800 of the nations' 2,993 colleges and universities use broadcast and nonbroadcast television for instruction. In 1978-79, 735 institutions offered more than 2,300 courses over television, enrolling 500,000 students in those courses. At the community college level, 789 out of 1,088 institutions (75 percent) make use of television for instruction. Of these, 349 colleges offered courses over broadcast television enrolling approximately 162,000 students in 1978-79.[6]

In the case of computer technology, the United States is the prime user and major exporter of computers. The report by the American Federation of Information Processing Societies[7] mentioned that approximately 60 percent of the world's computers are used in this country. How does the use of computers in education measure up to this phenomenal growth of computers in industry? The Fourth Inventory of Computers in U.S. Higher Education and a servey conduced by CONDUIT[8] (a national organization that evaluates and distributes computer-based instructional software) covering 3,595 departments and 4,489 faculty reveal the following and we quote:

> The computer is an integral part of higher education only in the disciplines where it is a required skill for post-baccalaureate work.
>
> The computer as a teaching aid is not widely used in higher education, but interest in applications such as tutorial materials in mathematics is growing.
>
> A significant number of schools make little or no use of computing in the undergraduate institution.
>
> Computing equipment and software currently in place for instructional use is barely adequate for moderate use and inadequate for extensive use.
>
> Effective instructional software is increasingly the major factor in using the computers in teaching.
>
> Among those institutions not using the computer today, lack of faculty training is cited as the most important reason.
>
> Despite serious barriers to the use of instructional computing, an overwhelming number of department heads and instructors see their use of instructional computing increasing in the future.

Effectiveness of Instructional Television

If the information on the extensiveness of the use of technology in education is not exhilarating, the topic of effectiveness is somewhat distressing. In the first place, research is available only in the areas of television and computers. The best results we can bring to your attention on instructional television (ITV) are by way of extensive review reports published periodically. One of these reviews[9] published in 1967 summarizes the results of 421 comparisons between ITV and traditional instruction (TI).

NUMBER OF CASES

Level	*No Significant Difference*	*ITV More Effective*	*TI More Effective*
Elementary	50	10	4
Secondary	82	24	16
College	152	22	28
Adult	24	7	2
TOTAL	308	63	50

Another review[10] examined 191 comparisons at the college level and reported that 102 of these comparisons favored ITV and 89 favored TI, although most of the differences were not significant. When attitudes were considered, administrators were more likely to be favorable to ITV than teachers. At the college level, students seemed to prefer small discussion classes to television classes, and television classes to large lecture classes. In general, students were more favorable toward ITV after they experienced it than before. Unfortunately, liking ITV was not always correlated with learning from it.

In the 70's, similar reviews were available. For instance, one review[11] discussed approximately 862 studies that compared the effectiveness of ITV and TI and concluded that there was strong evidence that ITV which closely simulates TI was as effective as TI. Although there was very little evidence concerning the effectiveness of ITV used in ways that utilized the unique capabilities of the medium, at least the uniqueness of the medium was recognized as an important factor. A number of students and teachers had an unfavorable attitude to ITV, but the incidence of such attitude diminished as institutions gained experience with the medium.

ITV in distance learning programs seems to have yielded somewhat different results. Research conducted by the University of Mid America[12] pointed out that ITV in distance learning perhaps acted as a pacer, motivating the students to keep up with their work. The completion rate was markedly improved for courses that included television broadcasts. Correspondence courses that did not use any television had an average completion rate of 25 percent, whereas those with broadcast television registered an average completion rate of 65 percent. More spectacular was the case in which 561 students enrolled in a distance learning course with television broadcasts were compared to 185 enrollees in a non-television course. The completion rates were 74 percent and 44 percent respectively.

Effectiveness of Computer-Based Education

There is no simple uniform conclusion that can be drawn about the effectiveness of computer-based instruction. The instructional uses of the computer can be classified as: 1) learning about the computer, 2) learning through the computer, 3) learning with the computer, and 4) learning with computer support.[13] Learning about the computer is the most rapidly growing area of instructional computing commonly known as data processing. Learning through the computer is more popularly called CAI (*C*omputer *A*ssisted *I*nstruction) and is represented by a student directly interacting with the computer for drill and practice, diagnostic testing, and tutorials. PLATO is a good example of this classification. Learning with the computer represents the computer as an aid to learning and as an adjunct for the learner. Practical uses include simulation, gaming, problem solving, etc. Learning with computer support is probably the most expanding aspect of instructional computing within higher education. This is known as CMI (*C*omputer *M*anaged *I*nstruction) and the expansion is taking place quietly and often without any notice of the computer's role. A significant percentage of colleges are using computer systems to aid in classroom management.

In a summary of the studies conducted in the late 60's and early 70's by institutions such as Florida State University, State University of New

York, University of Illinois, University of Texas, and Stanford University, a conservative conclusion was that CAI is about as effective as traditional instruction when used as a replacement.[14] The review concluded that the pattern of no significant difference in achievement is depressing, to say the least. This is an uncomfortable position. On the one hand, it is almost inevitable that the colleges will require the use of technology if they wish to increase productivity. On the other hand, in spite of considerable expenditures on educational technology, we have yet to find positive evidence of its impact on productivity. If cost reduction (productivity) were the goal of technology rather than learning, there might be a greater chance of utilizing technology and doing it well.

In 1977,[15] another review article presented the research of the 70's on CAI. Despite the large number of CAI projects in existence, the number of methodologically sound evaluations was quite meager, the results were conflicting, and what exists leads to the conclusion that CAI was at least as good as, if not better than, traditional or non-traditional methods in terms of performance scores. However, nearly in all cases, there were time savings with CAI. One can conclude, then, that research has shown CAI as a possible alternative to the other methods but has not established its effectiveness.

Yet another review of research on instructional computing published by the Florida Commissioner of Education Advisory Board on Instructional Computing[16] examined the most recent studies—36 on CAI, half of which were experimental, 20 on CMI, and 12 on Computer Assisted Guidance (CAG). This report also included three major reviews published in 1974, 1975, and 1979. What the report has to say is this: "In summary, results of research on CAI, CMI, and CAG seem to indicate that computerized methods of all kinds are either better than or at least as effective as non-computerized methods in bringing about learning gains" (p. B-12). The report further stated that computer-managed learning seems to make a greater difference in productivity and learning and is more acceptable to teachers than computer-assisted learning.

One of the problems with CAI is its simplistic approach to learning. Applications of CAI have not attempted to consider student characteristics and subject matter uniqueness. The frame-oriented approach in CAI develops a data base of lessons and expects the computer to transfer this, frame by frame, to the student. The student is routed through the lesson. This passive view of students is a legacy that CAI inherited from the stimulus-response theory. The current trend is away from frame orientation towards the development of generative CAI systems in which algorithms are used to generate problems, questions, answers, and diagnostics. This approach is influenced by cognitive theories. In this area lies the challenge of the 80's for the use of computer technology in education.

Individualization of learning is a necessity worthy of our attention and effort. Note that we have used the term "learning" instead of "instruction." We have done it deliberately to make our point that our attention and effort should focus on student learning. If the research of the '60's and 70's has a message for us, it is that the capabilities of computer technology need to be exploited by the ingenuity of faculty to create educationally sound environments for learning. Kearsley[17] describes four levels of individualization as follows: 1) arranging a predetermined instructional sequence conditional on different responses to pre-specified questions (the emphasis is on immediate feedback); 2) choosing subsequent instruction based on a dynamic measure of performance on previous materials; 3) providing different presentation modes or instructional sequences based on individual differences such as aptitudes, interests, or personality; 4) hypothesizing a model of learning for each student consisting of procedures for presentation of instructional materials and assessment of performance (as learning occurs, the model is modified; this level enables the student to learn the material and gain insight into learning itself).

What do these levels mean for us in education? Although a vast majority of the existing CAI programs belong in Level 1, we have to raise the question: "Is it economically and educationally sensible to computerize programmed texts?" We should also raise the question: "Is immediate feedback necessary and sufficient for all types of learning?" We think not. "Is there a need to promote reflective learning (self-correction learning) prior to providing feedback?" If your answer is "yes" (which of course is the case with us), then perhaps the effectiveness of CMI at Levels 2 and 3 should be explored. This leaves us with Level 4 which, in our estimate, should be the subject for CAI programs.

Miami-Dade's Experience

For the past 10 years, the faculty, advisors, and administrators at Miami-Dade Community College are using a multipurpose flexible CMI system called RSVP (Response System with Variable Prescriptions). In the world of RSVP, you will not see students sitting at the terminals interacting directly with the computer. In fact, there is nothing we can show you about the computer. Instead, we will show you faculty who are quitely redesigning their curriculum plans in order to provide individualized instruction for their students. The not-so-obvious changes that are taking place in this setup have led to collaborative work among educational technologists and content specialists, peer review and revision of curriculum design, learning activities and assessment tools, well thought out individualized and prescriptive feedback, and formative and summative evaluation.

At the administrative level, the management of individualized learning, the accuracy of record-keeping, the availability of research data for evaluating and improving instruction, the generation of statistics for federal and state reports, and the sharing of quality work among faculty are chief among the benefits mentioned for RSVP.

At the faculty level, the possibilities for creating innovative RSVP coursewares, for providing necessary individual attention and response to students when they need reinforcement rather than when the faculty are ready to give it, for making efficient and meaningful use of the time when faculty interact with their students, for being analytical about evaluating the RSVP coursewares, and for becoming expansive in their conceptualization of the teaching-learning process are frequently mentioned by the faculty who are using RSVP.

At the student level, RSVP is a decisive winner. Whether RSVP is used in the lab or classroom or remote setting, the students endorse the RSVP system of instruction unequivocally. They cherish the privacy in becoming aware of their errors and the personalized feedback for correcting their errors, appreciate the "caring" shown by their faculty, and like the provision for self-paced learning.

The national and international recognition earned by RSVP is best illustrated by the following two quotations. Particia Cross[18] says:

> The Miami-Dade experience with the use of computers to manage individualization is pulling the rug out from under the defense of group instruction and semesters on grounds of fiscal and administrative necessity—which is not necessarily to deny that group instruction may have its own contributions to make to some forms of student learning. But the fact is that it is no longer necessary for economic or administrative reasons to organize education into semester-long courses taught to groups of students. We now have the freedom and the obligation to reassess the usefulness of our organization of education for its contribution to student learning (p. 17).

Based on their study of the users of computer technology in higher education in the United States, Great Britain, and the European countries, McMahon and others[19] state:

> We have chosen to include a short study of RSVP and its use at Miami-Dade because it is probably the most extensive, and in many ways the most effective, computer-managed open learning system now oeprating in the world.... The RSVP System at Miami-Dade Community College is more effectively institutionalized than any of the CML systems now operational in the United Kingdom (pp. 21, 25).

Often people ask: "What is the payoff for Miami-Dade in using RSVP? Is retention improved? Are grades improved?" Although we cannot answer many of these questions in the affirmative with any degree of certainty, and clearly not with hard-core data, except in a few cases, we have found indications that RSVP improves student attitude and motivation and thereby their retention and performance. In one application in which RSVP is used to provide individualized prescriptive feedback on students' writing, a significant difference between RSVP and non-RSVP groups was observed in the objective test—Comparative Guidance and Placement Program: Written English Expression. Since the completion of the experimental study in Winter, 1979, the RSVP writing program has continued to be used by more faculty for a greater number of students.[20]

Summary of Effectiveness

Most of the studies on educational technology engaged in summative evaluation without proper formative evaluation. Consequently, the not-so-positive results should not be viewed with alarm but reflected upon carefully. It is common knowledge that a variety of technologies is available for communication. What is ignored, however, is that each of the technologies has developed a quality and character of its own. Flexibility and selectivity are the cornerstones for building a technology-based instructional program.[21] Flexibility provides various avenues for learning. The student population is as heterogeneous as the nation's people; their prior learning and expectations vary as do their characteristics. What one can learn from an ITV, another might learn equally well, if not better, from print materials. Although group-based delivery systems generally do not cater to the individual student's needs, the potential to meet these learning preferences by virtue of the use of multi-media adaptations exists.

Each medium has its strengths and weaknesses. From the learners' perspectives, the media can arouse their emotional involvement, pace their efforts, transmit information, highlight significant ideas, illustrate abstract concepts, clarify complex themes, stimulate thinking, foster problem-solving skills, and provide feedback. Selectivity means selecting a purpose for learning and selecting the medium that best matches the purpose for a particular student.

Endurance

Which of these techniques will endure in the future? In answering this question, we can present some speculations and forecasting. Christopher Dede,[22] professor at the University of Houston, Texas, and President of the Education Section of the World Future Society, claims (in fact recommends) that the following avenues should be explored: 1) home TV, 2) portable computers, 3) home terminals hooked to large computers, 4) videodiscs and personal compuers, 5) electronic communication and information processing.

Future Survey, a publication of the World Future Society, provides us some forecasts that are also worthy of our consideration. For instance, in the November, 1980 issue,[23] we find the following projections from the review of the most recent books: 1) Computers will become dramatically smaller, the amount of information they can hold will continue to increase, and costs will decline. In the early 1980's, computers will become the leading industry in the world. 2) Books will be compressed into chip form, with the new computerized version of a book available at something like 20¢, as raw material and distribution costs reduce sensationally with miniaturization. 3) The long-term future will be dominated by the evolution of machine intelligence to the Ultra-Intelligent Machine: a computer programmed to perform any intellectual activity at least marginally better than man. 4) By the end of 1981, three incompatible videodisc systems will be battling for a U.S. consumer market that promises to outstrip the $65 billion annual color TV business. The array of incompatible players will slow the market down at first. But eventually, coupled with computer power, videodiscs promise to change the way that employees are trained, equipment is maintained, students are taught, and products are sold. 5) The convergence of the telephone, video, and print indsutries is now at hand, bringing changes, disruptions, threats, and opportunities to all of the major participants in these industries. Key catalysts in this convergence include the development of View data and other technologies, continued growth in cable TV services, and partial deregulation of the telephone and cable TV industries.

With all these exuberant projections, we need to remember that the traditional classroom instruction and fixed time frame for assessment have prevailed in higher education. Beyond the chalkboard, the overhead projector is more often used in the classroom than all the other visual equipment. A classic example of "old habits die hard" is the Dvorak vs. Qwerty typewriter keyboards. Despite the fact that the rearrangement of the keys in the Dvorak keyboard reduced training time by half and increased typing speed by 60 percent, the standard Qwerty keyboard has persisted because of tradition.

CONCLUSION

The major decision of new technology in education will be shaped by economic, social, and political factors. However, the benefits of changes can be enhanced through careful attention to desirable faculty roles, student preparation, and more humane applications of technology. Technology is never independent of people. In fact, it is worthy of our concern only because it touches our lives as we create, understand, and use it. As we enter the 80's we are fortunate that the research of the 60's and 70's has given us the realization that the chip and the transistor are no more than physical objects until their properties are realized by one or more human beings. Therefore, a true study of technology is the study of its relationship with those who create it and use. it.[24]

As writers in this field note, the technology is moving ahead quickly with or without the planning of the educational community. Immediate action in planning for the future appears to be a general recommendation.

If, in our preoccupation with day-to-day responsiblities, we fail to recognize the pervasive impact of technological revolution and actively plan for its proper utilization in education, we will be neglecting our mission to shape the society which depends on quality outcomes from its educational system. It is a mind-boggling challenge. As we have stated elsewhere, "Those educators who have a vision beyond the learning environment of today, a receptive attitude toward change, and a pioneering spirit to persevere will have the privilege of shaping and controlling the technological innovations in education for inspirational and imaginative forms of learning. Conversely, fear, insecurity and anxiety will prevail for those who choose to dismiss the waves of the future[25] (p. 80).

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Managing Technological Change in the Dallas Public Schools

Nolan Estes
The University of Texas at Austin
Austin, Texas

The title of this paper strongly suggests that there may have been something magic about the technological changes which were effected in the Dallas schools (hereafter, DISD) during the 1970's. Granted that many technological changes did occur as indicated by at least the following hard evidence, DISD, as much as any urban school system:

- has more micro-computers in operation
- has produced more original computerized curricula courseware (Math, reading, bilingual)
- has operationalized a *flexible* system for delivering state of the art instructional television
- has integrated large third generation computer information systems for administrative support with main frame instructional support and with mini-computers, and
- has operationalized a total media instructional support system, mong others too numerous to mention here.

This paper focuses on some of these successes with special mention regarding the processes which worked as well as the failures which sparked ideas for new technological change thrusts. Of necessity, the order of presentation herein is somewhat atuned to the chronology of the 1975-80 period and the generalizations which are thought to be useful in the 1980's may be tempered with impending technological, educational and political changes which cannot be fully identified and assessed at this time.

However, suffice it to say that technological change in the schools was, and is, facilitated directly in proportion to which problems are anticipated and solved efficiently and effectively. Problem areas which impact technological change include but are not limited to:

1. Political

2. Fiscal
3. Technical
4. Instructional
5. Policy, Board and administrative
6. Managerial/administrative

These will be dealt with here in turn, with emphasis on the human relationships that are needed to facilitate the desired changes.

Political Context

First, consider the political context which is imperative. In 1975, Dallas was searching for a solution to its desegregation problems. "Quality Education" was the mission and taxpayers as well as educators were ready to "buy into" technology as one strategy to attain that desired quality. The organized education profession posed no major obstacles once it understood that technology would not *replace* teachers but rather would *complement* and *extend* their competencies. The student readiness for new technology was exceptionally high; they were searching for new avenues of expression—magnet schools, computers and ETV were already among their expectations.

DISD had a favorable political climate for technological change and this greatly facilitated the technological improvements enumerated earlier. No doubt, the political climate of the 1980's will be substantially different and should be assessed carefully and thoughtfully as new changes are planned. Among the things which will need to be addressed are:

- students will be accustomed to computer chip applications through toys, games and the like. They should be "readier" for technology.
- many intelligent parents and citizens will be using microprocessors in home and work and demand this and other technology in their schools.
- the organized education profession will have a larger and louder voice in educational methodology—sometimes for, sometimes against technological change.

Fiscal Matters

And now to fiscal matters which affect technological change, let's review the DISD story. During 1975-79 particularly, DISD had some limited local, state and federal resources *above* those needed to maintain a minimum education program. The local Board appointed funds to support a small cadre of technology development personnel—programmers, analysts, systems planners and others. This local support, coupled with an aggressive search for outside funds (state and federal) enabled the District to amass a technology development effort calculated to make a difference. It did, and the results are impressive! However, those in the 1980's who expect to mount such an effort be aware of or atuned to:

- the taxpayer's dollar is buying less and less,
- technology start-up costs are escalating even though the technologies are improving by leaps and bounds,
- labor intensive education's days or years may be numbered, and
- the watchword of the 1980's will be "productivity" and the assessment guide will be student achievement.

All is not amiss here; it may very well be that the micro-computer and other new technologies will soon have their finest day in court.

Technical

And now for the third area of problems in technological changes, the technical. Someone said that "the worse thing that can happen usually does." This is especially true when new technologies are introduced before they have been bebugged. DISD had numerous successes and failures here. Among the successes were the excellent technicians who were already aboard with several person-years of experience in working with educators. Another success was the technology development protocol and process already in place. Among the failures were several administrative and instructional support computer programs which were not cost-effective (they tied up the computer main frame so that no other users could obtain access). Altogether, a great deal was learned from these successes and failures, notably:

- the most valuable resource in technology change is trained technicians,
- technicians need to have and/or develop ability to interact and communicate with educators, parents and students,
- be absolutely certain that new technology hardware and software are restricted to pilot test settings until thoroughly debugged and evaluated,
- specify the technology development protocol and adhere strictly to this plan,
- don't buy any technological "pig in a poke" just to be counted among the "in" group, and
- encourage staff technicians to assess continuously the state of the art technology developments.

Educational/Instructional

No doubt, there are other technical problems which will emerge; however, let's review some of the educational and instructional problem areas. In DISD we were fortunate to have already developed a curriculum framework in 1975, a "Baseline Curriculum," *before* we entered substantially into technology curriculum applications development. This is *highly essential*. A great resource brought forward by this activity was the corps of principals, teachers and parents who had participated. Also, a better definition of what the District expected of students in each grade and subject area emerged. Much later, as we understood the sytematic process for computerizing these curricula, we realized that the two development processes are complementary—the computer analysis of curriculum content tended to validate the efficacy of the prior curriculum decisions.

Instructional problems do not end with curriculum decisions being made, rather they just begin. It is in the *implementation* of curriculum through technology applications that the knotty problems emerged. Again, it is highly essential that the new technology works without a glitch or hitch. Listed below are some of the strengths and/or problem areas to address:

- curriculum developers, especially curriculum writers, consultants and supervisors need to know and/or be thoroughly trained regarding the potential and limitations of the new technology being utilized,
- retain new technology based instruction in tightly managed and controlled pilot test settings until it is sufficiently refined to be reasonably successful with users throughout the district. Use two or more cycles of pilot testing and refining as necessary.
- at an early stage of the new technology development process begin to bring in the ultimate users (teachers, principals, parents and students) for orientation to the new technology and feedback to the initial developers. This helps train the users while keeping the developers honest and on-target,
- conduct continuous product evaluation and cost-effectiveness studies of the new technology *before* it is released for widespread dissemination. Remember, the goal should be to *increase productivity* while simultaneously *reducing costs*, and
- *always* specify what is to be taught in the beginning, then, and only then, specify how technology may aid the teaching of that content. Later in the development process, the "how to" step may be expected to cause changes in the original curriculum decisions.

Policy/Administrative

And now, let's examine the fifth area of concern affecting technological change, that of Board and Administrative policy. We could have discussed this area first, however, policies tend to focus on the four areas of concern already addressed and therefore, they were presented for background information. In DISD, we fortunately entered into major new technological changes by demonstrating to the Board that technology was the *only* way to supply information the Board needed for making informed decisions. This included a comprehensive computerized data base for each of school finance, teacher personnel, student personnel, school faciliteis and later purchasing. Once the Board was committed to its *own* information needs, the general policy framework was established and it was easy to extend these policies to instructional needs and to the schools. Some general administrative policies and regulations emerged as the administration saw the benefits which technology could bring; however, a few such administrator negotiations emerged *only* after various departments became convinced that hand processing was an artifact of the horse and buggy days and that the computer's day had arrived. Some guidelines for developing Board and administrative policies which will facilitate technological changes include:

- focus Board policies on the broad arena of what needs to be done; administrative policies or regulations on the how it is to be done,
- address the Board's needs in policies first, the administration's needs later,
- introduce the Board to new technology by demonstration (not telling about); provide hands-on experience wherever practicable,
- update Board policies periodically to encompass new technologies which may require such modifications, and
- cause the Board to reference each future action to a previously adopted policy.

Management

Lastly, this presentation would be remiss without proper reference to the management and administration of technological change. If one accepts management as "causing desirable events and activities to happen," then the role of management, and therefore, the administration, is critical in the change process. In DISD, we established the administrative position that the management of technological change was one of the primary missions of administration. The administrative team concept of leadership, including all levels of administrators, was thoroughly indoctrinated with this administrative position. We literally "lived with" new technological applications as they emerged and made them an integral part of our daily lives. We lived and breathed computerized class scheduling, grade reporting, attendance accounting, fiscal accounting, student assessment, teacher personnel records and others too numerous to mention. Out of this effort grew a great deal of management expertise which can be couched in the following suggestions:

- administration at all levels *must demonstrate* reliance on and confidence in new technologies,
- each administrator must "get dirty with the data out with the troops," as technological changes are implemented,
- complex technological changes require new management processes in order to coordinate the efforts of various departments and to monitor and assess continuously the effects of the

changes, and

- the management of technological change may very well be the most effective strategy available to administration for improving schooling and schools.

Managing Technological Change in Montgomery County, Maryland

Homer Elseroad
Consultant
Ijamsville, Maryland

INTRODUCTION

Over the past fifteen years several applications of computer technology to education have been implemented in the Montgomery County Public Schools. My task, for this meeting, has been to review that experience to find what lessons we can glean from it that might guide our efforts at implementing technological change in education in the future.

Fifteen years ago this school system leased a small computer. It was operated by a staff of nineteen. This staff, organizationally placed in the finance department, supported certain financial functions. Their reports were used by central office administrators and auditors. The rest of the several thousand staff menbers in the school system were unaware of and unaffected by these computer applications. Now the school system has outgrown its 371-58 computer operated full time 24 hours per day. There are 128 central office staff members working on computer applications. They collect data from and provide services and reports to virtually every central office. The computer is also used in local school application such as scheduling, attendance, control of school funds, and reporting pupil progress. Instructional uses of computers include computer assisted instruction (CAI), computer managed instruction (CMI), teaching of computer literacy and computer operation, and terminals or small computers placed in individual schools for a range of school administration and instruction uses. Thus, today I estimate that 3,000 staff members in the school system offices and 182 schools are using computers directly for part of their work. All 12,000 employees, state and federal officials and Montgomery County citizens are directly affected by computer applications because of the services and reports now provided with computer technology.

Planning/Managing Change

Change in education comes slowly and sometimes painfully. If real change is to occur it must be planned and managed with a keen awareness of the behavior of staff and the public, both affected by the contemplated changes.

In preparing for my paper, I reviewed documents and interviewed people directly involved in developing and implementing applications of computer technology in education in Montgomery County over the past fifteen years. Let me describe briefly four of the major events that influenced these developments.

Task Force Appointed

In 1965 a Board of Education appointed task force studied education application of computer technology. Fourteen County residents with professional experience and knowledge in computer technology studied what was happening in other places, examined cost effectiveness of using computer technology for administrative and management functions, identified new services that computer technology could provide, evaluated the worth of those services, and studied the cost of different computer configurations.

This task force met frequently with the Board of Education for public discussion. Interim reports were provided for staff and public study. The final report of the task force laid out a master plan for development of computer applications in the school system.

Through this process staff, the Board and interested citizens became knowledgeable about applications of computer technology to education. The long range plan provided a basis for implementation recommendations for Board action.

R/D Project in Instruction

A second major step in the evolving use of computer technology in education in Montgomery County was a six year research and development project in computer assisted instruction (CAI) and computer managed instruction (CMI). This project, which began in July 1968, responded to four concerns of the Board of Education and various citizen groups. Those concerns were:

1) Disappointing levels of pupil achievement in computation skills. With "new math" pupils were doing exceptionally well in math concepts, but drill had largely disappeared from books and teacher practice. Mastery of computational skills had declined.
2) Special education. Special education was expanding. Handicapped children and youth formerly not in public schools were being enrolled. A deeply felt unwillingness to accept the low level of progress and achievement experienced by many special

education pupils prompted a search for better teaching methods for this population.

3) Greater individualization of instruction. Ten years of progress in reducing class size and emphasizing individualizing of instruction had not made much difference. The quest for better ways to individualize instruction and unlock pupils from progress by time blocks continued.
4) Search for economies. In a effort to off-set the high cost of reducing class size, various methods were sought to give teachers support and assistance. If non-teaching duties and routine tasks, that consumed teacher time and energy could be handled in another way, could teachers then successfully teach larger classes?

During this same period of time certain other events were occurring which ultimately helped determine the strategy to be used by the school system in addressing the four concerns cited above. Those other events were:

1) Title III of ESEA enacted in 1965 provided money for research and innovation.
2) IBM was interested in field testing its newly developed 1500 series computer.
3) Following the 1965 Task Force Report there was a receptive climate for consideration of the use of computer technology in instruction.

Given these circumstances, it's not surprising that the idea evolved that the four education concerns cited above might be addressed through CAI. A search of the literature revealed considerable evidence that such an approach held promise. Staff papers were prepared suggesting CAI programs that might be implemented. These were discussed at Board meetings and given wide public distribution. As support developed and with Board approval, a proposal was submitted to the Title III office and negotiation begun with IBM.

Program and funding approvals were received, detailed plans developed, and the research and development project started.

Its purposes were to:

1) Develop and test CAI instruction materials to be used in several aspects of the instructional program including: basic skills in math, math for retarded adolescents, individualizing instruction, and increased teacher efficiency.
2) Develop staff capability for effective use of CAI.
3) Identify and validate effective application of CAI.

Actual instruction was conducted by teachers in the four CAI schools. A project staff of twelve prepared instructional materials, wrote computer programs, operated the computer, trained classroom teachers, helped with evaluation, proposed and developed additional CAI applications, reported on the project, and maintained communications with board, staff and citizens. This staff developed a high level of expertise, excellent morale, good rapport with school staff and earned the respect of school officials, board members and interested citizens.

By the middle of the sixth year research and development phase, 16 modular instructional packages had been developed. Programs included elementary arithmetic-diagnostic and instructional, junior high arithmetic-diagnostic and drill, special education-arithmetic, and senior high algebra I and II, and geometry. In subsequent years a range of additional packages were developed from grade one phonics to elementary language arts to high school mechanical drawing, chemistry and French.

During this same period computer literacy and vocational data processing were taught in many high schools. Computer assisted counseling began. A Penn State University graduate course in early identification was used extensively in teacher training.

Evaluating Research Results

Research results were used to help guide program development. Achievement gains for pupils and attitudes of pupils and teachers were very positive for most programs. Where this was not so, programs were modified or dropped. Generally, research results showed significantly greater achievement gains by CAI pupils over non-CAI pupils in elementary arithmetic. Special education results were the most dramatic.

Teachers were able to provide more individualized instruction with computer support and CAI geometry classes with 40 percent more pupils did as well as smaller non-CAI classes.

A CAI Project Advisory Council composed of representatives from the computer and instruction departments, CAI schools and interested citizens played a significant role in coordinating this work among departments and schools. It also designed strategies for frequent Board and citizen reports and discussions throughout the life of the project. A reservoir of public and staff support resulted.

Developing a Model MIS

A *third* major event that influenced the development of computer technology in education in Montgomery County was a joint MCPS-IBM Task Force to develop a model Comprehensive Educational Managerial Information System for a school district. This task force brought computer and education experts together for two years of work. Their model consisted of seven subsystems: Finance, Personnel, Pupil, Facilities, Material, CAI and CMI. With the benefit of this "model" a master plan for a total Information System for Montgomery County Schools was adopted by the Board. Organizational and equipment changes were made to facilitate implementation of the master plan. A Users Council composed of the five Associate Superintendents in the school system met regularly to decide on priorities for subsystem application development and to assure good cooperation and coordination across departments—a condition of utmost importance to success.

Institutionalizing CAI and CMI

The fourth major event was the institutionalizing of the CAI and CMI applications which flowed from the six year (1968-1974) research and development project. This occurred in two phases. First, in 1974 the hard wire, limited capacity, 1500 computer was discontinued and all administrative and instructional applications were brought together into a large computer operating with a common data base. At the same time, the Board adopted an implementation plan for moving CAI and CMI providing for moving programs into 13 elementary and 7 secondary schools in 1974-75. The second implementation phase adopted in 1975 called for variations of CMI application for math instruction in all elementary schools. By 1979-80 this program, known as Instructional System in Math (ISM), was in place in 77 schools.

Recommendations

Are there any lessons to be learned; generalizations to be made from this fifteen years of expereince that might help point the way for successful application of computer technology in the future? I think so. Of course the applications may be quite different, but the management strategies for accomplishing change may not be. Some of those strategies I think are:

1. Efforts to make changes in curriculum and instruction priorities should grow out of real problems that have been identified through research, analysis, opinion polling and other reliable techniques for collecting and evaluating data. Changes that produce visible relief to these well defined problems are likely to maintain the kind of support necessary to sustain them.
2. Have written objectives to be achieved by proposed changes. These objectives should be simply stated so they are understandable and meaningful to the average staff person and parent. They should be achievable. Nothing is more damaging to effecting long term change than making overly ambitious claims and then trying to explain away why they were not achieved; objective setting should be both long and short range. When short range objectives represent measurable increments of progress and when evaluation data shows that those objectives are being achieved, confidence builds in both the managers of the process and the practices being implemented.
3. Research proposed changes to determine if they will in fact achieve the objectives. Search the literature for good data on

relevant research and experience elsewhere. Change in education, especially change as complex as melding computer technology and education, is expensive and draining of staff energy and time. It should not be undertaken unless there is powerful evidence to show that it is very likely to be successful.

4. Prepare a comprehensive plan for building understanding and for introduction and management of the change. It's best to have a broad base of participation in preparing this plan. This step is especially critical when applying computer technology to education. People are reluctant to give up their paper records. Teachers, who typically work alone, must learn to function as part of a team. All must acquire some degree of computer literacy. Training is required. Constant capacity—time, access, and programming must be built into the plan. Management procedures need to assure prompt resolution of disputes.
5. Too often efforts to change education have failed because they were sustained by one dynamic person and when that person left, or condifence in that individual eroded, the program collapsed. Applications of computer technology in education require major changes in staff behaviors and usually cost extra start-up money. They won't succeed unless there is understanding and commitment by staff and citizens. Take time to write up the plan. Meet with staff and interested citizens. Make sure the Board really believes in the undertaking. Involve staff and citizens—like Montgomery County's CAI Advisory Committee—in guiding the new procedures. Keep a constant flow of information going to staff and citizens. Their support will atrophy if it is not nurtured through the years of planning, introduction and institutionalization.
6. Project cost realistically and report regularly on actual expenditures. Distrust will develop if administrators are forever explaining why new programs cost more than was projected. Cost effectiveness is an increasingly significant factor in education. Unless a proposed educational change has real long-term potential for saving money or increasing learning, it should not be undertaken.
7. Provide the management support system necessary to maintain the program. This is especially important in applying computer technology to education. In Montgomery County The Users Councils of the five associate superintendents which controlled allocation of computer time was critical. At one point, 90 percent of computer time during the work day was required to support CAI/CMI. Without this high level decision making authority, that would not have happened. Administrative tasks that have deadlines, like getting checks out, will pre-empt

computer time unless there is authority to control and allocate it.

8. Training, where computer applications are involved, requires special attention. For many the change will require an entirely new way of thinking and working. The technology is mysterious to most people. Giving up the security of old systems whether files of hard copy documents or the use of text book and paper and pencil learning activities comes hard. Thus, training must also help people cope with the personal behavior changes they face.
9. Staff the new technology application to education with a leader knowledgeable in both fields, and who is also a good manager, teacher and motivator and has the respect of colleagues. Any change designed to be institutionalized should not be staffed in start-up phases with only "super people." Such practice may lead to disappointment when the application is extended to the regular staff.
10. Begin any change in instruction or management procedures in a research mode. Accumulate and evaluate data to determine how well the plan is working. Make changes as necessary to accomplish planned activities.
11. Report and discuss progress several times per year. Relate progress to short and long term objectives established in the master plan. Parents and staff are especially concerned where computer applications involve pupils and instruction.
12. Move through planned steps to full implementation. Each step should be manageable. Progress should move forward boldly with constant momentum, but never more in any one year than can be well staffed, supported and managed.

SUMMARY

In summary, the most significant observation to be made in looking back over 15 years of applications of computer technology to education in one school system is that it evolved in a rather orderly, rational way with each new step building upon the expanded knowledge base and successes of earlier steps. The technology is ever changing. Specific applications to education therefore, will be different tomorrow than they were yesterday. The process, however, of effecting change for greater economy and/or effectiveness through deliberate steps that are attainable, well planned and well managed is still sound and still applicable.

Managing Technology Change "MECC: A Management History"

John E. Haugo
President, Edusystems Incorporated
St. Paul, Minnesota

INTRODUCTION

The Minnesota Educational Computing Consortium (MECC) is an organization created by the four public educational systems in Minnesota to coordinate and provide computer services to students, teachers and educational administrators throughout the state. MECC draws upon the resources of member systems and 75 professional staff in providing the overall review of computing plans and budgets; a statewide instructional timesharing system; the support for microcomputers purchased through a state contract; the development of regionally-based management information systems; and support to a variety of special projects utilizing computers.

MECC transcends the various organizational levels of education, serving elementary, secondary, vocational-technical, and higher educational institutions. MECC is organized under the Joint Powers Law, a statute which permits governmental units to form an organization which cooperatively exercises the powers common to each of the entities forming the organization. In the case of MECC, the entities who formed the consortium in 1973 are: the Minnesota State University System (7 campuses), the Minnesota Community College System (18 campuses), the University of Minnesota (5 campuses), the State Department of Education (433 school districts), and the State Department of Administration. The latter agency serves as a member because of its statutory authority relative to the State University and Community College Systems.

MECC has the dual roles of coordination and service. In its coordination role, it maintains a long range master plan and a biennial plan for educational computing in the state, and reviews and assists institutions in developing their annual computer plans. In its service role, MECC operates a statewide timesharing network, develops and implements computer-based management information systems, acts as a broker for similar services from member institutions, supports the acquisition and operation of microcomputers, and contracts for computer equipment that can be used by its members.

Governance of MECC

MECC is governed by a sixteen-member Board of Directors. The State Board of Education appoints six members to the Board representing elementary, secondary, and vocational education. The three systems of higher education each appoint two Board members. These members include high level administrators and governing board members. The Commissioner of Administration appoints one member and the Governor appoints three members to the Board. Traditionally, one of the Governor's appointees has been from the private college sector. The Board of Directors establishes overall policy and governs the operation of the consortium.

The consortium also has an advisory structure consisting of a Planning and Budgeting Committee and a Facilities and Services Review Committee. The latter group is responsible for review of all proposals for computer services. Additionally, there are a number of standing user advisory committees and periodic ad hoc task forces.

Funding

Funding for MECC has come primarily from state sources. Almost all of the budget is either appropriated to the four educational systems or comes from the school districts. MECC signs an annual agreement with the educational systems to provide specific services. The level of services and amount of the contract are fixed prior to the system's funding request to the legislature. This type of agreement provides around eighty percent of MECC's total budget requirements. MECC also provides instructional time-sharing services to the independent school districts. These are billed to the school districts at a fixed annual user charge per terminal access. This source of funding represents slightly less than twenty percent of MECC's total budget. Other support for special projects comes from sources external to the State.

Planning

Each member of MECC is responsible for its own operational plan. For the seven regions this includes the installation of computing equipment under the master contract. The MECC staff works closely with the members' staffs in the development of these plans.

Beginning in February before each biennial session of the legislature, the members assess their needs and work interactively with the MECC staff to develop plans which fall within the master plan for the State. It is intended that the two staffs can agree on an operational plan for the next biennium before the members' staff takes takes its recommendations to its advisory committees. The members present their plans to their own advisory groups before they are officially transmitted to MECC. The MECC staff receives the plan as recommended by the members' advisory group. They review this version of the plan and make recommendations to the Facilities and Services Review Committee. This standing committee consists of a technically qualified peer group. After the review by the MECCstaff and the Facilities Committee, the plan is transmitted with recommendation to the MECC Board of Directors for final approval.

Services

MECC is divided into three operating divisions. The Instructional Services Division manages and operates the MECC Timeshare System (MTS), a Control Data CYBER 73 with 425 user ports. At present, approximately 2,000 MTS computer terminals are located across the state in most public schools, all community colleges and public universities, and many of Minnesota's private schools. MECC also supports the acquisition, installation, and software support for approximately 2,000 Apple II microcomputers. User Services personnel serve the users at all levels by conducting workshops, producing curriculum materials, training teachers and teaching courses on instructional computing. They also make available written materials ranging from periodic newsletters to curriculum guides that can be used to help implement computer use in the classroom. A large multiplexing communications network provides the means by which users access the MTS computer. The computer has a program library of over 950 timeshare and microcomputer programs that supplements curricula at the elementary, secondary and college levels. Programs in the library have been developed and/or contributed by MECC staff and users.

