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ABSTRACT

New interactive technologies create new roles for teachers, present opportunities for and barriers to effective instruction, affect student and teacher satisfaction, and demand increased teacher time to learn to use the emerging interactive environments. Faculty development is vital for technical instructors to make effective use of new interactive methods of teaching and learning. It must be noted, however, that technology does not solve all teaching-learning problems, and it may not even be effective in some situations. Teachers are challenged to do the following: (1) become futurists; (2) become action scientists-researchers in the classroom; (3) be resource brokers; (4) be aware of results of research about teaching and teaching style; (5) be supported in their own intellectual work; (6) be encouraged to develop leadership; and (7) do evaluative and applied research. Barriers to the use of interactive technology in instruction include lack of access, inconvenient scheduling, unsupportive attitudes, and lack of time to integrate technology into the curriculum. Teachers presently teaching may not be familiar with computer uses; as they retire, new teachers will be recruited who will be more technologically involved and able to use new teaching methodologies. Southeastern Regional Vocational-Technical High School in Massachusetts is an example of a school that has restructured to change the process of instruction to take advantage of new teaching technology and theories. The latest technology is used to teach students in the various vocational programs at the school. Interactive learning environments of the future will use technology as a tool for delivering the curriculum in a learning environment that will reflect the diversity of the learners and the changes in society. Innovations include virtual field trips, learner-controlled classrooms, and use of Internet services. (Contains 21 references.) (KC)

Preparing Technical Educators for Interactive Instructional Technologies: A Review of Research and Practice

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by

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New roles for teachers and trainers resulting from interactive delivery alternatives

Success with interactive technologies depends upon an understanding of the following four factors: a) new roles for teachers, b) barriers to effective instruction, c) student/teacher satisfaction, and d) emerging interactive environments.

One of the most significant problems faculty have had to overcome in adopting these technologies is the heavy demand for professional development - not only for full-time faculty but for legions of part-time faculty as well. Employing technology effectively means faculty development.

In planning for and implementing faculty development strategies, we have come to rely on providing inservice which addresses the following four sub-thrusts: 1) interactive technology creates new roles for faculty; 2) interactive technology contains inherent barriers which can be overcome; 3) interactive technology can be an extremely satisfying experience for both faculty and learners, and 4) interactive technology results in a fundamental alteration of the traditional teaching and learning environment.

Our task is to summarize research and practice in the area of new roles for technical faculty arising from the use of interactive technology. Toward the end our session, we will

also attempt to enumerate the most significant challenges we face.

Historically, teachers have been considered content experts, knowledge disseminators, or classroom managers/controllers. But with the advent of instructional technology, these traditional keystones have begun to crumble.

Among the most significant outcomes of current era research is that no single technique or technology can address the needs or learning styles of all learners... compressed video will not do it alone - See you/See me technology will not do it alone - interactive discs and/or hyper-text(s) will not do it alone. At best, most instructional technologies augment but do not replace teacher/learner interaction.

Effective teaching practices

What are the most effective teaching practices emerging from current research when employing technology?

The first is both a caution and an opportunity. Action research designed to measure the effects of interactive technology points out the pitfall of assuming that employing technology results in increased learning over the long-term. It is clear that moderate to significant "wow" factors may result in early learning gains simply because the new technology is "fun" or "leading edge." Continuing and longitudinal research are needed to support the long-term effects of technological interventions.

The opportunity here is for faculty to become action researchers themselves. By establishing learning measures and pilot research projects to assess the effects of instructional technology, faculty themselves can monitor appropriate points at which to provide alternative interventions. Remember - no single technique or technology can address the needs or

learning styles of all learners.

A second effective teaching practice when employing technology is the application of adult learning principles to interactive learners - particularly at a distance. Perhaps the most important element here emerging from effective practice is the need for clear organization and expectations. Adults respond negatively to technology which is unclear and/or perceived to be unrelated to the task at hand. An overview session plus time each session devoted to clarifying the connection between the technology and the desired learning outcomes are critical.

Other effective teaching practices when employing technology include: modeling effective practices employed by a mentor in the use of the technology, and exploring new faculty roles in futuring, classroom research, learning assessment, and leadership.

