DOCUMENT RESUME

ED 367 659 SP 035 117

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TITLE Using Instructional Technologies in the Preparation of Teachers for the 21st Century.
PUB DATE Mar 93
NOTE 12p.; Paper presented at the National Conference on Creating the Quality School (2nd, Oklahoma City, OK, March 25-27, 1993).
PUB TYPE Speeches/Conference Papers (150) -- Viewpoints (Opinion/Position Papers, Essays, etc.) (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Beginning Teachers; Computer Uses in Education; *Educational Technology; *Electronic Classrooms; Elementary Secondary Education; Higher Education; Multimedia Instruction; *Preservice Teacher Education; *Rural Schools; Teacher Education; *Teaching Methods; *Technological Literacy

ABSTRACT

New teachers entering classrooms must have training and skills to merge today's technologies into learning activities and strategies that will stimulate and maintain student interest. Colleges of education must provide modeling of new and advanced technologies by professors and "hands-on" opportunities for students to become skilled in using technological hardware and software. Suggested elements of a successful teacher preparation program are: (1) an electronic classroom in which the professor can control from one central podium a computer-driven interactive communication system to create, store, transmit, and retrieve textual, graphic, audio, and video information or, should the cost of such a classroom be prohibitive, portable teaching and learning stations on roll carts, which may include a computer, videotape player, videodisc player, video projector or LCD viewer, CD-ROM drive, SyQuest drive, etc.; (2) a multimedia development and production laboratory for faculty and students to gain "hands-on" experience; (3) a distance learning center that incorporates telecommunications to bring instruction to remote locations; and (4) a program to design, plan, and locally produce instructional video segments. (LL)

USING INSTRUCTIONAL TECHNOLOGIES IN THE PREPARATION OF TEACHERS FOR THE 21ST CENTURY

Paper presented at
The 2nd National Conference on Creating the Quality School

Oklahoma City, Oklahoma
March 25 - 27, 1993

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"Traditional" Education Under Attack

Never before in American history have educators been under greater pressure by politicians and citizen groups to improve the preparation of teachers and the performance of students in our public schools. Change seems to be the order of the day. Increasingly school leaders see technology as a vital part of that change. Telecommunications and multimedia applications are at the forefront, linking students across the country and around the globe to offer them an exciting and instructional melding of text, sound and moving images.

New teachers entering classrooms in the mid-1990's and beyond must have training and skill to merge today's technologies (audio, video, computer, telecommunications, distance learning, and multimedia) into learning activities/strategies that will stimulate and maintain student interest, and at the same time prepare young people for the world they will live in. And, the need for teachers skilled in the use and application of educational technology is typically even greater in rural schools than for teachers in metropolitan or suburban schools. Due to factors of geographical isolation and distance, rural teachers and administrators must be adept in using telecommunications and distance learning technologies to broaden curriculum opportunities for students. (Barker, 1991; Cole, 1991; Forbes, 1990; Lewis, 1992). It is also important that they know how to use computer networks and bulletin boards in order to communicate with professional colleagues outside the confines of their local district.

An appropriate metaphor to describe the traditional public school classroom is to characterize it as following a 2x4x6 model -- that is, instruction is focused on the content contained within 2 covers of a textbook, taught within 4 walls of a classroom, separated by 6 evenly spaced instructional periods. According to the United States Office of Technology Assessment, typical school classrooms have changed little in either function or design over the past 50 years (OTA, 1988). As they always have, most teachers still stand in front of students, next to a chalkboard, chalk in hand as they lecture to the class. And, as they always have, a few students

take notes; others look out the window or stare randomly about the room. With integration of computer and electronic technologies into schools, the traditional classroom is facing its greatest challenge since the introduction of the chalkboard in the mid-19th century (Wilson, 1993).

Impact of Technology on Society and Schools

Present and advancing technologies are changing the way we learn, and of necessity, they will change the way we teach if educators hope to maintain the interest and attention level of students. Today's society, and youth in general, are highly visual. As an example, present cable TV services to residential homes offer, on the average, between 30 to 40 channels. Some larger metropolitan areas have as high as 150 channels (Thornburg, 1992). Telecommunications Incorporated (TCI), the nation's largest cable TV system, recently announced that in 1994 it will begin to use digital compression technology which may result in as many as 500 viewing channels to individual homes. In such a setting, a viewer spending just 5 seconds scanning through each channel to "see what is on" would need almost 42 minutes before viewing all 500 channels (Telecommunications Revolution comes Front and Center, 1992). It is little wonder some behavioral scientists claim that many of today's youth, upon graduation from high school, will have spent more time in front of a television screen than in an elementary and secondary classroom.