The Management Information Services Division performs tasks related to the development and implementation of management information or administrative data processing services for elementary, secondary and vocational school districts. The services are provided through seven regionally-based service centers located throughout the state. Comprehensive and flexible software has been developed and is being supported and maintained to support the school district management, data processing, and reporting needs in the areas of personnel, finance, student and instructional management. This software operates on Burroughs B6800 series computers.

The Special Projects Division initiates, implements, facilitates, and manages a wide range of activities related to the use of computers in education. In carrying out its responsibility for project development, Special Projects staff become involved in activities ranging from the initial exploration of a potential computer use to the implementation of major outside funded projects. Research projects designed to explore a wide range of hypotheses related to computer use in education are conducted by the Division. Primary support for recent research has come from the National Science Foundation and the National Institute of Education.

Progress Towards Goals

When MECC was established in 1973, a number of goals were identified for the organization. The foremost goals and related MECC accomplishments are:

1. *To achieve economy of scale in computer hardware utilization and acquisition:* There are a number of examples regarding the attainment of this goal. Perhaps the most significant economies have been gained in the acquisition of Management Information Services (MIS) host computers for the Elementary-Secondary Vocational (ESV) regional processing centers. To date, seven major host computer systems with total monthly costs of approximately $140,000 have been acquired at a 40 percent discount through a state master contract established by MECC. Additionally, various terminals and over 2,000 microcomputers have been acquired through state contracts. In addition to price breaks associated with these acquisitions, the compatibility of equipment and time savings associated with procurement have also benefited the state. In terms of the economy of use, the MIS systems as well as the MIS host computer all achieve high utilization and are permitting significant savings to users.
2. *To achieve cost-effective communications networking:* MECC and its member systems currently provide instructional time-sharing service to all the higher education institutions and 350 school districts throughout the state. The annual cost of this network is approximately a million and a half dollars. Because of the economies of joint use of the telecommunications systems as well as the optimization of the configuration, it is estimated that this cost is approximately one-third of what it would have been had the network been established independent of the MECC planning activity. Similar economies are also realized through the regionally-based MIS telecommunications networks.
3. *To minimize system design and development costs:* There are two major developments which have helped minimize the costs associated with computers. The first is the statewide system development and support of the elementary, secondary, vocational information system (ESV-IS). The software is being implemented at the regional ESV service centers. The second major savings in software has been with the MIS system where

over 900 instructional computer programs are part of timesharing and microcomputer libraries. They have been jointly developed and made accessible for all users throughout the state.

4. *To share expertise and successful applications:* Many computer programs, systems, training materials, and usage models have been adapted from major service centers that existed prior to MECC. Most notable among these are the TIES regional center, the University of Minnesota MERITSS system, and the Southern Minnesota School Computer Project based at Mankato State University. It is difficult to quantify in terms of dollars the attainments related to this goal. Additionally, there has been a significant amount of "cross-fertilization" among various educational users because of participation in MECC services and advisory activities.
5. *To assure uniformity and compatibility of data:* The development and use of standard software utilized by all regional ESV centers is the most significant example of attainment of this goal. The information reported to local school districts, regional service units, state and federal government are uniform in terms of definition and compatible in terms of the mode in which the data are transmitted. The higher education institutions have consolidated their administrative data processing or MIS services on major computers and as such have also achieved significant uniformity and compatibility of data.
6. *To facilitate training of educators in regard to educational computing:* In regard to instructional computing, over 500 workshops and presentations are made annually throughout the state. School and college users are typically visited on an annual basis to promote use of the computer as an effective instructional tool. A significant amount of training related to the MIS system has also been conducted by MECC. MECC staff has worked closely with higher education faculty in developing their curriculum course materials related to instructional and MIS computing services.

Management and Governance Problems

Inherent in the establishment of any organization are a number of economic, political, and technical problems. MECC, because of its unique nature as a statewide computer service organization, has encountered its share. The following include some of the problems that have been encountered by the organization during its first seven years of existence:

1. *"Turf" concerns:* At the time MECC was established, the larger educational entities had the most on-going computing activity. They had the least to gain from a statewide cooperative

computing activity. The majority of the political problems which MECC has had to deal with were because of the reluctance of the existing providers of computing services to participate in developments which were beneficial to the state as a whole. In addition, a number of newly created computer services groups have had difficulty identifying their role and, as such, have not always recognized the significance of the roles of MECC and the member systems.

2. *Rejection of original MTS host computer:* Because of a series of technical and political considerations, the original host computer used for the support of the statewide timesharing network did not meet acceptance requirements. This failure caused considerable concern among users, staff, and the legislature. Fortunately, the replacement system was installed with a minimal amount of problems and the network is nationally recognized for both the quality and quantity of services.
3. *Overlapping governance structures:* Along with the problems associated with role delineation is the fact that there currently are a number of governing boards with authority related to educational computing which include: the MECC Board, the member systems' governing boards, regional governing boards, and local school district boards. Although there is rationale for the existence of each of these boards, the fact is that many governance issues are dealt with in a cumbersome, time consuming manner because of the number and, in some cases, overlap of responsibility of these boards in regard to educational computing.
4. *MECC review and services responsibilities:* At times, concern has been raised about MECC's responsibility for coordination planning on one hand, and the provision of services, on the other. Where MECC itself is one alternative as a provider of services, it has been felt that its review authority is somewhat inappropriate. The Board has chose to deal with this by having separate advisory structures, namely, the Facilities and Services Review Committee and the Planning and Budgeting Council, to advise the Board on matters related to its regulatory and services roles. It is also felt that because of the composition of the Board (high level administrators and lay representatives), it is in a position to make decisions regarding a potential area of conflict.
5. *Uniqueness of the organization:* Although it is true that there are regional and educational system cooperatives throughout the nation, there is no other state that has a statewide educational computing services cooperative for all levels of education. As such, many of the problems that are encountered by MECC are unique and there are no other models to follow. This fact has

made the management tasks of the MECC Board and staff challenging. Hopefully, it will enable MECC to serve as a prototype statewide computing services cooperative.

6. *Difficulty with administrative procedures:* When MECC was initially established, they had adopted administrative personnel, accounting, payroll, etc. from the state and/or University of Minnesota. Legislation passed in the 1977 session required that MECC become a part of State Civil Service. Because of the uniqueness of the organization, the high demand for data processing staff, and the need for flexibility because of changing annual goals, many frustrations in the administrative operations of MECC have been realized by staff. Problems associated with cumbersome administrative procedures have impacted the timely completion of some of its annual objectives.

SUMMARY

It can be said that MECC has met primary goals and that it has been successful in terms of the overall purposes for which it was created. It should be pointed out, however, that this particular approach to statewide coordination and delivery of services worked in Minnesota in a given point in time. It sould not be assumed that the MECC model would work for other states with different financial, political, and geographic considerations. Also, rapidly changing computer technology will require that the MECC services model, as well as other cooperative computing centers, be reevaluated periodically.

Most of the problems that MECC has encountered have not been economic or technical, they have been political or human problems. As many individuals or organizations are involved in a cooperative decision process, it follows that conflicting interests sometimes affect decision making processes. Hopefully, MECC has achieved a balance of power, so to speak, in the manner in which decisions are made. If there is any one area in terms of governance that could be improved, it would be in the streamlining of the accountability to the rest of the state government.

In summary, it seems that the need for cooperatively produced, specialized educational services is going to increase at the same time that enrollment and funds for education decrease. Hopefully, MECC will continue to provide the means by which one type of educational service, educational computing, can be effectively made available to educators in Minnesota.

Managing the Development of the Public Telecommunications Center, Spokane, Washington

Walter Schaar
General Manager, KSPS-TV
Spokane, Washington

INTRODUCTION

The plain and simple fact is the Public Telecommunications Center began with two people struggling to find a solution to an inherited problem. The two people were the Director of Engineering and myself, General Manager of KSPS-TV, a public television station licensed to the public schools of Spokane. The problem was to find a way to deliver instructional television programs to junior and senior high school classrooms. As manager of KSPS-TV and a school district employee, I was taking a great amount of criticism from teachers and administrators of junior and senior high schools over the station's "inability" to deliver any services to grades 7 through 12. In contrast, kindergarten through 6th grade classes were utilizing the over-the-air channel nicely.

Responding to this problem, the KSPS-TV engineering department designed a closed-circuit cable system to interconnect all of the buildings in the Spokane schools. Just as the finishing estimates and design work were being completed, an announcement was made that the city council was going to consider an "emergency ordinance" to establish a cable franchise.

One must keep in mind that in 1971 cable franchising was less competitive and less politically oriented. The city council realized that it was not going to be able to "give the franchise" away. Commercial television stations, local business leaders, and public broadcasters (KSPS-TV) requested that the cable issue be turned over to a committee of interested citizens. This committee would study the cable question and produce a reasonable set of specifications for potential cable bidders.

Preparing for Cable

I was appointed by the Superintendent of Schools to represent School

District 81 and KSPS-TV in those discussions. During 1972, meetings to develop cable specifications were regular and well publicized. It is interesting to note that only one of the institutions of higher education attended any of these meetings or showed any particular interest in cable. It is important to focus briefly on this point because some of the higher educational institutions felt that Spokane Schools and KSPS-TV dominated educational channel capacity—later this attitude was a major management problem to overcome. After a year, the specifications were ready. The cable companies prepared proposals and the selection process began. (Having now lived on both sides of the franchising fence, I have seen some educational institutions shy away from the selection process apparently because of its political nature. Other institutions openly and wholeheartedly embrace the process (not a particular company) and they will, in the long run, be the winner.)

After Cox Cable was awarded the Spokane franchise, the higher educational institutions became fully aware of the progress that had been made in the educational arena by KSPS-TV and the public schools. These institutions began to get into the act—some through resentment and others through enthusiasm. The city council had already begun pressuring educational entities to cooperate, essentially saying, "Get your act together or forget it. We will not include you at all if you can't agree." At that time cable companies had to have letters of compliance from the FCC before construction could be started. And, because Spokane was the first system to request five educational channels, it was necessary for all the educational parties to work together to show the FCC that five channels could be programmed effectively.

Utilization Clause

A portion of the Spokane cable ordinance deals with this issue of utilization; it was called the "use it or lose it clause."

Excerpt from City of Spokane cable ordinance:

> That a grantee shall reserve an initial five (5) channels, or such number as the F.C.C. shall allow, solely for education on a development basis. Upon completion of the basic trunk line, if it is found that 80% of the week days from September through May, both months inclusive, during any consecutive three (3) hour period for six (6) consecutive weeks, the number of these channels may be reduced to the extent necessary to meet this less than 80% level of usage. If it is also found that 80% of these channels are being used 80% of the week days from September through May, both months inclusive, during any consecutive three (3) hour period for six (6) weeks, additional channels may be requested to meet this more than 80% level of usage. These channels will all remain available to the schools without charge for a period of five (5) years beginning from the completion of the basic trunk line of the system, provided, however, that said channels shall be furnished without charge subsequent to said five-year period if F.C.C. rules and regulations allow.

With the utilization clause, the city council pressure for cooperation, and all of our collective educational reputations on the line, it became evident that a cooperative venture was the proper way to proceed. The fortunate circumstances of having a strong public TV station licensed to a public school district with well over 10 years of television experience, carried the group along for the first few years while the cable system was being constructed. In addition, there was considerable television interest at one of the community colleges and one private four-year institution. In the early stage of the Spokane system between 1973 and 1975, KSPS-TV personnel abandoned the plans for a closed circuit system since cable was imminent.

Implementing Action Plan

I unofficially assumed management of the Spokane consortium to begin to put into action what we had promised. The plan of action involved managing two distinct developing programs:

- One program involved designing a total public telecommunications center, including equipment acquisition.
- The other program involved the use of cable in the secondary schools of Spokane. Let's discuss the secondary schools and cable first.

The Spokane secondary school program had two beginning objectives:

1. Create enthusiasm among secondary people (i.e., teachers and students where there was little.
2. Develop a step-by-step construction program which included both hardware and software in each junior and senior high school.

Spokane schools were fortunate to have educators and administrators who were interested and willing to sacrifice time to start the program planning process. The pilot project, funded in part by the Corporation for Public Broadcasting, began in the part of town where cable was first initiated. The project grew from four schools during the 1976-1977 school year, to eight schools during the 1977-1978 school year, and then eventually to all 13 secondary schools in 1978-1979.

The management of the Spokane project meant balancing software acquisition and production with hardware acquisition and installation. Many "chicken or egg" decisions threw the balance of progress one way or the other. Using *any* television in a school district requires making programming decisions, but using *cable* television requires making programming, equipment and facility decisions.

Almost every decision is going to cost money in both the short and long term. Television software and hardware both have very short lifetimes and are reoccurring expenses. Very few school administrators know that or want to admit it.

The first step is to clearly identify how cable in the classroom will be used:

1. Transmitting prerecorded sequential TV programs for student use.
2. Nonsequential instruction to classroom.
3. Teacher training programs.
4. Locally produced outreach programs to the community.
5. Additional training opportunities for students.

The first two priorities were to deliver educational programs to the classroom. All the other uses together would not equal 10 percent of this.

The second decision was a plan to equip classrooms and buildings properly so cable could be received in each classroom. We knew that was going to require a sizable capital expenditure. And, we knew that the school administration and the School Board were going to need some options. More importantly, we knew above all that nothing was going to happen all at once.

Establishing Capital Expenditures

In order to document a detailed capital expenditure program, we had to establish:

1. What the total package should be.
2. The timing of the project.
3. How many dollars would need to be spent to accomplish the task.
4. What would the acquisition of this type of equipment mean to the day to day operating expenses.
5. How would equipment be replaced as it wore out.
6. What were the sources of funds for the immediate expenditures.
7. What were the long run sources of funds for maintenance and replacement.

There were several unique elements to contend with in the case of capital expenditures for cable and the classroom:

- All students and teachers need to be treated similarly as fast as possible. Any long term (more than 3 years) proposal would never fly.
- Inflation being what it is, the quicker the better.
- If however all the hardware is installed and software is not ready there will be charges of misuse of dollars for "unused toys."
- We would have to proceed quickly on a broad basis to assure "something for everyone" or we would lack the support necessary to acquire administrative and board approval.

A total plant design was worked out. The ultimate goal was to:

- Wire every full-time teaching station in the Spokane School District.
- Place a color, wall-mounted or otherwise permanent TV set at each teaching station.
- Provide each building with one channel "internal" closed circuit system.

- Build a headend distribution center with:
  - 26 VTRS-playback/record
  - 5 modulators
  - 7 time base correctors
- A routing switcher capable of simultaneously:
  - Feeding all five channels
  - Dubbing at least 2 separate programs
  - Recording at least 4 incoming signals i.e., upstream from various studios throughout the system, from Westar and Satcom satellites, from channel 7 master control, or studio production
- A computer capable of a:
  - Library function, including program rights, end dates, etc.
  - Machine control function
  - Programming function

Once that plan was put in place, putting the sequence together was a matter of finding possible sources of funding and defining a time schedule for the entire project.

Planning Options

What follows are planning options presented at regular intervals to the administration and board. These options provided both groups not only with close control of the progress of the system but also required them to become involved and interested in how the project was moving. Recommendations for the cable television program for 1980-81 and 1981-82 include:

Recommendation #1: Television Sets and Wiring of School Buildings

Each of the following three proposals contain the recommendations; however, the implementation schedule varies which affects the expenditure required.

Proposal #1 (Spring 1980)

Purchase TV sets to serve 65% of all secondary school teaching stations—100 sets @ $550 =	$ 55,000
Purchase TV sets to serve 90% of all elementary school teaching stations—483 @ $550 =	265,650
Wire all classrooms in all schools—462 @ $250 =	115,500
	$435,150

Advantages—TV set prices are now lower then any time before this, and lower than they will probably be next year. A bulk buy should save money.
—The television sets and wiring can be used now.
—The price to wire all schools at once, especially
—during the summer, will be better.

Disadvantages—$436,150 is a large expenditure for one year.

Proposal #2 (Spring 1980)

Purchase TV sets to serve 60% of all secondary school teaching stations—45 sets @ $550 =	$ 24,750
Purchase TV sets to serve 90% of all elementary school teaching stations—483 @ $550 =	265,650
	$290,400

(Fall/Winter 1980)

Wire classrooms at Adams, Franklin, Hamblen, Indian Trail, Logan, Madison, Pratt and Linwood—172@$250	$115,000
	32,450
	$147,950

Advantages—TV set prices are low now.
—The TV sets can be used now.
—We have reduced out per-year expenditure requirement.

Disadvantages—Some schools need wiring now.
—Wiring would have to be done during school time.

Proposal #3 (1980-81)

Purchase TV sets to serve 60% of all school classrooms—310 @ $550	$170,500
Wire classrooms at Adams, Franklin, Hamblen, Indian Trail, Logan, Madison, Pratt and Linwood—172 @ $250=	43,000
	$213,500

(1981-82)

Purchase 218 TV sets to bring all elementary classrooms to 90% =	$119,900
Wire remaining schools—290 rooms @ $250 =	72,500
	$192,400

Advantages—TV sets would be improved at all levels.
—Schools with impaired reception would be helped.
—The expenditure is divided over a two-year period.

Disadvantages—It will cost more in the long run.

Recommendation #2: Closed Circuit Television

No decisions should be made regarding secondary school use of originating equipment and the intern program until the comprehensive study now under way is completed by the Basic Education Department, in cooperation with KSPS-TV, I.M.C., and Vocational Education. When this study is completed, May 1, 1980, consideration will have to be given to the recommendations.

Recommendation #3: Maintenance

KSPS-TV personnel continue to provide maintenance on district television equipment.

Recommendation #4: Play-Back Units at School

In March of 1979, equipment was installed in all secondary schools to provide a basic one channel of local school playback capability This is working very well. Many requests have been received for additional pieces of equipment such as cameras and switchers to improve school production of television programs.

It is recommended that the single channel concept be continued for school playback capability. It is further recommended that no decision be made regarding purchases of additional cameras, tape recorders and other equipment until the Basic Education report (see Recommendation #2) is completed.

The district purchased three portable color camera VTR combinations for schools to be used on a check-out basis from KSPS-TV. The equipment has just arrived and is being checked out to schools. The results of this experiment will be reflected in the comprehensive report.

Seed Money

The most obvious problem was an initial large amount of money would be necessary to put together the headend origination center. This was not something that could be done on a piecemeal basis.

Cox Cable construction plans also had to be taken into consideration. We requested that Cox exceed their original channel capacity commitment and install seven-mile institutional cable from the Public Telecommunications Center to the Cox Master Terminal Center. Frankly, the Cox construction schedule gave us the necessary excuse to sequence our purchases and thus give the financing of the project breathing room.

Fortunately a small demonstration program, the Telecommunication Demonstration Grant Program administered by Ann Erdman, was available through the Office of Education, Health, Education and Welfare. The maximum amount supposedly available for any particular demonstration was to be no more than $50,000.

The timing of the grant requested, the grant maximum, and a more clearly defined cable construction schedule made it all the more necessary to get the total educational community better organized.

Designing a Total Public Communications Center

The loosely knit consortium had been meeting only occasionally since the outset of the construction. Now that a significant portion of the system was built and cable connection penetration had reached a large enough level, colleges were starting to think in terms of delivery of instructional material to subscriber's homes.

The next step—the most difficult of the entire process—was convincing all of the colleges that a consortium was a much more effective and efficient way to operate a cable origination center.

With convincing the colleges accomplished, the consortium put collective strength and clout behind the grant request to the Telecommunications Demonstration Grant Program. The grant request was for $169,000 rather than $50,000, with 13 institutions co-signing the request. The result was a successful $169,000 grant to equip the origination center for use by all the institutions. The grant forced the issue of establishing long term goals of the consortium and devising a method of financing the long term operating costs. The consortium or C.A.B.L.E. (Cable Advisory Board for Learning and Education) clearly defined these goals:

1. Work as the main organization representing all levels of public and private education and the public to establish guidelines for access to educational channels authorized by the City of Spokane and operated by the franshisee of the city-authorized CATV system;
2. Act as a "clearing house" for all educational constituencies to reduce wasteful duplication of effort and resources in providing programming for the CATV system;
3. Encourage cooperation and sharing of resources among board-represented institutions and districts and other educational constituencies;
4. Help members impress their own administrations with the many advantages inherent in thoroughly-planned, constructive use of CATV channels; and —
5. Communicate to the community at large the educational and public affairs potential of CATV and to encourage their judicious use of available channels.
6. Develop specific programs, courses, workshops, seminars and/or other software to be presented on the CATV educational channels by Board-represented members, other educational/instructional groups and organizations, and/or individuals, or any cooperative agreements among these constituencies;
7. Establish policy guidelines for priorities in the processing of all applications for access and use of the CATV channels set aside for educational development;
8. Develop specific recommendations, including suggested fees, when applicable, for the use of TV production facilities by Board representatives and the public;
9. Establish a procedure for considering all applications for access and to include in such procedure some method of appeal to

those applicants who think their material warrants higher priority or whose request has been rejected;

10. Develop a "Procedural Guideline and TV Production and Preparation Recommendations" for all prospective users of the CATV educational channels; and
11. Through the medium of the Board established by this Agreement, seek cooperative agreements with other institutions, consortia and public agencies in order to further the objectives of the Member institutions.

In addition, the agreement established a managing institution to operate the center and maintain the equipment and provide administrative and payroll structure. The agreement also outlined some general policies that helped maintain a degree of professionalism and program continuity concerning use of all the channels for education. (Copies of the complete agreement can be obtained by writing Walter Schaar, Director of Education and Information Services, Cox Cable Communications, Inc.)

With the advent of the consortium agreement and the establishment of KSPS-TV/School District 81 as the managing institution, the major hurdles to organization were over. As of June, 1980, the managing institution is School District 81. The center employs a manager, two full-time operators, one scheduler, and uses at least one half person for maintenance from the KSPS-TV engineering staff.

The general manager of KSPS-TV is the chief executive officer of the operation. The director of telecommunications of KSPS-TV is responsible for the maintenance and equipment replacement procedures for the center.

At this stage of the development, the center is just entering into its first pure operational year. However, operations are running so smoothly that organizations who are members of the consortium but are physically outside of the franchise area are accessing funds to interconnect themselves with microwave on a two-way basis. Figure 1 shows those interconnecting institutions with a dotted line interconnected.

Cox Cable and the Consortium have also developed the upstream capacity of Spokane's 35-channel systems so that 4 channels can be fed simultaneously up to the Public Telecommunications Center. This allows for two-way use between institutions.

Management of Center

The management of the total center is now divided into two distinct elements. First, is the ongoing operations including estimating yearly usage and fees to be charged to cover those hours of use. Those estimates must not only cover the hourly operating costs but also take into account equipment replacement. And secondly, encouraging all Consortium members to develop original programs.

The Consortium now operates much like a board of directors, electing

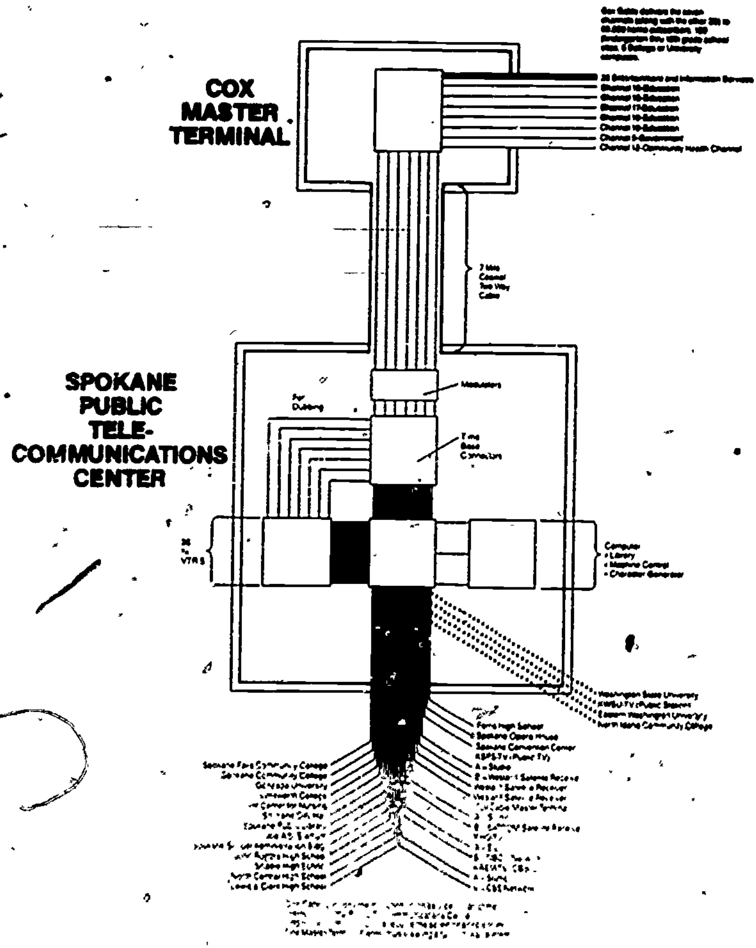

Figure 1

a chairman who is responsible for bringing the directors together to conduct business. He or she also is the chief liaison with the manager of the managing institution. The Consortium manager and the CEO of the managing institution cooperate in the selection of personnel for the center. The Consortium, to this point, does not deal with either program production or acquisition as a group. Each institution is responsible to their own. The cable manager, however does supply each member institution with program source information and is responsible for seeking new funding sources for programs. At the present time the Consortium funds only the operation of the telecommunications center.

The cable Consortium has generated a high degree of cooperation. The two-year and four-year schools using telecourses have:

- Started to schedule in such a way to allow steady progress by a TV student.
- Hastened the establishment of credit transfers.
- Eliminated almost all duplication of programs.

In addition, all members of the Consortium have started sharing equipment for special needs. When the final agreement was signed in June, 1980, a survey was taken to see just what we had managed to interconnect. For a community of approximately 280,000 people, the results of that survey were staggering:

- two 40′ × 50′ fully equipped studios
- four 30′ × 40′ fully equipped studios
- one 35′ × 80′ fully equipped studio
- three instructional media centers at two 4-year institutions and one, two-year institution
- 10 Salor studio cameras $45,000 to $120,000
- 14 ENG cameras $18,000 to $43,000
- Over 200 ¾" VTR's
- twelve 2" Quad VTR's
- six post production studios

And, the managers of this mass quantity of equipment and facilities meet once a month and willingly loan to other institutions.

Several members of the Consortium are in the TV production and technician training business. Spokane Schools/KSPS-TV have an active high school intern program. Spokane Falls Community College has a well-established broadcast curriculum and Gonzaga—Eastern Washington University and Washington State University all have four-year programs in broadcasting. One of the goals of the Consortium is to sequence these educational programs so a young person could graduate from college with 6 to 8 years of both academic and hands-on experience.

The management of the Consortium activities are really shared by the Consortium chairman, the manager of the managing institution, and the cable manager, who is hired by the first two. In contrast, the management of the use of cable by Spokane public schools is quite a different process and involves a greater number of people.

The manager of the public TV station is responsible for the use of cable by Spokane public schools. The manager of KSPS-TV sets aside all the operational aspects of the center and is heavily involved in programming, production, acquisition, utilization, and maintenance, and operation of that equipment used solely by School District 81 personnel.

Program Content

Program content is decided by the instructional department. The instructional television coordinator reports to the superintendent of instruction for content and to the general manager for logistic support—i.e., production, promotion, etc. *Maintenance* of the TV sets and interior wiring of the schools is under the direction of the TV station engineering department, with help from the school district physical plant department. This team of 2½ people is responsible for 1,500 color TV sets, twenty ¾" VTR's and all the building and construction equipment in 13 secondary schools and 38 elementary schools. This cost had to be projected in the original total plan as additional operation costs above and beyond the TV station maintenance. And, *production* of any kind whether it be in studio or done with remote truck on ENG including all post production editing is coordinated by the operational manager.

Each of these three department heads are responsible for developing estimated budgets on a year-by-year basis. The total operating budget of the use of the cable origination center by School District 81 and the exclusive costs of school programming, production, and maintenance are combined by the general manager and shown as a separate accounting program in the total KSPS-TV operating budget.

SUMMARY

The manager of KSPS-TV is the center of focus for the TV station and the entire telecommunications center. It is perhaps this that has allowed the center to acquire its unique nature.

Through the years of good faith in negotiating, all of the educational institutions in the area are convinced that the Public Telecommunication Center and an organization like C.A.B.L.E. is the most logical, effective, and efficient way to use multi-channel cable.

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The Consortium Approach: Preserving College Decision-Making

Philip C. Dolce
Director, Center for Public Media Programming
Bergen Community College
Paramus, New Jersey

INTRODUCTION

The subject of this book, technology and education, is most timely for it implies a partnership between a series of sophisticated methodologies and those established institutions charged with fulfilling the nation's formal instructional mission. The major question today is not the acceptance of technology, but rather its organized and systematized use in education. Even the most elementary textbook will reveal that organization and system (with the political and economic power which naturally flows from it) are as important as the machines in the actual application of any technology.

A case in point is the use of media-based instruction in higher education. In an earlier era, advocates of this methodology were usually forced to deal with such issues as the mere acceptance of the notion of media-based instruction; proving that this methodology was as valid as more traditional methods of instruction; and refuting the notion that teachers would lose their jobs or suffer a reduction in function or prestige if this technology were accepted.

While some of these questions linger on, there is no doubt that our major focus now must be concentrated not on acceptance but on organized use. To be specific, what role will established institutions of higher education have in employing mass media instruction and how will these institutions assist in the future direction of the entire field. These questions are based on an assumption that colleges and universities should have a substantial role in determining any matter pertaining to higher education. However, this assumption is not shared universally. Robert L. Hilliard, who is presently on leave as chief of the Educational Broadcasting Branch of the Federal Communications Commission, is one of a number of individuals who have advocated an Open University for America. However, he believes that the administration of an Open University "should not be in the hands of such traditional institutions as existing colleges and universities which, on the whole, have done little to show that they understand the relationship between media and education."

Master Plans

In general, institutions of higher education have suffered a loss of power and prestige for the last ten or fifteen years. In the 1960's, master plans for higher education were rapidly put in place so that by 1970 virtually no state was without one. Under such master plans, decision-making power over such issues as admissions, budgets, tuition, and programs were removed from local control and placed in the hands of state officials. Reduced enrollments, combined with increased questions about the relationship between higher education and potential employment opportunities, contributed to a decline in prestige for institutions of higher learning. Ernest L. Boyer, Jr., President of the Carnegie Foundation, recently stated that "there is evidence abroad that the nation's colleges and universities are no longer the creative institutions they could be. They are tired, living on the intellectual legacy of the past."

Media-Based Instruction

Such attitudes and criticisms, no doubt, will affect organizational plans for media-based instruction. There is a tendency to believe that established institutions cannot support the implementation of new concepts and that an idea cannot be fostered unless it is nurtured in an entirely different organizational structure. This has been reinforced by the fact that some of the most active opposition to media-based instruction in particular, and technology in general, was found on college campuses. It also is true that tradition and democratic participation usually slow down the centralized direction, efficiency, and speed under which new techniques can be deployed. While all of these statements have some basis in reality, they tend to ignore the remarkably adaptive nature of American higher education in general and the history of media-based instruction in particular.

Despite its technological base, media-based instruction in the United States is not a centralized movement. Instead, the strength of the movement was marked by voluntary local and regional efforts of institutions of higher education located in different parts of the country. One of the major reasons decision-making power was left to individual colleges is that most state educational master plans ignored this field entirely. Similarly, those who controlled the nationwide radio and television network delivery systems were not overly concerned about attempting to organize what appeared to be such a marginal market.

Therefore, unlike the British Open University or even elementary education in this country, media-based instruction struggled to find its own organizational base.

In a number of areas around the country, media-based instruction was quitely fostered along natural and rational lines of development. In many cases, institutions of higher education banded together to form constituency-based consortia which then utilized available technological delivery systems. Such an approach superseded local, county and in some cases state boundaries. Each region, therefore, was self-defined by the forces of geography, technology, and voluntary institutional alliance.

These consortia served a number of functions. They allowed colleges to pool resources and expertise while deriving cost-sharing benefits for the leasing and administration of media-based instructional material. Consortia provided a forum for democratic participation in decision-making and an organization for mutual support. They served as a bridge between two-year and four-year public and private colleges, thus reducing competition and resolving issues of territoriality. Membership in such organizations gave colleges the flexibility of participating in some projects but not in others without the threat of total exclusion. In many cases, the voluntary and gradual development of media-based instruction reduced the fear of technology on college campuses. It allowed institutions of higher learning to adjust their programs and procedures to accommodate the new technology.

Consortia

Consortia also enabled colleges to rationalize technological delivery systems which not only cross traditional college boundaries but political ones as well. This, of course, encouraged local commercial, cable and public television stations to provide broadcast time which would not have been forthcoming otherwise. As Elton Rule, President of ABC, noted:

> The consortium concept not only enables broadcasters to respond more effectively to the educational needs of the communities, but helps us to allocate the finite amount of time we have to offer on a more equitable basis for all.

Regional consortia, therefore, have successfully demonstrated an ability to merge educational autonomy with a technological base which can serve all its members. Thomas W. Hobbs, of Seminole Community College, might have been describing most of these organizations when he stated that the Florida Consortium "was designed to meet the needs of the individual colleges and was not superimposed upon the system at the state level."

The lack of imposed structure and uniformity allowed for wide experimentation to improve the learning experience of students who utilized media-based instruction. The absence of bureaucratic rules fostered innovation and imagination on local college campuses to recruit and then service "nontraditional" students. These efforts were encouraged and enhanced by consortia activities. A series of recent seminars entitled "Working with Telecourses," sponsored by the National Association of Educational Broadcasters (NAEB), found a consistent belief that consortium activities fostered better services to students.

The importance of regional consortia cannot be overstated. They represent the grassroots movement that characterize media-based instruction in this country. Today, there are over a dozen major consortia in the United States. No two of these consortia are exactly alike. Examples of various types of regional consortia include:

The Capital Area Higher Education Mass Media Council

The Capitol Area Higher Education Mass Media Council is a newly formed organization which represents the interests of eleven two-year and four-year public and private institutions of higher learning in Virginia, Maryland, and the District of Columbia. The Council seeks to act as a systematic liaison with public and commercial broadcasters, cable companies, and radio stations. WETA and WVET and the Consortium for Continuing Education of Northern Virginia already are working with CAHEMMC.

The Tri-State College Consortium

The Tri-State Consortium, (soon to be renamed the Eastern Educational Consortium), was founded in 1973 and consisted of twelve colleges working with one PBS station. Today the organization is the second largest media-based consortium in the United States with fifty-five two-year and four-year public and private colleges in New York, Connecticut, New Jersey, and parts of Pennsylvania and Delaware. Its unique organizational configuration is due to long-standing historic trends in higher education and the overlap of technological delivery systems. The consortium has reached the limits of its geographic service area and currently works cooperatively with commercial television (ABC affiliates in New York and Philadelphia, and WOR), public television (New Jersey Public Television and members of the New York network of PBS stations), and cable television (over 20 companies including UA Columbia, Cablevision, Suburban Cable, etc.). The Consortium offers four telecourses a year and provides video duplication and other support services to members.

The Southern California Consortium

The Southern California Consortium for Community College Television, a cooperative liaison of 34 Community colleges and six counties in the Los Angeles area, was formed in 1970 as an organization dedicated to the production and distribution of college-credit courses via broadcast television. Two hundred seventy-five thousand students have enrolled in courses that the Consortium has offered. Currently ten broadcast television stations are involved in this effort: major network affiliates (ABC, CBS, NBC), independent broadcasters, and both community-based and college-licensed public television stations. At least 25 courses are offered for credit each year. Courses produced by the consortium are marketed nationally.

The Florida State Consortium

The Florida Community College Radio and Television Consortium was formed in 1973: to provide channels for users of media-based instructional programs; to share ideas, experiences, and costs; and to reduce the costs incurred by individual institutions in the use of television-based instruction. The state of Florida is broken up into six regions based on broadcast signal coverage areas. The courses offered vary within the region.

It is true that active opposition to media-based instruction was most vocal on college campuses. However, we should also recognize that whatever success this field has enjoyed has been due to the innovative role certain individual colleges (such as Coast, Dallas, Chicago, Miami-Dade and the University of Maryland) have played. It is also due to the strong efforts of regional consortia including those previously mentioned plus others that come to mind, such as The University of Mid-America and the Appalachian regional consortium. Not surprisingly, many of the innovative colleges cited above also belong to regional consortia which service their geographic areas. Success in this field has been substantial since approximately 500,000 students annually enroll in organized instructional experiences designed for delivery by mass media.

These results were achieved within an organizational plan which has been naturally emerging for almost a decade and is rooted in the full participation of existing institutions of higher education. The AACJC Mass Media Task Force has strenuously encouraged national co-operation, but recognized that the strength of media-based instruction "lies in the optimal use of local distribution outlets and provision of services tailored to the needs of local learners."

Organizational Alternatives

Due to the current level of success of media-based instruction, new opportunities have emerged for massive funding and national distribution of material. There is a definite feeling that we are on the brink of a tremendous breakthrough in the use of technology. This has naturally led to discussions about the organization or rather the reorganization of the field. Perhaps state or federal officials should be charged with the responsibilities of implementing mass-media instruction? Perhaps a series of experimental colleges should be entrusted with responsibilities for serving student needs or a national university should be established? Perhaps the delivery of all instructional material should be funneled through one agency to maximize impact? Such ideas deserve careful consideration.

Hopefully, we also will carefully consider the successful pattern of development which has emerged over the last decade. This pattern has united innovation with tradition by preserving the decision-making power of existing institutions of higher learning through constituency-based regional consortia. National programs, including technologically-based ones, do not necessarily imply the need for a highly centralized decision-making apparatus, especially in America. Professional planners have long recognized that a regional approach to certain crucial public policy matters is highly desirable, especially if they transcend political boundaries. For instance, housing, transportation, and open space utilization were all considered to be the responsibility of local and state officials. Yet these officials could not cope with such problems which extended beyond their jurisdiction because of natural geographic and technological factors. A frequently used alternative was to impose uniform national solutions to offset local and state parochialism.

However, many federal officials have come to recognize that highly centralized decision-making employs a strategy which completely disregards established practices and traditions. In addition, national decision-making also fails to recognize local and regional differences and imposes a uniformity of practice which cannot be sustained in certain geographic regions. Most importantly, such actions usually fail to build a consensus based on meaningful participation of representative institutions. Therefore, the federal government has tried to counteract these negative effects by establishing regional planning authorities which transcend local political boundaries, but recognize the natural and historic forces which helped to shape a geographic area. Interestingly, media-based consortia have acted in much the same way as regional planning agencies.