There are a number of new roles emerging for technical faculty when employing interactive instructional technologies. These new roles include faculty as futurists, outcomes assessors, resources, breakers, teaching and learning styles specialists, proactive learners, and missionary leaders.

Seven Challenges

If these newer roles for technical educators are, at least in part, a result of our increasing use of technologies, and if we are committed to the development and renewal of our faculty at least as strongly as we are to adapting still newer technologies, then we must be willing to respond to the following seven challenges:

First, we must explore methods by which we can make futurists of ourselves and of our learners. This is not to be confused with "crystal ball gazing" - rather, it is the ability to

employ effective techniques which result in a clearer picture of the critical focus and trends which will have an impact upon the workforce and the workplace of the future. Such techniques as environmental scanning, focus groups, alternative scenario drafting and the Delphi process are but a few of such strategies leading to a clearer perception of what skills and which technologies will be most appropriate.

Second, we must encourage ourselves and our colleagues to become action scientists - researchers in the classroom. We must explore techniques and inservice opportunities to allow for and provide for faculty to "test" the efficiency of their instructional efforts. To devise research strategies to help explain the variance in learning outcomes can only provide much needed support for continuing human and fiscal investment in interactive technologies.

Third, we must make of our teachers "resource brokers." Rather than support the notion that there exists one "best way" or one "best instructional practice," we must encourage faculty to explore and become knowledgeable about the various instructional delivery alternatives available to them and to their learners. As technology continues its rapid ascendence, teachers not knowledgeable about which techniques are most appropriate for which learners or for which outcomes will have failed their students, the students' future employers and, most importantly, they will have failed themselves.

Fourth, technical faculty must become more aware of the results of research regarding teaching and learning styles. Clearly, the more self-directed instructional technologies (video-disc & hypertext, e.g.) are tremendously effective - but only for learners who are less field dependent and who are characterized by sufficient initiative. Matching preferred learning styles to preferred teaching styles remains elusive - if not unrealistic. Yet to assert that

addressing learning style distinctions is unproductive is to negate the power of much of the emerging technology.

Fifth, technical faculty must be supported to nurture their own muse. Faculty need to be purposive - proactive learners themselves before they can hope to inspire such characteristics in their students. Are there systematic ways and times by which faculty can "renew" their expertise and their spirit? Dispirited and out-dated faculty consistently fail to deliver on the promise of interactive technology.

A sixth challenge for our technical faculty involves leadership - if we aren't prepared to develop leadership behaviors in our faculty (to include visioning, collaboration, participation and rigorous regard for educational standards), then how are we to sustain hope that with the on-rush of the coming technological age, our learners will be prepared?

Finally, where is the applied research validating our teaching and learning strategies? If, as indicated by our examples of exemplary practice, such role elements as "learning outcomes assessment," "learning styles specialists," "resource brokers," and "teachers as leaders" are to be validated, where is such applied research happening? Where is it being conducted, where are the results being posted, and how are faculty being encouraged to apply the results?

Are these challenges to the effective use of interval time technology too overwhelming? Will we fail to recognize and address the new faculty roles created by technology?

If so, then the promise of interactive instructional technology is doomed to failure. To paraphrase: if we don't know where we are going or how we are going to get there, then

how will we know we have arrived?

Barriers to the Delivery of Instruction Via Interactive Technology

Our world is changing and changing ever so rapidly! In the 1950s, only a handful of scientists and mathematicians used computers and, in the late 1970s, approximately 50,000 computers existed in the world. Today, approximately 50,000 computers are built every day. In today's world, technology goes beyond computers to include all areas of on-line communications, multimedia, and telecommunications, with possibilities for technology seemingly endless.

Technology within schools is receiving much attention and, since the integration of technology and education is relatively new, effective strategic planning is only beginning to emerge. Relatively few of the nation's 2.8 million teachers use technology in their teaching, despite over a decade of investment in educational hardware and software (Office of Technology Assessment, 1995). It is, therefore the intent of this study to investigate some of the barriers as well as strategies to overcome these barriers with regard to teachers and technology used in today's global society.