The exponential developments occurring in the information revolution are other examples impacting teaching and learning. The information revolution began shortly after invention of the electronic computer in 1946 coupled with developments in communications technologies. Computers of the 1950's cost millions of dollars, required large teams of operators, filled entire office suites, and still remained cumbersome to operate. In the past three decades, computers have grown in efficiency more than a millionfold and are affordable to most middle income families. Along with video cassette recorders/players, they are the most sought after technology in American schools (Hayes, 1986; OTA, 1988). Advances in telecommunications (satellite technology, fiber optics, and compression) have also increased in efficiency a millionfold. Today, AT&T is able to transmit data between Chicago and the East Coast at the rate of 6.6 gigabits per second (the

equivalent of 1000 books). At this rate, the entire Library of Congress could be transmitted in just 24 hours. By contrast, using conventional copper wire and a 2400 baud modem, the same task would require almost 2000 years (Wriston, 1992).

Perhaps the single most powerful technology that has impacted our global society has been the satellite. Satellites were unknown prior to Sputnik, yet now bind the world in an electronic infrastructure that conveys news, data, voice, and video signals anywhere on the planet at the speed of light. Geosynchronous orbiting satellites have made it impossible for political boundaries to block the flow of information from outside sources (Wriston, 1992).

Beginning in 1985 with the start-up of the TI-IN Network in Texas and the Arts and Sciences Teleconferences System in Oklahoma, satellite technology has also been the driving force behind the U.S. Department of Education's $100 million Star Schools initiative and the increasing interest in and acceptance of distance education as a viable alternative for delivering instruction (Barker, 1992). Between 1988 and 1992, the acquisition of satellite dishes in schools nationwide increased by more than 225 percent (Update: The Latest Technology Trends in Schools, 1993).

The Challenge to Prepare a Technology Literate Teaching Force

Modern technology must be incorporated extensively in public schools. To maintain the status quo or to do otherwise will risk the relevance of schools in the lives of today's young people. Colleges of education face the challenge of preparing a cadre of teachers who know how to operate present day technologies and are able to integrate them in teaching/learning settings. Equally important, teachers of the future must not feel intimidated or afraid to train themselves to use new technologies as they are developed. To properly prepare teachers for the future, colleges of education must incorporate current and advancing technologies as significant experiences for each education major enrolled. This means that prospective teachers must:

- see and experience the proper use of technology in an instructional context, modeled by professors who know how to use the latest innovations (hardware and software);
- be provided with "hands-on" experience themselves to use these technologies in order to develop skill and confidence for future application with their own students.

Accordingly, in developing plans for technology implementation, colleges of education should emphasize (1) modeling of new and advanced technologies in an educational context that provides prospective teachers with positive examples of how to teach specific concepts and ideas using technology as a tool; and (2) ample "hands-on" opportunities for students to become skilled in using technological hardware and software. In each case, it should be reme bered that technology is merely a tool for teaching/learning -- it is not nor should not become the curriculum.

Essential Components for Integrating Technology in Teacher Education

If colleges of education accept the challenge to prepare teachers who are highly skilled in the use of instructional technologies, the following elements of a successful teacher preparation program are suggested:

- An electronic classroom
- Portable technology teaching/learning stations
- A multimedia development/production laboratory
- A distance learning center or program
- An instructional video program

An Electronic Classroom

In very general terms, an electronic classroom is a high-tech teaching facility in which the professor can control from one central lectern/podium a computer-driven interactive communication system which can create, store, transmit, and retrieve textual, graphic, audio, and video clusters of information to be delivered to students. The professor has available at his/her fingertips the means to access an array of multimedia images and telecommunications devices to provide learners with multisensory and interactive learning experiences (Dyer, Ringstaff, Sandholtz, 1991; Fawson and VanUitert, 1990; Hassan and Harris, 1992; Watkins, 1991).

In an electronic classroom environment, the instructor uses a video projector instead of a chalkboard, an easy-to-load VHS videotape player or videodisc instead of a 16 mm film projector, a microcomputer and large image video projector to present colorful visuals instead of using 35mm slides and overhead transparencies, and distance learning programs via satellite or fiber optics instead of physically bringing a guest speaker into the classroom (Jaffari, 1990).

New construction of electronic classrooms or refurbishing of an existing room to upgrade it to a technologically rich teaching/learning environment is a recent thrust among progressive educational technologists (Phillipo, 1992; Hassan and Harris, 1992). Equipping an existing room with a video projection system, a computer(s), CD-Rom drive, videodisc player, videotape player, connecting to Internet, etc., can range (depending on extent of items purchased and services provided) anywhere from $50,000 to over $100,000. A new building can cost millions (Wilson, 1993).

An electronic classroom serves as a demonstration facility, showing students how technology is integrated in a teaching/learning environment. Preservice students are exposed to state-of-the-art technologies for teaching and learning from a cadre of skilled professors who are able to properly demonstrate and use a mix of technologies. And, students would be able to do micro-teaching or peer-teaching in the classroom in order to receive "hands-on" experience themselves with the technologies.