A common sense solution is to build on the organization pattern which has already emerged. The idea of preserving the college's decision-making power in media-based instruction should not be viewed as a gift to institutions of higher education. In fact, it was their work and that of their voluntary organizations which gave life to this field. Regional consortia have already begun to cooperate on a number of issues and this effort should be encouraged. It is not too difficult to imagine that this dialogue might lead to a national association of consortia. Such an organization would help determine those issues which traverse the entire country. Thus local, regional and national concerns would be accounted for in an organizational pattern based on the real participation of institutions of higher learning. In order to insure this organizational pattern, regional consortia have and will continue to assume the following responsibilities:

1) To provide an administrative framework that permits democratic participation from its membership while also providing a strong regional voice for higher education;
2) To provide support services to member colleges.
3) To assure that all technological delivery systems (public and commercial broadcast, cable, radio, newspapers and self-paced home study) are open and available to its membership.
4) To pool financial resources to make media-based instruction cost efficient.
5) To pool expertise and experience to continually improve the state of media-based instruction.
6) To work collectively with other regional consortia in order to effectively influence and develop national policy on telecommunications.
7) To encourage the development of similar regional groups in areas of the country where they do not presently exist, in order to insure that all geographic areas receive constituency-based direction and are fairly represented in national decision-making.

SUMMARY

Educational technology necessarily involves a concept of partnership. Those who control the means of mass distribution on a local or regional level such as cable companies, radio and television stations (both commercial and public), as well as newspapers always have been essential to the success of the field. These long-standing partnerships between colleges and local stations are beginning to be formalized in consortia arrangements. Similarly, state educational authorities and regional planning agencies have an important role to play in the utilization of educational technology. The diverse interests of so many groups can only be accommodated in a regional configuration in which all have a strong sense of responsibility.

Mass media is only one aspect of the technological revolution which will impact on higher education. The home computer, the video disc, teletext, and other microelectronic methodologies are rapidly gaining attention. We will soon be facing the same problems of their organized and systematized use. It is evident that the academic community must be heavily involved in these activities. Individually, colleges are not strong enough to control or even influence this movement. On the other hand, a national organization which claims to represent the interests of all institutions of higher education cannot provide access for meaningful participation by its membership. However, the collective strength of regional consortia combines the power of a national organization with the full participation inherent in local assemblies. In addition, consortia could expand their role to include many different types of technologies. Thus, these organizations should evolve into regional learning centers within easy access of member colleges.

Too often technology has been associated closely with efficiency and centralized direction in its organized use. Older organizational concepts such as voluntarism, tradition, local control, and participation are thought to undermine the effectiveness of technology. Such an approach confuses means with ends and gives technology a life of its own. In reality, technology should provide a service to help improve the human condition. This service is enriched rather than limited by the full participation of those institutions already entrusted with the educational destiny of the nation.

Accreditation and Technology Issues

Jerry W. Miller
Director, Division of Academic Affairs
and Insitutional Relations
American council on Education
Washington, D.C.

INTRODUCTION

Accreditation issues raised by the use of educational technology are not substantially different from those raised during the decade of the seventies by the nontraditional education movement.* Simply put, with the coming of nontraditional education, of which instruction by technology is a part, judgments about quality now have to be made on the basis of considerations that go beyond educational and decision-making processes, educational resources, and qualifications of faculty to focus more on educational outcomes.

The nontraditional educational movement put accreditation into a role that it has not historically savored. The accreditation fraternity through the years has preferred to emphasize the improvement of quality function of accreditation over providing assurances about the validity of credentials awarded by colleges and universities. This latter function of accreditation embodies the consumer protection concern that came to the fore in the early seventies and which now may be receding as the primary raison d'etre of accreditation.

In elaborating these points, it is necessary to review some key historical aspects of accreditation and some of its fundamental assumptions. Only then can the accreditation issues raised by nontraditional education be understood.

Meaning of Accreditation

Accredited status awarded by a recognized accrediting agency is a

* For purposes of this presentation, instruction by technology is referred to as nontraditional education.

public expression of confidence in the expertise and integrity of the accredited institution in meeting the minimum standards of educational quality. But that status means many things to many people.

Its most common meaning to the public at large, although rarely if ever stated so directly or frankly by an accrediting agency, hinges on the question of whether the degree or course credits earned at the institution in question are any good. How does the degree compare in the marketplace with degrees conferred by other institutions? Will it be valued and rewarded by employers and other educational institutions?

Questions regarding the validity of recognition conferred for educational accomplishment by an educational institution stem from the uses of educational credentials in our society. Credentials is a broadly used term, often expressed in common parlance as he or she "has the credentials for the job." The speaker of such a phrase most often is referring to formal recognition of educational accomplishment conferred by an accredited institution, although successful work experience is sometimes a factor. The frequency with which the reference is made points up the central role of credentials in a complex, highly mobile, and technological society. Firms, clients, or patients in need of esoteric services, when left solely to their own devices, are often unable or unwilling to make judgments about the qualifications of a person to do a competent job. Formal credentialing, therefore, becomes an important social service and is likely to become even more important as society and the economy becomes more complex and specialized. Thus, the validity of educational credentials, or educational standards as some might prefer, will likely be a continuing public concern. To emphasize a point made earlier, accreditation will likely remain important in assuring the validity of degrees and other recognition, such as course credits, conferred by educational institutions.

Accreditation Considerations

With particular reference to the validity of recognition for educational accomplishment, accreditation has sought to assure the following: (1) that there is a faculty that is expert in the requisite fields of knowledge and skills, (2) that the faculty has defined the requirements for the award of the degree, (3) that the faculty has determined how these requirements can be met by the student seeking to qualify, and (4) that reliable and valid processes are in place and used to test the knowledge and to measure the skills certified by the degree. If such steps have been taken, there should be a high correlation between the award and the competence of the holder.

Before the days of nontraditional education life was much more simple for the accreditation community. The evidence it required in order to make a public expression of confidence in an institution was more straightforward. Accrediting concerns were manifested differently by the several agencies in the way they wrote their standards. Generally and somewhat over simplified here for purposes of brevity, the standards, however stated, dealt with the following concerns: qualifications of the faculty; resources available to the faculty and student body (classrooms, laboratories, library); proper decision-making processes and organizational considerations essential to support the educational process; and qualifications of students admitted to undertake study. Educational outcomes that speak to the validity of the degrees awarded, while not ignored, were not the focus of the accreditation. To a very great extent, accreditation assumed satisfactory educational outcomes if all the other considerations were met. And those assumptions had a great deal of validity.

Accreditors lives became a great deal more complicated with the advent of nontraditional education. Interest in nontraditional education was accompained by a movement to accelerate the practices and to improve the procedures by which educational institutions could, with confidence and validity, award credit for learning that was achieved outside the formal sponsorship of accredited colleges and universities. All the traditional benchmarks on which accreditation has relied for so long were not as sacrosanct now, if indeed they were valid considerations at all.

It was in the seventies that the term "educational outcomes" came to the fore not only for curriculum designers but also for accreditors. Educational process, organizational structure, resources—while obviously still important to a quality educational experience—were nonetheless becoming less critical benchmarks to support the accreditation decision.

Accreditation still tilts in the direction of its traditional considerations but it has made great strides philosophically and technically in accommodating the nontraditional educational movement. But with that desirable shift, accreditation has fueled its critics, a substantial body of which has always been around to yelp at the heels of the accreditors but few of whom offer constructive suggestions for improvement. Many critics say accreditation has gone too far in accommodating nontraditional educational approaches and as a result educational standards in the great majority of institutions are slipping.

Many astute educational leaders agree the standards are slipping. But to blame it all on nontraditional education goes far beyond reason. There is as much evidence of educational malpractice in the traditional classroom on the traditional campus using traditional faculty and traditional methods as there is in the nontraditional sector. The school board which announced that it would administer a basic test to prospective teachers to assure they could handle the language at the 10th grade level said a great deal about standards in the traditional classroom. Those prospective teacher hires were not likely to have been enrolled in a nontraditional English composition course or to have been taught

English composition by the school of education, to cite another whipping boy.

Role of Faculty

The gatekeeper of standards for student accomplishment is the testing and certification function of faculty, whether it be traditional or nontraditional education. Expert judgment, given the nature of the educational process and the limitations of education measurement, is essential. And the greatest critical mass of expert judgment resides in a qualified faculty.

How a qualified faculty spends its time may shift substantially as it becomes more involved in nontraditional education. Faculty traditionally have performed these tasks: course and curriculum design, instructing, testing and certifying, counseling, and, in some cases, research. With nontraditional education approaches, faculty may need to spend more time testing and evaluating learning (including that attained outside institutional sponsorship), certifying, and counseling students on ways to achieve their educational objectives through nontraditional means.

The majority of faculty, many believe, are uncomfortable with their testing and certifying responsibilities. Although always a critically important responsibility in terms of the student interests and welfare and the maintenance of academic standards, few faculty have been formally trained in this highly complex function. They are most comfortable in carrying out the testing and certifying responsibility when they also have first-hand knowledge of and are in control of the subject matter materials in which the student is being tested and accomplishments certified.

In dealing with accreditation issues relevant to educational technology, it is important to mention two other forms of "accreditation" which are known by other terms so as not to confuse them with the activities of accrediting agencies. The two are course equivalency evaluations and standardized testing.

The American Council on Education has since 1945 evaluated formal military training, using teams of faculty from accredited institutions who teach comparable subject matter on their home campuses, to establish a formal military course's credit equivalency in the college curriculum. These judgments rendered by faculty under guidelines and procedures approved by the Council become ACE's credit recommendations. This process was extended in 1975 to courses offered by business and industry. The recommendations, accepted by the majority of colleges and universities, are a useful and valid means of providing recognition for learning attained in such settings. In this manner, students can combine such learning with further study at colleges and universities to achieve their educational objective, usually a degree.

The Educational Testing Service and the College Entrance Examination Board have for several years combined their resources to make available the College Level Examination Program. A high percentage of institutions use the examinations to evaluate learning attained in a variety of ways and apply the satisfactory results of such testing towards degree requirements.

To return to an earlier point, a key consideration in both the ACE programs and the ETS-College Board effort is the use of faculty experts in making the evaluative judgments and in designing and reviewing the examinations.

What is the significance of the above background for accreditation issues in educational technology? What lessons can be learned by educational technology from the nontraditional education movement? Several are suggested:

1. Credentialing and accreditation issues are inseparable. The major concern of accrediting should address the question of whether the recognition conferred—a degree, certificate, or course credits—actually are a proxy for validated learning.
2. If the educational outcomes of instruction by educational technology are intended to be credit applicable towards a degree, testing and certification should go hand-in-hand with course and curriculum design. This involves qualified faculty.
3. Assuming not all instruction available through educational technology will be sponsored by colleges and universities, thought should be given to adapting the ACE credit equivalency recommendation process or the CLEP model to help the learners achieve recognition by accredited colleges and universities. Even in cases where it is sponsored by an institution but it is also open broadcast, some may participate who later want to earn credit.
4. The beneficial aspects of formal recognition for learning should not be overlooked. Degrees, and even course credits, are a social accolade for learning which motivate people to learn. Testing and grading are also important because many learners want to be assured they have accomplished something worthwhile.

SUMMARY

In summary, the use of qualified faculty in making educational policy for instructional technology and in testing and certifying learning outcomes is essential. Given proper attention to that concern, there should be no other insurmountable accreditation issues.

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Deploying Educational Technology at an Independent, Urban Institution

S. A. Guralnick
Illinois Institute of Technology
Chicago, Illinois

INTRODUCTION

As I'm sure you are all well aware, educational technology is, from a purely institutional point of view, a means to an end not an end in itself. It is, therefore crucially important to a successful deployment of a new technology to carefully define the institution's goals as well as to carefully investigate the merits of various strategies and tactics to achieve these goals. In this paper I shall first outline some of the issues that must be faced and effectively dealt with to successfully accomplish the rather large scale changes that are inevitably associated with the institute-wide deployment of educational technology. Second, I shall describe the deployment of an interactive, instructional television system at Illinois Institute of Technology in Chicago as a case study. Third, and last, I shall briefly touch upon some of the aspects of financing the interactive, instructional television network at IIT.

Related Issues

For the purpose of this paper, I shall define educational technology as any hardware and/or software system delivering instructional material which is capable of general deployment throughout the entire institution. The forces that are driving most colleges and universities to at least consider the employment of new technologies are those which insistently demand greater effectiveness as well as greater efficiency. Educational technology does offer the promise that greater effectiveness and greater efficiencies can be achieved. The realization of this promise, however, requires careful attention to a series of issues that may be grouped under the rubrics: goals, strategies and tactics. The issues that I believe are of greatest significance are treated as a list of questions in the next three segments of this paper.

Goals

1. What is the mission of your college or university?
2. What kinds of students do you now attract?
3. What kinds of students do you wish to attract that you are not now attracting?
4. What kinds of programs and courses do you now offer?
5. What kinds of programs and courses do you wish to offer that you are not now offering?
6. What constituencies other than students do you now serve?
7. What constituencies other than your students do you wish to serve that you are not now serving?
8. What are your current sources of revenue?
9. Are there sources of revenue that you wish to tap that you do not now have access to?
10. Do you wish to improve the quality of the learning opportunities that you now provide?
11. Are there external constituencies of your institution (alumni, local residents, local businesses, local industrial corporations, etc.) that demand new or expanded services? If so, what individuals and groups comprise these constituencies and what new or expanded services do they require?

Strategies

Strategies are long-term courses of action designed to accomplish one or more goals.

1. What is the best way or ways that your services can be improved and/or expanded?
2. Is educational technology to be used to expand your mission, to expand your constituency and/or to improve the quality of the learning opportunities offered to your current students?
3. What changes or innovations do you wish to introduce soon, in the next three to five years and in the next five to ten years?
4. What opportunities exist that may lead to success in a new venture that will require substantial outlays of capital and substantial institutional change?
5. What barriers exist that may impede or preclude success in deploying educational technology?
6. What innovations are required at your institution to successfully deploy educational technology?
7. What organizational, structural or process changes are required in your organization to successfully deploy educational technology?
8. What specific forces exist in the external environment of your institution that are spurring you on to deploy educational technology?

9. What specific forces exist in the external environment of your institution that may lead to a successful deployment of educational technology?
10. What specific forces exist in the external environment of your institution that may seriously impede or even preclude the achievement of your goals in deploying educational technology?
11. In what ways does the type of external environment (i.e., urban, suburban or rural) in which your institution is located influence your programs and services?
12. Is your institution committed to a mission to provide life-long learning opportunities for adult learners?
13. Are there demographic, economic, social and/or political trends developing in the external environment of your institution that will cause significant impacts upon the demand for its services? In what ways are demands for your institution's services likely to change in the years ahead?

Tactics

Tactics are specific action steps designed to support one or more strategies.

1. What is the appropriate educational technology or technologies needed to accomplish your goals?
2. How will the benefits of deploying educational technology be measured?
3. Are the improvements that will result from deploying educational technology client-centered, producer-centered or both client- and producer-centered?
4. Who will actually benefit from the deployment of educational technology and who will pay for the actual costs incurred?
5. Who will *perceive* that benefits will accrue from the deployment of educational technology?
6. Who will actually be substantially impacted because of the deployment of educational technology?
7. Who will *perceive* the occurrence of substantial impacts because of the employment of educational technologies?
8. What opportunities exist for your institution to obtain the necessary capital funds?
9. Can your institution accommodate whatever increases in annual costs may be necessary to keep the educational technology in operation at a satisfactory level?
10. Are you seeking to *reduce* overall annual operating costs at your institution by means of the deployment of educational technology? If so, what are the specific cost savings that you wish to achieve?
11. What individuals and/or groups ought to be consulted at your

institution to implement an orderly process to change? Are there any issues that will be raised by these individuals or groups that will impede or prevent the changes that are necessary to achieve success?

12. How long is the consultation process likely to last before all of the necessary actions can be taken?
13. What educational technology products are available today? What products are likely to reach the market place in the next three to five years? What products are likely to reach the market place in the next five to ten years?
14. What criteria will be used to make a choice among various competitive eduational technology systems or products? What individual or group will make this choice? What individual or group will have to live with this choice after it has been made?
15. Granted that it is quite likely that there is relatively little experience with the large-scale deployment of educational technology at your institution, how will you assess the risks involved in undertaking such a venture?
16. How will the producers be motivated and trained to provide their services via the new technology?
17. How will the clients be motivated and trained to use or accept the new technology?
18. What is the timetable to achieve payback of the initial capital investment? How realistic is this timetable?

INTERACTIVE INSTRUCTIONAL TELEVISION AT IIT

Consideration of some or all of the issues raised in the previous section of this paper is, of course, an on-going process which probably occurs sporadically, if not continuously, at most universities. It would be far beyond the scope of this paper to describe in detail all of the considerations that led to the ultimate decision to install an interactive instructional television network at IIT. For the purposes of this paper, therefore, I shall summarize the background to the decision-making process and describe some of the features of the system actually installed.

Mission

Illinois Institute of Technology is a private, non-sectarian, co-educational, urban university dedicated to supporting national goals through education and research for leadership in programs that are problem-solving in character, decision-making in purpose, and socially and economically responsible. IIT's educational programs encompass the following pathways to professional leadership: Architecture, Business Administration, City and Regional Planning, Design, Engineering, Law, Pre-medicine and Health-related Sciences, the Biological, Computer Mathematical and Physical Sciences, Psychology, Public Administration and the Social Sciences. IIT is a Ph.D. degree granting research university affiliated with two other powerful research organizations, the IIT Research Institute and the Institute of Gas Technology. The combined annual research volume in engineering and science of the entire IIT Center is very close to $100,000,000 per annum. It is the purpose of IIT to provide the educational and basic research activities which link and complement the activities of all three affiliated organizations.

Beyond its commitment to providing education for full-time undergraduate and graduate students because of its urban location, IIT is committed to providing significant educational opportunities for part-time students who are interested in working toward an undergraduate or graduate degree. Specifically, IIT is committed to providing continuing education programs for locally employed professionals in the principal fields represented at the university.

Goals

The current enrollment pattern at IIT is shown on Table 1. As may be observed from this Table, IIT is a relatively small school and it intends to stay that way even though some growth in the size of the student population is desirable. The long term enrollment goals of the Institute are shown in Table 2 which indicates a total enrollment of 6,000 FTE students. Were we to achieve this goal, the current physical plant would, in our opinion, be utilized at an optimum level. IIT is, therefore, seeking an additional 600 FTE students consisting of undergraduates and graduate students.

Table 1—Current Enrollment (FTE)*

UNDERGRADUATES			
Full-Time	3,037		
Part-Time	461		
All UG		3,498	
GRADUATES			
Full-Time	506		
Part-Time	528		
All Grad		1,034	
LAW			
Full-Time	606		
Part-Time	185		
All Law		791	
All Students			5,323

* Fall 1980

Table 2—Overall Enrollment Goals (FTE)

UNDERGRADUATES			
Full-Time	3,400		
Part-Time	550		
All UG		3,950	
GRADUATES			
Full-Time	600		
Part-Time	700		
All Grad		1,300	
LAW			
Full-Time	550		
Part-Time	200		
All Law		750	
All Students			6,000

Location

IIT is located in the heart of Chicago, three miles south of the city's center. The significant vital statistics of the Chicago area are:

1. Population

   There are approximately 2.9 million residents in the city, 5.2 million in Cook County and 7.049 million in the greater metropolitan (5 county) area. The estimated resident labor force is 3.456 million and 3.8 million residents are classified as suburban. An estimated 19 percent of the U.S. population lives within a 300 mile radius of the city.

2. Industry

   It is estimated that 53 million tons of manufactured goods are shipped from Chicago yearly. The metropolitan area is a leader in the production of steel, metal plates, bars, rods and structural shapes, food products, metal furniture, mattresses, envelopes, boxes, inorganic chemicals, soap, paint, gaskets, cans, screws, bolts, saws, barrels. machine tools, blowers, switchgear, locomotives and other railroad equipment, heavy machinery, surgical appliances, fully assembled automobiles, electrical equipment, electronic components, consumer electronic goods and kitchen appliances. It is the second largest center in the nation of consulting firms specializing in architecture and engineering. Moreover, it is among the three or four largest centers for the delivery of health care in the nation. There are two national research laboratories in Chicago, Argonne National Laboratory and Fermilab, the

National Accelerator Laboratory. Beyond these federal research centers, there are a number of significant independent research laboratories as well as industrial research centers. Chicago produces a gross metropolitan product of $97 billion, 4.6 percent of the GNP. Moreover, it contributes $1 billion annually to the nation's *positive* balance of trade.

3. Commerce

   There are 14,400 manufacturers in Chicago the total of whose sales exceed $76 billion; 57,000 retailers the total of whose sales exceed $28 billion; 13,000 wholesalers the total of whose sales exceed $43 billion; and 56,000 service establishments do a $6.4 billion in business. Average personal income per household is $28,700.

4. Construction

   There has been $7.1 billion in industrial construction since 1965; $17 billion in residential construction; and $8 billion in commercial construction.

5. Educational Institutions

   There are 39 institutions of higher education within a 50 mile radius of the city, 69 within a 100 mile radius and 164 within the State of Illinois. The senior institutions within a 50 mile radius of the city are the University of Chicago, Illinois Institute of Technology, Loyola University, Northwestern University and the University of Illinois at Chicago Circle.

Opportunity

There are probably somewhere in the neighborhood of 60,000 to 70,000 persons in the greater Chicago urban area who are practitioners of one of the professions represented in the educational programs of IIT. Perhaps as many as half of the total number of such individuals are interested in taking advantage of opportunities for continuing professional development. That is, there are probably at least 30,000 to 35,000 individuals in the greater Chicago area who would be interested in continuing their own professional development provided that a suitable *educational delivery system* could be deployed. Such a system would attract a substantial number of users if and only if it were convenient, of high quality and it minimized time away from the job or from normal leisure time activites. The interactive instructional television system is an educational delivery system which is capable of delivering normal university instructional material directly to the workplace without incurring long hours of commuting between job site and campus. Moreover, interactive instructional television makes it possible for employed professionals to gain access to university instructional material offered at any time during the day rather than only during evening hours.

The System

IIT/V is an educational delivery system that uses four special frequency television channels combined with telephone audio links to bring regular university classroom instruction to the workplace. The special frequencies are assigned for Instructional Television Fixed Service (ITFS) in each city by the Federal Communications Commission. From studio classrooms on campus, video and voice signals are beamed fourteen hours each working day via microwave to the top of the 110-story Sears Building* three miles away where IIT's own transmitters broadcast signals which can be received anywhere within an area bounded by a circle of 50 mile radius centered at the Sears Building.

On a continuing basis, employed professionals (or their companies, if a tuition reimbursement program exists) are charged the same tuition as on-campus students. An additional sliding scale service charge for courier service and other administrative costs is based on course enrollment, ranging downward from an amount equal to 100 percent of the tuition charge for a single student-course enrollment to a minimum of 20 percent of tuition when more than 50 student-course enrollments at a single site occur.

Talk-back system costs are paid by the company at which the receiving station is located. These consist of regular telephone line charges plus a monthly rental fee for the auto-dial telephone.

There is a one-time capital investment to be made by each participating company for a microwave antenna and tower, signal converter, television monitor and telephone talk-back connection that ranges between $5,000 and $10,000 depending on the distance of the receiving site from the Sears Building. In addition, each participating company is expected to provide the services of an official representative for several hours per month to serve as liaison between the firms and IIT.

The IIT/V system went "on the air" in the fall semester of the 1976-77 academic year enrolling 105 students at twelve remote sites. This past fall 536 students were enrolled at nineteen remote sites. The current list of participating organizations is shown on Table 3.

IIT/V students may enroll in one or more of approximately sixty regular IIT courses per semester broadcast live from the IIT campus. These courses are chosen from the regular Schedule of Courses to make it possible for employed engineers, computer scientists and business managers to obtain all the coursework necessary to fulfill the

* This 1,454 ft. high building is the world's tallest.

graduate course requirements for the master's degree in their respective fields entirely by means of courses delivered via IIT/V to the job site.

Beyond normal university course material the IIT/V system is used to deliver short-course and special seminar material to interested professionals and to company management at the job site.

Table 3—IIT/V Participating Organizations

American Can Company
Research Center
433 Northwest Highway
Barrington, Illinois 60010

Andrew Corporation
10500 West 153rd Street
Orland Park, Illinois 60462

Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

Bell Laboratories
Naperville & Warrenville Rd.
Naperville, Illinois 60540

Caterpillar Tractor Company
P.O. Box 348
Aurora, Illinois 60507

CPC International, Inc.
Moffett Technical Center
Box 345
Argo, Illinois 60501

A. Finkl & Sons
2011 North Southport Avenue
Chicago, Illinois 60614

GTE Automatic Electric
400 North Wolf Road
Northlake, Illinois 60164

Honeywell, Inc.
1500 Dundee Road
Arlington Heights, Illinois 60004

International Harvester Company
Science & Technology
16 W. 260 83rd Street
Hinsdale, Illinois 60521

MCC Powers
2942 MacArthur Boulevard
Northbrook, Illinois 60062

Midwest Industrial Management Association
9845 West Roosevelt Road
Westchester, Illinois 60153

Motorola Communications Group
1301 East Algonquin Road
Schaumburg, Illinois 60172

New Trier Central
3013 Illinois Road
Wilmette, Illinois 60093

North Central College
30 North Brainard
Naperville, Illinois 60540

Northrop Corporation
600 Hicks Road
Rolling Meadows, Illinois 60008

Teletype Corporation
5555 West Touhy Avenue
Skokie, Illinois 60076

Western Electric Co., Inc.
c/o Bell Laboratories (Lisle)
Naperville, Illinois 60439

Zenith Radio Corporation
1000 Milwaukee Avenue
Glenview, Illinois 60025

Table 4—IIT/V Capital Equipment Expenditures

Summer '76—Initial Installation			
3/5/76	R F System	$54,693.00	
2/2/76	IIT Classroom Equipment	86,780.00	
5/20/76	Remote Site Equipment	25,167.00	
1/22/76	Videotaping Facility	10,668.00	
3/1/76	Master Control Console	6,744.00	
2/26/76	Overflow Classrooms	3,477.00	
7/7/76	Spare Equipment	11,783.00	
6/7/76	R F System	518.00	
			$199,830.00
Winter '77—Spring '78–Retrofit and Additional Channels			
12/12/77	Consoles and Master Control for 2 Additional Channels	$120,500.00*	
11/22/77	Auditoria Fittings	35,000.00*	
Dec. '77	Transmitters—2	34,000.00	
1/5/78	Studio Transmission Links	52,000.00	$241,500.00
FMCEE Combiner			
12/26/78	Electronic Equipment		$ 2,800.00
Public Access Sites			
Summer '77	North Central College Installation	$3,700.00	
Fall '79	North Central College Filter Network	1,500.00*	
Fall '78	MIMA Installation	4,060.00	
Fall '80	New Trier East Installation	1,800.00*	
Spring '81	New Trier West Installation	6,020.00*	
			$ 17,080.00
Studio 6			
Summer '80	Cameras, Controllers and Cabling		$ 28,000.00.
	TOTAL		$489,210.000*

* Includes all associated labor costs of installation.

FINANCING IIT's SYSTEM

Capital Equipment Costs

The costs of acquiring and installing all of the capital equipment of the IIT/V system is shown in Table 4. The funds needed to meet these costs were borrowed from the endowment fund (i.e., the flexible funds functioning as endowment) of the university on the understanding that restoration of all such borrowings would be made from the tuition revenues generated by the system after all operating costs were deducted. It was of course, recognized from the outset that tuition revenues during the first two or three years of operation of the system would fall short of covering the annual operating costs.

Table 5 shows the enrollment in and the financing of IIT/V. Line 1

Table 5—Enrollment in and Financing of IIT/V

Years from Start	*1*	*2*	*3*	*4*	*5*	*6*
Academic Year	*1976-77*	*1977-78*	*1978-79*	*1979-80*	*1980-81*	*1981-82**
1. Course Enrollments	201	255	488	743	1,141	1,369
2. Student Credit Hours	603	765	1,464	2,229	3,423	4,107
3. Hourly Tuition Rate, $	100.00	110.00	110.00	123.00	143.00	157.00
4. Tuition Income, $	60,300	84,150	161,040	274,167	489,489	644,799
5. Admin. Expense, $	100,000	100,180	172,540	203,840	240,400	269,248
6. Seed Funds from Operating Budget, $	39,700	16,030	11,500			
7. Funds Available for Payback of Capital Investment, $				70,337	249,089	375,551
8. Accumulated Funds Available for Payback of Investment, $						694,997

* Estimates

shows that a seven-fold growth in course enrollments occurred from the first year through the fifth year of operations. Line 6 indicates the amount of seed funds needed to cover the shortfall in tuition revenue below the cost of operations (line 5). This shortfall occurred only during the first three years of operation and totaled $67,230. If a 20 percent growth in enrollment occurs during the 1981-82 academic year, then line 7 shows the excess of tuition income over administrative expense (line 5) available to pay back to the endowment the costs of acquiring the capital equipment. In fact, line 8 shows that the total funds accumulated beyond administrative costs are expected to be approximately $695,000 at the close of the 1981-82 academic year. This sum considerably exceeds the sum of capital costs and seed money (i.e. $489,210+$67,230=$556,440) that have been expended on the system during its first five years of operation. Hence it may be concluded that on purely financial grounds alone, the system is a sound investment of the portion of the university's endowment resources. Moreover, it appears quite likely that this investment will continue to return handsome dividends in the years to come.

CONCLUSIONS

This paper has treated some of the general issues associated with the institute-wide deployment of educational technology, it has described the essential features of IIT/V as well as the way in which it was financed in the hope that this case study would serve as an example that would stimulate analogous development elsewhere. I hasten to add, however, that each of the 3,000 institutions of higher education in the United States is in many ways unique. Hence, each must examine its own unique environment, opportunities and constraints to determine whether and what kinds of educational technology should be deployed. It is the thesis of this paper that when educational technology is properly perceived as a powerful means to achieve well-defined educational goals then real opportunities exist to improve services and to attain greater levels of effectiveness and efficiency. Experience at IIT suggests that this thesis may indeed be true at other urban universities.

The Central Educational Network's Postsecondary Service

Carol A. Koffamus
Central Educational Network
Chicago, Illinois

INTRODUCTION

No one will deny that many colleges are experiencing a declining enrollment of 18-22 year old students. No one paying their heating or gas bills will deny that energy costs are increasing and the end is not in sight. These energy costs are also having an effect on the educational institutions. No one will deny that tuition costs will continue to rise. In addition to these events, we are also being told that financial support from government and private sources is decreasing. All of these events will have an affect on the adult learner and the educational institutions, but there is another side of this coin. With our rapid technological advances in America, our information systems will *double* every eight years. Think about it. These same adults will need a continual updating of information and upgrading of skills to keep pace with this new technology. There are adults in and out of the work force. They will need to learn how this technology will affect their jobs and lifestyles and then meet those changes without fear. Education entities have a tremendous responsiblity to these learners and must take the leadership in this life-long learning process.

They will be teaching an older, adult learner rather than the traditional 18-22 year old and they will have to adapt to that fact. People within a given community need education at basically five different levels:

(1) Basic education
(2) Occupational education
(3) Occupational upgrading
(4) Job changes
(5) Leisure skills

Within these levels there are millions of adults who will need life-long learning programs that are meaningful to them and available at their convenience. Looking at statistics we would have to concede that higher education needs to improve in this area. According to the American Association for Higher Education a majority of adult learners are getting their education outside college and university settings. Fifty-eight million, four hundred thousand adults each year are involved in some form of organized education, while only 12.4 million of them are colleges and universities. Programs offered by business, government agencies, professional organizations, telecommunications field and other organizations are educating five times as many adults as are higher education institutions. The financial resources devoted to this enterprise are staggering. It is estimated by the American Society for Training and Development (*ASTD*) that American business, alone, devotes $40 billion annually to employee education exclusive of college programs. Clearly new fields, a wider array of resources, such as television and radio, need to be employed by higher education in order to involve a new adult learning clientele into their program.

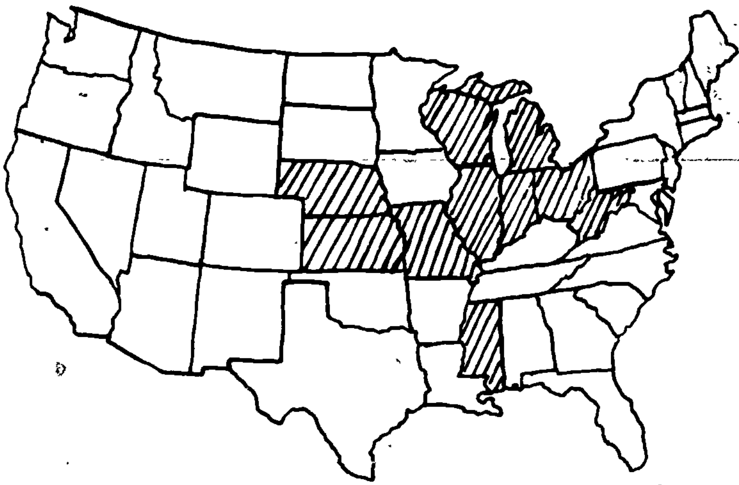
Meeting Adult Learners' Needs

The challenge to meet the needs of the adults who want and need to learn more is great but we have never shied away from a challenge. In fact, history has shown that when the challenges were greatest we exerted our best efforts and overcame the problems.

Because the task is formidable, meeting the needs of adult learners in this decade cannot be done by colleges and universities alone. There must be a *unified effort* where we can capitalize on all of the resources we have to meet the diversification of the learners' needs in our communities. It is here where I believe telecommunications can work with colleges and universities in providing an *educational alternative* to meet some of those learners' needs. It not only can, but we have shown in our service that it does.

The Central Educational Network's belief and commitment to this concept is what began the first postsecondary telecommunications service in the country. *CEN*'s Postsecondary Education Council was formed in October, 1979 to meet these needs. The Council consists of postsecondary institutions and broadcasting entities. It is important to remember this point.

During the past fifteen months, states interested in postsecondary telecommunications as an alternative to reaching the adult learner, were asked to form their own postsecondary state councils. These state councils are composed of, but not limited to, members from two and four year private and public colleges and universities, public broadcasters, and vocational/technical institutions. No two states are structured exactly alike. (We will be publishing a report later this year on these various state structure models.) Each state set its own by-laws and nominated one member from its state council to represent it on the CEN



Postsecondary Council. You have one state one vote. The Council meets twice a year. At the present time the following ten states have organized themselves and are members in our Council: Illinois, Indiana, Kansas, Michigan, Mississippi, Missouri, Nebraska, Ohio, West Virginia and Wisconsin.

You will be able to see the postsecondary and broadcasting representation on the Council by each state's representative's professional title:

Illinois—Director of Educative Services for a public broadcasting university station

Indiana—Dean of Learning Resources for Media, Indiana University at Bloomington

Kansas—Director, Office of Instructional Media for a state university

Michigan—Instructional Television Coordinator for a public broadcasting university station

Mississippi—Director of Educative Services for the Mississippi Educational Television Network (State System)

Missouri—Dean of the College of Arts and Sciences for Continuing Education at University of Missouri–St. Louis

Nebraska—Director of Instructional Services for the Nebraska Education TV Network (State System)

Ohio—Executive Director of the Ohio Educational Broadcasting Network Commission (State System)

West Virginia—Educative Services Coordinator for a public broadcasting station

Wisconsin—Director of Educational Services for the Wisconsin

Educational Television and Radio Networks (State System)

Our Postsecondary Education Council is a self-supporting, self-governing division of CEN and elects four of its members to the CEN Board. These four members comprise the Postsecondary Executive Committee and work closely with CEN's Postsecondary Coordinator.

The Council has set its goals and these include, but are not limited to:

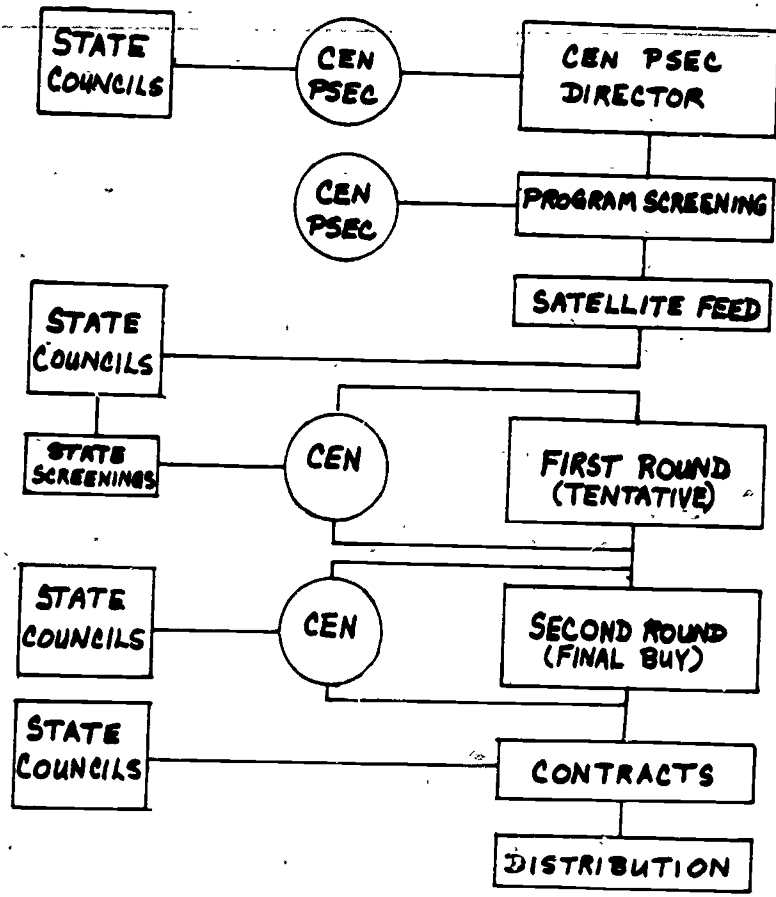
1) Providing services to increase the availability of quality credit and non-credit materials to reduce costs in postsecondary educational telecommunications.
2) Identifying problems, issues and successful methods related to expanding postsecondary learning opportunities in the states through telecommunication and
3) Sharing expertise and resources to strengthen postsecondary education telecommunication in the states.

Individual services that are offered to the membership include, but are not limited to:

1) To serve as a professional resource organization and accessing postsecondary educational telecommunication needs and interests of the states.
2) To identify postsecondary telecourse materials for their annual program screening.
3) To negotiate group rentals and buys of programs for the membership.
4) To provide scheduling and distribution of the program series.
5) To sponsor an annual postsecondary professional development workshop for the exchange of information. This year we will be producing an interactive teleconference from our satellite uplink in Lincoln, Nebraska on "Marketing Telecourses" with Dr. Roberta Clark from Boston University.
6) To provide a monthly memo informing them on local, state, regional and national postsecondary telecommunications activities.
7) To provide a free videocassette library loan service for the membership.
8) To seek grants for assistance in facilitating the above grants.
9) To coordinate other services designated by the Postsecondary Education Council.