Question of Access

A prerequisite for effective teacher use of technology is access. Schools, over the past several years, have made substantial investments in hardware and software much of which is now outdated. It was projected that by the Spring of 1995, 5.8 million computers will be available for use in U.S. schools. Unfortunately, about half of these computers are old 8 bit machines which cannot support CD-ROM-sized data bases, networked integrated systems, or run complex software. The most rapid growth of technology in schools has been

in CD-ROMs, video discs, modems, and LANs which require newer 16 or 32 bit machines. According to the Office of Technology Assessment, the most common technology used for instruction in most schools today is video which includes direct broadcast, cable, satellite, or videotaped programming. The reason video technology remains popular is due to it's ease of use within the school.

Regardless of dollars spent, student/computer ratios, or the amount of technology equipment available, it is the access students and teachers have to technology that is most important. The placement and flexibility of technology directly affects the amount of use by both teachers and students as well as the amount of time students and teachers spend to explore this technology.

Support and Training

Many schools limit the effective use of technology by teachers because of inconvenient scheduling, attitude toward the use of technology, and a lack of time to fully implement technology into the curriculum. Teachers usually have little in the way of support or training available for technology within their school setting and must seek training on their own. Schools spend much more on hardware (55%) and software (30%) th· 'hey do on training (15%), and less than half of american schools report that introductory computer courses are available for teachers (Office of Technology Assessment, 1995)). It is not just the availability of training but the type of training that is available to teachers that is important. Much of today's training tends to focus on the mechanics of operating the machinery and little about integrating technology into a specific subject area or program.

According to the Office of Technology Assessment, "Probably the greatest barrier to

technology use, however, is simply lack of teacher time." This could include time to attend workshops or training sessions, experiment with software, talk to other teachers about what they are doing, or prepare lessons using new technological materials or methods. Most teachers are given little compensated development time and there are many demands on this time. Unless there are significant changes allowing teachers more time to learn and experiment with new technologies, this barrier to technology will remain immense.

Issues Created by Technology Itself

As the possibilities for widespread information networks emerge and their use by teachers and students increases, other issues start coming to light that may affect how teachers and students use technology. Some of these issues include privacy of student records, censorship of objectionable materials versus access to potentially valuable information, copyright, and intellectual property issues. One of the most widespread and promising uses of telecommunications technology by the teacher is the retrieval of information from remote resources including networked information, books, journals, data bases, software, and multimedia. As students and teachers use these resources for projects, share them with colleagues, or store them in portfolios, issues related to the fair use of copyrighted material and copyright protection are raised.

Conclusions

To bring about technological changes within the school or school system, one must remember teachers are an incredibly diverse group. Some teachers have a solid background in technology while others have never even used current technology that is available to them. It is becoming more common for teachers to have access to computers and, while some are

eager to experiment even at the risk of failure, others have little or no interest or time for experimentation with technology. Most of the 2 8 million teachers in the United States attended school before computers were commonly used within the classroom. Statistics show the median age of teachers in the U.S. is 42 with 15 years of teaching experience, so the majority of teachers were never exposed to computers as students. It is estimated 3.3 million teachers will be needed by 2003 and, with many of today's teachers retiring, it will be a formidable task to provide teachers with the skills and knowledge necessary for tomorrow's technology.

Policy makers will have to support teachers who realize a vision for schools where teachers effectively identify, enlist, and use electronic and communications technology to improve learning. If learners are to make to most of educational technologies, support must be given to teachers who guide and encourage the use of technology within their classrooms and program areas. The use of effective technology in classrooms needs to be shared, evaluated, and built upon. The challenge for schools and school districts over the next decade is to lead by example and commitment.