Portable technology teaching/learning stations

Costs will likely prohibit most colleges from having more than one state-of-the-art electronic classroom. Many may not even be able to support that. An affordable alternative is to use portable consoles on roll carts that could easily be moved from room to room and used by professors while teaching. Furthermore, students could use the same units for classroom presentations and peer teaching to classmates. Each console might include the following, or a mix of the following equipment items: MS-DOS computer, MacIntosh computer, videotape player, videodisc player, video projector or LCD viewer, CD-Rom drive, SyQuest drive, etc. Depending on component items included with each console, portable units would typically range between $3000 to $6000. The essential element is that a number of portable consoles, equipped with advanced technologies, would be available for professors and students. As in an electronic classroom, professors using portable technology teaching/learning stations, would be able to properly demonstrate and model how technologies are to be integrated into instruction. Students would also have opportunities to use the equipment for classroom presentations and peer teaching.

Multimedia development/production laboratory

A technology-rich environment for teaching, either in the form of an electronic classroom or through use of portable technology teaching/learning stations, is of limited value if neither faculty nor students have extensive "hands on opportunities to work with multimedia. A laboratory facility for faculty and students is essential to allow users to become familiar and comfortable with technology before using it in an instructional context. Once a comfort level has been established, users can begin to review and evaluate existing software/courseware to be delivered in either an electronic classroom or via portable technology teaching/learning stations. A multimedia lab would also serve as a facility for inservicing college faculty in instructional design and development skills. As user skills become more advanced, commercial software/courseware might be adapted by faculty to meet local needs or to personalize instruction. Highly advanced users, will be able to design and produce multimedia computer-assisted programs and other technology-driven educational programming.

The equipment requirements for such a lab will vary depending on whether an MS-DOS, a Macintosh, or a combination of both platforms is desired. As an example, a multimedia Macintosh lab might include the following: 15 state-of-the-art MacIntosh computers (Quadra 700 or better), 10 videodisc players, 15 CD-Rom drives, a scanner, video input equipment, etc. Of course, adequate software (application software and instructional software) must be included with any hardware acquired.

A Distance Learning Center or Program

The term "distance learning," which incorporates the use of telecommunications to bring classroom instruction to remote or distance locations away from the origination site, is receiving increased attention by state and federal policy makers. Within the past few years, telecommunicated distance education has become widely practiced in the United States. Distance learning programs are being delivered by individual schools, school districts, colleges and universities, and by private vendors. The most pervasive telecommunications medium is satellite signal, but fiber optics, microwave, radio, T1 compression, and regular telephone lines are also

widely used. In each case, the learner(s) and the teacher(s) are separated by substantial distance and the separation is bridged by a communications medium or some combination of media.

The federal and state support given to distance learning is clear indication that this approach to educational delivery is not a passing fad. Distance education is an accepted method for teaching and learning, and its practice is expected to grow significantly in coming years. Prospective teachers should understand the advantages and disadvantages of different technologies used in distance learning. In addition, they should be exposed to instructional design principles and presentation practices for teaching "at a distance" and for interacting with students who are located away from the host instructional site.

An Instructional Video Program

For better or for worse, we are a nation of TV viewers. According to 1991 data, 97 percent of American homes have at least one color TV and 74 percent have a video cassette recorder (Thornburg, 1992). Since 1985, the number of videotapes rented from video stores has surpassed the total number of books checked out of libraries (Ornstein, 1991).

With the ubiquitous presence of television in American homes and in schools, prospective teachers must know how to make the best use of educational television as well as possess skill in how to make instructional videotapes. Teachers of the future must recognize the value of TV as both an informational and an instructional medium. Despite criticisms that TV is passive, that socialization among students is minimized, or that content is often shallow, there are countless skills and knowledge that can be assimilated faster and more efficiently through video-based learning than lecture or demonstration (Milone,1992).

A part of the educational experience provided each prospective teacher should be training in how to design, plan, and locally produce instructional video segments. Declining costs of hand-held video cameras and their ease of use have made them an affordable and desirable feature in many American homes. Video cameras, recorders, and players are now accessible in virtually all schools. Teacher preparation curriculum most definitely should expose students to this important technology and its instructional use.

Conclusion

New and developing instructional technologies will continue to bombard the educational marketplace. This is occurring at a time when some teachers are still trying to cope with the introduction of the microcomputer in the mid-1970's. The thought of incorporating laser disc technology, CD-Roms, video text, electronic mail, video imaging, telecommunications, and distance learning must seem mind boggling to many. Certainly, the challenge is not a simple one. Yet, if those who administer teacher education programs fail to incorporate modern technology as part of the preparation process for tomorrow's teachers, and if educators in general fail to integrate modern and evolving technology in American classrooms, the education provided in our schools will have limited meaning in the lives of our students.

Reform and improvement efforts in American education begin with the premise that our schools, designed in the industrial age, do not meet the needs of today's information-based society. The task facing today's teachers is to prepare young people for their future, not our past. The U.S. Office of Technology Assessment's epic study *Power On! New Technologies for Teaching and Learning* suggests that the new tools of the information age can be pivotal in shaping the American classroom to fit and adapt to it's ever changing environment:

> although new interactive technologies cannot alone solve the problems of American education, they have already contributed to important improvements in learning. These tools can play an even greater role in advancing the substance and process of education, both by helping children acquire basic skills and by endowing them with more sophisticated skills so they can acquire and apply knowledge over their lifetimes (OTA, p. 4).

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