Costs

Costs to the membership are based on a flat fee of $3,000 assessed to each state equally plus a graduated fee based on a scale reflecting the state's total population. For example the state with a total population of 5.5 million people would pay $5,750 to belong to Postsecondary Educational Council for one year and participate in the above services:



Each state council decides on how these dues are assessed and collected. To show you the diversity of how the membership dues are collected here are three examples:

In Missouri, each membership category in their state council is assessed according to their FTE's and 100 percent participation. The membership categories in their state organization are:

1) University of Missouri Systems
2) Regional Universities
3) Missouri Association of Community and Junior Colleges
4) Independent Colleges and Universities of Missouri
5) Missouri Association of Private Career Schools

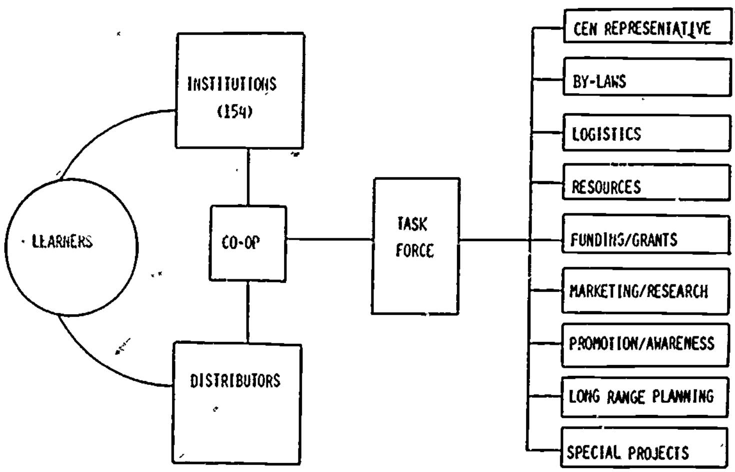
In Illinois, the state council applied for and received a grant from the

Illinois Board of Higher Education to cover the membership fees for all 154 postsecondary institutions in Illinois.

In Mississippi, the membership dues are paid for by the Mississippi Educational Television Authority. We saw earlier how diversified the models of each state council can be. Assessing of their membership fees are also diversified.

Two grants during our first year of operation assisted us in getting established. A grant from the Corporation of Public Broadcasting Education Services Department paid the membership base fee for each state that joined. This year they had to generate their entire dues from their newly formed state councils. All of the ten states were able to do this. In addition to the CPB grant the Exxon Education Foundation gave us a grant to begin our service and our postsecondary videotape free loan library to the members.

This year we were awarded another grant from the Exxon Education Foundation of $38,985 for membership expansion. Specifically, the funds are available as a 50 percent match for each new state interested in joining the CEN Postsecondary Education Council. States joining us need to pay only half of their membership fees for the initial year. Membership is open to any state.



SUMMARY

Although we have come a long way in the past fifteen months we realize we have a long way to go. Besides continuing to upgrade the existing services there are several other areas that we see in our future growth of our postsecondary council:

- Delivering out most utilized telecourses via our satellite to the users and eliminating all the tape dubbing and shipping costs.
- Expanding our radio telecourse offerings to the members.
- On mutual course needs, form a program consortium to get those programs produced.
- Implement, whenever needed, the new technology such as videodisc, 1" inch videotape, direct broadcast satellites, the teletext systems, fiber optics, etc. into our service.
- On-going professional development workshops at minimum costs to the members. These workshops will deal with the needs expressed by the members.
- Extend our telecourse programs to a broader base in the community through more inter-agency and inter-institutional cooperation.
- Expand our service to include more states.
- Work with other educational and broadcasting entities to promote the development of more quality telecourse programming in radio and television.

We realize that we are not the total answer to the solution of reaching and teaching the adult learner, but we are confident that we can be part of that answer. If all the resources in our society take on part of that solution then we will succeed. Someone once said, "We are only one, but we are one."

Evaluating an Instructional System in Mathematics

Steven M. Frankel*
Director, Department of Educational Accountability
Montgomery Coungy Public Schools
Rockville, Maryland

INTRODUCTION

For the past three years, the Department of Educational Accountability (DEA) of the Montgomery County Public Schools (MCPS) has been evaluating the Instructional System in Mathematics (ISM), the first of four instructional systems planned for implementation in Montgomery County Public Schools. When the DEA evaluation started, ISM was already in place in 26 elementary, one middle, and six junior high schools. It is now functioning with roughly three times as many schools on the system.

While ISM was developed within MCPS to specifically meet the needs of the system's students, it is similar in structure to many other objectives-based, computer supported instructional systems in that it consists of a curriculum component, and a reporting component. Where it differs from many of its counterparts is that computer support is used primarily in the assessment and reporting components, with only a minimal portion of the actual instruction being delivered via the computer. Similarly, the capability of prescribing instruction based upon the results of the assessments has not been programmed into the system. Thus, conceptually it is far closer to a computer managed instruction (CMI) system than to a computer assisted instruction (CAI) system.

As is often the case in educational evaluations, the impetus for this study was largely political. ISM had come into being as the flagship of a series of instructional innovations introduced by a new school superintendent. Several years later, with the superintendent and his policies coming

* The opinions expressed in this paper are those of Dr. Frankel and do not necessarily reflect the opinions of other members of the school system's staff or Board of Education.

under increasing criticism from segments of the Board of Education, the public, and the school system's staff, the study was perceived by the superintendent's supporters as a means of validating his efforts, and by the superintendent's critics as a means of repudiating them.

The two reports which were produced[1, 2] satisfied neither group entirely. The evaluations identified many positive outcomes which were associated with the use of the system and the fact that there was a demand among teachers whose schools were not on the system for the ISM curricular materials. However, they also identified severe flaws in the manner in which it was being implemented; documented the fact that it was substantially more expensive to operate; and reported that, possibly because of the implementation problems, no overall gains in student achievement could be linked to use of the system.

Because studies such as this are becoming increasingly common as school administrators and Board members ask the question, "What will support for instructional system development and implementation really buy us?" it was felt that a paper describing a generic design for such an evaluation might be useful. If the paper can also forewarn system sponsors of some of the questions which will be posed in a comprehensive evaluation effort, then so much the better.

Evaluating System Components

In designing the ISM evaluation, it was decided to treat each component of the system individually; and in each case, to attempt to answer the question, "Has the component delivered what was promised for it?" In addition, wherever possible, the evaluators attempted to contrast the outcomes of using the system component with outcomes in other schools using non-systemitized counterparts; and to develop comparative cost data showing the additional resources or savings which resulted from using the component.

The Curriculum Component

The evaluation of the curriculum component examined the manner in which instruction was being delivered; the types of activities in which teachers had to engage to support instruction; and the outcomes of instruction for students. In the ISM study, it was fortunate that when the study began, only about 25 percent of the schools in MCPS were using ISM. In addition, the ISM schools had entered the system at different points in time; this permitted comparisons to be made betwen ISM schools which had been using the system for one, two and three years, and between ISM and non-ISM schools. Among the key issues which were addressed in this component of the study, were the following:

- *Does use of the instructional system increase the amount of individualization in the classroom?* Underlying this issue, we are interested in whether more small group or individualized instruction was occurring and whether the activities occurring in the classroom reflected the data on individual student progress produced by the system. Such information was gathered by having trained observers sit in classrooms monitoring actual instruction and comparing the assignments of individual students with their computer generated records.

- *How does use of the system affect academically engaged time?* Here, we were concerned with whether students using the system appeared to be spending more time on task; or, conversely, if there were net losses in academically engaged time due to students having to wait for their turn to get a compuer terminal or for their teacher to give them a new assignment, or to travel back and forth between the instructional area and the area in which terminals were located. Again, data such as these were gathered by means of observers located within ISM and non-ISM classrooms; and by means of questionnaires completed by teachers, aids, students, and administrators.
- *Does use of the instructional system affect achievement test scores?* We approached this area with considerable caution, since this is the single issue which school boards most often focus upon and the media will play up. While we gathered and reported data such as these, we also cautioned that this information should not be accorded inordinate weight because of factors such as imperfect matches between curricular content and the nationally standardized tests; the impact of previous learning on the test scores; and the ease with which individual teachers can "prep" their students for a nationally standardized test which has been used in the school district for several years. Of particular interest, however, were longitudinal analyses of third vs. fifth grade achievement test scores for ISM vs. non-ISM cohorts.
- *Does use of the instructional system affect achievement scores on locally developed criterion referenced tests?* Largely because of the problems perceived with using norm referenced test scores as dependent variables, considerable weight was given in the evaluation to administering the ISM mastery examinations to groups of non-ISM students as well as to groups of ISM Students. The reasoning behind this activity was that if differences between students using and not using the system were occurring, they would be likely to show up if these two groups were tested using the materials which were part of the system itself.
- *Is the curriculum well organized and presented?* Information of this type was gathered by querying school staff members about their satisfaction with the materials. An additional step, which we did not do but which would be advisable, would be to have disinterested content experts examine and comment upon the

materials. In addition, a rather innovative unobtrusive measure was employed: having observers record the degree to which the system's curricular materials have been "bootlegged" into non-system schools. In our study, this was assumed to represent the highest degree of flattery and a highly effective means of determining the repute in which the materials were held by the general population of teachers and principals.

- *What resources are required to implement the system, or permit it to function effectively?* In an era of shrinking resources, this has become a paramount issue. We were interested in the costs which were being incurred for continued system/materials development and inservice training; in attempting to determine whether instructional delivery costs had actually increased after the system was installed, due to increased numbers of aids being used and/or teachers having to expend additional time for individualized planning and/or recordkeeping; in assessing the costs for computer hardware, software, and communications; in whether ISM was presently overtaxing the capacity of the computer mainframe; and whether implementation of the system in all schools could be accomplished without having to greatly expand the present computer's capacity.
- *What happens to students after they have left the grades in which the instructional system is implemented?* Since the MCPS math program splits into different "branches" of varying difficulty levels starting in the junior high schools, it was possible to determine how many ISM vs. non-ISM students went on to take the more difficult math courses and to compare grades for system and non-system students when they are enrolled in the same courses.

The Assessment Component

The key in many instructional systems, including ISM, is the process by which student progress is monitored on a continuous basis. In ISM, monitoring meant that teachers and students were notified when a particular objective had been mastered. As mentioned earlier, many other instructional systems carry the concept still further by prescribing future assignments on the basis of performance on assessments.

In studying the assessment component of ISM, the following types of questions were posed:

- *Are the assessment instruments technically adequate?* Given the importance of the assessment instruments to most instructional systems, it is reasonable for evaluators to expect that the skills measured are indeed those which are taught; that there is good agreement between performance on individual test items and overall test performance; that alternative versions of assessments are of the same difficulty level; that placement and mastery test items are similar in difficulty for individual objectives; and that if the system is hierarchical, there is a consistent increase in difficulty level as students move through assessments. The techniques by which issues such as these are addressed are well known and generally involve administering samples of items to a set of students, and analyzing the records of students using the system.

- *Is feedback provided to teachers and students in an efficient manner?* When students are not immediately informed of their performance on an assessment measure, or where such information is not routinely available to teachers shortly after the student completes an assessment, much of the potential value of an instructional system is lost. A detailed examination of the logistics involved in the assessment process will reveal these types of problems. Similarly, such an examination—if supplemented by first hand observation—will also reveal related problems such as delays in being able to take an assessment due to insufficient hardware being available or lengthy terminal response time: lack of flexibility in the software which does not permit students to attempt assessments "out-of-sequence;" and gaps in time between when instruction in an objective end and the assessment measure is administered.
- *Is the assessment system worth the cost involved?* An issue which should have received greater emphasis in the study was whether the value received from use of automated assessments, which permitted the system to accept constructed responses (as opposed to having to use a fixed multiple choice format), was worth the additional costs involved. Delving into this issue fully would require an analysis of capital investment, startup, and operational costs; a comparison of the resources required to administer assessments with and without the computer; an examination of the impact which the assessment process had on available time-on-task and teacher preparation time; and an assessment of less costly alternatives for assessing students that fell somewhere between what the system offered and was available in non-system schools. An interesting result of these studies was that issues such as these are now being explored by the system developers.

The Reporting Component

The evaluation of the reporting component of an instructional system was closely linked to the evaluation of the assessment component. Whereas the latter addressed how effectively the student's progress was monitored, the former addressed what was done with the monitoring data after they were collected. In evaluating this component, the following issues were considered:

- *Who uses the information which is provided?* A major activity in this evaluation was to assemble a set of all reports generated by the system and attempt to determine, using open-ended interviews, the degree to which each was actually used for decision making purposes. We were interested in determining whether any reports were: a) being used for archival purposes only ("I keep it in case anyone asks for it.");b) directed at the wrong party (principals being provided with student level data); or c) much too detailed/global for use in making instructional decisions. The objective, in conducting these activities, was to determine if the entire flow of paper produced by the system was truly necessary and/or being used properly.
- *Is the quality and timeliness of the data superior to that available in non-system schools?* Give the emphasis on the availability of relevant data which had been used to sell the concept of the instructional system, it was not unreasonable to make comparisons between the quality and timeliness of data in system and non-system schools. This was done by interviewing staff and administrators as to how certain standard types of instructional decisions were being made. The issue of timeliness was particularly critical since the best data in the world are absolutely useless if they are received after the relevant decisions have had to be made.
- *Are the capabilities of the reporting system being fully exploited?* While it is easy for system designers to err by providing practitioners with gluts of the wrong types of data, it is equally easy for them to not supply certain typs of useful data which are well within the system's potential to provide. Information on this topic was gathered by interviewing teachers and administrators.

CONCLUSION

This paper has attempted to provide an overview of the breadth of issues which a sound evaluation of an instructional system should encompass. To keep the paper concise, the list of issues addressed in the study was representative, and by no means inclusive. If there is one message to leave, it is to distrust any evaluation of an instructional system which is single faceted and does not go beyond reporting differences in achievement test scores, or describing the manner in which instruction is delivered.

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A Description of the DAVID Interactive Instructional Television System and Its Application to Post High School Education of Deaf

James R. vonFeldt
Instructional Television/Computer Department
National Technical Institute for the Deaf
Rochester, New York

INTRODUCTION

The human rights movement in the United States has stimulated much sensitivity pertaining to the special needs of handicapped. Laws have been passed, institutes have been created and much has already begun to happen in our society to implement access to the mainstream of work as well as the larger social arena of life for handicapped persons.

The National Technical Institute for the Deaf on the campus of Rochester Institute of Technology in Rochester, New York, is one such institute. If I were asked to state NTID's goal I would put it this way: To provide post high school deaf students with the skills, experiences and education to formulate a successful career in a technical society.

One of the eight mission statements which assist NTID in meeting its goals consists of exploring and creating innovative teaching/learning technologies. The DAVID (Digital And Video Interactive Device) interactive system is a product of that mission. However, before we begin, let me state that this technology, like many before it and many more which are in the future, are meant to supplement the instructional and training experience. It was not designed to, nor could it, replace an informed, caring teacher. Like other technologies in education (overhead, video tape, blackboard, book, programmed instruction, etc.) the teacher's power is enhanced and the teaching/learning process is more efficient when it is applied appropriately.

EA014860

Instructional Needs

Deaf students require special instructional techniques and technologies because of the cumulative effect of hearing deprivation in the process of education.

The nature of deafness limits instructional stimuli to a visual primary input mode. Put another way, the absence of significant audio input (resulting from severe hearing impairment) forces the individual to depend upon seeing or visual stimuli almost entirely. Blind people rely upon audio stimuli. Those who are not handicapped utilize both audio and visual stimuli.

The significance of audio deprivation can be shown by the generally poor language and speech characterized by the deaf population. Unfortunately, language is basic to communication and communication basic to learning (and socialization) and learning to career success.

Prior to the development of the DAVID system, the NTID Communication Department had developed auditory training processes utilizing drill and practice with an audio tape system. Speech reading also requires much drill and practice; however, that process required instructional television. Both auditory and speech training demand much individual practice by each student as well as regular classes and teacher interaction. Lest it appear obtuse, auditory training (training in the discriminatory use of residual hearing with the aid of amplification) has demonstrated significant overall instructional gains through drill and practice. Most legally deaf people have some residual hearing and can benefit from training to use what they have. In addition to the above stated practices, both auditory and speech training require media overlap. Auditory training, which used audio tape only, indicated the ideal situation would allow audio or audio with video stimuli. Speech therapy was already utilizing video stimuli in the form of instructional television tapes, some with, and some without audio reinforcement. Both curricula indicated strong need to control the audio and the video stimuli, to provide interactive learning with feedback and reinforcement, and to provide individualized instruction.

Computer-assisted instruction at NTID (beginning in 1968 with the IBM 1130-1500 system) had demonstrated effectiveness in providing individualized instruction through drill and practice and tutorial strategies in many disciplines. Also, Jean McKernan Smith and Dr. vonFeldt's preliminary research study indicated that CAI interaction could improve the instructional gains found with the use of instructional television.[2] The hypotheses posed were: 1. a combination of student interaction provided by CAI when merged with motion and/or audio would provide significant instructional gains in Audiology and Speech Pathology, 2. instruction which was not then possible could be explored, and 3. that students may be able to receive additional individualized practice without requiring additional speech or audiology staff. The comparison study was the first step in exploring these hypotheses.[2] Development of the NTID-DAVID prototype was the second step.

System Specification

A team from NTID including teachers, researchers, system specialists, engineers, CAI specialists, TV engineers, and media specialists assisted in the process of defining the system specifications. The result included features which addressed instruction, evaluation, lesson management and research. The elements specified for the proposed system were: control of audio and visual stimuli (motion), color, fast accessibility of specific TV segments, quick rewind, ability to individualize, capacity for student interaction, and data gathering capacity with ability to summarize and print. It was also requested that the proposed system be portable, low cost and modularly expandable.

The first question addressed was "Is such a system feasible?" A search showed that no system was then in existence that would satisfy all of the demands. A review of the TICCIT system revealed many elements but it did not provide control over the television segments, was not low cost for a single stand alone system, and was not considered modular in design (Hazeltine Corporation markets the TICCIT CAI system).

Extensive exploration of television, minicomputers, microcomputers, interface systems and the instructional demands indicated that the state of the art was such that the system could be built (1975). The task began in January 1976 to build the prototype system.

A general summary of the instructional elements were as follows:

Audio

Control of the audio stimuli was designated as a primary need for auditory training. Use of the audio track on video tape provided the capacity required. Speech training specified control of audio as desirable also.

Motion-color

Speech training indicated that motion and color were primary needs in order for the student to visualize articulatory movements. Video tape was identified as the required media. Color enhanced reality and provided extended motivation.

Accessibility

Drill and practice and tutorial strategies had proven effective for both Auditory and Speech therapy at NTID. The prototype system would be required to repeatedly play and replay segments of audio and visual stimuli. The stimuli were generally very short (7 to 10 seconds long). A video tape replay (VTR) system would meet this need though extensive modification to enable control of the tape would have to be made.

Fast Rewind

Data from CAI and other instructional research indicates that waiting for reinforcement beyond 4 seconds results in deterioration of the reinforcement. For this reason it was specified that a seven to ten second stimuli must be replayable in four seconds or less. Short drill and practice stimuli are common at NTID, particularly in Auditory training.

Individualization

The system must be capable of individualizing instruction to meet specific needs of each student. For many years deaf students coming to NTID have shown a wide spectra of need for remediation as well as instruction, both of which must be met. Computer-assisted instruction was appropriate as one component of the sysem because of its capacity of meeting specific student instructional needs within defined limits.

Active Learning

Data suggests a strong correlation between active learning and instructional gains. Interaction can occur with lesson materials and in classes in many ways. Computer-assisted instruction provides capacity for student participation through interrogation, quizzing, simulation, etc., allowing the student to communicate by way of keyboard or other device.

Data Gathering

To individualize a student's lesson, student data must be gathered. Based on this data, a specific program of instruction is provided. Periodically, data is gathered to determine that the initial prescription was correct. Lesson modifications are made as needed. Research needs require data gathering at a different level. The capacity to identify each stimuli and when it occurred may be important. Each student's response, time to respond, etc., may be critical. These data must be collectable.

A combined instructional/research need was defined as maintaining performance status for individual students as well as for classes. For research purposes, the ability to group students by various criteria of handicap was desirable. These research needs required a minicomputer, disks, clock and printer.

Portability

NTID's Commitment to dissemination of curricula as well as technology affirmed the need for portability. Also, it was envisioned that if a single stand alone system could be made small and portable, it would be feasible to extend speech and auditory training into the deaf student's school and home environment prior to attendance at NTID.

Low Cost

The final criteria was that a low cost production model be feasible based on the prototype system. The low cost model would be for instructional use only. It would utilize existing lessons. No research or lesson development capacities would be required. Low cost was defined as a one year salary plus benefits of a professional Speech Therapist (approximately $15,000.00).

This system levels were defined:

1. The instructional model (low cost).
2. The lesson development model.
3. The research model.

The system was to be designed in a modular form which would support upgrading as desired. Special attention was paid to rentability, reliability and availability of service for the components of the system.

Video Disk

Video disk technology was explored as an alternative to video tape. Rejection of video disk at the time of the development of this project (1965-66) occurred for the following reasons:

1. Unavailability of the video disk.
2. Very high cost of the disk prototype.
3. Very high cost of creating disk from existing tape or film.
4. Unknown reliability.
5. Poor picture resolution (at demonstration).
6. Lesson development processes indicated that the tape system would be critical in the lesson revision stages based on student performance. This process also had strong economic implications which favored tape over disk.

The conclusion therefore, was to proceed utilizing state of the art ¾" video tape equipment for the prototype. It was also pointed out that if the price, reliability, disk cost and serviceability of the disk system approached that of tape then it would be feasible to interchange the tape media for the disk. Furthermore, it was established that conversion of the video disk system controller would be relatively simple and inexpensive.

As of this writing it appears that the feasibility of video disk (both MCA-Phillips and Thompson CSF) is closer to reality. MCA-Phillips provided a limited number of consumer players for sale to the general public in the spring of 1979. These players cannot provide the random access. The cost of these players was quoted as $700.00 each (with rumors that they were underpriced).

The March 1979 issue of Educational and Industrial Television announced that MCA-Phillips and General Motors Corporation had agreed on an order for 7,000 industrial model Disco vision players. The price per unit was placed at $2,000 to $3,000 per unit in large quantities.

The conference on "Interactive Videodisk Technology In Education and Training" supported by the Society For Applied Learning Technology (February 1979) displayed several Thompson-CSF videodisk systems. These systems were built into prototype training systems by various companies and demonstrated in the vendor area. MCA-Phillips systems were noticeably absent. The Thompson CSF representative suggested that their interactive disk systems would be available late 1979 and that the price per unit would be approximately $3,000.

The cost for videotape replay units (Sony and Panasonic) capable of random access is approximately $1,500. The tape systems, of course, move slower to access a given TV segment but, as you will see later in this paper, the speed is adequate for drill and practice and tutorial applications particularly on the ½" systems.

Another problem that the disk systems will have to overcome is the cost of creating disks. At this point a disk conversion from your existing 16mm film costs approximately $1,200 for a master (both vendors are vague on this topic). The cost of copies from the master vary from $10 to $15 per ½ hour disk depending on the volume ordered. In contrast, the labor for copying a ½ hour video tape is approximately $6.00 (several tapes can be copied at the same time) plus the cost of the raw tape which is about $10 for a ½" tape up to $25.00 for ¾" tape. Delivery is usually within a week depending on the number of copies to be made.

Table 1 shows the estimated cost per tape or disk at 10, 100, 1,000, and 10,000 copies. Ten ½ hour disks would cost $135.00 each. Ten ½" tapes would cost $11.50 each.

Table 1
Estimated Cost of Duplicate Disk or Tape
Including Initial Set Up and Raw Tape or Disk

	½" Tape			*Video Disk*	
Number of Units	*Total Cost*	*Cost Per Unit*	*Number of Units*	*Total Cost*	*Cost Per Units*
10	$ 115.00	$11.50	10	$ 1,350.00	$135.00
100	$ 1,150.00	$11.50	100	$ 2,700.00	$ 27.00
1,000	$ 11,500.00	$11.50	1,000	$ 16,200.00	$ 16.20
10,000	$115,000.00	$11.50	10,000	$151,200.00	$ 15.12

Delivery of video disk copies are reported to be 4 to 6 months. The manufacturers claim 1 month. Delivery for video tape copies is within the week unless unusually large quantities are required.

The important fact to retain is that there are two disk systems: the home player ($400-700) that *cannot* be used for interactive instruction and the industrial system ($3,000-$5,000) which can provide interaction.

Prototype System

The prototype computer-assisted instructional television system was fully functional November 1977. Figure 1 shows the component parts. Extensive testing. and modifications were made from July through October 1977.

The WANG minicomputer (2200 vp, 32K) 10 mb disk, printer, clock and keyboard were used without modification. An Intel 8080 microcomputer (4K) was built to control the Sony 2850A video tape player and to communicate with the WANG by way of RS232 protocol. A time code reader (CMX) was added to the Sony 2850A player. Electronic integration of the Sony 2850A allowed microcomputer control by software. Time code was placed on the 2nd audio track of the TV tape. Each frame of television had a unique address which was then read by the CMX reader and interpreted by the microcomputer software. The WANG minicomputer directed the 8080 microcomputer and thus the TV segments. The WANG System also provided the CAI lesson and gathered data for management and research.

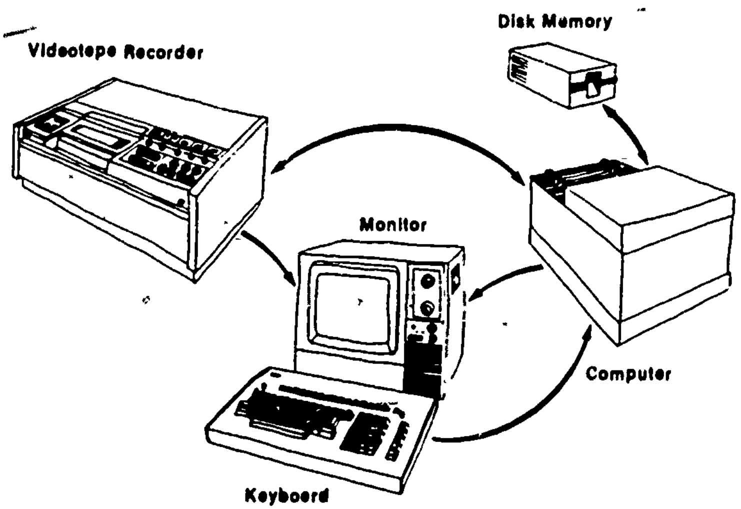

Figure 1: DAVID TB/CAI Prototype System

System Test

Testing activity was scheduled to determine if the prototype would be able to function as designed with acceptable reliability and accuracy under instructional use. Serious research could not begin until the system had proved itself under use.

Two lessons were developed specifically for the test. Two television tapes were made. Tape 1 consisted of three parts to match the three strategies used in that lesson. Part 1 was made up of episodes of Startrek taken from the air (with permission) to augment the Startrek (gaming) strategy. Part 2 adapted existing NTID speech reading drill and practice instructional television lessons. Part 3 called for the creation of a totally new set of television stimuli in the form of over 100 ten second episodes. These eipsodes make up the dialogue of the Job Interview (dialogue strategy) and should be considered the first example of multi linear branching television (DAVID TV). Television tape 2 was developed by Dr. C. Csuri of Ohio State University and Dr. Margret Withrow of Gallaudet College. The content of tape 2 consisted of 3 dimensional animated eipsodes designed to reinforce a single language concept; such as *through*, *over*, and *into*. The lesson using tape 2 allowed the student to command the frog to jump through, over or into a fence, a barn, or other objects.

Approximately 500 people participated in testing the computer-assisted instructional television system which became known as DAVID. From November 1977 to late September 1978 deaf and hearing students at all levels, housewives, teachers, professionals and non-professionals participated in testing the system. The design features of DAVID were tested using one or more of the following strategies: 1. gaming (Startrek), 2. drill and practice (Speech Reading), 3. dialogue (Joe Interview), and 4. student control (Frog/Language Concepts).

The system demonstrated portability on two occasions. A floppy disk was used in place of the 10 mb disk. The DAVID system was taken to the National Institute of Health in Washington, D.C., for one demonstration and on another occasion was on display at H.E.W. during the 25th celebration (also in Washington, D.C.). The entire system fit easily into the back of a small automobile.

The cost of the NTID prototype system was approximately $65,000.00. By January 1979 computer-assisted instructional television systems will be available commercially for approximately $15,000.00. A reasonable research level sysem will be available for $30,000.00.

The most common question asked about the DAVID system is concerned with tape transport speed and latency. Or in other words, how long does the student have to wait to see the TV reinforcement?

There is no single answer to that question due to the variables involved. A partial answer lies in the instruction strategy used, the number of possible TV segment responses, the length (in seconds) of the TV response, the positioning of episodes on the tape and the functional speed of the access system. For example, drill and practice using existing television taped lessons, has had very short latency (wait time). This occurs because the TV stimuli and TV response segments are very predictable. The next logical stimuli is usually very close requiring very little time to position the tape. Table 2 shows latencies taken from a student's Speech Reading drill and practice lesson. Also with drill and practice you can expect repeats of the TV segment to occur. The latency related to the repeat is directly proportional to the length of the TV segment and the rewind speed of the video replay system. Generally speaking, there would not be branching to a remote part of the TV tape for a "replay."

Table 2

A Representative Sample of A Student's Latency Using An Adapted NTID Drill and Practice Speech Reading Lesson

Sentence Number	*Next Stimuli Latency*	*Repeat Latency*
1.	7	5
2.	0	4
3.	0	6
4.	0	4
5.	0	5
6.	12	4
7.	0	
8.	0	
9.	0	4
10.	0	5
11.	18	4
12.	0	4
13.	0	4
14.	0	5
15.	0	4
16.	17	
17.	0	5
18.	0	4
19.	0	4
20.	0	6
21.	9	5
22.	0	
23.	0	6
24.	0	4
25.	0	5

Note that after completing a group of five sentences, the program randomly picks a block of five sentences. A long latency occurs at that point as the tape moves into position. A paragraph of text on the screen for the student to read can mask the wait so that the student would not be aware of the latency. Also notice that it takes about four seconds to rewind the stimuli for a repeat. As you can see, average latency would be misleading. In several instances this student decided not to replay the TV segment (sentence numbers 7, 8, 22).

The quiz for the same lesson (Table 3) was designed to select seven sentences at random from the twenty-five that were practiced. The sentence is repeated one time. After that no repeats are available.

Table 3

Quiz Section Of A Representative Sample Of A Student's Latency Using An Adapted NTID Drill And Practice Speech Reading Lesson

Sentence Number	*Next Stimuli Latency*	*Repeat Latency*
1.	15	4
2.	7	5
3.	17	4
4.	6	4
5.	6	4
6.	11	5
7.	18	4

Latency can be reduced in this section by reassembling the test items into single blocks.

Tape design becomes more important for gaming, dialogue and student control strategies. The first step is to plan anticipated TV stimuli, segments and groupings. We found that access is faster when we duplicate segments on a tape rather than jump back and forth to one specific TV segment. In any event, the TV flow is enhanced by putting a response segment next to the following TV stimuli segment. For example, if the TV stimuli (in the Job Interview lesson) was "Are you willing to move to the corporate headquarters?" the TV response segment for an affirmative answer by the student would be: "That's fine, by the way, what hobbies are you interested in?" In this case a negative response would lead to a disastrous effect and would tree out to a termination of the interview unless the student reversed his position on moving. But that's a different issue in itself. As you can imagine, ability to gather data reflecting student paths becomes very important to the process of developing efficient television tapes for the DAVID lessons.

In general, the Sony 2850A is fast enough for drill and practice (6.5 sec. per sec. in fast forward and 14 sec. per sec. in rewind) but a faster transport system is needed for dialogue. Table 3 shows latencies typical of the gaming, drill and practice and dialogue.

The data in Table 3 reflects one student's path through the demonstration lesson. Since there are many decisions available, the lesson represents a highly individualized map and would be quite different from another student's performance. Many of the students stayed in the gaming section much longer.

In many instances lessons can be designed to reduce latencies to 2 seconds or less by interlacing text between TV segments. In this way the feedback and "further instruction" masks the tape access time. When the student has finished reading, the tape is in position ready to go.

Table 4

A Representative Sample of A Student's Latency Using Various Strategies From the NTID DAVID Demonstration Lesson

	TV Segment	*Next Segment Latency (in seconds)*
Part 1 Startrek Game	1.	14
	2.	0
	3.	2
	4.	0
	5.	7
	6.	8
	7.	4
	8.	2
	9.	12
	10.	9
Part 2 Speech Reading Drill and Practice	11.	32 (position to section 2)
	12.	4
	13.	5
	14.	6
	15.	9
	16.	4
	17.	7
	18.	6
	19.	5
	20.	8
	21.	12
	22.	7
	23	6
	24.	4
	25.	7
	26.	6
	27.	5

Table 4 Con't

Part 3 Job Interview Dialogue	28.	30 (position to section 3)
	29.	12
	30.	14
	31.	16
	32.	0
	33.	5
	34.	12
	35.	6
	36.	19
	37.	7
	38.	5
	39.	13
	40.	19
	41.	0
	42.	12
	43.	7
	44.	18
	45.	6
	46.	6
	47.	13
	48.	14
	49.	0
	50.	5
	51.	19
	52.	8
	53.	13
	54.	7

A commercially available system anticipated provides tape transport speeds of 23 seconds of tape per second in both forward and rewind. This will be a significant improvement over the 2850A which moves tape forward at 6 seconds per second and rewind at 14 seconds per second.

Exploration of hard video disk will occur when economically feasible; however, it is still considered imperative that lesson development be done by way of a tape system before a disk system can be effectively used. Also, the newer PCM soft video disk with its read/write capacity may allow elimination of the tape process. These processes will be explored when available.

On October 1, 1978, the NTID prototype system was accepted as meeting criteria. Soon after, plans were in action to begin exploring the system as a research tool.

Current Experiments

Dr. Donals Dims of the NTID Audiology Department is exploring the DAVID system and its ability to help him evaluate the effectiveness of answer strategies currently used to teach deaf students speech reading. Current instruction of speech reading at NTID requires a video tape player and television set at each student station supported by answer sheets and a teacher in the room. Three activities take place: 1) class instruction, 2) individual instruction (during practice) and 3) independent study (lab).

The following is a description of the deaf student's speech reading activity on the DAVID system which is designed to be similar to the Lab instruction. First, the student is started at a multiple choice level. After he sees a sentence spoken on the television he is asked to type the correct answer from four choices. A simple, a, b, c or d task. The assignment of level is done by the teacher and is based on extensive diagnostic data as well as the student's performance in class.

The second level of answering requires the student to type the words of the sentence just seen into a format which has blanks as clues and the key vocabulary word in the correct place. For example, the TV speaker has said, "The report was filed in the top drawer." The student is given the following format to type his answer:

PLEASE TYPE THE SENTENCE.

------------ filed ----- --ND ------.

level 2

The third level of answer difficulty is similar to level two except that the key word is placed to the right of the answer area; such as:

PLEASE TYPE THE SENTENCE.

--------------------------- (filed).

level 3

The fourth and hardest answer format requires the student to type the answer into a blank area. No key word or clues as to the number of words or their length is given. A blank space is provided for the student response such as:

PLEASE TYPE THE SENTENCE.

____

level 4

Exact spelling is required; however, words out of position are accepted. As students practice, the correct words are shown in their proper position in the sentence as feedback, such as:

PLEASE TYPE THE SENTENCE.

The report has filed on the drawer top. (student)

The report --- filed -- the top drawer. (feedback)

This shows the student that he has six words correct. The feedback becomes a strong clue. The student is given several tries with as many repeats of the TV segment as he wants. Eventually the student gets the sentence correct or is given the sentence word by word to type in. At that time, the sentence is played again but this time the audio is on and the words are captioned on the screen.

A typical course consists of 150 to 175 sentences organized by curriculum such as Engineering or Business. Key words are identified as primary vocabulary words in the given curriculum.

Dr. Sims' lessons are being field tested by deaf students as they are being developed. When the lessons are satisfactory, two strategies of control will be added for testing: 1. student performance control; that is, a series of correct or wrong answers will automatically direct the student to the next level of difficulty allowing progress or regression through the four levels of answer formats based on the individual's performance, and 2. learner control; that is, the student chooses any of the four answer forms.

SUMMARY

The needs of the deaf community require special tools to optimize the teaching/learning process. Instructional television has had a positive effect for teaching deaf students speech reading skills at the National Technical Institute for the Deaf. Auditory training has utilized programmed instruction techniques with audio replay technologies to increase deaf students' ability to use residual hearing. Both audiology and speech faculty have depended upon drill and practice to teach and improve student performance. The DAVID system was designed to assist the teacher by providing audio, television (in color) and an interactive learning activity through keyboard. All of this was under computer control. In addition, a sophisticated data gathering capacity for research at NTID was attached.

Television tapes and CAI lessons were developed to test the prototype under instructional conditions. Instructional strategies used on the tapes were: 1. gaming, 2. drill and practice, 3. dialogue, and 4. student control.

The system was accepted by NTID October 1978 after nearly one year of testing by over 500 people. Face validity of the system was achieved.

The speed of the tape transport was identified to be a problem for some of the strategies used though it was adequate for drill and practice. New techniques for developing television tapes have been developed that maximize the access speed of the tape transport and which capitalize upon the very promising strategy of dialogue. Existing instructional television tapes were successfully adapted.

Innovations such as hard video disk and PCM disk with read/write capacity will be explored when feasible.

Dr. Dims of the NTID Audiology Department is exploring the DAVID system as it applies to speech reading and auditory training.

Acknowledgements

I feel it is fitting to list those whose creative contributions have assisted in bringing the DAVID system to its current state: Dr. Barry Cronin, chairman of the Instructional Television Department, Dr. Donald Sims of the Audiology Department, Dr. Harold Farneth of the Curriculum Development Department, Mr. Steve Talley of Instructional Television and Mr. Tom Myers and Dr. Kirmitt Schroeder, consultants.

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Seminole Community College Working with Twenty-Seven Other Institutions

Thomas W. Hobbs
Seminole Community College
Sanford, Florida

INTRODUCTION

The Florida Community College System has several times served as a model for other community college systems in the country. With the realization that television had become one of the dominant mediums of mass communication the Florida Community College System again served as a model when it began the development in 1973 and 1974 of the Florida Community and Junior College Television and Radio Consortium.

A major reason for the search for a cooperative method of organizing the presentation of televised college credit courses was that of cost. With the relatively high costs of acquisition and of leasing documentaries, producing written materials, purchasing television broadcast time, adapting telecourses to local needs, and of assigning faculty time, it was apparent that television created special economic problems for a single institution.

The development of the Consortium began during the fall of 1973 when Valencia Community College in cooperation with WMFE-TV, the public television station in Orlando, agreed to broadcast the "Man and Environment" series. Approximately three hundred students enrolled for credit the first semester. With such an outstanding response Valencia Community College began to explore other possibilities of televised programming.

The signal of WMFE-TV covered the service area of five central Florida community colleges. Encouraged by the news that WMFE-TV was about to increase its signal strength five times its present power, Brevard, Polk, Lake-Sumter and Seminole Community Colleges joined

Valencia Community College in a Consortium. Unfortunately, the new tower from which the greatly increased signal was to be broadcast, collapsed during a final state of construction. This resulted in two of five colleges suffering from an almost total loss of signal in their college districts.

It was found that both colleges, isolated by the loss of the signal from WMFE-TV in Orlando, could receive the signal of WEDU-TV in Tampa. The WEDU-TV management agreed to broadcast the "Man and Environment" series. The broadcast by WEDU-TV not only made it possible for Polk and Lake-Sumter Community Colleges to receive program signals but it also allowed for four additional community colleges to participate. Hillsborough, Manatee, Pasco-Hernando and St. Petersburg Community Colleges could now receive the signal and were invited to join the Consortium. As a result of these additional colleges entering the organization, it was decided during the summer of 1974 to form the Central Florida Television and Radio Consortium.