Student/Teacher Satisfaction with Interactive Instructional Technologies

Recent concerns in how to professionally update teaching methodologies using learning technologies and interactive teaching strategies are catching the country by surprise. Surprise indirectly associated with the technology and the speed in which the technology methods are being developed seem staggering. An alarming number of young Americans are ill-equipped to work in, contribute to, profit from and enjoy our ever-growing technological society (Brooks, 1993). Students are exiting our elementary and secondary schools with

inadequate preparation in math, communication, science and technology. One concept we as teachers, as educators, have to consider is this trend to utilize the new methodologies surrounding educational technology. If CORE curriculum components stressed as the backbone of educational reform as we approach the year 2000 are to successfully learned, it is clear that our teachers need to be of high talent, high motivation and must be allowed to function in a setting in which effective teaching is possible. Top priority must be placed on retiring present teachers and recruiting new teachers who are and will be the technological educators of our students.

There is a complete paradigm shift occurring in America - old teaching methods are no longer working effectively and standardized testing results and countless student observations bare this out. Most students are focused on understanding "info-bytes" or small portions of useful information. Society and family lifestyles support this behavior shift, for no longer do we focus large amounts of time on recycled information. We have indeed created a "throw away" society where information is used for a specific purpose and then discarded. Teachers can no longer lecture on topics that are antiquated and from curriculum contexts that have not been updated in a decade. Teachers can no longer teach using the methodologies of the past - they must be effective facilitators using themes and concepts to introduce problem-solving and critical thinking skills to their students. Students have to be exposed to these elements within the paradigm shift in education for the same kinds of changes are occurring in the world of work. Along with the philosophical change in teacher delivery systems, there has to be a long-range strategy to develop sound principals in using technology (such as the computer) as a tool, a medium, to deliver the lesson or lessons.

Effective teaching mirrors effective learning, yet as educators we have not mounted a serious effort to organize teaching around the learning process. Instead, we have viewed education as an institution or an administrative system or set of instructional techniques. The ultimate act of restructuring is to change the process of instruction and its related acts (planning, curriculum design, and assessment) so they reflect best of what we know about learning. Southeastern has taken steps to do this and absorb maximum output from students who are going through the restructured educational pattern that has been greatly altered by the Education Reform Act of 1993 (Antonucci, 1993).

Background

Southeastern Regional Vocational-Technical High School, located in South Easton, Massachusetts. The school is regionalized and an administrative district. Students are recruited from eight surrounding towns and the city of Brockton. Students at Southeastern Regional Vocational-Technical High School graduate with a diploma from the Department of Education, Commonwealth of Massachusetts, and a competency-based trade certificate. The school serves a student population of some 1,300 students who come from multi-cultural backgrounds as well as various socio-economic communities ranging from high to low income and high to low crime influence.

Nature of Problem

Since the enactment of the Education Reform Act of 1993, education systems statewide have gone through dramatic change as these systems set up timelines to implement new forms of how students will be educated and prepared more vigorously for a very competitive worldwide economy.

There are several fundamental changes that are transforming both the job market and American society as a whole. One is the massive growth of technology, an economic and social force whose impact we have only begun to feel. Technology is now creating hundreds of new jobs; at the same time, it is rendering many existing careers obsolete and raising the educational level required for many traditional forms of employment; already, an estimated 73% of jobs require at lease some information processing skills. Thus, the technical workforce has become the fastest growing job sector by far. According to Cetron and Gayle (1991), the demand for technical workers is expected to grow at least twice as fast as that for other fields.

Target Generic Skills and Attitudes

Teaching faculty at Southeastern Regional Vocational-Technical High School has become very well read and prepared as a result of well-planned and carried out professional development activities. The activities included human resource development strategies which lead to teacher empowerment. Teacher empowerment lead to the creation of design teams whose purpose was to isolate "bugs" in the system and design strategies to correct the problems in an efficient manner. All teaching faculty recognized the need to establish instructional goals that would allow them to better serve their students while going through lasting change in the school's reform movement. The teachers had a mix of instructional goals that included logic and reasoning skills, cooperative skills, and work-related activities. Teachers planned to instill positive work-related attitudes in their students by acting as role models and stressing self-esteem building activities throughout classroom performances. These activities varied by class but included students taking ownership in their own learning

and daily performance. Work was more personalized or customized so that the student could find the lessons more interesting and rewarding. An element of cooperative learning was introduced to increase the students' responsibility for learning by holding the student accountable for group participation and requiring the student to assist in helping others learn.

Uses of Interactive Technology

Most secondary schools in our area of the state rely primarily on computers as their specific source of technology training. All students in the state are required to be computer literate and have a knowledge of programs. That is as far as most public schools go with regard to technology training. Some private schools are better focused on software packages that provide simulation training or program infusion for supplement to what is occurring in the classroom. There is relatively little movement into interactive components of teaching and learning. Most involvement is surface value at last.

Several possible reasons could explain this phenomenon. Namely, funding for interactive technology is minimal in most school systems. Budgets do not address the specific need to "tool up" the classrooms. Reform has been costly and dollars go elsewhere - keeping systems running and institutions alive takes the "lion's share". Another reason we don't see a lot of reform to technically update is the lack of well-trained faculty who can foster the need for this lasting change. Programs for training the trainer do not exist. Southeastern Regional Vocational-Technical High School is considered among the lucky because we have been able to financially plan to include interactive technology into our system until every program and teacher is equipped to deal with the demands of classrooms

of the future. The school has utilized talents and expertise from within and has researched product lines from many vendors to assembly a system that will grow with our needs as we grow and advance into the 21st century.

Best Practices by Program

The Graphic Communications program is a very busy lab with state-of-the-art tooling that comparable with today's industry in graphics. Students learn simulation through Prepress2 System. Set-ups are generated by the instructor in Quadra 700 and students use power Macs to set print and layout design. A display on 21" radius monitors allow for clear interpretation of the print. Tektronix color printer, QMS tabloid printer and AGFA Imagesetter produce quality print to industry standards. Some of the students' work is displayed direct to film or direct to printing plate output. Software used in the program are state-of-the-art and include Adobe Photo Shop, Adobe Illustrator, Corel Clip Art CD, Kodak Photo CD. The CD output can be viewed by students on 27" JVC monitor as well as LCD overhead panels and a 4000 Lumen overhead. Students in Building Trades receive CAD before they enter grade 11. This CAD program works off Dell Pentium Stations 27" monitor/VCR, HP plotters and HP deskjet 2000. Each student learns the Autocad and Visual Cad software packages and designs their "dream home".

The Computerized Office Technology program uses the learning package designed by South-Western Publishing Company. All computers are IBM and networked through the Novell systems. Students work dependently and independently of the teacher in a variety of settings; medical, legal, general. Once the student is checked off on their competencies they intern in a regular office setting to get a sense of regular office practices and utilize the

technology they have been exposed to.

Students in Health Services programs are exposed to a program series from Delmar. CD-Rom medical terminology brings up the latest vocabulary and definitions and uses them in actual "live-work" scenarios that students are more apt to identify with and remember longer. There are several dolls (male/female) from Health EDCO that have interchangeable hyper cards that allow for simulations of illness and irritability. The infant dolls are robotic and move and make noises as if it were a real baby. Students enjoy working through this phase of training because of the "real-ness" they are exposed to in the clinical setting of their training.

Science labs utilize the programs of several vendors: Optical Data Corporation puts out Living Textbook Laserdiscs for life sciences and physical sciences. During the course of a classroom or lab activity the teacher simply points (using an infrared printer) to a section of the text and a laser disc program highlights the process. Video Labs provides the instructor with a Flexcam camera and a microscope adapter for interactive TV lab application. Students literally get a microscopic view of elements being studied in the life and physical science curriculum. Besides these programs the school also has the services of a contemporary audio-visual department that can augment any curriculum. Resources such as Varitronics

Poster Printer Plus with poster lynx (IBM), Video Toaster workstation, Elmo EV-368 Visual Presenter and LCD Projector XV-PIOV give teachers added dimension to preparing and presenting a stimulating array of lessons that provoke students into learning and understanding the multi-faceted learning and training tools brought about by advanced

technology. As we approach the 21st century it is indeed time to trade our old education model for total integration of work and learning. We are at a point where we need to totally rethink the basic scheme, the basic purpose, the basic paradigm of our schooling process in this country (Hoerner, 1995).