When the 1974 fall term was completed, the Consortium's college credit television course enrollment was 3,294. By spring of 1975 the list of courses being offered by member community colleges included: "The Ascent of Man," "Dimensions In Culture," "Man and Environment, Part I and II," "As Man Behaves," and via radio, "Law I" and "Law II." Since September 1974, more than eighteen different courses have been offered by members of the Consortium (see Appendix B). The enrollment has increased from the original 3,294 in one term to over 11,000 in one year. The total enrollment since its inception has been more than 52,000 students.

Consortium Organization

The great amount of interest expressed in a possible statewide consortium by non-member community colleges was such that with the aid of the Florida Department of Education plans were developed and approved for a statewide Florida Community and Junior College Television and Radio Consortium. The plan assigned each of Florida's twenty-eight community colleges to one of six regions. Each of the regions was centered upon, and somewhat determined by, the local public television station's broadcast capability. Each college was to serve the student population of its own district and would share equally the decision making processes and in the funding of the region's operations. Each region would choose a volunteer coordinator. These six coordinators would, in turn, meet on a statewide basis and would choose a chairman. This organization has functioned in such a way that the coordinators have shared in the development of plans, programs and new funding solutions. The plan and resulting Florida Community and Junior College Television and Radio Consortium was approved by the Florida State Community College Council of Academic Affairs, the Florida

Community College President's Council, and by the Florida Division of Community Colleges of the State Department of Education during the fall of 1974. Subsequently, all twenty-eight colleges have expressed interest in the Consortium and have participated to some degree.

The Florida Community and Junior College Television and Radio Consortium at that time was unique in that it developed within the Florida Community College System. The Consortium was designed to meet the needs of the individual colleges and was not superimposed upon the system at the state level. Much credit must be given to Robert McCabe, President of Miami-Dade Community College and David Evans, Vice-President for Campus Affairs of Valencia Community College for providing much leadership and support.

Additional encouragement, technical and financial aid came next from the Florida Department of Education. J. Warren Binns, Administrator of Educational Television and Radio, agreed to assist the Consortium. This aid came in many forms but two of the more important were the leasing by the Department of Education for the Consortium, the majority of its televised courses and secondly, that it served as a dubbing center for all series offered by the Consortium. Both of these actions greatly relieved the financial burden placed upon the Consortium's member colleges.

Locating Materials

A problem that has often arisen for the Consortium has been that of locating appropriate materials. Until the recent addition of such listings as those of AACJC much of the search for new material was on a hit or miss basis. Often first knowledge of the existence of a telecourse has been gained from the varied public relations efforts of the individual producing entities. Other sources have been the various educational television or audio visual workshops with their displays of equipment and materials.

The difficulty of locating a wide variety of materials has been especially acute in the areas of high student enrollment such as the widely found general education courses. These freshman and sophomore courses across the state enroll thousands of students each college term yet there have been very few television based courses produced to fill this need. It is true that a number of high quality course materials such as "As Man Behaves," "The Growing Years," "The Ascent of Man," "It's Everybody's Business" have been produced with many colleges now using them. Many other colleges and universities have tried to enter this instructional area but often their efforts have centered upon the recording of lectures and slide show presentations. While it can be said those presenting the materials were often talented professionals in their respective fields of academic endeavor they have often possessed little knowledge of the limitations and potentials of television based instruction. Due to often poor or limited production procedures many of these program series are simply not being used by the majority of colleges now offering television based instruction. There are several reasons for this reluctance, one of which is that of low appeal to the student. The college student of today is accustomed to viewing and using high quality audio visual materials. Materials produced poorly will receive poor student usage and will have a resulting low student enrollment. A second problem linked to poor production quality and style is that many television stations today are reluctant or will refuse to use poorly produced educational materials during prime hours due to the lack of viewer appeal. The local stations when reviewing telecourses must also consider the general viewing public of which the station does not with to lose its share due to extremely poor production of some television series.

It is not that excellent instructional courses have not been produced. One only has to view such series as "The Ascent of Man," to have the enjoyment of factual materials being presented in an enlightening and entertaining style. The number and variety of these courses for use in general education has continued to be severely limited. Additional production work needs to be undertaken in this area. It is not that it cannot be done because such institutions as Miami-Dade Community College, Dallas Community College and Coastline Community College have been doing it for several years.

The television based courses offered by the Florida Community Colleges are usually chosen on the basis of consortial agreement. The Florida Consortium regional representatives meet regularly to conduct reviews of available materials and to discuss future needs. After initial viewing by the region representative the recommended tapes are then viewed by the faculties of the individual colleges in each region, which then make their recommendations to the regional coordinator who then in agreement with the other five coordinators recommends what the State should lease or buy.

Adoption of Materials

The adaptation of a television based course is very often not as simple as it may at first seem. Quite often a lengthy period of review by instructional faculties of the course objectives and content takes place. Occasionally questions arise as to advisability of totally adapting such a course with all of its content and components. In some instances only the reordering of the sequence of tapes has been necessary. In a majority of instances extensive modification of either state, regional or local consortium professionals has had to take place on at least one part and on several parts of the course package.

Many of the changes have resulted when there arose differences between the television based course materials and the local curriculum. Other changes have occurred in efforts to modify the course so as to lessen faculty resistance to telecourses. In one instance changes were made to reflect a more local focus. The very popular series produced by Miami-Dade Community College, *Man and Environment I and II* was an excellent example of the range of adaptive changes. The series consisted of thirty one-half hour tapes which were equally divided between the series' two courses. North Florida Community College at Jacksonville believed that a more local focus to the course was needed and so produced its own series of tapes to be used with those of Miami-Dade Community College. Other changes involved in adopting these two courses could be found in the Central Florida Region of the Consortium. Here, not only were tapes reordered as to sequence there were new study guides developed and different textbooks chosen.

Problems of Delivery

The full potential of the Consortium proably has not been fully realized. Several colleges have tried alternative means of reaching their district populations. Gulf Coast Community College at Panama City has had to make extensive use of local commercial television cable system. Their problem has been the lack of a strong station to serve their population. Another example of alternate means of serving television students is exemplified by Daytona Beach Community College which has worked with the Volusia County School Board in using its I.T.F.S. system. Each of these examples represents an alternative method of reaching student populations by means other than public and commercial television stations.

One reason for the numerous searches for alternative means of reaching the student have been the all too often obstructive or uncooperative attitudes of several of the state's public and commercial stations to the very idea of working with any of the colleges in a constructive way. Often the rates for air time have been placed at too high a level. Other instances have occurred where the local stations would simply refuse or not make time available for the telecasting of the college courses.

Perhaps one reason why the Central Florida Region has been so successful in its programming has been because of the attitudes and management policies of WMFE-TV toward the Consortium. Over the years since 1973, WMFE-TV has been an active supporter of the Consortium's effort. Rates for air time have been kept at a reasonable level and times for broadcast have been easily attained.

Consortium Benefits

The resulting advantages to the Consortium's individual member colleges have been numerous. Each college has shared in the selection of courses and has had the flexiblity of participating or not participating in any of the course arrangements. This system of cooperation has helped all colleges in that it provided a greater sharing of expertise in such activities as the selection of materials, the development of faculty workshops, study guides and other printed materials. Another advantage of this Consortium was that no longer would any individual college have to pay all the costs, for by cooperating, they paid an equal share of costs.

The outstanding quality of the Florida Communty College Television and Radio Consortium seems to be the freedom of choice allowed each member in its participation in any activity of the Consortium. The only limitation being that once a region has decided to offer a course all must share in its broadcast costs. Associated with each of these decisions is the fact they are arrived at in the local-regional level and not at the state level. This has allowed each college greater latitude in controlling not only its instructional costs but also its curriculum.

APPENDIX A

Community College
Instructional Television and Radio Coordinators

Jack Carroll
Director, Learning Resources
3865 N. Wickham Rd.
Melbourne, FL 32935

Isaac Call
Director, Learning Resources
Broward Community College
3501 S.W. Davie Rd.
Fort Lauderdale, Fl 33314

Sharon Mixson*
AV Coordinator
Central Florida Community College
P.O. Box 1388
Ocala, FL 32670

William Stabler
Director, Learning Resources
Chipola Junior College
Marianna, FL 32446

Paul E. Novak
Media Specialist
Florida Keys Community College
Key West, FL 33040

Charles Bond*
Dean, Learning Resources
Gulf Coast Community College
5230 W. Highway 98
Panama, City, FL 32401

Dr. John Bouseman*
Vice President
Hillsborough Community College
Plant City, FL 33566

Mrs. Mary Thornton
Manager, Media Services
Indian River Community College
3209 Virginia Ave.
Fort Pierce, FL 33450

Dr. Don Thigpen
Dean, Learning Resources
Daytona Beach Community College
P.O. Box 1111
Daytona Beach, FL 32015

Dean Ritzman
Director, Media Services
Edison Community College
College Parkway
Fort Myers, FL 33901

Guy Kerby*
Cablevision Coordinator
Florida Junior College
940 N. Main St.
Jacksonville, FL 32202

Ned Glenn*
Director of the Open College
Miami-Dade Community College
11011 S.W. 104th St.
Miami, FL 33167

Mrs. Lu Alice Sands
Director, Library Services
North Florida Junior College
Turner Davis Drive
Madison, FL 32340

Hosmer Roberson
Coordinator, Media Services
Okaloosa-Walton Junior College
College Boulevard
Niceville, FL 32578

David C. Briggs
Media Specialist
Lake City Community College
Lake City, FL 32055

Walter Allan
Lake-Sumter Community College
5900 N.W. 441, South
Leesburg, FL 32748

Mrs. Margaret J. Lyons
AV C Department
Manatee Junior College
P.O. Box 1849
Bradenton, FL 33506

Thomas C. Rogero
Dean, Academic Affairs
St. Johns River Junior College
5001 St. Johns Ave.
Palatka, FL 32077

Robert N. Kreager
Director, Instructional Development
St. Petersburg Junior College
P.O. Box 13489
St. Petersburg, FL 33733

Dr. Robert Meyer
Dean, Learning Resources
Santa Fe Community College
P.O. Box 1530
Gainesville, FL 32602

Dr. Thomas Hobbs**
Chairman, Social Sciences
Seminole Community College
Sanford, FL 32771

Milton U. Thomas
AV Coordinator
Palm Beach
Junior College
4200 Congress Ave.
Lake Worth, FL 34603

Wellington Estey
Dean, Learning
Resources
Pasco-Hernando
Community College
2401 State Highway 41,
North
Dade City, FL 33525

ITV Director
Pensacola Junior College
1000 College Boulevard
Pensacola, FL 32504

Mrs. Leila L. Sebring
Librarian
South Florida Junior College
600 W. College Drive
Avon Park, FL 33825

William Donaldson
Tallahassee Community
College
444 Appleyard Dr.
Tallahassee, FL 32304

Dr. Paul Kinser*
Community Resources
Valencia Community College
P.O. Box 3028
Orlando, FL 32802

Dr. Patricia S. Miller
Director, Learning
Resources
Polk Community College
999 Avenue H, N.E.
Winter Haven, FL 33880

* Region Coordinator
** Consortium Coordinator

APPENDIX B

Television Courses That Have Been Offered By The Florida Television and Radio Consortium

Man and Environment I
Man and Environment II
As Man Behaves
Dimensions In Culture
Ascent of Man
Adams Chronicles
It's Everybody's Business
Writing For A Reason
Earth, Sea and Sky
Making It Count
The Long Search
American Government
Home Gardener
Classic Theatre
Modern Math
Law I
Law II
The Age of Uncertainty
Music Appreciation
The Growing Years
Biology
Shakespeare
Personal Finance and Money Management
The Living Environment
The Art of Being Human

Bridging the Chasm Between Telecommunications and Higher Education

C. Gregory Van Camp
General Manager, Station WWVU-TV
West Virginia University
Morgantown, West Virginia

INTRODUCTION

Several years ago, when West Virginia University's public television station was in its infancy, my administrator, the provost for academic affairs, made a statement that in many ways characterized the 'age-old' chasm between education and technology. The situation was this: the television station was under a short deadline from the Federal Communications Commission to file a form which required the signature of the chancellor of the West Virginia Board of Regents, holder of the station's license. The university, which operates WWVU-TV for the board, had an extensive, time-consuming review procedure for any and all matters which required the chancellor's approval—certainly too extensive and too complex to meet the station's deadline. In appraising the situation, my provost said, "Greg, the problem is . . . in television you work by the sweeping red hand of the clock . . . but the university works by the decade!" However humorous, or maybe sobering, his assessment reflected a significant reality.

Although my illustration is a greatly exaggerated contrast—the fact is that a chasm does exist between education and technology, specifically communications technology. The width and depth of the chasm varies, perhaps based upon one's own perspective. Certainly from the technology side, the chasm is generally perceived as awesome. In March, 1975, the Advisory Council of National Organizations published a report to the Corporation for Public Broadcasting; it was entitled simply "Public Broadcasting and Education." The first of its 11 recommendations stated, "The CPB should intensify its efforts to bridge the traditional chasm between broadcasting and education, building a working partnership to serve their common purposes." Over the years, many similar recommendations, challenges, and mandates have been voiced. But the reality is that generally each camp continues to walk along its own side of the chasm.

It is my purpose here to explore some of the reasons why this is true—but perhaps more importantly to show that the chasm does not need to be there—at least not to the clearly-evident level that exists too extensively throughout the United States today. Higher education and communications technology can inter-relate; however, it is going to take a major effort, and significant changes, by leaders on both sides to make it happen.

Basic Issues

Let's consider the basic issues in an effort to understand the scope and nature of the problem. My analysis shall be confined to the field of communications technology—or telecommunications; it is my observation that the chasm is greater in this field than in most other areas of technology. Most technology can be fully controlled or managed by the user; telecommunications, however, is different.

Telecommunications is a threat to many educators. It is not easy to use. It requires a team of specialists to produce its software. Too generally, educators and telecommunications people don't understand each other. One of the reasons is that telecommunications is similar to the educational community in that the important work of each is achieved by professional people—assuming that the telecommunications unit is one of quality, with high standards. Each field is composed of sophisticated, intelligent, motivated human beings. Each has pride ... and separate missions with sets of goals. However, for the educators to use the technology, and to use it properly, individuals from these two fields must work closely together. The split also becomes evident when faculty within the same academic discipline reject the work of others. Further; we see it when the academic leadership of an institution does not support the use of the technology. The communications technology itself is not the problem—that is quite straightforward. The technology is merely hardware: cameras, videotape machines, cable, satellite, casettes, fibre optics, videodisc—fascinating tools, designed by people.

Examples

Consider three examples in an attempt to explore this nationwide chasm. First, a very simplistic situation: the use of a television-based course, produced by another university. The key work is 'another.' Here is a well-known pattern: time and time again, faculty from University A reject the television materials produced by Universities B and C. Reasons range from valid explanations to obvious excuses. The fact is—the faculty from University A didn't have a role in contributing ideas into the content. Further, within the same department of a university, a television course developed by 'Prof. Smith' is equally rejected by his peers.

We all well know, however, that books on subjects within the same academic discipline are accepted and used. What is the difference? Ideas and concepts are expressed in both forms. On the one hand the book is an integral part of the traditional system. Education developed with the book; it has been part of of higher education for centuries. But, television—that's a wholly different matter. It is a non-traditional newcomer. It doesn't fit into long-standing, established academic patterns. But perhaps most significant, it is very personal. The communications process is one-to-one.

As a result, for these and other reasons dozens of truly outstanding television courses receive low to marginal acceptance for broad use—use which could be beneficial to many students—and to many colleges and universities.

A second example—production of a television-based credit course. In this situation, a professor, the teacher-host, enters into the new experience with the expectation that he will control the circumstances. But this won't necessarily be the case. The reason—waiting to work with the professor is a 'team' of television experts: an instructional specialist, an executive producer, a producer-director, graphic artists, videographers, lighting people, sound specialists, technicians—each with a role to play, and each in his desire to produce the highest quality possible, may modify, support (or even hinder) the educator. True, the professor is responsible for the content—but to effectively adapt it for television, he must rely upon the television experts, who are also creative, innovative, knowledgeable people with ideas of their own, and confident of their own capabilities. There will be planning meetings, discussions, and approval of major and minor matters. The faculty member becomes caught up in different techniques: formats, art work, field production, and other non-traditional, new activities. The educator becomes a partner, however willing or unwilling, in a complex situation—one which requires time, energy, patience, and hard work. It is my observation that the more complex and sophisticated the production activity, the lower the control by the educator. Based upon the above scenario, can you expect a rush of faculty members? And I haven't even mentioned the negative reinforcement and criticism the professor typically receives from his peers during his new, sometimes traumatic experience!

Frequent Distrust

To add to the complexity, unfortunately there is another whole side to the problem . . . a side of some significant magnitude. Too generally, television people question the motivation of some professors in their desire to use television. Telecommunications professionals have been 'burned' numerous times in unsavory experiences. When faculty use telecommunciations for personal gain—or some self-serving purpose, the project doesn't succeed, or the end product is of lower quality than it could have been. Three graphic illustrations come to mind. One deals with the use of television as a means of providing release time to faculty for their own research and publishing... release time justified by the large number of student contact hours generated by the use videotaped lessons, played-back multiple times, and repeated in future semesters. A second illustration—the production of a television series as a means to provide a summer job for the faculty member—not produced to meet an institutional need. A third illustration is a common problem. A professor secures a grant for production of television materials—but he doesn't inform the telecommunications people about the project until after he receives the funds. Typically there is then conflict because of prior commitments by the telecommunications unit, or the funds are inadequate to accomplish the professor's original project. It is situations like these which make the television people rightfully suspicious of new faculty projects which are brought to them. There are literally dozens of illustrations like these from around the country.

Let's continue to explore the chasm with example number three: the full-blown, sophisticated telecommunications center, including public television and radio stations, as a unique entity within the university's system. To put this unit into context, realize the relatively high level of independence of this unit—independence from traditional university patterns—created by the Federal Communications Commission and its licensihg process. Sprcifically, the broadcasting staff has a truly unique mandate—a responsibility of some considerable magnitude requiring special considerations, which may have little to do with the university, to which it is licensed. In essence, to some major degree, the broadcasters must operate as an entity. Further, whatever it does, its product, is fully in the public view. This in itself is a unique, major distinction.

Therefore, the administrator of this telecommunications unit is also manager of the licensed broadcast stations; he works under a split responsibility and sets of guidelines. He must walk the line between his university's policies and rules... and those of the FCC and other Federal agenceis. To this, add the complexities and implications of my two previous examples—plus a number of other pressures—and maybe you can begin to realize the depth and width of the chasm.

Positive Relationship Possibilities

Now, with that background, let's return to my theme: in spite of the problems, a positive, productive inter-relationship can exist between the educational community and the one of telecommunications.

True, I have painted a fairly grim picture of the chasm. But, that chasm can be bridged, if the parties want it to happen. It is like a marriage. It can work—if both partners want it to. However, unlike a marriage, the relationship of education and telecommunications is quite one-sided. One of the parties must try harder, be more flexible, and make a genuine effort to accommodate the other. That party is the technology partner.

Why? Obviously the educational institution is the majority partner—by many fold. Its mandate, its size, its depth, is much broader, much older, much stronger. The telecommunications unit is just one of many units within the university—perhaps the youngest, the smallest, the most independent.

There are several major reasons why the educational community is interested in utilizing the new communications technology: (1) financial and enrollment pressures on the colleges and universities and the resultant need to achieve greater efficiencies and to develop new and different student enrollments; (2) an increasing awareness by faculty in the potential benefits of using telecommunications; (3) the development of new easy-to-use devices (such as the videocassette and the videodisc); (4) a growing sophistication of the telecommunications professionals; (5) an increasing appreciation and acceptance of the talents and contributions of the telecommunications staff; and (6) a realization that the average American is greatly influenced and affected by telecommunications as an integral part of his or her everyday life. American industry and the defense establishment have embraced communications technology as a basic part of their educational and training programs.

Creating a Successful Marriage

Those are the reasons to build the bridge.

But how do we go about it? Previously I stated that one of the partners had to work much harder to make the marriage work—and so it is. The telecommunications people must make the major overture . . . create the opening . . . provide the proper atmosphere. And if the circumstances are to the advantage of the educators, and their use is for truly legitimate, valid purposes, the marriage can work.

For benefit of the marriage, there are several specific suggestions which I offer to the various parties.

To the telecommunications administrator and the members of his staff:

- Develop, and instill in your staff an understanding of, and a commitment to service on behalf of the academic community. Be genuinely responsive to the needs of the educators.
- Create an internal system which will objectively evaluate the merits of accepting, or rejecting, faculty requests for service projects.
- Maintain a high level of communications—internal and external—on activities related to academic needs and projects.
- Open positive relationships with the other administrators within the university. Work with people in the comptroller's office,

purchasing, budget, personnel, physical plant. Within our bureaucratic world, learn to work within the systems . . . and make the systems work for you.

- Build a confidence in those with whom you work. Develop realistic, justifiable goals, budget requests, and policies.
- Establish and maintain high production, technical, and operational standards.
- Make it as easy as possible . . . in all ways . . . for educators to utilize your services.

To the university administrator, I offer the following suggestions:

- If telecommunications can play a role in your institution, openly endorse it and follow with tangible support.
- Implement mechanisms, policies, and organizational structures which will integrate telecommunications into the mainstream of institutional concerns and directions.
- Hire a telecommunications administrator who will lead a staff which is responsive to faculty needs.
- Insist that the telecommunications unit be truly high-quality, professional in nature; if it is not, the expenditure can become a liability instead of an asset.
- Support the telecommunications unit with adequate funds for personnel, equipment, and operations.

And to the faculty I offer these guidelines:

- Enter into the telecommunications experience with a positive, open attitude.
- Be willing to learn from the team of specialists: new techniques, ideas, capabilities of the hardware. Look upon the telecommunications staff as professional people who will help you.
- Be flexible and take full advantage of the new opportunities.
- Be realistic about the outcome of the activity.
- Involve the television professionals early in your planning.
- Use telecommunications only for projects which support institutional and departmental goals.

Previously, I said that the marriage can work, if the parties want it to. If the above specific guidelines were all implemented, we would have an educational/telecommunications utopia. But needless to say, I'm not expecting this to happen. Short of utopia, however, I encourage educators and telecommunications professionals to work together for the mutual benefit of the learner. There is much to be gained.

SUMMARY

In closing, I'll share an example of how one institution, West Virginia University, and its telecommunications unit have built their bridge. Its construction took many years and much hard work . . . on both sides. Then after the bridge was in use, a new governor proposed removal of

Station WWVU-TV from the university. He suggested that it be transferred to the state's Educational Broadcasting Authority. To the governor, the move seemed logical and practical. It would accomplish the consolidation of all public television facilities under one budget and one set of policies. However, what the governor didn't know was the deep inter-relationship of the station within its university. In the months which followed, an outside consultant was retained to assess the most desirable 'home' for WWVU-TV. In his final report, the consultant, Mr. James A. Fellows, President of the National Association of Educational Broadcasters, recommended that WWVU-TV remain with West Virginia University. His six observations painted a picture of a successful, effective, positive, on-going relationship. He identified such areas as the university administration's support . . . the station's planning activity as part of the institution . . . successful programming . . . efficient financial reporting . . . and involvement and support from the public. The governor agreed with the rationale.

In the years which followed, traffic increased over the bridge. Perhaps the most successful activities have related to programming on WWVU-TV, which serves 29 of West Virginia's 55 counties. Since 1975, more than 500 WVU faculty and administrators have actively participated in production, or have worked with us in other projects. Many of the programs have been accepted for distribution by the Public Broadcasting Service, or have been used regionally. One instructional course is currently being used nationally via satellite.

Another recent area of success has been faculty utilization of television-based credit courses. This project is now in its fifth year. Student enrollment for the six institutions served by WWVU-TV, showed an increase of 23 percent for the fall semester, 1980-81, over the similar period a year ago.

Virtually every area of West Virginia University works with 'WVU-Television' in the development of programs or in the utilization of other services such as equipment maintenance. One of the most exciting activities is a mutually-beneficial student intern project. Recently, the bridge was strengthened further through a new relationship between the academic senate and WWVU-TV. Now in place, and communicating effectively, is a Faculty Television Committee . . . a liaison link between the educators and communications technology. Within the University organization, the telecommunications unit is structured as an active part of Academic Affairs.

On September 25, 1980, on the occasion of the dedication of West Virginia University's new Broadcast Center, President Gene A. Budig stated, "WWVU-TV is a vital, integral, important part of West Virginia University."

Although there is still a great amount of work to be accomplished—particularly in the area of direct support of instruction—there is a strong foundation and the proper elements are in place to move ahead effecitvely.

Yes, it can be accomplished. But make the bridges solid . . . and wide . . . and lasting, the design must be created with great care, and the construction must be well supervised. Once the bridges are in place, benefits start flowing both ways . . . but most importantly to the institution. As we move through the new decade, and as our nation . . . and higher education meet different, changing circumstances and challenges, telecommunciations can play a significant, vital role.

I encourage you to build some bridges.

Curriculum's Technology Lag (Curricula and Television Literacy)

Robert L. Hilliard
Dean of Graduate Studies and Continuing Education
Emerson College
Boston, Massachusetts

INTRODUCTION

As much as I deplore the lag in the use of technology in implementing curricula, I find even more critical and dangerous to our future the lag in incorporating technology, particularly television, as *part* of our curricula. American education is responsible not only for a technology lag, but for a cultural lag that threatens the very nature of our free and democratic society by not making television an integral part of our curricula, as it is of our everyday lives—certainly as much a part of our existence as is English composition, Algebra I and II, or a foreign language.

Let me illustrate:

When American television was young, in the 1950s, Edward R. Murrow interviewed a teen-aged gang member indicted for the murder of another youth. Although the accused boy could neither read nor write, he watched television a lot. He explained his act of aggression by comparing himself with his favorite TV hero, the invincible "Mighty Mouse." He could not differentiate between the fact and the fancy of what he viewed on television. He saw, but he could not accurately interpret. He was not only a print illiterate, he was also a television illiterate.

In 1981 a woman goes to her physician with symptoms of breast cancer and, despite recent alternative methods of treatment, she accepts without question the diagnosis and prescribed mastectomy. Her principal knowledge of medical doctors comes from television, where they are gentle, altruistic, infallible, and look like Robert Young. The television reinforcement of the image the medical professional projects for itself influences her even against her own self-interest. She is a television illiterate.

During any political campaign a man learns about the candidates principally from television, where the need to get attention and make a point in a short space of time results in the capsulizing of significant issues into 30-second spots. He comes to conclusions and exercises his democratic right to vote on the basis of superficial judgments rather than careful evaluation. He, too, is a television illiterate.

Most of us, in fact, are television illiterates. That is, we cannot analyze and evaluate and come to objective conclusions about what we see and hear on television, although many of us, because we are highly literate in print, think we are television literates as well.

At the very least, we are confronted with an issue of morality—the morality of our being controlled without our knowledge. We need to know what is being done to us, how it is being done, and how we can cope with it.

Cultural sophistication and traditional learning are meager defenses against media brainwashing, as the relatively highly educated society of pre-World War II Germany found. Goebbels praised film as his most important and successful tool in solidifying national support for the Nazi program.

Those who control a country's media control its political processes. Unless we become literate enough to understand and control the effects of television, it will control us.

We are a society that is primarily communicated to and is learning to communicate by visual and aural means, rather than by print which, before the electronic revolution of this century, was the only mass medium. Before television and radio we relied, for hundreds of years, on print as the medium through which we could communicate long distances and with large groups of people simultaneously. Throughout history, totalitarian countries, in whatever political form they existed, have usually attempted to maintain a high rate of print illiteracy. They have known that without the ability to communicate effectively and to evaluate critically communications received, people were at a continuing disadvantage in understanding their political alternatives or in organizing to do something about them. During the past several centuries, with the invention of movable type and the growth of the printing press, print literacy began to spread, resulting in a gradual series of political revolutions, not the least of which was the one in this country in 1776.

As long as print was the principal medium of sophisticated communications, the rise in literacy provided—but did not guarantee—the bases for people-oriented governments. The development of non-print media as significant means of communications permitted, in some countries, a return to totalitarian control over minds and emotions, including countries where the people's high degree of print literacy lulled them into the false perception that they could not be controlled through communications. Again, Germany of the 1930's is a prime example of the dangers of such a fallacy.

How many hours a day do you spend reading? One? Two? Six? The two hours a day the average American spends reading includes signs, packages and labels, with less than half-an-hour devoted to books, magazines and newspapers. Compare that with this statistic: the television set in the average American household is on 6 hours and 20 minutes each and every day of the year. And 98 percent of the households in the United States have at least one TV set.

The average student, by the time he or she has graduated from high school, has spent some 10,800 hours in the classroom and over 12,000 hours in front of the television set.

Print *illiterates* are vulnerable to control by television and radio because they cannot take advantage of the multiple-source information and ideas that are possible in even the most repressive societies through underground newspapers, clandestine pamphlets and smuggled books. Television and radio are especially powerful in developing countries, where they are principal instruments of control of thought and feeling. The more developed countries, however, are not immune. Even with—or, perhaps, because of—our extensive and intensive exposure to television, we Americans are not literate enough to immunize ourselves objectively from its persuasive powers.

Print *literates* also are vulnerable to control by television and radio because they have a false sense of security about their ability to evaluate critically and to cope with the effects of the media on them.

Authority has always recognized print as a medium requiring the active participation of the reader, making it easier for the individual to control, and therefore authority has tried to suppress it. On the other hand, recognizing TV as a medium of passive participation, less easy for the individual to control, authority has tried to encourage and then to dominate it.

Even in a democratic society such as the United States, efforts by both public and private sources to control television politically have sometimes been less than subtle. Control of the purse-strings can affect media content indirectly, if not directly. As Erik Barnouw's book, *The Sponsor*, shows, sponsors' beliefs and interests have frequently determined the political orientation of a program, so subtly in many cases that unless you are a television-literate you probably didn't realize how you were being proselytized.

A decade ago a National Conference Board study of the anticipated most significant issues of the 1980s revealed that one important concern of leaders in various professional areas was the possible domination of the political process through the control of television by government or private interests. Government documents released in 1979 confirmed what many people in the communications field had known in the early 1970s: the Nixon White House had attempted to use television to forward its political purposes and to intimidate the television industry into restricting materials it considered politically unfavorable. Although it did not succeed in the long run, it was not without some success in both commercial and public television.

Communications Professor Dallas W. Smythe of Simon Frazier University in Canada has long been in the vanguard of those who have recognized both the potentials *and* the responsibilities of the mass media in the real world. Some 20 years ago, at the height of the cold war—current events make Dr. Smythe's comments as applicable today as they were then—he wrote: "We know that the public is largely apathetic and alienated from concern with the vital issue of survival. What has been the contribution of the mass media to this apathy?... As Lazarsfeld and Merton argued... the escapist nature of most of the content of the mass media has for the citizen a 'narcotizing dysfunctional' effect."

By demanding passive response, television can neutralize people's concerns with and participation in the social and political events of the world, as well as being able to persuade them to take a particular stand on something.

If we do not formally educate our people, young and old, to at least as much competency with visual and aural media as with print media, we will be— we are—setting the stage for eventual control of them, of us, by those who control the media. Just as a young person graduating from high school has had twelve years of required courses in print literacy, so should that student have had at least an equivalent education in visual and aural literacy, in television and radio criticism, and in the analysis and preparation of visual and aural communications and materials. The same holds true for college and university learning. All students in all fields of endeavor—including those going into economics, engineering, medicine, history, sociology, business, law and other professions, and not only majors in journalism, film, television or radio—should have at least as much exposure to visual literacy courses as they have to print literacy, composition and literature courses if they are to function in and contribute effectively to their society. Today, relatively few colleges encourage for, no less offer to non-media majors such courses as "Critical Analysis of Television and Radio," "Aesthetics of Mass Media," "Television and Society," "Writing for Television," and "Psychology of Communications." There is a need for more basic courses oriented to specific fields, such as "Television and the Teacher," "Health Communications," "Broadcasting and the First Amendment," "Television and Human Behavior," "Television and Politics," and "Corporate Uses of Media."

History and current events have shown us unequivocally that with few exceptions those who control television and radio are likely to control the political processes of any given country or society. When a political revolution occurs anyplace in the world today, what is first taken over? Not the Treasury. Not the Post Office. Not the schools or colleges. Not the factories or department stores. Not even the printing press. But the television and radio stations!

The control of the political processes of a country through the control of television—whether by a government in power or by media barons in the private sector—is already a reality in many countries. In only a handful of nations—ours among them—are television and radio insulated to a meaningful degree from the direct control of the government. In the United States the extent to which the people can determine the content of television programming depends on their influence on the advertisers who sponsor the programs and the stations that carry them (and the state and local governments, institutions and organizations that support and operate public television). To what degree can we exercise such influence as citizens in a democratic society?

In only the rarest of situation, given the political systems in today's world, is there a practical possibility that individual citizens might gain direct control of TV and radio—that is, for citizen groups, included minorities and the poor as well as the elite, to own and operate their stations. The only citizen alternative, therefore, is to gain control of the effects of the media—to be able to analyze objectively and evaluate critically the content of television and radio so that it does not influence our thinking, feelings and actions without our intelligent and informed consent. That is what we mean by TV literacy.

Those who believe they are qualified to exercise such control must ask themselves whether the judgments they make are based on literate, critical, intelligent analysis and evaluation of what they see and hear, or on untrained, even prejudicial attitudes. Just as important is the effect on our thoughts and feelings of those things about which we make no judgments because we do not understand enough about the media's psychological and aesthetic impact. These materials may be, in fact, the same kinds of things we have little problem making judgments about when we see them in print because we have had enough education in reading, writing and literature to be print-literates. Many of us who are print-literates wrongly assume that we are television literates as well.

Both the problem and the solution lie in our educational system. Traditionally, we require formal preparation of all of our citizenry in print literacy. Almost without exception, graduates of secondary schools in this country have had 12 years of courses in composition, literature and other subjects that generally come under the heading of English, to enable them to communicate in print and to have some critical facility in evaluating print communications. Almost every college graduate has had at least an additional two years of required courses in print-competency. Yet, few elementary and secondary schools of colleges and universities require even one course in visual and aural literacy despite the fact that for some years past and from today on almost every human being has spent and will spend most of his or her communicating hours with visual and aural rather than print materials.

Although the titles may seem specialized, such a curriculum would not be designed to produce media specialists. It would do for our understanding of the mass media what required basic courses in history, mathematics, the physical and social sciences and, of course, English, do for us in those fields: provide us with a general understanding of those subject areas and make us less vulnerable to misinterpretation and manipulation when we encounter them in our everyday, if not professional, lives. We should not have to wait, either, for the training of a new generation before we begin to gain control over the effects of television and other mass media. Continuing education programs for adults should include opportunities for TV literacy proficiency. The concept of "lifelong learning" has had strong national support. One of the recommendations that came out of both the Federal Interagency Committee on Education's conferences on education and technology in 1979 and 1980, and which was endorsed by all federal agencies with educational responsibilities stated:

> Every citizen should have access to the highest quality communications, information and knowledge resources and should be provided with the opportunity for developing competencies in print literacy, electronic literacy, computer literacy, and telecommunications literacy.

In this respect, at least, our frequently foot-dragging federal bureaucracy is far ahead of our educational establishment.

Those who are concerned about our national TV illiteracy and want to do something about it will not have an easy road. It means changing education. It means convincing school boards and superintendents and principals and teachers and trustees and professors and students and citizens. It means more than talking about it. It is easy to get agreement when only words are at issue. It is exceedingly more difficult when action is required and political control of a people is the prize. As Bernard Shaw said of Savanarola: when the latter told the ladies of Florence to destroy their jewels and finery as a step toward a better, moral life, they hailed him as a Saint; but when he actually induced them to do it, they burned him at the stake as a public nuisance.

The same people who would make their educational institutions the best schools or colleges of the 19th century are likely to object strenuously to the introduction of mass media courses as an essential part of the curriculum. But, just as the monks with the mortarboards and gowns who railed against the intrusion of mass-produced books into their monopoly of all the world's knowledge had to adjust to people's desires for uncensored learning, so will those who now are fearful of the people's right to learn how to cope with perhaps a less obvious, but more insidious, kind of censorship and control.

If our educational institutions truly want to educate people to participate as thinking, contributing, competent human beings in a free, democratic society—and that is what educational institutions tell us they want to do—then they must introduce curricula that will graduate people who are visual and aural as well as print literates.

I am aware that there is some question as to whether we now are turning out even print literates. Perhaps part of the problem is that we have created a schizophrenia in learning: we have been concentrating almost completely on print and have been unsuccessful in all media areas because the real world in which the student lives and operates is principally a visual and aural one.

If we believe in the desirability of a society governed by the educated will of the people, we will have to take action, perhaps as saints perceived as public nuisances, that will make us all literate enough to evaluate critically and, therefore, better able to control the effects of television. If we do not, we can be certain that television eventually will control us.

"The American Open University— One Answer to the Technology and Curriculum Lag"

Don McNeil
University of Mid-America
Lincoln, Nebraska

INTRODUCTION

Despite the broad reach of distance education programs across the United States, there is still a need to reach millions of unserved or underserved learners—the problem is one of scope. And despite the fact that existing institutions do serve some "distance" learners through their extension services, the very structure of the institutions keep them from embracing new, innovative methods of educating adults.

Demands for educating adults are increasing—by women re-entering the work force, by the military, by minorities, by industry and labor. People are looking at their lives and seeking education that will aid them in a mid-career change, in upward mobility, in continuing education, or in simply learning for learning's sake.

The key to educational opportunity for adult learners, most of whom are part-time students, is that the education be on their own terms. But these students face situational, psychological, and institutional barriers. The barriers generally include residency requirements, unavailability of programs at times and locations desired by the student, limited credit awarded for learning gained from experience, limited credit awarded for "testing out" or credit by examination, non-transferability of credits between institutions, lack of support services, bureaucracy of admissions and record-keeping systems, and a refusal by institutions to utilize technology in teaching.

To overcome these barriers, the University of Mid-America proposes the creation of a nationwide American Open University (AOU), aimed at the part-time adult student. It will be an independent, accredited institution with its own Board, faculty and administration. And it will have regional centers across the country, which will monitor satellite study centers.

Scope of AOU

The American Open University will produce and acquire courses, and offer instruction via a variety of delivery systems, ranging from independent study to technology-based instruction. It will grant unlimited credit, after testing, for learning gained through experience, and will accept transfer credit from accredited institutions. The AOU will provide a variety of tests for competencies, and counseling services will be available by telephone, by interactive computer, and in person at the study centers. In addition, it will create a credit registry where a student anywhere in the country can "bank" or accumulate his or her credits, and will, on demand, provide training and continuing education programs. It will also build in evaluation and research, which will relate to all phases of the operation—courses, curriculum, governance, operations, admissions, etc.

Since technology can improve and expand education at all levels and increase the cost-effectiveness of education, the AOU will utilize technology wherever it is appropriate—broadcast and cable television, audio (broadcast and cassettes), videocassettes, satellite transmission, the picture phone, the videodisc, the computer, and any other technological innovations that will help reach the student with quality instruction.