Conclusion

Fundamental learning of core curriculum components are indeed taking place in the classrooms at Southeastern Regional Vocational-Technical High School, but there is a heightened awareness for the elements of a technological society in these classrooms as well. Students and teachers communicating through several mediums that assist in the sharing and the manipulation of the learning process. Teachers who have become facilitators and students fine-tuned apprentices ready to accept the challenges of what they study in a rapidly changing society. Both are learning the immediacy of interactive technology as it is occurring. Classrooms that are no longer boring or mundane but active through electronic resources have become the centerpiece for the restructuring movement at Southeastern Regional Vocational-Technical High School. Faculty and students involved in interactive technology training are excited by the prospects. Those who sit on the edge get closer and closer to the process. Professional development, cooperative teaching and train the trainer strategies will eventually get everyone on board. This institution has indeed turned the corner as we advance our system to meet the demands of generating a well-educated, technically skilled and flexible individual able to compete moderately well in a global economy.

Emerging Interactive Environments for Teaching and Learning

A review of the literature on emerging interactive environments provided over three hundred records of information; over half of these listings have occurred in the last five years, and nearly all of them during the past fifteen years. Technology has been used in secondary schools and colleges for about a decade and a half; and after the first few years of fascination, the emphasis has now shifted to how this tool can become a vehicle for delivering the curriculum. As with any new tool, teachers have had to learn how to use it (Siegel, 1995). The move has been from "nuts and bolts" training to a format that emphasizes how to apply the technology effectively. Dockertman (1995) recently suggested that it is not just how many computers a school has or how much time students spend in front of them that should be considered; but rather, whether or not the technology causes dialogue in students' minds and encourages students to think, to discuss issues, and to find solutions to real problems.

For this kind of learning to occur, the environment must be carefully created. In the early 1970's Malcolm Knowles (1970) talked about the importance of the learning climate and cautioned educators to be aware of its affect on learning. Hiemstra (1991), some twenty years later, reported that educators need to address psychological, social, and cultural awareness as important factors in developing learning environments that promote learner growth and development. Nowhere is this concept more important than when educators begin developing interactive learning environments.

The really effective learning environment will reflect the diversity of the learners; be aware of the context in which the learners live and work; and whenever possible, reflect

societal changes as they occur (Tisdell, 1995). This will be evident in the selection of methods and materials that match the differentia of each learner group.

Design

There are many considerations in developing interactive learning environments that must be carefully evaluated. Collins (1995) notes that the decisions on design of interactive environments must balance cost and benefits, always striving for maximum benefits at minimum cost. Authenticity is another major consideration.

Authenticity allows students to perform complex tasks that occur in the real world. In today's workplaces, by the time employees completely understand a problem, conditions have already changed (Deim, 1994; O'Neil, 1995). In an interactive classroom students learn to make decisions with partial information, logical thinking, and sometimes unclear objectives. Authenticity allows these learners to see application of this process to problem-solving in the real world.

Another example of authenticity is the virtual field trip (McLellan, 1994). Students go into a virtual "real" world and identify concepts they have learned in the classroom. The virtual field trip is more cost effective in terms of time and money, as well as a safer means of travel. Rensselaer Polytechnic Institute and AT & T have created an interactive distance learning prototype that allows students to learn in virtual environments through this type of computer teleconferencing (Wilson & Mosher, 1994). Duke University has taken authenticity one step further by creating a paperless, wireless classroom using laptop computers (Stetten & Guthrie, 1995). Students literally take their interactive environment with them wherever they go, creating and re-creating it throughout the community that they

are a part of.

Teaching with authenticity is often difficult. The teacher must become the facilitator, and emphasis changes from knowing to learning. Participants share equally in the learning process. In the interactive environment, the teacher is not the "Sage on the Stage," but is the "Guide on the Side." As teaching styles change, so too does consideration for learning styles.

The Classrooms

The interactive classroom is a learner-controlled environment. The type of learning that is to take place will influence the design of multimedia-based instruction (Schwier, 1993). Chris Dede (O'Neil,1995) reminded us that some students are learning from lectures everyday and enjoying it. Educators should not shut down this process entirely just because technology is available. Technology can be used to extend the lectures and provide individualization, breadth, and depth never before possible.