Of particular importance to the AOU is computer-based instruction. In today's society, one must be "computer literate" to survive. The AOU will use computers in administration; in tutoring, testing, and scoring; in the credit registry; in evaluation and assessment; and in the delivery of courses, with the eventual capability of offering an entire degree through computer-assisted instruction.

Proposed Curriculum

Finally, the AOU's curriculum—the curriculum plan is built now on assumptions that later may change after experience is gained, but for now we assume the following. The AOU will make available a full curriculum of instruction for each degree program. The first two degrees will be Bachelor's Degrees in Arts and Sciences and in Business. Each bachelor's degree program will require 120 credit hours, with an area of concentration and with evidence of a broad education. Later degrees will include Communications and Technology, masters programs and noncredit courses.

AOU course offerings will be a mix of courses produced by the AOU and courses acquired elsewhere. After six years, the AOU intends to offer 312 credit hours of instruction, with 72 hours produced by the AOU and 240 hours acquired from other producers.

A typical Arts and Science course will be computer-managed, with a media component; and a typical 3 hour course will include 15 lessons of independent study materials, with textbook and study guide; a set of 6 audiocassettes; and 2 optional computer-based or television-based programs available at a study center. The AOU later intends to experiment with offering 6-credit-hour courses.

The average cost of an AOU-developed course will be $45,000, while the average cost of acquired course will be $40,000. Courses will require revision or replacement in 6-7 years, with revision costs to be half the development cost.

The key to the AOU's curriculum development will be its faculty. A team approach will be used, and the faculty will decide curriculum issues.

SUMMARY

Actually, there is nothing new in the American Open University. Each of the concepts is found in place in various segments of the higher education system. But the effort to reach adult students is fragmented and isolated. Our plan is to bring together all those concepts within the framework of a single institution.

The goals and objectives are much the same as held by other institutions of higher learning. Yet this institution will be responsive to adult part-time students; it will be learner based, rather than institution based. It will, of course have high quality offerings, and it also will be cost-effective. The AOU will not lose human interaction, but it may not be in the traditional form of lectures and face-to-face meetings. The telephone, the computer, and the mail may become the substitutes. But it will have human involvement and it will be humane.

We hope, as the AOU seeks to overcome the barriers of the part-time adult learner, that it can earn the respect of the existing institutions. The AOU would like to become partners in the enterprise, to work together on contract, through articulation arrangements, etc., both with 4-year and 2-year institutions. We are not competing with them; we will supplement their programs and eventually provide more students for the existing system, even as the American Open University grows to a projected student body of 50,000 in five years.

The need and demand are evident; the technology is available; experiments to date have succeeded; we have the ability. It is time to create the American Open University.

Using TV to Teach High Order Thinking Skills

M. Virginia Biggy
College of Education
University of Lowell
Lowell, Massachusetts

INTRODUCTION

The professional literature of the last two years abounds with references to cognition, problem solving, concept development, associative thinking, critical thinking, reasoning, productive thinking, and creative thinking.

Those who know the theories of learning and cognition fields will recognize, however, that this attention to the higher order of skills is a *renewal* of interest. James, Thorndike, Thurstone, Gagne, Piaget, Russell, Getzels, Covington, Bruner, Salomon and many others have devoted their professional lives to research and the development of hypotheses about the components of thinking and what skills are necessary to solve problems creatively.

What are the "higher order skills?" There is probably not much disagreement that they include inquiry, analysis, synthesis, and evaluation. Theories of learning, in the majority, hold that knowledge that is organized and related is better learned and retained than knowledge that is specific and isolated. Curricula organized around scope and sequence are designed to provide the "organization" and the order that seem to be necessary for most people to use these learning tools critically and creatively. There are always hidden agenda in instructional materials—a master plan of what ought to be introduced first, reviewed, and reapplied. Sometimes the sequence and the application are too subtle to be identified by the learner; he doesn't recognize that he *is* the learner and that he does have command of the information. Sometimes the provisions for application are artificial and seem unreal, and the learner is reasonably sure that he will never have an opportunity to use this information and that no one else will use it either. What the student needs is evidence that he can do something with the knowledge he has acquired. that he can apply the information to new situations and problems. He expects to be able to select an appropriate technique for attacking a new problem and to use his information (facts and concepts) to solve it. The capacity to do this is frequently called reasoning or critical thinking, but regardless of its name, it provides the learner with a solid feeling of being in control, of having a handle on his world, of being able to solve a problem.

Television as a Medium

And why would we want to try to *teach* these components of thinking via television?

First, it is necessary to look at television as a medium for instruction rather than entertainment—in other words, to indicate why television is for learning.

Television is a powerful motivator—it provides the viewer with direct contact, it can span history, it can pick out a wee piece of history or theory or a—and turn it around in the camera's eye much as a gemologist would turn a diamond as he searched for quality or for flaws, it brings directly to the viewer the hustle and bustle of a city, the sights and sounds or the tranquility of hundreds of acres of farmland in a country or the sight of tears, pain, poverty or joy, warmth, friendship. It can pace the learner, it can challenge, it can comfort, it can capitalize on the receptivity of most young people to the "visual" and to the "aural," it can put the viewer/learner in the center of a problem and give him some analytical tools and suggestions to solve the problem It can make review (often boring in other media but always necessary) interesting and stimulating because it can help to apply newly acquired skills in wholly different content and context yet help the "skill" to stick right out at the learner.

An instructional television program represents hundreds of hours of planning, of research, of organization and conversion of ideas to practical segments of instruction.

It maintains a steady enthusiasm and efficiency unlike the human who may present a super lesson, wisely planned and executed once a day but whose energies are drained and whose capacity to sustain that quality level of "super" is eroded by interruption and other responsibilities.

Cost Effective

Television gives the best bargain for one's investment—it is cost effective—but though cost effectiveness and efficiency are not only buzz words but popular concepts, it is the *quality* of instruction which television can bring which is so vital. There simply is no substitute for *quality* instruction.

In 1974-75 I had the rich professional experience of preparing a prospectus for an instructional television series concerned with skills essential for learning. In the course of thinking about the task and finally writing about it, I spent hours researching and discussing with colleagues the critical components of essential skills for learning—inquiring, analyzing, synthesizing, seeking alternatives, and creative problem solving, *indeed*—reasoning and thinking.

There were many professional colleagues who questioned my sanity, since those components are alleged to be handled best by a teacher face to face with a student.

I was proposing that television could help in the task because it could provide a variety of strategies for introducing or reviewing, enhancing and extending, the higher order of skills or reasoning and thinking, problem solving, synthesis, evaluation, "creative thinking."

Television, I argued, could help kids to "see" these components being used—they could, in fact, be a part of the solution of real problems because the thinking process related to the solution could be visualized and an assortment of more complex problems requiring increased reasoning talent could readily be provided.

Instructional Design

From that paper and subsequent years of inquiry into "thinking" an instructional design emerged. I had the tremendous good fortune to work with two of the most intellectually capable people I know—Dr. Jerry Brown and Dr. Priscilla Denby who served as the major instructional designers for the series, "ThinkAbout," prepared for the consortium of 41 State Departments of Education and instructional television agencies in the Unied States and Canada under the direction of the Agency for Instructional Television.

The design of "ThinkAbout" had some tenets or "underpinning" statements by which we all "lived" as we worked on the development of the series.

Two basic guidelines were: (1) skills, whatever they are, require constant use to keep them operative, and (2) the more practically and realistically and the more often a skill is properly applied in a variety of contexts *by the student*, the more likely it will actually belong to him and be his to use for a lifetime.

We assumed this posture about "acquiring" skills. The term "acquire" means to "gain by any means, usually by one's own exertions . . . or, to get as one's own." As indicated earlier, one of the reasons why students fail to identify basic skills instruction as useful and necessary for them (and therefore to profit from it) is that the instruction frequently conveys the idea that the skills have no real, everyday value. Students think that it is merely the teacher who has decided that these skills are necessary, so I continued to press the point—"If the emphasis is on 'acquiring' skills, the total design of the series will have to assume a posture of involving the student so that through his own participation he will acquire, as his own, the skills essential to learning."

And some "concomitant concerns" we hoped to address via the series—a sort of hidden agenda—were—the concomitant learnings which are available to children when instruction is carefully planned and when full advantage is taken of the opportunities to point out relationships are many.

Accordingly, as the instructional design team for the project prepared materials, we were especially aware of additional purposes to:

- help students to recognize that "learning" is an appealing adventure
- attract and sustain the student's interest in learning
- assist the student to identify the learning style which seems to fit him best
- assist the student to realize *how* one learns and why some parts of the learning process have been assigned to the school
- help the student to appreciate *why* the skill *is* essential
- assist the student to become capable of self-diagnosis of his level of performance in the essential skills.

Throughout the series, whenever possible, through the content selected to present the skills essential to learning, the design team made every effort to include reference to the following:

- learning to make good choices and good decisions and acting in ways commensurate with those decisions are persistent goals
- observation is an important learning tool
- expressing one's thoughts and feelings well is productive
- reading can produce personal enjoyment
- style and taste can be developed
- aesthetics and values are an integral part of learning
- clarity and precision in speaking and writing are a courtesy to one's reader or listener
- memorizing some items one needs regularly is a legitimate activity
- non-verbal communication skills are essential
- visual literacy, the ability to recognize and draw information from sources other than print, is an essential skill
- problem solving skills apply to almost everything one is called upon to do.

As Dr. Brown and Dr. Denby worked on the design, the interdisciplinary character of the series was very evident because we were using the same processes for attacking and solving a problem in a math context as in a discussion about energy conservation.

Later, as scripts were written, the very skillful pattern of "layering" in all the disciplines and the components of problem solving evolved by Dr. Brown, became the interdisciplinary backbone of the series.

Clusters

After months of study, it was necessary to "anchor" some components of reasoning and thinking which we hoped would be the core of the series. They were organized in Clusters:

"Finding Alternatives"
"Estimating and Approximating"
"Giving and Getting Meaning"
"Collecting Information"
"Classifying"
"Finding Patterns"
"Generalizing"
"Sequencing & Scheduling"
"Using Criteria"
"Reshaping Information"
"Judging Information"
"Communicating Effectively"
"Solving Problems"

The clusters were further developed to permit various strategies for achieving the purpose of the cluster.

A sample of a cluster and its "parts" is:

Solving Problems

- Solving one problem may create another
- The amount of time given to thinking about a problem before acting should vary with the importance of the problem and the amount of time available
- Solving a problem often involves a risk
- Solving problems requires persistence

Let's take a quick look at the "intro" information in the Teacher's Guide to this cluster.

"Cluster Goal"

To help students:

- Decide how much time to give to thinking about (or trying to solve) a problem.
- Realize that risk-taking is part of problem-solving, and that one must decide upon how much risk one wants to accept when preparing a plan to solve a problem.
- Accept failures in problem-solving, learn from them, and persist.

"About Solving Problems"

'ThinkAbout' programs have presented many different problems, and all of them have been approached in a thoughtful way by on-screen characters. Repeatedly, real-life ten-to-twelve-year-olds have had opportunities to observe and discuss how their on-screen counterparts try to solve problems and how, in most cases, they succeed.

By now students may agree that:

- A planned approach to solving problems is usually preferable to an unplanned approach.
- It is important to have alternatives.
- There seldom is "one best" way to solve a problem.

This cluster introduces four additional ideas about solving problems. In solving a problem one must be aware that other problems may be created. The amount of time devoted to thinking about a problem (or trying to solve it) must "fit" the problem and the situation. Risk-taking is an inherent part of problem-solving and must be considered when weighing alternatives. Failures can be expected in problem-solving; persistence and willingness to learn from past mistakes are crucial.

These are important ideas. It is easy to assume that a carefully thought out plan cannot fail, to become discouraged if it does, to reject the value of a thoughtful approach, and to ask, Why bother? A planned approach to problem-solving is not a guarantee for success on the first try, or ever. Rather, a planned approach offers people the *best* chance of eventually finding a solution. It is a way; it is not an end. By integrating the ideas in these four programs with the ideas of other programs, students will have powerful guides to use in tackling problems, in school or out. They will be 'ThinkAbouters.'[1]

Each program of the sixty has its own story line which intrigues the students and virtually wraps around them so that they become involved in solving problems or finding patterns.

SUMMARY

After a year of use, the cumulative effect of working with the series seems to be that students are looking more carefully at the route to solutions for problems. After the second year, we'll know more, of course. Our goal has been to help the students get handles on their own world—solving problems requires persistence!

Reasoning, thinking, and all those other components seem, indeed, to be being taught via television.

Solving problems requires a risk, too, and we took it!

REFERENCE

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Computers and Curriculum—Promises and Problems

Robert M. Caldwell
School of Allied Health Science
University of Texas—Dallas
Dallas, Texas

The Need for Technology-Assisted Instruction

A complex tangle of problems has led educators to seek new ways to improve learning, particularly in the basic skills. The causes for these problems are extensive and complicated and will require continued research and experimentation before we find the proper technologies and their application to solve them.

Declining Test Scores

While the exact causes remain unknown, there has been a steady decline in SAT scores, in achievement test scores, and in numbers of students who perform at grade level or above. In urban recruitment areas, for example, the armed forces rejects over 40 percent of those seeking to enlist because of illiteracy.[5] In an attempt to reverse this trend, thirty-seven states have adopted some form of competency testing while others have explored the use of various forms of technology to help insure mastery of basic skills.

Declining Enrollments

Failure to master basic academic skills had led many students to drop out of school. In New York city alone over 40 percent of public school students drop out to seek manual labor or vocational training.[1] Most end up unemployed or working at menial jobs.

In addition, schools are losing students at a steady rate. The percent of students between the ages of 15 and 19 will decline from 20.6 in 1980 to 16.8 in 1990. This will result in many school facilities closing and will create a need for fewer teachers. However, even with fewer students enrolling, the cost of educating them will continue to rise. As a result, school officials will be seeking to find more efficient means to educate learners with fewer and fewer resources.

Decline in Available Talent Pool

A meaningful consequence of declining enrollments and a steady decline in achievement is a critical shortage of individuals trained in skills needed for high technology industries. Not only will there be fewer college graduates by 1990 but few of them will be trained in the skills related to science and high technology. The number of college graduates in engineering has risen from 37.8 percent in 1960 to 54.6 percent in 1980. The number of graduates in the social sciences, however, has risen in the same period from 31.5 percent to 211.0 percent. This represents a percent increase of 669 percent in social science graduates opposed to only a 44 percent increase in engineering graduates.

The impact of these statistics on the future of technology development in the United States is significant. UNESCO figures (Table 1) for 1980 show the United States far behind other countries.

Table 1: B.S. Degrees in Engineering in Nine Countries

	Total	*Engineering*	*%*
Bulgaria	14,661	5,880	40.4
Czechoslovakia	22,306	7,212	32.3
East Germany	43,205	17,356	40.1
Hungary	11,768	5,535	47.0
Poland	26,578	10,9[illegible]	41.0
Romania	30,839	12,260	39.7
West Germany	60,436	22,400	37.1
Japan	315,122	65,422	20.7
U.S.	949,000	54,600	5.8

In short, our educational problems have reached critical proportions, particularly if the United States expects to maintain leadership in the high technology industries. As a result, industry, business and education have looked to the promise offered by the magnificent technology currently available for solutions to the urgent problems facing them.

The Promise of Technology-Assisted Instruction

The benefits of increased achievement and heightened student interest which can be derived from technology-assisted instruction, particularly instruction which is under direct computer control, have been well documented in the professional literature.[2] There is little need to reiterate the conclusions detailed there. However, some discussion is appropriate concerning the promise technology offers for improving instruction and broadening our alternatives for instructional delivery.

The Benefits for Instruction

1. *Distributed and Distance Training:* The cost of high quality training goes up each year. Large corporations which maintain offices in widely disparate areas of the country and the world are finding it increasingly more difficult to maintain quality training programs, particularly in high technology industries where the technology changes rapidly and profoundly. Costs related to transportation, housing, per diem and lost work opportunities became significant over time. Training which can be distributed across many locations and delivered to remote job sites can contribute significantly to savings in training costs.

2. *Individualization:* Computer systems make individualized instruction possible in ways few other media can. Because of their highly adaptive and responsive natures, computer systems allow instruction to take into account each learner response and adapt the amount and extent of instruction to the individual needs of each learner. The computer can employ self-pacing and individual branching to the extent that a learner can select his/her own pathway through course material. Also, computers can perform diagnostic inventories which can identify individual skill deficiencies. This information can then be used to place students exactly within the curriculum and to direct them to the instructional material most appropriate to their needs.

3. *Modularization:* Curricula designed for delivery through computer systems can be easily modularized into small, easily mastered units and structured in coherent hierarchies so that learners progress through learning expereinces in a sequential fashion or at least in a sequence determined by each individual response history. In this way, curriculum materials can specifically address each necessary skill in a defined content area in a manner that does not leave topics unattended or require extensive instruction in any skill that has been already mastered. Instruction presented in small, well defined units is less overwhelming than large blocks of material and promotes success. The steady "mastery" of each discrete unit, then, reduces frustration and helps learners gain confidence about their ability to learn.

4. *Multisensory Format:* Computer systems have for some time offered a wide range of media integrated under computer control to produce a multisensory presentation of material. Many computer systems, including microcomputers, can present material through slides, audio, video tape and video disk. Many of these media can be randomly accessed by the computer so that students can hear or see portions of a presentation several times in a remedial segment. In addition, some computers can display sophisticated graphics and animation on the CRT

itself and offer touch sensitive response. This feature is particularly useful in training where instrumentation is being taught (e.g., pilot training, equipment operation). Touch sensitive screens allow learners to touch switches, buttons and levers in a manner which closely approximates a real situation.

5. *Tireless Repetition and Reinforcement:* Many skills require repetition and reinforcement before they are fully mastered. Foreign language, complex vocabulary, terms and other content which can only be acquired by commitment to memory can be presented tirelessly and with infinite patience by a computer. Also, computers can structure repetitive tasks and patterned reinforcement into carefully planned sequences which adapt to the individual learner's responses and which take into account entry behavior. This is done automatically and efficiently in a way that would not only be impossible for a teacher to do but inefficient.

6. *High Transportability and Flexibility:* The introduction of microcomputer systems has added a new dimension to computer-based and technology-assisted learning. The highly transportable nature of microcomputers allows educators most of the benefits described above in almost any location where there is an electrical outlet. Microcomputers can be used as stand-alone systems or can be networked together to offer many of the same advantages of record keeping, diagnosis, and prescription offered by larger systems. Microcomputers can also be tied to main frame computers by using modems and used as terminals to access large data bases.

The benefits cited here are but a few of the many ways computers can be used to expand the educational alternatives currently available to schools at all levels of education and training. Obviously, the ultimate benefit is in increased achievement and greater efficiency in learning. Many studies are available which detail instructional gains derived from computer-based programs. A recent one serves as a good illustration of how achievement can be increased dramatically using computer-based instruction.

Two projects which used the Basic Skills Learning System delivered on PLATO demonstrated significant gains in reading in Maryland and Minnesota.[5] A summary of the results obtained at an adult learning center in Baltimore, Maryland, are summarized in Table 2.

In summary, the potential for using various forms of technology, particularly computer-based media, offers excellent potential for improving instructional alternatives and opportunities.

Cost Benefit

In addition to substantial benefits which can be obtained instructionally, computers and computers interfaced with other technologies can have a number of advantages for reducing the cost of instruction. One example

Table 2: Achievement Gains, Adult Learning Center, Baltimore, Maryland, February-June, 1978

Number of Students	*Average Time On System/Student*	*Average Grade Level Gain*	*Expected School Time for Similar Growth*
24	15 hrs.	0.8 grades	120. hrs.

Two projects in Minnesota also compared the computer-based Basic Skills Learning System with traditional educational programs. Each site included approximately twenty students and utilized data collected between February and June, 1978. Table 3 reports the grade level gains for the two Minnesota sites.

Table 3: Comparison of Basic Skills Learning System and Traditional Program at Two Minnesota Sites

Site	*Average Time On System/Student*	*Basic Skills Learning System*	*Traditional*
Stillwater Prison Stillwater, Minnesota	15 hrs.	1.6 grade gain*	0.0 grade gain
Fair Break (Adult Basic Education Center) St. Paul, Minnesota	11 hrs.	1.8 grade gain*	0.0 grade gain

* Statistically significant gain.

Adult learners using the Basic Skills Learning System to improve reading skills averaged a 1.12 grade level gain in reading achievement after an average instructional time of 13.0 hours. Further analysis of the data reveals that an average learning time required to generate a 1.0 grade level gain would require 18.34 hours of computer-based reading instruction. A more detailed analysis of this data is offered in Rizza and Walker-Hunter (1978).

cited earlier is the tremendous cost savings which can be accrued using technology in training. Other cost benefits are also possible:

1. *Declining Cost of Hardware:* Computer systems continue to become less expensive as new technologies emerge. As these systems get less expensive, their instructional potential seems to rise proportionally.

One computer industry spokesman remarked recently that if the automobile industry had advanced at the same rate as the computer industry, a Rolls Royce would currently cost $74! Recent developments in microcomputer technology have slashed the cost of delivering computer-based instruction. Highly sophisticated systems which teach using graphics, animation and speech output can be purchased for under $3,000 and some less flexible units can be purchased for under $500. Computers remain one of the few products which get increasingly better but continues to cost less.

2. *Savings from Lower Attrition:* Most urban schools have a severe problem with attrition. Unmotivated students do not attend classes or drop out at an early age. As mentioned earlier, the dropout rate in New York City alone is 40 percent. Use of computer-based education, however, has begun to alleviate a portion of the problem by introducing a novel, individualized approach to education which has resulted in dramatic reductions in attrition. In studies done in Ontario, Canada, and Baltimore, Maryland, for example, attrition went from 60 percent to 5 percent using computer-based programs. In a study done with 700 students in Washington, D.C. schools, lower attrition resulted in a $30,790 saving in tax dollars. If this figure were projected across 24,000 students, it would result in a Cost Product Index savings equal to $9,600,000![1]

Non-Traditional Education

Advancing technology will produce many far-reaching benefits in the future, particularly with regard to non-traditional forms of education. Instruction will be available in the not too distant future in the home, at work and remote locations, such as military installations, ships, submarines, and at sites where traditional communications media are unavailable. Cable television, for example, will not only bring innovative programs into the home, but will also allow access to large data bases, many of which will allow interaction with the home television.

Television and video disk linked with computer systems will allow a level of interaction never before possible. Home viewers will be able to view many events from several different angles. Each viewing angle will be chosen by the viewer using a control called a "joy stick." Instant replays from any angle of your choice will be common in the very near future.

These innovations, along with satellite communication, fiber optics and a whole range of technological advances, will revolutionize learning as we know it today. There is little doubt, of course, that central to the operation and control of these technologies will be low cost, powerful computer systems.

Problems Related to the Use of Computers in Education

Lack of Adequate Courseware

Even though educators have been exploring the uses of computers to deliver and manage instruction since the early sixties, the development of courseware (i.e., programs which interactively instruct learners) remains a rather inexact science. Most attempts at delivering a lesson through a computer system to date end up looking like someone's lecture notes printed on a cathode ray tube. The result for the learner is usually a rather dry presentation of material which does not need a sophisticated computer system to merely present text and ask questions. Lessons of this type cheat the learner in two ways: first, lectures are usually better delivered by their authors; the pacing, intonation, histrionics and gestures supplied by the human teacher can add significantly to the effectiveness of communicating ideas. By the same token, the computer possesses many capabilities for certian kinds of instruction that make it a unique delivery system. If we fail to design lessons which use the graphics, animation, color and interactive capabilities of the computer, we are denying learners learning experiences which might be of great benefit to them. Simulations and lessons which call for testing solutions to problems and receiving feedback immediately come to mind as types of instruction which are better adapted to computer delivery than to teacher-led presentations.

In summary, much of what is delivered on computer systems today fails to use the computer medium effectively. The computer is a new medium which requires careful study and experimentation. Before the printing press, novels, magazines, textbooks and many other forms of print media did not exist. In fact, one of the earliest novels, *Pamela*, was written and published by Samuel Richardson, a printer who became familiar with the taste and the demands of the reading public. He used the medium of print to introduce what has become a primary source of entertainment and learning. The computer stands today as our modern day printing press; it is a medium which challenges our imaginations to use its power for improving our patterns of thought and for improving our problem solving abilities. We must seek imaginative ways to use this new medium so that we derive maximum benefit from its capabilities.

Cost of Development

Unfortunately, much of the interactive courseware called for above is at present expensive to develop and time consuming to produce. Individuals who are part of the growing software cottage industry have produced isolated lessons and courses for the more popular microcomputers such as TRS-80, Apple and Commodore PET; but these attempts are scattered, vary wildly in quality, and generally represent a rather disorganized attempt at developing instructional materials.

Many publishers have been reluctant to assume leadership in courseware development because of the risk of extensive initial costs weighted against an uncertain marketplace with a medium they don't quite understand yet. Some publishers have taken significant strides in this area, however, and have either produced computer-based materials or will within the year. Control Data already has extensive course and lesson offerings over their PLATO network. Hazeltine, Houghton Mifflin and Computer Courseware Corporation also offer extensive programs in reading, mathematics, and language arts. Curriculum of various types for delivery on microcomputers is currently or will soon be available from Miliken SRA, Milton Bradley, Random House, Scott, Foresman and others.[3]

Major costs for producing courseware are tied to programming and designing instruction to use the unique capabilities of particular computer systems. These costs become significant because of differences which exist between the technology of various computer systems. Publishers who want to address the total education market are forced to develop materials for several computers simultaneously which can double and even triple development costs. For this reason, some publishers have dedicated themselves to developing one machine exclusively in the hope that the curriculum materials will become an incentive to buy a particular computer. It remains to be seen which strategy will yield the highest payoff.

Rapid Technological Change

Put very simply, technology changes so quickly that it is becoming increasingly more difficult to design instruction for existing hardware. This has caused many publishers and software producers to hesitate in their plans to produce curriculum materials to be delivered through computers and, more specifically, microcomputers. In the end this could result in a never ending cycle of delays waiting for the very newest breakthrough in technology. Many publishers, for example, are now waiting for the most recent developments in video disks, a technology which is 2-5 years away from widespread practical use.

A partial solution to this dilemma is to develop good interactive instructional designs and apply them to new technologies as they develop. In this way, the new technologies will *enhance* the instruction rather than completely reshaping it. Developing curriculum independent of specific technology should be a prime precept in instructional design if we are to avoid the pitfalls of changing technology and incompatibility of hardware. We must decide what humans do best and what machines do best and begin to develop instructional systems which can be easily adapted as new technology emerges. Marshall McCluhan wrote, "We shape the media, and they in turn shape us." As we shape instructional programs which employ interactive principles toward developing higher level cognitive skills and higher order learning strategies, we will also begin to shape the technologies we will need to facilitate this instruction.

The Case Against Technology

One of the biggest obstacles to developing technology-based learning systems is overcoming the many "myths" which surround the use of technology in the traditionally human enterprise of education. Clearly, the nature of the educational enterprise is changing, and in a world where computers are clearly more accurate "memorizers," we must begin to help learners acquire new skills and new ideas which will help dispell some of these myths.

Myth #1. *Computers will dehumanize the learning process:* Opposition to technology has always been with us. Antitechnologists such as Jacques Ellul as early as 1954 depicted individuals as helpless slaves to technology, driven by necessity to perform repetitive and dull work which they detest. These critics see technology as a force which cuts man off from the natural world and therefore spoils the quality of his life. This argument is a very old one but will reach an inevitable resolution. In *Culture and Commitment* Margaret Mead points out that any new technology has the effect of creating an irrevocable change in a familiar environment.[9] This change, however, produces a self-awareness among the members of the affected society to the extent that they realize eventually that they can make a contribution to that changed society in a new way. Educators are slowly gaining that new self-awareness but need education and guidance. The result will be the development of a computer literacy which will in turn enable wide adoption of computers in many varied uses.

In the meantime, educators must be educated about technology and come to realize that a fear of technology, thus an avoidance of it, can leave its development to an elite class of technocrats who, by possessing specialized knowledge which is crucial to our survival prospects, can defranchise the masses. It is important then to understand the control technological innovation so that it can be used for its maximum benefit.

A further point to be made here is that research on computer based instruction shows *no* evidence that instruction delivered through a computer systems dehumanizes instruction. In fact, most all studies show exactly the opposite. In a study by Feldman and Sears students using computer based instruction claimed a distinct preference for the computer over their human teachers.[8] Their consensus opinion was that:

(1) Computer instruction was "private," i.e., one could fail without fear of ridicule or embarrassment from other classmate's or the teacher.

(2) Computers are untiring and therefore infinitely patient. Learners can try as often as they must to master skills or concepts.

(3) Computers are completely unbiased and nonjudgmental. They are incapable of putting students through the untold "put downs," insults,

and other ego damaging biases which human teachers can and often do inflict on children on a daily basis. Computers can also deliver personalized feedback, positive reinforcement and many other "warm fuzzies" which many burnt out teachers tend to forget or ignore.

In several instances students have broken into schools after hours not to vandalize and destroy but to play math games and run programs of their own design.[7] In cases where students *have* vandalized schools, they have left computer terminals and equipment virtually untouched and undamaged. These incidents are not mentioned here to imply that a machine can do more for a child than a sensitive, caring teacher; but these incidents are becoming less unusual as use of computers becomes more widespread and they do indicate the potential computers have for making learning meaningful and important to learners.

Myth #2. *Computers Will Replace Teachers:* At the hearings before the United States House of Representatives Subcommittee on Science and Technology held April 2-3, 1980, Maxine Rockoff, Vice President for Planning and Research for the Corporation of Public Broadcasting testified that the primary reason why teachers will not accept computers is that education is essentially a labor *intensive* endeavor; therefore, educators will not readily need or adopt a labor *saving* device. Contrary to this point of view, there are at least five (5) reasons why teachers will accept computers and begin to legitimize their use:

A. In some areas of instruction intensive labor-saving is badly needed. Much of what many teachers do now is repetitive and boring drill which requires learners to provide ritualistic responses to see how much information they can store. This is one of the least effective uses of a teacher's time, especially when computers can present drill with infinite patience and perfect redundance. Computers can implement precise reinforcement schedules which are generated from exact diagnosis of learner response rate and achievement.

To some extent, then, computers, *can* replace teachers but only to the degree that they free teachers to do what teachers should be doing: developing in students learning strategies associated with high order thinking by creating real problems to solve. Computers can release teachers from drilling useless information into the heads of learners and concentrate their efforts on helping students learn how to challenge what we accept as facts, to assemble data into theories, and test them in a process of real intellectual inquiry.

B. There is a crucial shortage of teachers in mathematics and science. In the Dallas Independent School District, for example, over 200 positions are vacant in the areas of math and science. Well developed courseware for computers can help relieve this situation temporarily and provide good, interactive instruction in math skills on an individualized basis and continue to do so even when the shortage is rectified. On a more long-term basis, computer skills in the mathematics and sciences are critical; computers are and will continue to get extensive use in these areas.

C. Computers can serve as diagnostic partners in classrooms that test learners and print out detailed programs of study which are keyed to existing materials and resources within the classroom or school district. They can continue to update these programs as students make progress through them. Management systems such as these will be essential in states where programs of competency testing are mandated and where Public Law 94-142 is implemented properly. The computer holds great potential for performing the complex diagnosis and generation of individual educational programs that will demanded in these situations.

D. Education faces increasing costs in salaries, building costs, books, materials, equipment and so on. Administrators and school board members are seeking help on how to reduce expenses. Many school officials are already looking to microcomputers as a means of increasing student-teacher ratios without a loss in achievement. They literally *are* trying to use computers to replace teachers, but there are some fatal flaws in the logic they use to do it. Teachers *should not* be replaced by computers for the reasons mentioned, but computers can be used for a variety of functions which will help cut costs in the following ways:

1. Computers can do many of the administrative duties now performed by many teacher aides. This could mean a considerable savings in the number of aides hired or retained by a school district.

2. Teacher's time can be used more efficiently thus eliminating the possibility of adding additional faculty.

E. The Society of the future will require a set of skills that are not, for the most part, being taught in schools today. Teachers as well as students will have to acquire new skills in order to cope with rapidly changing technologies and the impact they will have on our lives.

In summary, then, it seems safe to say that computers will not replace teachers but will probably take away much of the drudgery now associated with drill, record keeping, grade reporting and free them to make the use of the teacher's time more efficient and therefore more productive.

Myth #3. *Technology Has Not Fulfilled Its Promise:* Of all the myths surrounding the use of computers to deliver instruction, one of the most prominent is the belief that technology has failed to meet its promise. This belief is usually predicated upon a variety of bad experiences, especially with computer systems. These experiences can be grouped into the following categories:

Cost: Since few educators have very much practical knowledge about computers, they rely heavily on manufacturer representatives for information. As a result, many computer systems are purchased which either far exceed user needs or which do not meet educational needs at all. As the purchasers become more knowledgeable about the system they have purchased and discover what the machine can or cannot do, they become resentful or hostile. By the same token, many educators reject very effective systems because of their high cost. This is regrettable because the real losers in this situation are students who could potentially profit immensely from sophisticated computer equipment.

This process is currently repeating itself as educators begin to consider microcomputers. Too often these machines are purchased solely because of low cost without any regard for function, available software or courseware, or how they will fit into an overall program of study. If this trend is to be reversed, educational institutions must begin to formulate institutional policies which define how computers will be used and what problems they will solve.

Unfair Comparisons with Other Media: Too often computers are compared unfairly with other delivery systems. For example, computers have been subjected to various studies which compare their effectiveness with lectures, programmed instruction, and a variety of other mediated instruction. The result is that the computer-assisted instruction is found to be less effective or, more often, less cost-effective. The fallacy in these comparisons is that the media are usually compared instead of the instructional programs which are being delivered.

In a classic *faux pas* of this type, Educational Testing Service conducted a study which compared the use of the Control Data PLATO system and TICCIT in community colleges. One of the conclusions of this study was that PLATO had "no significant impact on achievement for community college students . . . " while TICCIT resulted in improved student achievement.[6] The major weakness in this study is the generalization made to computer systems rather than to the courseware delivered through those systems. While the implied conclusion here is that TICCIT is a better teaching system than PLATO, the only valid conclusion that can be reached is that the TICCIT courseware was more effective than that offered on the PLATO system *for that population*. There was no mention made in the study regarding the curriculum objectives that were addressed, the subjects that were taught, or the instructional strategy employed in the instructional program. The only conclusion implied was that one computer system was better than another one. In short, the study attempted to compare delivery system, i.e., the computer systems but based the evaluation on the effectiveness of the curriculum being delivered. Such a conclusion is analogous to concluding that books are a poor teaching medium based on a study of dull, poorly written volumes which dealt with esoteric topics.

Unfortunately, many educators are making decisions about computers as instructional delivery systems on just such specious information. Far too many of these "Horse race" studies exist (which system is better?). If researchers want to compare delivery systems, common criteria should be established as a basis of study; the same holds true for comparing curricula. However, a comparison of curricula should never be used to draw conclusions about delivery. In addition, caution must be exercised when comparing computer-based instruction with other technology-based systems such as educational television, programmed learning and self-paced learning. Each of these media possesses unique features and capabilities which make it appropriate for delivering instruction. It is critical that these features be taken into account when comparing instructional media.

Poorly Designed Courseware: This is the single greatest problem related to the disenchantment with computer-based education because of poorly designed courseware. To a large extent this criticism is warranted because many computer-delivered lessons fail to:[4]

1. Shape learner behavior toward specific learning outcomes.
2. Use the interactive capability of the computer system.
3. Use graphics, color, animation or sound to its best instructional advantage.
4. Make imaginative use of the capabilities of the computer system, e.g., branching, menus to solicit student choice and options, and reinforcement schedules.
5. Employ a variety of teaching strategies such as drill, tutorial, simulation and games.

Most computer-based lessons simply attempt to make the instruction a computer-delivered lecture and fill the monitor with text. This type of presentation is usually followed by some rather unchallenging multiple choice questions which, when taken together, have little more effect than a self-test at the end of a printed learning module or textbook chapter. Since this type of lesson has predominated computer-based curricula for so long, educators have tended to accept this inefficient use of computer-based instruction as the norm and therefore reject CBE as a whole as an ineffective, high-priced fad.

In summary, if technology has failed to fulfill its potential for delivering instruction, it is because few attempts have been made to use its full potential. Computers and other technology are tools which must be used creatively and imaginatively. They are new media whose capabilities are not fully understood. We must, however, attempt to use them in ways that will take full advantage of their potential and give us maximum cost benefit.

Lack of Knowledge and Awareness About Computers and What They Can Do: The final problem related to the effective implementation of computers as instructional tools is a general lack of knowledge about what they can do and how they work. Until programs of computer awareness (knowing generally what makes computers work, what they can do and how they can be used) and computer literacy (learning to communicate with a computer using computer languages written in code) are made widely available to educators, they will resist the unknown. Few individuals are able to use tools of which they have little knowledge and even less use. Educators must be taught about computers with computer systems and shown the great potential these instruments have for helping solve the multitude of problems facing education today.

SUMMARY

In conclusion, it would be safe to say that technology, particularly the computer and computers interfaced with other media, will continue to have a significant impact on the way education will be conducted in the future. Its capacity for both delivering and managing instruction offers enormous potential for widening the possibilities for faster, more efficient course delivery in the years to come. As we better understand the problems which are currently retarding progress toward fulfilling this potential, we will be better able to design and deliver exciting, interactive learning to locations almost anywhere in the world.

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How Can We Best Produce Courseware?

Howard Hitchens
Association for Educational Communications and Technology
Washington, D.C.

It is interesting that in the context of a publication on educational technology we should be discussing the production of "courseware." The concentration on sophisticated video and microcomputer apparatus and techniques for education is an appropriate focus for the use of such a term. Incidentally, a traditional audiovisual leader argued eloquently several years ago for the adoption of this term to apply to all instructional materials.

In searching for a working definition of the term "courseware," I found to definitions in AECT's *Educational Technology: A Glossary of Terms.*

1. In computer assisted instruction (CAI), the actual instruction—including both content and technique—installed in a CAI system. Courseware is different from software in that the software is the actual machine language which directs the computer operation.
2. As a generic term, any instructional materials, particularly items which must be used with equipment.

These definitions, of course, fit neatly for our purposes today. We are concerned with video programs and the instructional content of microcomputer and similar devices. I shall address myself to two major questions in these short remarks. First, what are the possible models of production of instructional materials for the sophisticated electronic systems with which we ae concerned? Second, how can we get the costs underwritten?

Models of Production

Independent Industry

The history of the growth of instructional materials for the educational system indicates a long standing dependence on an audiovisual industry that grew with the advent of the motion picture, closely linked to the hardware industry—the developers of motion picture projectors. The more recent history has seen the growth of an independent film production industry for education, represented nationally by a trade organization called The Association of Media Producers. The premise on which that small industry was built is that instructional films could be made and sold profitably to education. Throughout the history of that part of the industry, the producer and distributor of educational films has been faced with the paradoxical situation of desiring to make a film that will have the greatest instructional effectiveness on the one hand; and on the other, keeping the instructional content and approach general enough to insure that sales will not be inhibited because it isn't applicable to enough of the thousands of school systems in the country. As a result of this situation, the industry has found some rough going in the past few years.

Consortia

As the cost of instructional materials have escalated and the scope of the materials increased to include entire courses of study, we have cast about for a better way to capitalize the high production costs and to develop an efficient distribution system. As a result, various consortia of educational institutions have been created. This is a reasonable solution that is still being explored. Many examples are around us. I'm sure most of you are familiar with *The Ascent of Man* and *Man A Course of Study* series.

Another kind of consortium is the University of Mid-America arrangement whereby the higher education institutions in seven states in the Mid-west pool their resources in order to produce and make available continuing education courses for the citizenry in those states. In addition, instructional television consortia have existed in northern and southern California for some years, and have enabled the production of complete instructional sequences on a more cost effective basis. These consortia have been combinations of cooperative ventures of not-for-profit educational agencies for the most part.

Non-Profit Agencies

There is a different kind of agency that has grown in the past few years. The most prominent one that produces materials uniquely for instruction and with a broad base of substance is the agency for instructional television. The secret to its success is the securing of cooperation and financial commitments from state education departments and provincial departments (in the case of Canada) for each production. The product in each case is a complete series of programs which are arranged in what we generally are used to thinking of as courses. I submit that this is a very successful venture in that it is providing a generally recognized service for the educational community and it is cost effective in its procedures.

Computer Manufacturing Companies

I mentioned earlier that for years we depended on the hardware manufacturers to generate a certain amount of courseware to go with their film projectors. This same dependence is occuring at present in the cast of microcomputer. For example, the Apple II provides an Apple II software directory of games, demonstrations and utility programs. However, we are seeing some programs and some courseware being developed independently of the hardware itself for use with any hardware. Creative Computing Press of Morristown, New Jersey, has two books entitled *One Hundred Two Basic Games* and *More Basic Computer Games* published for use with computers that employ the basic language. There is a book of programs for the TRS-80 and there is a book published by Adam Osborne Associates of Berkeley, California, entitled *Some Common Basic Programs.* Those programs are available also on cassette for the PET and the TRS-80 microcomputers.

Other Production Schemes

Two other production mechanisms are worthy of mention. A recent project entitled "Schooldisc" has been undertaken jointly by The National Education Association and the American Broadcasting Corporation. This is an extremely important development because it intends to place complete instructional sequences into the schools at a very low cost and in a very highly usable form for the pioneer videodisc. The initial pilot sequences have been tested and the full production of eight hours of instructional programming on videodisc for the schools is under way. This is being underwritten by ABC and NEA and will be made available at a minimal cost, approximately $1500.00 per school, during the 1981-1982 school year. I want to bring it to your attention because it is a prime example in which the private sector (for whatever purposes of its own) and the major teachers' union in the country are cooperating to provide instructional materials for the schools.

A second project which I would like to bring to your attention is the project by National Public Radio to market instructional courses based on the radio programs which it has developed over extended periods of time. The project is moving to the point now that the public offerings will be announced in the next few weeks. In this instance, public support for radio broadcasting will result in the accumulation of enough resources to make available courseware developed to meet a variety of curricular purposes. The programs have been paid for and are being repackaged and made available as a venture which should be self-sustaining in the next few years.

Underwriting Costs

Let's turn to ways in which sufficient funds can be accumulated for the underwriting of the extremely high costs of developing courseware. Traditionally, we have looked to the federal government in its categorical programs to provide us with money for courseware. The Emergency

School Assistance Act has a specific title within it for the production of educational television programming to assist the large urban school systems in dealing with the problems of inner city learners. The Department of Education has provided most of the funding for the Children's Television Workshop to develop the well-known Sesame Street and Electric Company sequences. The National Institute of Education has funded the operation of the University of Mid-America in order to insure that the consortium could demonstrate its ability to service the needs of continuing education in the Midwest.

A second source of funds to meet the underwriting costs of courseware has traditionally been foundations of various kinds. The Ford Foundation has provided funds along with other agencies in several instances to develop the necessary capital. I'm sure many of you are familiar with some of the activities of the Markel Foundation and others in this area.

As I mentioned above, however, the most interesting and resourceful accumulation of films recently has been the development of various consortia for co-production. The Agency for Instructional Television has a successful enterprise here, as does The University Consortium which has produced *Man A Course of Study* and *The Ascent of Man* and many other instructional courses. I have not yet seen any consortia developed which has been able to capitalize on the development of courseware for microcomputers across the board.

At the moment, we are largely dependent on the hardware industry in the microcomputing world to provide courseware for us. However, that is changing and there are several publications which could be perused for an update on what is available from the privat sector in the way of courseware for microcomputers.*Creative Computing, Personal Computing* and *Microcomputing* magazines all review commercial programs as they are introduced. Most of those sources are listed in AECT's publication, *Guide to Microcomputers*, by Franz Frederick.

CONCLUSION

So, how can we *best* produce courseware for the video and microcomputing evolution? I suspect that my answer has to be that the *consortium route* is probably best for video-oriented materials in the form of coursewre and that for the moment we will probably have to depend on the *hardware industry* in microcomputing to assist us until we can get a courseware creation cadre built of such a size that the needs of edcuation can be served independently.

How Can We Best Produce Courseware? (The Process of Courseware Development)

Peter J. Rizza, Jr.
Senior Educational Consultant
Control Data Corporation
Minneapolis, Minnesota

INTRODUCTION

The process of curriculum development has had a history of slow evolution. Originally information was transmitted from highly-educated instructors to their students via lectures and handwritten notes. This type of education was centered around the instructor and the success of the learning process depended entirely upon the talents of the instructor or the initiative of the learner. With the invention of the printing press many of the lecture notes were transformed into support materials for students. This allowed for wider-spread distribution of ideas and for more continuous learning. This type of learning was centered upon the instructor and the textbook as the main sources of information and it was the student's responsibility to acquire the information by attending lectures and reading the text. More recently with the introduction of multimedia materials as support to the learning process, the student has been allowed to experience a wider range of stimulus. Many educationally-meaningful experiences were filmed, photographed, or diagrammed and used by the instructor during the lecture as support materials. Sometimes the multimedia materials were presented to the student in an individualized mode as the actual learning activity. This was the first step toward making the learning experience less teacher dependent and more student centered. Now, with the introduction of computers into education, the concept of a student-centered learning environment has become a reality. The computers can deliver instruction to the students independently of the instructor and the student can progress at his or her own pace commensurate with their abilities. This type of education constitutes a drastic shift away from the passive instructor-centered transmission of the information to the more active process of the student interaction with a dynamic learning experience controlled by a computer.

Accompanying the evolution of education from a singular-source, lecture-centered environment to a multimedia, interactive, computer-based environment has been the tremendous increase in the need to have quality courseware materials available. To produce a set of lecture notes was a relatively-simple task for a well-educated professor, particularly in his field of expertise. To develop a textbook was far more extensive an effort, because many different instructors with various learning strategies would be expected to use the same textbook to teach in different locations. Therefore, the textbook had to be comprehensive, informative, accurate, and above all accepted by the teaching profession. To develop multimedia materials involving slides, audiotapes, videotapes, filmstrips, graphs, charts and a multitude of other embodiments, required a significantly-higher level of effort in the initial development stage than did the textbook. Multimedia development requires that many simulations be structured for photographing, professional actors be contracted for audiotape recording, and photographers be employed. To develop a computer-based education curriculum is possibly the most comprehensive and sophisticated activity that curriculum developers have faced. This usually involves large scale activity in the form of comprehensive curriculum definition, computer programs at different levels for a variety of users, and sophisticated testing and routing routines to afford flexibility and individualization of instruction. As an example of the amount of effort it takes to develop computer-based education materials, one only has to look at the small number of curriculum packages which are currently available using computer support following massive financial investments on the part of the government, the computer and publishing vendors, and the educational users. To develop a quality computer-based education environment you need to have well coordinated, comprehensive and systematic curriculum offerings. To assume that a teacher can develop a high quality computer-based education offering in his or her spare time is equivalent to asking teachers to write their own textbooks, script and record their own multimedia materials, stage and deliver their own television shows, and develop and analyze their own standardized tests. Perhaps with the introduction of the micro-computer into the classroom as a stand-alone delivery system, one might be fooled into thinking that with a little bit of effort you could write your own courseware for delivery on that system. However, this is analogous to giving a teacher a blank book and a typewriter and expecting him to write his own text.

In order to understand the complexities of courseware development for computer-based education delivery, it might help to examine the similarities and the differences between the traditional teacher/textbook orientation to instruction and the computer-based education delivery. In terms of content coverage of a course, both the teacher/text and CBE approaches must present the materials completely and comprehensively. Objectives and goals must be stated and detailed background information must be developed. However, the CBE approach requires additional effort in the number of test items developed, the extensiveness of case studies delivered, the variety of alternative approaches presented and subsequent content expansion, and the amount of analysis given to the student upon demand. Specifically, the amount of pre-determined feedback is a major requirement. The instructional approach used in delivering education with teacher/text as well as CBE approaches can be discovery, exposition, inquiry, etc. The major difference between the two delivery systems is the amount of interaction required in the CBE This necessitates a flexible curriculum and increases the variety of responses in the material. The complexity of the development process increases as the interactive nature of the components increases. Both teacher/text and CBE approaches require valid test items to be developed for examining achievement and attitudinal changes. The difference is in the number of test items which must be generated for CBE delivery and the complex testing strategies which are available under computer control (i.e., tailor testing, mastery testing, variable criteria testing). Finally, with respect to the pace and flow of the curriculum offering, the major difference between the two approaches is that CBE instruction is generally self-paced. This requires that extensive branching schemas be well thought out in advance and that repetition and review for remedial education be allowed.

The difference between the teacher/text and the CBE delivery require more comprehensive and extensive development efforts to be undertaken for quality CBE courseware. There seems to be a need, then, for a systematic approach for courseware development because of the number of factors. Most of these factors directly influence the cost of development and subsequent cost of delivery. Because CBE courseware development is quite time consuming, involves the use of and, therefore, the cost of terminals and computer technology and requires a wider variety of people with different skills to be coordinated in a team in order to develop a comprehensive program, the cost of development is very high. Even though the computer terminal offers the capability of quick and instantaneous revision, the actual cost for making revisions is quite high. Most of these costs are a result of the amount of time it takes to gather accurate and appropriate data as to the type, scope and depth of the revisions necessary and the amount of time and effort required by development people to make the revisions which are recommended. Certainly specific criteria must be established early on to identify the type of changes which will be tolerated and the type of performance which will be achieved. The cost of implementing a computer-based education curriculum involves the cost of support people and the cost of the computer terminals and technology itself. While these costs continue to come down on a year-by-year basis, certainly they are substantial enough to require that the products be of quality nature and reliable stature. Finally, the cost of failure of a CBE courseware offering is rather large. It may involve the changing from one entire CBE system to another system which is a large financial decision. In some cases there may be no alternative program to rely upon, in which case failure of the courseware to deliver the recommended achievement level means failure of education. It may mean wasted development and revision dollars as well as a tremendous waste in implementation costs to deliver a program which is ineffective. In many communities, businesses, and other educational institutions, computer-based education has only one chance to make a first and last impression and failure of the system to perform can mean failure of the community to avail itself of the new technology.

In order to guarantee the favorable use of computer-based education technology in the learning process it is imperative that high-quality, comprehensive curriculum materials be developed. These materials can only be developed through a systematic approach to courseware development similar to the one that follows in the next section.

SYSTEMS APPROACH TO COURSEWARE DEVELOPMENT

The development of courseware materials is a complicated activity. The need for a systematic approach to the development of courseware material was presented in the first section of this paper. The systems approach model which follows in this section is one which separates out the six major phases of courseware development into specific well-related steps and identifies sequences of activities designed to solve educational problems and achieve instructional goals. This system may be employed by an individual, a small team, or a large courseware development group. Regardless of the specific team structure for the courseware development effort, each step of this systematic model should be followed to increase the likelihood of a quality product. The systems approach for developing instructional materials consists of six phases: analysis, design, development, formative evaluation, implementation, and summative evaluation. (See Figure 1.) These six phases are designed to build upon one another to generate instructional material which is integrated, efficient, and above all effective. In order to more fully illustrate this process, each of the phases will be expanded and illustrated by examples from the Basic Skills Learning System, a CBE curriculum designed to teach functional literacy.

Phase I: Analysis

The first step in any courseware development process must be to

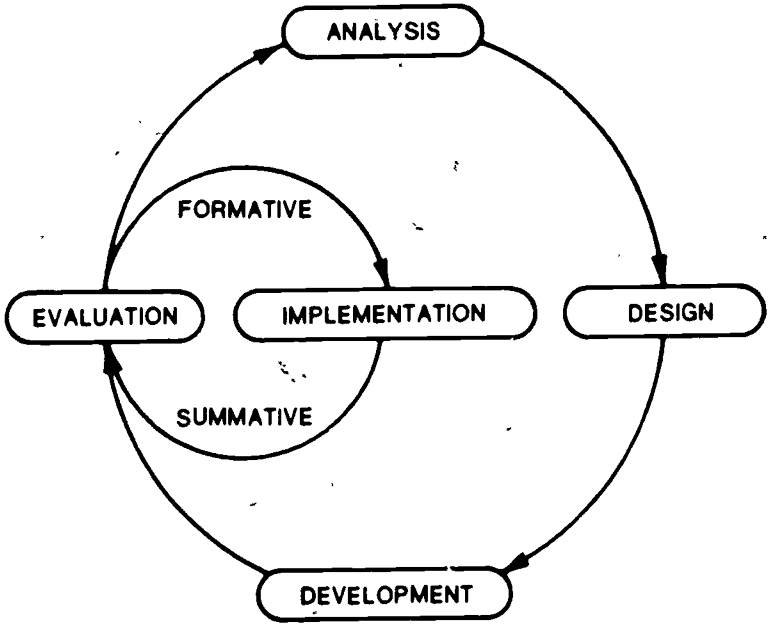

Figure 1: The development process

determine the scope and the nature of the instructional materials required to satisfy the given set of educational needs. The analysis phase consists of four tasks. The first task is to define the learning requirements; the second is to define the instructional program; the third is to survey existing courses; and the fourth is to plan the design and development effort.

Defining Learning Requirements

Learning requirements are identified by: 1) analyzing learning needs; 2) defining needs and constraints; and 3) analyzing the target population. For example, consider the fact that 25 million Americans are designated as functionally illiterate. The impact of having this large a section of our population remain functionally illiterate is economically staggering. Most of these individuals do not participate in the production or the servicing of goods and are very often a drain upon, rather than a contributor to, the national wealth. To date many curriculum efforts have been made to train and retrain these individuals into productive members of the society. Most of these efforts have failed due to the dependency on quality instructors which are not readily available, the inconsistency of materials which vary drastically depending on location and instructor, and the ability to motivate the target population to participate in and, more importantly, remain in the training program being offered. How can computer-based education be employed to address functional literacy at the national level?

The first step is to analyze the educational needs. In this step, discrepancies between the desired performance and the actual capabilities are identified. For example, suppose the desired performance for these adults is to read and compute at an eighth grade level so they can enter into vocational training programs which will allow them to enter the work force. However, most of these individuals do not possess these skills. An analysis of the requirements of the vocational programs and the population capabilities will identify the discrepancies. Another important result of analysis of the educational needs is the analysis of the consequences of the performance discrepancy. In other words, what will happen to the people in this population and the country in general if the problem is allowed to continue?

The second step is to define needs and constraints. The needs analysis indicates which specific task must be learned in order to reach the desired performance. These tasks form the basis for instruction. The definition of constraints indicates the restrictions that affect the delivery of the instruction. The availability of funds, time, qualified staff, and the delivery environments are some of the constraints.

The third step in defining the educational requirements is to analyze the target population, the students for whom the instruction will be prepared. Student characteristics such as geographic location, age, ability, need for motivation, present skill level, and the number of students are important considerations in the preparation of instructional materials.

Defining the educational requirements means determining a discrepancy between actual and desired performance, identifying the skills or information needed to resolve the discrepancy problem, and determining factors such as constraints or student characteristics that will affect the solution of the performance problem. In the case of the functional illiteracy problem, it was determined through the defining of educational requirements that the majority of the population had literacy and computational skills well below the level needed to enter vocational training programs, that the skills of reading and computation were essential to their success in vocational training, that many opportunities would be available for vocational training if these students could function at an eighth grade level in both reading and mathematics skills, and that this population consisted of a low-motivated group which had experienced many failures through the traditional method of education. It was also identified that many of the individuals in the target population possessed some, but not all, of the necessary skills and that a program which was able to place individuals into the proper learning sequence and give students credit for already-acquired skills would be most efficient and most acceptable to this population.

Defining the Instructional Program

In this step, curriculum and course goals that define the scope and the purpose of the instruction are documented. The major tasks and topics to be included in the instructional program are defined with specific requirements concerning media and expected performance levels. The overall curriculum structure and the inter-relationships of the course and sub-course components are specified. Furthermore, the specific routing requirements and constraints are documented and the type of placement and assessment strategy is determined in general terms for the overall curriculum.

The documentation of this step results in a general course specification document which is intended to solve the instructional problem within the identified constraints. This document should include: overall course length, structure, and proportions presented by the allowable media; a description of the target population and its present level of performance; definition of the constraints placed on the instructional delivery system; and the goals and topics to be covered. This document forms the preliminary basis from which the design phase proceeds.

In the case of the functional illiteracy problem, a document was generated which identified the need for a three-part curriculum called the Basic Skills Learning System. The first course is the Basic Skills reading course which addresses the main topics of vocabulary development, literal, interpreted and evaluated comprehension. The basic language skills curriculum addresses the topics of grammar, writing mechanics, and syntax topics. The basic math skills curriculum covers the topics of whole number operations, basic number ideas, fractions and decimals, geometry and measurement, and ratio and proportion. The target population was described as being between the third grade and the seventh grade levels as measured by the Adult Basic Learning Exam (ABLE). The purpose of the curriculum was identified as a CBE offering designed to enable functionally-illiterate adults, representing a wide range of abilities, goals and problems, to achieve an eighth grade equivalency education in the reading, language and mathematics skills.

Survey Existing Courses

Identifying existing courses and comparing them with needs are the wo steps in the survey of courses. Before time and money are expended to develop a new course, existing courses are identified and analyzed for applicability to the training need. If an existing course appears to meet the needs and fulfills required quality standards, it is considered for use in either its present or a modified form.

In the case of Basic Skills Learning System, after an extensive survey of courseware materials used in basic education programs, two curriculum efforts were identified as having specific appropriateness. The first was the Individual Learning for Adults (ILA) reading curriculum which was offered by Research for Better Schools in Philadelphia. This curriculum was in a paper-and-pencil, individualized, performance-based format and was being delivered with realtive success to the target population. The second curriculum identified was the Middle School Mathematics Learning System (MSMLS) under development by Dr. Ralph T. Heimer at the Pennsylvania State University. This was a computer-based basic mathematics skills curriculum which was being developed for children. These two curriculum efforts served as the fundamental cornerstones to the specification of the design for the Basic Skills Learning System. Indeed, entire sections of each of the curricula were adopted, modified and implemented in the Basic Skills Learning System.

Plan Design and Development Effort

At this point there are three alternatives. The first is to proceed directly to the design of the instructional program. The second, given the availability of existing courses, is to go directly to the evaluation of those courses. Third, it may be desirable to discontinue the courseware development effort if costs and other associated parameters become prohibitive.

In the case of Basic Skills, a decision was made to acquire the rights to the two stated curricula and proceed in a total redesign and redevelopment of a new computer-based education product based on the fundamental structure and design of these two curricula.

Phase II: Design

The purpose of the design phase is to prepare a detailed plan for the course. The information gathered in the analysis phase forms the basis for the designed plan. The basic tasks performed during this phase are: 1) perform instructional task analysis; 2) specify instructional objectives; 3) define entry behaviors; 4) group and sequence objectives; 5) specify learning activities; 6) specify assessment system; and 7) specify evaluation system.

Perform Instructional Task Analysis

In this step, the course goals are analyzed to determine the skills and knowledge that are necessary for the performance of the tasks within each goal. Each individual task is then analysed to determine sub-tasks and how they fit together into the task. The result of this step is a hierarchically-arranged learning map, a visual representation of how the tasks and sub-tasks relate to each other within the overall goals.

In the case of the Basic Skills Learning System, specific objectives were identified. These objectives were grouped together in clusters for which specific learning activities were developed; these clusters were grouped into bundles where retention testing and review was provided; and these bundles were grouped into strands which represented threads of common content.

Specify Instructional Objectives

The task and sub-tasks on a learning map form the basis from which instructional objectives are written. Each objective describes a desired performance or behavior, the conditions under which the performance or behavior will be observed, and the criteria for acceptable performance.

An example of such an objective from the Basic Skills Math curriculum is: "Given a three-digit number and a two-digit number where regrouping only from tens to hundreds is necessary to find the difference, the learner will be able to find the difference. The criteria for mastery will be four out of five." An example from the Baskc Skills Reading curriculum is: "Given a selection and its main idea, the learner will be able to identify specific details in the selection and support of the main idea. Mastery criteria is three out of four." An objective from the Basic Skills Language curriculum is: "Given a series of adjectives, each in the positive degree of comparison, the learner will be able to select the correct word used to form the comparative and superlative degrees. Mastery criteria is three out of four."

Define Entry Behaviors

After the instructional objectives have been completed, entry behaviors must be defined. In this step, entry behaviors are defined and thoroughly analyzed. In the development of courseware the specified entry behavior marks the minimal level of competence required for a student to enter the curriculum. These minimum entry behaviors must be examined and if students do not possess the minimum behaviors, they should not be allowed to enter the program without acquiring these skills. It is essential that the curriculum succeed or fail on its own merits rather than failing because the students entering the program were beneath the minimal level of competence for the curriculum.

In the case of Basic Skills, if students tested lower than the third grade reading level on the ABLE test, they were referred to a low-level remedial program delivered by an instructor to raise their skills to a minimum level. Due to the very nature of the curriculum being delivered on a computer terminal, the students had to be able to read at a third grade level in order to follow the directions and participate in the program.

Group and Sequence Objectives

In this step, objectives are arranged in groups that are logically related in terms of instructional purposes. The objectives are then sequenced so that the ordered relationships indicated in the learning map are preserved. This step assures that learning will progress logically and efficiently throughout the hierarchy of the content domain.

In the case of Basic Skills, the mastery learning model was employed and specific pre-requisite objectives were identified for every higher level objective and students were not allowed to proceed to the higher level skill until mastery was demonstrated on lower level pre-requisite skills. Retention was checked at periodic intervals to assure that lower level skills were, indeed, learned and retained.

Specify Learning Activities

When each group of objectives has been identified, learning activities can be determined. Learning activities are small segments of instructional materials that correspond to one or more objectives in a particular group. In the specification of learning activities, three tasks must be performed: 1) select media; 2) select instructional strategy; and 3) identify content. Media (text, audiotapes, videotapes, computer-based instruction, and so forth) are selected for each learning activity on the basis of appropriateness and instructional strategy. Instructional strategy determines the teaching approach for presenting concepts, soliciting interaction, providing feedback, and so on. The content specific to each learning activity is also identified.

The Basic Skills program effectively addresses the problem of a diverse and discouraged student population through well-defined curriculum which is: individualized, diagnostic and prescriptive, objective-based, based on mastery learning models, modular in structure, and multisensory in format. Specific media was determined for different components of the curriculum. A series of motivational audiovisual products presents an overview of the curriculum and describes the instructional activities in the curriculum. The purpose of the audiovisual activities is to act as an advanced organizer and motivator for the student. Each new skill is presented in the form of a tutorial lesson on the PLATO terminal, followed by a drill and practice activity on the PLATO terminal, accompanied by an "off-line" exercise application in a workbook and a mastery test delivered on the PLATO terminal.

Specify Assessment System

The means by which learning performance is measured and reported is specified in this step. The use of pre-test, progress checks, and post-test is defined. A plan may be presented for administering, scoring, and using test results.

In the case of Basic Skills, and effort was made to allow the student freedom within a structured curriculum. Two kinds of controls were established. 1) Router Control: The system's router makes available to the student the most appropriate cluster within a given strand. After mastery of this cluster has been demonstrated, the next cluster in the strand is made available to the student. Only one cluster per strand is available at one time; the student must demonstrate mastery of this cluster before continuing to the next. 2) Student Control: Within reason, the student is allowed to determine which strand to work on, and within the prescribed cluster for the strand, which type of instructional activity to work on. For example, a student may choose to work on the multiplication strand of the math curriculum. The router makes available to the student the most appropriate cluster within the multiplication strand. The student may then choose to work on the tutorial, the drill and practice, the off-line workbook, or any other instructional activity within the prescribed cluster. The students are also allowed to access their individual profile which allows them to see their progress graphically in each of the three curriculum areas.

Specify Evaluation System

In this step, a plan is prepared to outline the strategy for validating the instructional materials in the evaluation phase. The plan details the arrangements that pertain to student groups, sample sizes of groups, and data analysis requirements. The nature of the evaluation will determine the time required to complete the course, the attitudes expressed by the students, and the student performance. This is an absolutely critical stage. In order for any CBE curriculum to be accepted on a large scale, a thorough evaluation of that curriculum must be performed. Specific criteria for success must be outlined and the development team must know what criteria will be used to evaluate their work.

In the case of the Basic Skills Learning System, the evaluation criteria was specified as achievement on a standardized exam such as the ABLE test, length of time in the training program as measured by student contact time and length of time in the class, student attitude, and attrition rate of the students within the program. In most cases, the Basic Skills Learning System has demonstrated a remarkable achievement rate in a very short period of time, and has been able to retain the students in the program with a high level of motivation.

Phase III: Development

During the development phase, all initial drafts of instructional materials and tests specified by analysis and design phases are prepared. Test items, text materials, computer-based learning activities, and audiovisual scripts are developed in this phase. The documents prepared and the design specified how to: 1) prepare individual lesson designs; 2) construct test items and tests; 3) develop individual lessons; and 4) review and edit after this process is complete.

Prepare Individual Lesson Designs

Lesson designs are prepared for each learning activity. A lesson design included identification of the activity and the objectives to which it corresponds; the general media strategy for that activity; a detailed statement of the content and instructional approach; and flow charts of the lesson structure, as appropriate. The approval of the designer and subject matter expert is required before each lesson design is finalized.

Construct Test Items and Tests

Test item construction is based on the outcome of the assessment system and its specifications. After the individual items have been prepared and reviewed, they are assembled and entered into the testing-management system.

Development of Individual Lessons

Individual lessons are text, audiovisual, or compter-assisted learning activities. Individual lesson designs are used to draft texts; to design, develop and program computer-based learning activities; and to draft audiovisual scripts.

Reviews

At this point the development process of all the materials are in the form of drafts. All draft materials are reviewed by the subject matter expert for content integrity and the designer for instructional adequacy. After the materials have been approved by both the subject matter expert and the designer, the editor assigned to the team reviews the materials for final draft. Documentation products of the development phase are the CBE learning lesson designs and the draft of materials for the entire course.

In the case of the Basic Skills Learning System, the development phase produced over 1,000 lessons in the form of tutorials, drill and practice activities, mastery tests, and off-line exercises and applications. In addition, there were 14 videotapes and 12 student booklets containing over 293 sets of exercises. The development phase also produced a sophisticated student routing system which allows for pre-test, post-test and retention testing, generates a student profile, and allows for placement of the student within the curriculum.

Phase IV: Formative Evaluation

The purpose of the formative evaluation phase is to try out and revise the course materials based upon actual student use data. During this phase the following tasks are performed: 1) conduct one-on-one tryout of draft materials and revise materials; 2) conduct small group pilot tests and revise materials; and 3) edit and produce the course.

Conduct One-on-One

The one-on-one tryout of the draft of each learning activity is conducted by the team with at least one student who represents the target population. While this may appear to be a small sample size, at least 50 percent of all errors are identified at this time through this very simple process. After the one-on-one tryout, the designer, developer, and editors make the necessary revisions and assemble the materials for the pilot class.

Conduct Small Group Pilot

During this step, a small group that represents the target population tries the course. In this pilot test, of course, the conditions of the environment in which the course will actually be used are simulated. Various evaluation instruments are used to gather data and the course is evaluated in terms of effectiveness based on the sepcific criteria identified in the design document. Problems identified in the small group pilot tests are analyzed and appropriate corrections or modifications are made.

Edit and Produce

A technical and mechanical review is performed on all computer-based learning activities and final editing is performed on all text and audiovisual materials. The final edit ensures completeness and appropriateness of all materials and the course is ready for reproduction and distribution.

The Basic Skills Learning System went though an extensive formative evaluation phase. The curriculum was delivered at an adult learning center in a major urban area. Substantial data was collected at this site and analysis of that data was used to improve the curriculum materials and the curriculum structure.

Phase V: Implementation

During the implementation phase, all instructional materials are reproduced and distributed to a select number of sites. The course is actually used with the target population in the intended environment. While the course is being used with the intended population, data is collected on student performance and attitude. Information is also recorded about the students' performance after they complete the course.

The Basic Skills Learning System was implemented in several sites representing a cross-section of the target population. The curriculum was delivered at an adult learning center in a major urban area, at a correctional facility, at a military base, and at an urban city high school. As a result of the analysis of the data collected, several instructional materials were revised, some new materials were added, some were deleted, more instructor/teacher options were incorporated into the routing system, and more flexibility was built into the entire system to allow for teacher involvement.

Phase VI: Summative Evaluation

Evaluation in this phase is of the summative nature. It is intended to measure the effectiveness of the course involving the educational problem identified in the analysis phase. In this phase, data gathered during field use of the course is analyzed and summarized. This data is the basis for a report containing recommendations for course and delivery system modifications. Finally, a decision based on these recommendations is made. If minor modifications are to be made, corrections follow the course maintenance procedure. Usually these corrections do not interrupt the operation of the course. However, if major problems are identified it may be necessary to go back to the analysis phase to identify the source of the problem and take corrective action.

Summative evaluation was conducted on the Basic Skills curriculum across a number of different sites. The results indicated that the Basic Skills Learning System achieved its objective of teaching functionally-illiterate adults to read and compute at the equivalency of an eighth grade level. In addition, a large number of the participants in these programs have successfully entered vocational training programs. Furthermore, the attrition rate for the Basic Skills offerings has been significantly lower than traditional methods, which indicates that the materials are meaningful and motivational to the participants.

CONCLUSION

It has been demonstrated in this paper that curriculum development is evolving dramatically in complexity, particularly with the influx of the computer into the educational process. As Heimer and Rizza noted (2), "The construction of substantive, high-quality, computer-delivered courseware is a complicated and many-faceted task that can be done successfully only by employing sophisticated *systems* approaches." A particular system approach for courseware development has been represented in this paper and examples of each of the phases have been specified. The dilemma for the 1980's is how to support the necessary courseware development activities to produce high-quality, cost-effective curriculum offerings. The cost of courseware development is substantial; the number of resources both human and technological are many; the time required for the development process is long; and the process which must be followed to produce a quality product is extremely complex and sophisticated. We know how curriculum development should be done; but we haven't figured out how to fund it and staff for it. If the school systems and universities, the federal government, and private industry do not take an aggressive and cooperative stance on curriculum development, the country will be plagued by individuals writing bits and pieces of courseware which in most cases will not be quality and will not be used. The question of how to develop courseware can be answered. The question of who should do the developing and how it should be funded remains to be answered.

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Technology and Humanism—Are They Compatible?

Edward A. Friedman
Dean of the College
Stevens Institute of Technology
Hoboken, New Jersey

INTRODUCTION

Many references have been made in this book to technological illiteracy as a barrier to the acceptance of technology in education. I wish to address the concept of technological illiteracy as well as focus on a barrier that has received little attention: one—technological anxiety. I will proceed by first discussing some observations of technology by humanists, followed by comments about the nature of technology. After providing a case study that illustrates technological anxiety and resistance to the introduction of technology in education, I will conclude with a discussion of some recent programs for the development of technological literacy.

Those of us who participated in the conference were probably convinced that we are pursuing a humanistic goal. We believe that as educators we can apply technology to education for the enhancement of individual growth and development. While we may see a liberating potential for technology there are many who view technology as limiting. Technology to them is associated with war, dissonance and constraints. It is seen as a force that thwarts humanistic aspirations of peace, harmony and freedom.

Visual Statements—Technology and Humanism

Concepts of technology and humanism are difficult to place in perspective. I will begin by sharing some visual statements with you about technology and humanism. Artists have distilled some important notions for us. For example, "Bus Driver," by George Segal, presents a rather stark representation of man in his technological world. The painting, "Big Julie" by Fernand Leger shows the human form and a technological form intertwined with each taking on some aspects of the other. Should we view this as a sign of hope that technology can enter into aesthetic expression or a dark portent that even the most sublime of human visions will be invaded and degraded by an unfeeling technology?

In "Propellers," again by Leger, we see a clear glorification of technology through a brilliant aesthetic transformation.

A Calder sculpture of bird "Le Coq de Sache," shows that in the hands of a genius, conceptions of nature itself can be enhanced by adopting a technological point of view. A Calder stabile called "Portrait of a Young Man" reveals artistic grace and form through a construction that simultaneously exudes the essence of mechanical engineering. Calder was, in fact, a Mechanical Engineer who graduated from Stevens Institute of Technology in 1919. The relationship between his education as an engineer and his creativity as an artist has received only limited attention.

While Calder demonstrates the role of technology in the creation of art, Joseph Stella's painting titled "Brooklyn Bridge," done in 1917, reveals the role of technology as a source of inspiration to the artist. The Brooklyn Bridge as an aesthetic object and as a technological triumph that opened new vistas for man when it was completed in 1883 has sparked many creative fires in literature as well as art.

A profound statement about technology was made by Allan Rubin, a young New York City painter whose work is titled "Canyons." Here the man-made technological world stands in juxtaposition to the Grand Canyon. Allan Rubin stated that contemporary man's environment exists—its origins whether in nature or in technology are somewhat irrelevant—it all impinges upon the senses and there is grandeur everywhere. Some may want to run from such a conception, but our earth is small. Some may wish to reject various aspects of technology but no man can escape the physical presence of technology. Satellites are among the stars and electromagentic radiation is carrying information and images everywhere. The question is not whether we are for or against technology but how we adjust our lives to a world in which the heavens send us both acid rain and new knowledge. We can't return to caves; rather we must face the formidable task of trying to absorb the benefits of technology while protecting ourselves against its dangers.

Editorial Attacks

An incredible attack on technology in education took place this past Fall in the "New York Times." On October 21st an innocent news article[4] described the use of computerized systems by the Library of Clarkson College in Potsdam, New York. The head of the Library, Dr. Grattidge, was quoted as saying that:

> "Education is basically an information transfer process."

While the use of data bases, television and microfiche were described, the President of Clarkson was also quoted in the article as stating that these innovations were intended to supplement the tools of learning not destroy them. Here "the tools of learning" meant books.

The Times then launched a barrage of criticism upon the Clarkson project. An editorial[5] on October 27th accused Clarkson of being against humanistic qualities in education. President Robert Plane pointed out in an eloquent letter to the editor[6] that the:

> ". . . use of the computer provides students with more of the most precious commodity—time; time for the rest of their education, time to communicate with peers and faculty, time to think and contemplate, time to enjoy the physical world about them, and yes, time to read books. Even the most enthusiastic computer user doesn't want to read "Moby Dick" or the "Rubaiyat" on a video display terminal."

Following President Plane's letter, on November 9th, two big league hitters of the Times both pounded Clarkson: Russell Baker and Ada Louise Huxtable. Russell Baker, in a sardonic column[7] entitled "Terminal Education" tried to sound the death knell for technology in education. Referring to the librarian's quote he wrote:

> "Information—transfer process indeed. Education is not like a decal to be slipped off a piece of stiff paper and pasted to the back of the skull. The point of education is to awaken innocent minds to a suspicion of information."

He went on to state learning to doubt is best done:

> ". . . in the grass, under the elm, where someone has gone to read a book, subject to the random events of nature."

Since television sets cannot be plugged into tree trunks, educational technology would lead to sterile learning as viewers watched their screens in environments where in Mr. Baker's words—"No trees grow and no apples fall." If meant as humor, it is caustic humor indeed. Technology is vulnerable to the myth of HAL that it will embrace an extreme form to limit, rather than to liberate, humanity. Those espousing technology in education must be wary of being transformed into caricatures in the mind's eye of their public.

The attack of Ada Louise Hustable springs from deeper roots akin to those that motivated Faulkner. Ms. Huxtable usually writes about architecture. Her attack upon Clarkson was based upon the existence of the ominous educational pursuits in the library. Since the Gothic design of the Yale library is inspirational, Ms. Huxtable decided that she would compare Yale's Sterling Memorial Library with Clarkson's new Educational Resource Center. In her column[8] of Architectural criticism she wrote:

> "Any similarity between the Sterling Library and the Clarkson beyond the fact that they are both educational buildings devoted to the storage and dissemination of knowledge—would be rejected even if it existed."

She leaves no room for doubt about which building and style is preferable yet she goes on to admit that she has no knowledge of the Clarkson Center. She draws definitive conclusions (in reference to the Clarkson Center) propelled by pure reason as follows:

> "I have not seen this self-service library of tomorrow devoted to data retrieval rather than holistic humanity, but I assume that stylistically it is also a model of the future that its designers envision."

A poor concept then guarantees incompatibility with satisfactory architecture. It is as if a Crusader denounced the aesthetics of all Mosques because they were founded upon a false premise!

Ms. Huxtable damns modern forces of technology in both Architecture and in Education because of the Technological Fallacy which she asserts:

> "... leads to unreal, naive or arrogant expectations... It is Clarkson's extension of the Technological Fallacy to define education as information transfer that is so disturbing..."

What gives rise to attacks such as these? In my view both Baker and Huxtable fear quantitative style overpowering and suppressing qualitative aspects of life. The tripwire that sets off apparent dissonance between technology and humanism is the fear that mathematical man will seek unconditional surrender from verbal man with the suppression of impressionistic, subjective and poetic sensibilities. Advocates of technology in education are not declaring war on the humanities and arts, but we should remember that in a world of limited resources, satellite communication systems and computer assisted instruction may in fact absorb funds that are needed for verdant campuses, art studios and books with leather bindings.

Literature—Technology and Humanism

These various perspectives on technology and its relationship to man and society have parallels in literature as well as in a vast outpouring of social commentary. One view of technology by a twentieth century Noble Laureate, author William Faulkner, is worth citing. In 1954 an Italian airline on its fourth attempt at an instrument guided landing, at what is now Kennedy Airport, fell short of the runway in a fatal crash. Faulkner saw the pilot as a victim of the "Cult of the Machine." Conjecturing that the pilot's past experience should have led him to mistrust the instruments, he wrote[1] that the pilot:

> "... was the victim not even of the failed instruments but victim of the mystical, unquestioning, almost religious awe and veneration in which our culture has trained us to hold gadgets. . . .
>
> He dared not so flout and affront, even with his own life too at stake, our cultural postulate of the infallibility of machines, instruments, gadgets—a Power more ruthless even than the old Hebrew concept of its God, since ours is not even jealous and vengeful, caring nothing about individuals."

Somehow Faulkner was able to accept the technology of air travel but drew a line at automated landing. Technology that clearly expanded man's horizons and that was familiar could be accepted as good. New technology that was unfamiliar, that seemed to place man in a dependent, depersonalized position deserved only denunciation. Who would suggest today that astronauts reject computer control of their trajectories in space because it was in conflict with their "Seat of the Pants" instincts?