Laszlo and Castro (1995) pointed out that students no longer need to function as "human databases or robots." Instead they seek to adapt to a continuous assortment of daily occurrences in the world. The fundamental issue is to develop a significant kinship between the learner and the environment. And further, Brenda Litchfield (1993) reminded us that because there are so many learner choices, programs can be problems or solutions to problems for individual learners. Learner abilities also range from the extremes of low achieving dependent students to highly motivated, productive, independent learners. We must create environments that teach learners how to learn. Learners are working on a new set of skills: navigational, representational, and referential (Laszlo & Castro, 1995).

Communication is critical to selecting appropriate methodology for each student.

In the interactive learning environment, the learner can proceed as far as skill and ability will allow. When the learner encounters gaps in knowledge necessary to move forward, new skills can be learned, with the computer providing immediate feedback. There are no wrong answers in the interactive environment, just some that are more useful than others in different circumstances.

The facilitator would collaborate with each student to devise a plan of learning. This plan would also include development of interpersonal skills, self confidence, and self-control, resulting in truly individualized learning.

The physical design of the interactive environment varies, with at least three different choices and combinations of the three available to schools for connections with other environments. These include: traditional phone lines, cable television lines, and computer companies' on-line service to the Internet. Wireless technology seems to have appeal to other groups of users, as well. Interactive classrooms typically have computers, telephones, fax machines, and modems (for connection to the Internet). Some operate through networks. New peripherals include CD-ROM, video cameras, sound systems, and quick-take cameras. The array of software is seemingly endless. Whatever the design, the technology should be as transparent as possible "so as to minimally intrude upon the user's consciousness of the information it mediates" (Laszlo & Castro, 1995).

Staff Development

Interactive classrooms should provide for all participants in the learning environment. Some of the most successful programs (such as North Aurora, Illinois; New Orleans Public

Schools, Louisiana; Newport, Rhode Island; and Concord, North Carolina) focused early in the implementation process on teacher needs. Identifying early on the key leaders in the technology movement has been important in individual schools, such as at the Salisbury High School of Advanced Technology. Here, as well as in many schools where technical assistance is centralized, and the wait for answers to technical questions can be long and frustrating, teachers turn to fellow teachers first and most often when they encounter difficulty with the technology.

North Carolina has launched a unique staff development activity called the North Carolina Teacher Academy. In the second phase of this state-wide initiative to provide teachers with the tools that they need to be effective educators, emphasis will focus in one array on technology. Teacher Academy is a concept of "teachers teaching teachers," and the technology piece will feature school teams of two or three teachers, at least one of which will be a "pro" and one will be a "novice." Instruction will take place over the course of a week, in a residential setting on a college campus, with all expenses paid, and the highest professional atmosphere maintained.

Barriers

In reality, the Office of Technology Assessment (1995) reports that in a only a small number of schools, students are using technology extensively. Teachers in these schools are enhancing their lessons with on-line resources; communicating with parents, central office administrators, and colleagues; calculating and reporting grades easily and accurately; and, in general, working smarter instead of harder. These examples are the exceptions, rather than the rule, however. The Office of Technology Assessment found that the use of a VCR and

video tapes was the extent of advanced technology in most schools.

In addition to cost for wiring, equipping, and maintaining equipment, the greatest barrier to expanding the interactive classroom appears to be time. Teachers need time to experiment with the technology, learn its capabilities, discuss the possibilities with colleagues and time to create a vision for the use of technology in individual classrooms (O'Neil, 1995).

With new and emerging interactive environments increasing continuously, Clifford Stoll, author of Silicon Snake Oil (1995), reminds us that participants may spend so much time accessing technology and operating in their virtual world that they do nothing in and for their real world. They could live virtual lives; and the social structure, which depends on interaction and voluntary contributions itself, will suffer.

Conclusion

The school will become the arena in which learners will develop the social side of their lives. Group interaction and opportunities to apply learning beyond the classroom walls will provide exercise in values such as honesty, respect, and cooperation. Educators are poised to take advantage of interactive learning environments. We must continue to learn how to learn and address new ways of thinking, as these will be the building materials of the future educational process.

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