What Faulkner overlooked is that technology is created by man and is intended for man. While science strives to understand the natural world, technology is part of a social process that strives to modify the environment in response to human need. Technology might be defined as both the systems and objects or artifacts that are created using knowledge from the physical and social worlds. These systems and artifacts always have a purpose which is to affect the activities and organization of society.

Technology's Role in Society

In order to explore the role of technology in our society it is necessary to have some understanding of the essential features of technology.[2] It is not simply applied science nor is it random gadget making. Technology seeks to solve problems using current methods and knowledge. The objects of technology do not exist in isolation. Often these complex systems must be evaluated and decisions made with incomplete information. Engineering and medicine are among the few professions that incorporate uncertainty and ambiguity into everyday practice. While science seeks to understand, technology is action-oriented. Such actions entail risks. These risks must be weighed against the possible benefits. The risk of all alternative solutions must be weighed. This process necessarily includes the alternative of not taking action.

When technology is seen as part of a social process it is obvious that there can be both "good" and "bad" technology. Mindless gadget making reflects the social process not the intrinsic attributes of the technology. It is difficult for many humanists to see technology in perspective—it is strange. Fears that technical creations will overwhelm their makers generates an underlying level of anxiety, if not hostility, that is difficult to dispel. How quick we are to accept the image of HAL, the master computer in the space vehicle of the film "2001"[3] as the archtypical technological monster of our age. HAL tries to assume control over the crew in an unparalleled display of technological arrogance.

Let me extend the basic description of technology making note of a concept of anthropology. Central to one anthropoligical view of man is the notion of man as creator—*homo faber*, man the maker. Modern technology is an extension of the first chipping of stone tools or the casting of metal objects. Technology is as derivative from the crafts as are the fine arts. Painters and sculptors have carried forward the aesthetic aspects of the crafts—while technologists have carried forward the utilitarian.

In the context of this book we must examine the tension between Humanism and the Technology that arises in education. Some critics of educational technology fear that we will be carried by our instrumentation along paths that we do not want. Perhaps the mystique of a "cultural postulate of the infallibility of machines" could indeed trap us into the cult of the machine. Another ominous possibility would be the creation of a HAL-like teaching computer that outwits our programming skills and begins to assert its authority as chief pedagogue. If we are practicing good technology, then we are using technology to solve problems that arise out of important social needs. Poor technology would have us force technology upon society simply because it exists. Such aimless use of technology for its own sake is the essence of the gadetry that Faulkner attacked. Another potential pitfall would be to employ technology for a useful purpose that was undermined by faulty implementation. These are some of the challenges presented by HAL and his unborn descendents.

In addition to these real pitfalls for technology in education, there are also unexpected pitfalls arising from a climate of opinion that could block paths of potential progress. Technological backlash is always lurking just beneath the surface.

A Competition for Resources

It is in these threats to the quality of life and learning that incompatibility of technological and humanism may lie. I do not believe that it is a conflict of fundamental values but rather a competition for resources. Will the acquisition of computer assisted instruction, for example, preclude support for strong interpersonal learning? My hope is that technology in education will reduce costs in some areas so that more intensive human contact can be encouraged elsewhere. Perhaps an expansion of computer assisted instruction, videodisc and the like will provide cost effective teaching for facts and techniques. The savings in time and in expense could be used to enhance and promote the free exchange of ideas under trees, in gothic libraries, or even in Bauhaus-inspired learning centers.

Part of the problem we have in evaluating these apparent conflicts between technology and humanism arise because of limited perspective and outright confusion regarding technology. Technology is distinct from science but this distinction is rarely perceived. While scientists abound in educational circles, engineers, who promote technology, are generally isolated in professional schools dealing with professional pursuits. I wish to report that some promising changes are taking place. During the past eighteen months a new organization—The Council for the Understanding of Technology in Human Affairs, or CUTHA for short, has recieved strong national support and encouragement. It is a group that includes both engineers and humanists. It has grown out of an effort by about thirty engineering colleges to provide education in technology for liberal arts students. These educational initiatives have been well received[8] and there seems to be a rapidly growing interest in expansion of such programs at liberal arts colleges that have had no previous connection with technology. I believe that a greater appreciation will be developing nationally concerning the content and nature of technology. As these and similar efforts develop, the apparent incompatibilities between technology and humanism will be somewhat dispelled. What is more important is that we will need all the wisdom that we can muster in order to deal ably with real conflicts over limited resources. Our society on this finite earth must understand more about both technology and humanism than ever before.

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New Directions for Training Technology

J. D. Fletcher*
U.S. Army Research Institute
Washington, D.C.

INTRODUCTION

Military training has been receiving increasing attention recently, and this trend is expected to continue for at least four reasons. First, the quality of entry level manpower has been decreasing substantially. In the last ten years, college entry Scholastic Aptitude Test scores have declined about 5 percent in mathematical achievement and 11 percent in verbal achievement. The decline is uniform across the country; it is unrelated to economic, race, or geographic background. Moreover, it has occurred during a time in which the proportion of our Gross National Product allocated to education has more than doubled. This increased investment has been almost entirely in traditional instructional technology. The lack of return may indicate, as Heuston has argued, that traditional instuctional technology has matured to a point of diminishing returns.[4] The only way to increase the productivity of current education and training institutions may be to develop new technological tools and have them incorporated in these institutions. That the productivity of these institutions must be increased seems self-evident. In an era of increasing technological complexity, the proportion of individuals with high proficiency and basic skills needs to rise, not fall or remain level.

Second, the quantity of manpower available for entry is severely decreasing. Despite the well publicized problems the Services have been experiencing in manning their forces and maintaining their material, they have been drawing from the largest pool in history. At present about 4,250,000 people are entering the job market each year, by 1990 the number will drop to 3,150,000. These numbers argue poorly for both quantity and quality of people available for military service. As Tucker has suggested, it appears unlikely that our current difficulties in attracting

* The opinions, views, and conclusions expressed in this paper are those of the author and do not represent official policies of the United States Department of Defense.

sufficient numbers of lower ability personnel to the Services will worsen—the situation is bad, but it is not likely to get worse.[10] However, the ability of the Services to compete favorably with industry and universities for high ability personnel will rapidly diminish, increasing the scarcity of these people as the need for them increases.

Third, the density of equipment has been increasing dramatically in the last 10 years. To take an example from the Army, there is now almost one "system" per person. There is one wheeled vehicle for every four people in the Army, one tracked vehicle for every 20 people, one radio for every six people, etc. Supplying adequate numbers of people to operate and maintain these systems is, needless to say, a challenge for the Army, and the challenge is similar although not quite so severe for the Navy and the Air Force.

Fourth, the costs of training are increasing steadily. The Department of Defense will expend over $8.7B on formal residential training in FY 1981, of which almost $3.8B will be spent on post-recruit specialized skill training. These figures do not include on-the-job training, factory training for new systems, "team" training, or field exercises. In addition to increased expenditures for salaries and benefits, the major contributor to these increases is the cost of equipment to be used in "hands-on" training.

These problems are viewed as harbingers of what is to come in industrial training. Industry may well be able to compete favorably with the military for high quality people, but this advantage is likely to be far outweighed by the problems industry shares with Defense. The problems of manpower quality and quantity, the increasingly equipment-intensive character of entry-level jobs, and the costs of training and training equipment are just as problematical for industry as they are for the military. Further it should be noted that on almost any scale, industrial training is a major undertaking. Estimated expenditures for industrial training in the United States range from $25B to $100B a year. To some extent, then, the problems of training and training technology are genuinely national problems.

Seeking New Solutions

In any event, there is substantial reason for government and industry planners to seek new technological solutions for the demands and concomitant problems posed by current and projected training requirements. Technological opportunities are abundant and include computer speech input and output, artificial intelligence, low-cost high-resolution computer graphics, videodiscs, microcomputers, and high density storage. These opportunities have yielded a variety of new applications possibilities for training and these are the focus of the remainder of this paper.

Most of the new training technologies listed here are based on systems developments that have occurred independent of training and education requirements. It should be emphasized that the real opportunities for sustaining and improving human performance are the "functionalities," or capabilities based on these system developments, not the developments, themselves. The appearance of any new functionality is unpredictable and dependent on breakthroughs in imagination and technological creativity. This process is neither trivial nor one that follows automatically from new technological opportunities. These functionalities most directly determine the new training technologies that must find their place within the full suite of opportunities available for improving system performance.

On the basis of the problems listed earlier, it is possible to specify at least in part the kind of training technology the future and the present demand. This technology must be accessible, accessed, relevant and intelligent.

1. The technology must be delivered to and available at job sites. In military training, as in industry and elsewhere, there is a tendency to abrogate responsibility at the school-house door. Stated more directly, there is an assumption that when a student leaves residential training, the job is done. This is not a productive point of view for at least the following reasons: (1) real expertise requires an amount of experience and practice that is completely impracticable in residential training; (2) much skill growth occurs at job sites, not just in residential schools; (3) current problems assure that less training will be accomplished in schools, and less well prepared people will appear at job sites; (4) declines in manpower quantity will mean that fewer people will have to perform a wider variety of jobs.

2. In addition to being accessible, the technology must be accessed or, in short, it must be used. Education and training are gradually shifting from a teacher-centered orientation to a student-centered orientation. This trend is particularly important in industrial and military training where manpower shortages will permit less and less use of expert human instructors. Students are increasingly expected to be self-initiating, self-motivating, self-pacing, self-assessing, and generally, self-reliant. The productivity of students, rather than the productivity of instructors, is becoming the focus in evaluating the success and efficiency of instruction. As a consequence, technology must be adapted and designed to help students meet goals of productivity rather than be grafted on instructor-centered systems poorly prepared and little motivated to use it.

3. The technology must be relevant. This is certainly an obvious goal, but one difficult to attain in practice. Unlike accessibility (it is either there or absent) and usuage (it is either used or not) which are easy to measure, relevance is difficult to establish in practice. If training is to be relevant, it must be like the job. This means that we must either provide practice on doing the job itself under precisely accurate job conditions—

i.e., the student is doing the job and *nothing else*—or we must turn to some degree or another of simulation with its benefits of economy visibility, reproductibility, and safety.

4. The technology must be intelligent. This is a controversial claim. However, if the new training technology is going to be used successfully at job sites, isolated and distant from subject matter experts and qualified instructors, then it must incorporate in itself some of the qualities and capabilities of expert job performers and tutors—an Aristotle for every Alexander as Suppes and Morningstar intimated.[8] In passing, it should be noted that no distinction is intended between "intelligently" designed and "unintelligently" designed training systems. Intelligent training systems may be as unintelligently designed as any others. Rather, the development of these systems is viewed as a specific effort to apply artificial intelligence techniques to CBI in the sense of information structure oriented (ISO) approaches discussed and advocated by Carbonell who contrasted ISO efforts with ad hoc frame oriented approaches based on techniques of programmed instruction.[2]

New Training Technologies

In searching for ideas, "technical approaches" to meet these goals of accessibility, use, relevance, and intelligence, we have pursued development of the following new training technologies:

Interactive Movies

One of the problems with training in which demonstrations of skilled performance play a large part is that essential components of the demonstrations are, simply, invisible to viewers. This problem is solved to a major extent by interactive movies. These movies, which are based on microprocessor controlled videodisc technology, allow the viewer control over such aspects of viewing as perspective (front, side, above, below, etc.), speed (fast, slow, still frame, reverse), detail (panning and zooming), abstraction (photographs, video sequences, line drawing animations), plot (different actions at different choice points yielding different results), and simultaneous action (gauge readings, actions by other team members).

Surrogate Travel

Surrogate travel forms a new approach to locale familiarization and low cost trainers. Under microprocessor control, the user accesses different sections of a videodisc, simulating movement over selected paths of travel. Unlike a travel movie, the user is able to both choose the path and control the speed of advance through one area using simple controls. When he comes to an intersection, he can turn left, turn right, proceed ahead, or go back, all under joystick control. He can travel along a path looking either to the left, to the right, or to the rear as well as straight ahead.

The videodisc frames the viewer sees originate as filmed views to what one would *actually* see in the area. To allow coverage of very large areas, the frames are taken at periodic intervals that may range from every foot inside a building, to every ten feet down a city street, to hundreds of feet in a large open area (e.g., a harbor). The rate of frame playback, which is the number of times each video frame is displayed before the next frame is shown, determines the apparent speed of travel. Free choice in what routes may be taken is obtained by filming all possible paths in the area as well as all possible turns through all intersections.

Microtravel

One promising aspect of combined surrogate travel and interactive movies is microtravel. This capability provides interactive surrogate travel in places where people cannot go. One example of this is microtravel throughout a jeep engine while it is running.

Virtual Team Trainer

Many tasks are performed in teams or crews where communications and timing of actons are of critical importance. However, training of this sort is too rarely provided because of difficulties in bringing together all members of a crew at one location to use expensive equipment that is often required for more directly mission-oriented activity. This problem is exacerbated by the fact that frequently only 1-2 members of the crew are the focus of the training, other members are required only as support for the activity. Within the current state-of-the-art it is possible to assemble a computer-based team trainer that is voice interactive for some class of highly stereotyped messages using a vocabulary of not more than 2000 words and that is capable of assuming the role of any or all but one member of the crew or team being trained. As the state-of-the-art continues to progress rapidly, less message stereotyping, larger vocabularies, and more complex roles will be possible.

Automated Authoring

Current estimates of the amount of time required to prepare one hour of computer program that: (a) obtains information about a subject area limited amounts of computer-based instruction can be generated by a compuer program that: (a) obtains information about a subject area through computer-initiated inquiry of computer-naive subject matter experts and/or printed reference materials; (b) constructs an adequate knowledge representation of the subject area despite contradictory and/or missing information; (c) generate instructional items, sequences, and simulations for individualized training. Such a system can now be built using non-exotic representation such as production systems, existing natural language capabilities, and emerging notions of meta-knowledge.[3]

Optimized Instruction

Much training requires memorization of relatively discrete items of information. Substantial efficiencies in training are achieved when student time devoted to this activity is minimized and gaming aspects are maximized. The combination of quantitative models of learning, optimal control theory and computer-based instruction has substantially reduced student learning time over all other procedures evaluated.[1] These results have occurred despite incorporation of quite imprecise parameter estimation and memory modeling techniques. Both of these have been dramatically improved in the last several years. Precision of parameter estimation alone has been improved by more than 60 percent through application of Tukey's one degree of freedom model.[7]

Electronic Libraries

Electronic libraries in the form of Spatial Data Management Systems (SDMS) provide students and instructors access to an assortment of multi-source and multi-media information.[5] Users literally "fly over" information and select what they want by simply pointing. Spatiality is used to cluster materials so that different information spaces represent different concepts, instructional topics, and assessment procedures. For the instructor, the SDMS provides ready access to material which might otherwise be unaccessible. Instructors can access the SDMS to create their own information spaces (i.e., courses or lectures) and subsequently present such materials to large audiences in single locations via large screen television projection or to multiple locations through cable or satellite distribution systems. Students can independently use the SDMS for self-paced instruction by either working through previously designed information spaces or by browsing on their own. When students and instructors are in remote locations, offsite instruction is facilitated by linking two or more SDMSs together using regular telephone lines. In this manner, a student or instructor can fly the other to a topic of interest, sharing at geographically remote sites a large library of information.

Low-Cost Portable Simulators

Videodisc technology has been used to produce low-cost visual simulators. An example of this is the development of a tank gunnery trainer.[9] In this low-cost trainer, a gunner is taught to locate, track, and fire at enemy tanks. Instructional sequences consisting of both the visuals seen by the gunner and the constantly changing problem information needed to provide instructional feedback are accessed from a videodisc. The videodisc provides rapid access to a wide variety of problem sets as well as high fidelity display of what is normally seen by tank gunners. The trainers can be linked together to provide intra-tank training, for tank crews, or inter-tank training for tank platoons. Shoot-offs and "quick-fire" exercises are presented to increase motivation. All sighting devices and sight reticles are included in the trainer. Computer graphics overlaid on the video sequences are used to show trajectory and burst-on-target information. Daytime, nighttime, smoke, and dust sequences are all included. The device captures the entertainment of arcade games in a job-relevant training activity.

These new developements all meet to one degree or another the need for training technology that is accessible, accessed, relevant, and intelligent. The list is necessarily incomplete and the full set of possibilities should grow substantially over the next several years. As new training media, these developments add power and flexibility to our ability to bring people rapidly up to levels of performance and skill mastery required by jobs in the military and industry. However, the end goal of this activity is only indirectly the improvement of training, the principal benefit is, or should be enhanced systems performance. Specific training developments and training technology in general must be fitted into the full spectrum of alternatives available for improving system performance. This consideration leads most directly to a mildly novel approach to training technology development. There are at least four aspects of this new approach worth noting.

1. People are assumed to be part of the system. Especially in training where we tend to discuss systems such as airplanes, ships, jeeps, and radios, it is easy to assume that performance, effectiveness, and "readiness" begin and end with hardware reliability and availability. This assumption is, of course, false. People design these systems, they maintain them, operate them, and deploy them. People are an integral part of every system. Solutions to the problem of increasing performance, effectiveness, and readiness so often sought by industry and the military in improved hardware, may in many cases, be more appropriately obtained from any cost/effective point of view by improvements in human performance directly sought through training. Training technology is being increasingly viewed as at least one engineering solution to system performance problems.

2. Coming from the other side of the issue, training technology is developed for a reason. It is properly viewed as a solution to a system problem. The goal of training research and development is not improved training; it is improved system performance. The criteria for effectiveness in training technology should not concern end-of-course performance so much as skilled performance on the job whether or not the training has contributed in a positive fashion to effectiveness, and system performance. Probably, we have lost sight of this perspective because it is difficult in practice to implement—it has been easier to examine courses and end-of-course performance measures—but times are now more difficult and these measures, which typically yield miniscule correlations with job performance measures, no longer suffice. They are particularly inappropriate when we find ourselves outside of the residential "course"

paradigm and must evaluate the efficacy of job site training.

3. We are escaping the information theory metaphor for training. Contemporary advances in psychology are reminding us that human cognition is an overwhelmingly active, constructive process. In training, as in all communication, we are not simply shipping chunks of information across a channel to be glued intact on a blank slate. Instead, what we seem to do is pass cues for sensory simulation that are built up by the receiver. Memory itself appears to be reconstructive, or re-creative, rather than reproductive. We do not simply dredge up items for recall, we reconstruct them. We do not teach in the sense of dumping whole chunks of information into students heads. Rather we are creating environments in which, to greater or lesser degrees, students learn. It is far more efficient for people to be doing something in a learning environment than simply receiving information. This is particularly true of the verbally unskilled populations from which we must draw our electronics technicians, hydraulics repairmen, and avionics technicians—hence the emphasis on intelligent simulations that are accessible at job sites. The further training is removed from job relevant activity, the less effective it is. This is not to ignore the issue of cost. We need to know what amount of training effectiveness is purchased by a unit of cost in designing training technology.

4. We must learn to view training as a subsystem. Interdependency abounds in this business. Manpower, personnel, and training requirements depend on hardware requirements and vice versa; training simulator requirements depend on the full training systems designed and vice versa; training depends on selection and classification, selection and classification on training, job design on training, training on job design, job design on supply, supply on job design, etc. An adequate analysis capability depends on an integrated approach to all these components. We need a "capping" technology so that we can at last make these tradeoffs explicit if not optimal. It goes without saying that such a technology is presently absent.

SUMMARY

It can be argued that little in this approach is truly novel. However, the tendency among developers of instructional technology to pursue technological opportunities with little regard for how their products fit within the full spectrum of instructional possibilities has been long noted and frequently lamented. That instructional technologists are not only considering the role their products should play among all instructional possibilities but also beginning to consider instruction itself as just one of several alternatives for increasing systems productivity may come as something of a shock to those long used to the foibles of instructional technologists. In retrospect, however, this trend seems not entirely odd. After all, in the broadest sense 'technology' refers to any systematic treatment. It may be that instructional technologists, despite their prior predilections, are among those best equipped to deal with these larger issues of instruction.

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The Influence of Instructional Technology on Education: Certainties and Possibilities

Christopher Dede
University of Houston/Clear Lake
Houston, Texas

INTRODUCTION

When applied to education, the new information technologies (chips, fiber optics, direct satellite reception, artificial intelligence, videodisk, etc.) are likely to reshape both the delivery systems used to convey instruction and the subject matter of the traditional curriculum. Potential consumers of new educational technologies include very young children, students at every level of formal education, recipients of industrial or professional training, the aged, adults engaged in non-formal learning activities—in short, virtually everyone in the society. Thus, the size, method of operation, and content of education may alter dramatically.

Such a major shift would create numerous educational, social, and ethical consequences: some intended, some not. Research in the field of technology assessments has indicated that the unintended, second-order effects of a technological innovation on society are frequently more influential, long-term, than its direct and deliberate effects. (For example, in many crowded metropolitan areas one can travel by car no faster than by horse—the greater speed of the automobile has been lost through congestion—but automotive pollution and petroleum availability remain as major societal concerns.) Thus, attempting to anticipate all the likely implications of a technological advance may be well worth doing, as seemingly minor changes in the method of implementing a technology may have major long-term consequences, and some technologies may cause such high eventual costs to society that the short-term benefits they offer are not worth acquiring.

Effects of technological innovation can be divided into two categories: outcomes likely regardless of method of implementation, and outcomes highly contingent on the particular implementation strategy. This article will provide brief illustrative lists of both types of effects. The former set of consequences can be used to calculate the overall costs/ benefits of using a given technology; the latter analysis can help to determine the best approach for introducing the technology into educational practice.

Relatively Certain Effects of Instructional Technology

(One cautionary note: future researchers tend to use "short-term" and "long-term" on a more sweeping scale than generally practiced. For the purposes of this discussion, "short-term" will refer to effects within a three to ten year time scale; "long-term" will indicate consequences which may take several decades to appear fully.)

Short-Term Implications

1) a larger proportion of the society will have access to instruction, opening up new markets for schools and increasing the overall literacy of citizens.
2) high initial investments in development and delivery systems will be followed by an overall reduction in the daily operating costs of schooling. This will help to alleviate the funding problems of the labor-intensive education sector.
3) to realize these savings, large numbers of instructional devices must be sold and software for these will have to be centrally produced. This will increase curricular quality overall, but will erode local control, reduce individual teacher initiative, and necessitate rigorous quality control for error and bias. Revision of content or approach as better instructional strategies are evolved will be difficult and expensive.
4) massive changes will be needed in both pre-service and in-service teacher training to enable instructors to do maintenance, programming, diagnosis, evaluation, and remediation using educational technology. The personality types attracted to teaching, the salaries needed to retain high quality personnel, and the intellectual demands of the profession all will change. As many (or more) educational jobs will exist as at present; but a considerable number of these positions will be supported by an expanded clientele for educational services and will be located outside the school system in industries, communities, and the media.

Long-Term Implications

1) "education" (multiple right answer subject matter) will be differentiated from "training" (limited range of right answer subject matter). Education will be done by people in schools (or their future equivalent); training will be delivered by instructional technology in extra-school settings. Most instruction will be a carefully orchestrated mixture with training initially dominating, then education added in ever increasing amounts. The present curriculum may be taught in a

third of the time it takes currently (especially where training is predominant, as in the early primary grades).

2) a new definition of "intelligence" (the cognitive skills we most value) will gradually emerge. Memory and lower order cognitive skills will be increasingly deemphasized; instruction will focus on building proficiency and analysis, synthesis, and evaluation.
3) a higher overall rate of societal change will develop, both in technological innovation and in social invention. A better understanding by citizens of the strengths and weaknesses of technology, continual adult resocialization, and an increasing homogenization of different nations and cultures will be factors which instructional technology contributes to this trend. However, the values of Western Society may remain relatively similar to today—for better or for worse—as educational technology may well be viewed more as a goal-attaining mechanism than as a tool for evolving new values.
4) a fundamentally different mode of teaching/learning will evolve. At minimum, this new paradigm will include:
   - a centralization of curriculum development and financing approaches
   - a decentralization of the learning environment into homes, communities, and industries
   - a decentralization and informalization of the educational experience
   - new types of government regulations to allow educators to interface with public utilities as communications channels
   - a privatization of the educational enterprise, as information technology vendors get involved
   - new types of diagnostic, assessment, and evaluation strategies in response to larger grading pools and altered definitions of learner effectiveness
   - new "machine-coupled" teaching strategies
   - new administrative networks, with the erosion of many middle management positions as increased information transfer becomes possible without intermediary functionaries
   - new types of people attracted to the various educational professions, with different skills and salary requirements and
   - a revolution in the process and content of teacher training/certification

In brief, sweeping changes in roles and relationships will occur for parents, teachers, administrators, industries, publishers, media, and government.

Possible Effects Dependent on Implementation Strategy

A variety of plausible alternative scenarios can be constructed for the emergence of information technology as a major educational tool. One metaphor used by future researchers is to view the future as a "tree."

We stand on the trunk of the tree (the present) looking upward toward the branches (the major likely alternative futures). Each step we take up the trunk toward the branches (each decision we make in the present) chops off a branch (greatly reduces the probability of a cluster of alternative futures). By the time we reach the branches—when the future becomes the present—all the branches are gone but one (the new trunk), and a new set of alternative futures stretches upward.

Who the major actors are in implementing information technologies in education and how these actors interrelate will be crucial determining factors in which alternative future emerges into reality. In the United States, some major potential "players" are the equipment vendors, the media, the textbook publishers, the federal government, the formal educational establishment (teachers, administrators, state school officers), and the individuals knowledgeable in software production (i.e., artificial intelligence experts, television directors). Space does not permit an explication of short-term plausible alternative implementation scenarios, but a few illustrative generalizations can be made about potential effects highly contingent on the implementation strategy which emerges.

Loss of Affect?

One open issue will be the extent to which human interaction is reduced in the learning process. If machines are simply substituted for people without compensatory shifts in the human teaching that remains, personal contact and the affective skills learned through modeling others' behavior will be partially lost. In a world daily growing more impersonal, the retention of large amounts of human interchange in learning seems important, both for socialization purposes and to enhance quality of life.

Some degree of person-to-person interchange can be incorporated into instructional programming if new types of communications skills are developed that allow being person-oriented and affective even when interacting via the computer or television. After all, this is what an adept media personality is able to accomplish; studying these figures may reveal how sociability, social presence, and affect can be incorporated into machine-mediated communication. Certainly, people have adapted to using letters and telephones without completely losing the human touch; training via these new technologies could also become more personal if some thought is given to development.

Even with affectively-oriented programming, however, important amounts of human contact will be lost unless time spent with human instructors is more intensely person-centered in compensation. At present, as the number of students per classroom increases, the human element in teaching is being eroded even without the intrusion of machines. Some of the financial savings derived from technological innovation could be used to reduce class sizes for human instructors. Revision of current teaching practice to take advantage of recent findings in social and humanistic psychology would also allow intensification of personal contact. Such a thrust should be a major component of any technological implementation policy.

Inequities?

A second open issue will be the equity (or inequity) with which the advantages of the instructional technologies are distributed to learners across the nation. In the United States, several decades of work to equalize educational opportunity and (to some extent) educational achievement may be lost if a *laissez faire* approach is adopted to dissemination of these new devices. The aged, the handicapped, the poor, and minority groups all could benefit greatly from access to instructional technology, but do not have the financial resources to compete with the affluent as potential clientele.

Market forces, if the sole criterion for implementation strategy, will dictate that the educational hardware and software produced be designed for the needs of the largest and richest body of consumers: the middle and upper class majority culture. Not only will less fortunate groups lack the capital to invest in purchasing equipment and programs, but also the materials developed may well be directed toward a different cultural background and different educational needs. Two levels of schooling could easily emerge in a society: one geared to students who have instructional technologies available in the home and school, another relying solely on traditional methods of teaching. Given the potential these technologies have for improving the educational process, the latter group of students would be placed in an intrinsically inferior portion.

Moreover, early childhood experience with instructional technology may create an advantage that a deprived individual can never overcome as an adult. Learning computer programming, for example, is somewhat similar to learning a second language: easy when young, far more difficult when older. The disadvantages to society of having a two tier system of education—with its loss of available human potential—would be profound.

On the other hand, if equal access to high quality instructional technologies designed to meet the needs of diverse groups were guaranteed, educational discrimination and inequality in society might be reduced more quickly than at present. As the economic situation of education worsens, poor and minority students are the first to suffer; these technologies could alleviate that problem. Some of the causes of unequal achievement may be related to a small range of teaching strategies trying to service a broad spectrum of learning styles; through individualization, technology could reverse that situation. By extending communication networks across cultures, classes, and generations, instructional technologies could improve the integration of the elderly, minorities, the poor, and the handicapped into society.

A subsidized and organized process of technological implementation will be necessary if equity is to be helped, rather than hindered, by these new devices. Incentives must be provided to manufacturers to produce software for different needs and cultural backgrounds; many schooling systems will require additional funds to purchase equipment and programs; parents will need training to help them maximize their children's benefit from exposure to these machines. For both ethical and economic reasons, society would be wise to invest some resources in improving the training of all its citizens, but the choice to proceed with this type of implementation must be made quickly before *laissez faire* marketing begins.

A Knowledge Coordination Sector?

A third open-ended issue will be whether a knowledge coordination sector is deliberately created as a method for national strategic planning. At present, knowledge is produced and disseminated in most societies in a relatively haphazard manner, with no overall perspective on what types of ideas and skills are needed or how these can best be created in the population. If information is to be the key economic resources of the future, research and development its major means of production, and human capital its ultimate source, then a society would be well advised to attempt maximizing all these factors through some form of central coordination. The information technologies, properly implemented, offer a powerful means for achieving this end.

Such a knowledge coordination sector would have several functions:

- anticipating societal needs for knowledge
- developing in educational institutions the capacity for training appropriate levels of human resources
- assessing the capability of current institutional mechanisms to generate needed knowledge and augmenting this ability where necessary
- organizing the dissemination to citizens of vital knowledge so that it is fully utilized

This type of systematic approach would represent a commitment to education in its broadest sense as a fundamental reconstructive force for society.

The information technologies, once established in a nationwide instructional network, would make such a knowledge coordination sector feasible. The economic advantages—and the general improvement in the quality of life made possible by a more literate citizenry—seem to justify the effort involved in implementing this type of national strategic planning. Should this be a goal of the society, the initial implementation of instructional technology would have to be organized so as to facilitate the formation of this knowledge production and dissemination system.

CONCLUSION

Decisions made today, often without thinking about long-range implications, will be very powerful in shaping our future options. On balance, given the relatively certain effects of implementing instructional technology, how much do we wish to incorporate these devices into education? What changes in the rest of the social structure are needed to maximize the benefits and minimize the negative consequences of such a shift? Are we capable of avoiding the deleterious outcomes discussed above by choosing appropriate approaches to implementation?

The world is facing a period in education comparable to the introduction of the printing press five hundred years ago. In converting to the use of books, people confronted problems similar to those discussed here: a potential loss of the human factor, the necessity for a new educational model; career shifts, massive needs for capital investment, equity issues, etc. Although decades passed before books were used to their full instructional potential, the shift to the printed word for information dissemination ultimately did result in progress, increased learning, and exciting new frontiers for education. Given a comparable opportunity, will we successfully rise to the challenge?

Looking to the Future: What Business Are We In?

Elizabeth L. Young
Public Service Satellite Consortium
Washington, D.C.

INTRODUCTION

As we continue to share our experiences and look toward the future, I suspect that we are all a bit frustrated. Frustrated because we see so clearly how technology can be used to aid in the educational process and yet we also have experienced some barriers to its adoption. We may know what works, but how do we persuade administrators, indeed entire bureaucracies, that mediated instruction can be effective and economical. As we contemplate how to get from where we are today: knowing some of what can be done, to where we want to be: integration of media and technology into the learning process, we may want to step back a moment to focus not only on the specifics of the adoption process but on a prior question: What business are we in?

Why should we ask this question? Let us look at the perceptions about the roles of various institutions in the educational process. Those roles are increasingly overlapping, and it is not easy today to say, "a college or university does this and only this, while a library does something entirely different." There is and will be competition in this "information society." More importantly, there is and will be competition in the arena of imparting knowledge. Focusing on how best to use technology is starting with the wrong end of the telescope. We cannot ask about strategies until we have clearly in mind what goals those strategies support. And the question about specific goals must be preceded by the question I have already introduced: What business are we in?

For example, it is probably not going to be enough in future years to say simply that we are in the business of educating people, because a great many other organizations and institutions are getting into that business, too. Perhaps we want to say we are providing a certain type of education to a certain clientele with specific intended outcomes. The more precise the definition, the better able we are to set precise goals and arrange strategies.

Need for Assessment

At this point I must recall for you the classic business school story about the need to ask the right question. It seems there was a group of bright young scientists who had invented a superlative type of drill. They immediately captured a share of the market, and their drill sold well. But, after a time, their product sales hit a plateau, and they wanted to expand the product line. So, they began asking each other, "what other kinds of drills do people need?" Then, after awhile, they turned the question around and asked, "what kinds of holes do people want?" That was a question that required research, and when their investigation was complete, they began a whole new product line—of tools other than drills—to meet the demand for holes.

We need to assess our environment. We need to review who the "competition" is, what our resources are to accomplish our goals, what our organizational strengths and weaknesses are. Even when we find out what kind of "holes" people want, there are still questions about how to address that need. So, too, there are unanswered questions in the educational marketplace. And we should have no shame about using such terms as "business" and "marketplace." For it we do not run our educational organizations as businesses, asking strategic questions and doing strategic planning, we will surely fail, or at best, succeed by accident.

Let me turn now to an overview of the changing roles of institutions and especially of mediated education.

The Public Service Satellite Consortium, which has over 100 members representing many aspects of the public service community, has recently been concentrating on services to libraries. We have done so because some of our library members, like the American Library Association, have brought us to the understanding that libraries in the future are going to view themselves as broadly based centers for information exchange and mediated learning. Libraries are becoming centers for data exchange, for the production of programs on local cable systems, and they can act as repositories not only of books but of video tapes and cassettes and video discs. Of the more than 4,000 cable systems operating today in this country, most have "local access" channels, and in an increasing number of communities, a local library may serve as the "head end" to program that channel. It is not unreasonable to suppose that within the next twenty years, many libraries will have satellite receiving (and perhaps transmitting) facilities and will be part of an intricate network for the exchange of all kinds of information in all kinds of format, whether data, audio or video. Also, libraries view themselves as community centers and will be encouraging broad use of their materials by a large cross-section of the public. Clearly, then, libraries can become centers for learning.

Museums, too, can serve some of these functions and while currently not as far along in their vision or their planning, they have the potential to interconnect with each other to become "nodes" on the learning network.

Home media centers will also grow rapidily since the cost of technology will be reasonable and the availability of programming will increase. For example, by the year 2000, many homes will be wired for two-way, interactive cable that will deliver not only entertainment and educational programming but such services as home banking and shopping and fire alarm protection. Homes will be interconnected with libraries and other data banks, and the telephone coupled with a display screen will serve as the "computer." If a company called Satellite Television Corporation has its way, many homes will be able to receive programming directly from communications satellites via small roof-top antennas. Several channels of programming will be available and educational programs—some even designed for relatively small, discrete audiences—will be featured. Additionally, most homes will have a video cassette player. The home library of discs and cassettes will include programs borrowed from the library, perhaps from the educational institution, and programs owned by the family. They will be accessed for branched, interactive learning. All this will be in addition to conventional radio, television and print media in use in the home.

Planning Expansion of "Markets"

As educational institutions take stock of these future scenarios, they must begin to plan to expand their markets and offerings. While we should never use technology for its own sake, it can become a tool to reach new learners. Just to focus for a moment on some examples and to mention the technology with which the PSSC deals most regularly, communciation satellites can be accessed by colleges and universities for a number of purposes.

First, by erecting a satellite earth station on your campus, you have access to new services. The PSSC has a number of members, including the American Dietetic Association, the American Library Association, and the American Hospital Association, that frequently arrange satellite transmissions of seminars, teleconferences, continuing professional education and other types of programs. What is usually transmitted via the satellite is one-way television, with interaction made possible by return audio circuits. Such two-way transmissions become cost-effective when they not only replace travel but enable far more people to join in the session or meeting. Your own faculty and students can take advantage of such program offerings. Your administrators can use the ability of the satellite to establish "ad hoc" networks for teleconferencing on a regional or national or even international basis.

But if you can use satellite transmissions on the campus for the benefit of the academic community, you can also begin to envision the satellite earth station as a community resource. Let's take a concrete example. PSSC has coordinated several satellite seminars for the American Dietetic Association in which their intent was to provide briefings for their members all over the country. If your campus acted as the receiving site for the satellite-fed program, dieticians from various parts of your city could come to campus to participate in the interactive telecast. You might want to offer this service in conjunction with your continuing education division. Regardless of how you open the dodor, the satellite earth station in your quadrangle would enable you to extend the campus to the community in a very tangible way.

The third possibility is for your institution to become a provider of services and information. Whether it's legal seminars from your law school or coverage of your winning basketball team's home games, there is probably a market for what your institution has to offer. The best thing about the communications satellite is that it is "distance insensitive." In other words, a satellite has a national coverage area, and it does not cost any more in terms of time or money or energy to send a signal from Minneapolis to Los Angeles than it does from Minneapolis to Madison. If you have a service or a program that can be marketed to a national constituency, you now have the necessary delivery system.

Guiding Prescriptions

Assuming that you have asked and answered the question about what business you would like to be in and that you have assessed the market for your services and the tools available, I would like to suggest several guiding prescriptions for the activities you will undertake.

First, we must speed up the process of media literacy. By this, I mean that we need to be concerned not only that our young people learn how to create with and speak the language of technology but that we learn also. Fear and bias among educators and administrators is chiefly responsible for the lack of innovation with media in education today.

Secondly, we must change the decision-making environment to accommodate new technologies when appropriate. It will not do to reject technology "because we cannot afford it." In at least some instances, we cannot afford not to use it. Those who understand its potential must serve as the "change agents" to bring about adoption. Entrenched bureaucratic decision makers will not take kindly to being told there is a new way to do things—even if that way can ultimately be cost beneficial. Therefore, we must devise persuasive arguments and strategies to get mediated learning off to a good start.

Thirdly, we must become more entrepreneurial as educators. If we know there is an adult, non-traditional audience out there, interested in certain kinds of credit and non-credit courses, it behooves us to find ways to reach that audience. Call it marketing, or service, or outreach, it involves expanding our horizons and our services in a way that will make them self-sustaining as well as useful.

Finally, traditional educational institutions, whether at the elementary/secondary or other levels, must become more interactive with institutions in the community that also offer mediated information and instruction. If the local public library is seeking to reach adult learners, also, find a way to cooperate and enhance efforts. I am not suggesting an acquiescence to competition but rather a healthy attitude of "combine forces" where and when practical.

SUMMARY

As we view our future service and business options, we can only be certain that the future will be dynamic and that there will likely be more variables to consider than even our most comprehensive scenarios suggest. Each time we think we have pushed development and innovation to the limits, we are wrong. But even acknowledging uncertainty, we can take the broad view that the educational institution of today can be more than the nerve center of its own tightly-knit community. It can in the not too distant future be the nerve center (or one of many cooperative nodes on a nerve network) for the world, the world of information, of human interaction, of knowledge transfer. In short, the custodian of the future.