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ABSTRACT

In the past 5 years educational institutions in North America have begun to incorporate audiographic conferencing technology into their distance education programs. The use of audiographic conferencing is escalating rapidly since this technology offers the potential of serving distant students at a reasonable cost without requiring instructors to radically modify their classroom behavior and without requiring extensive new institutional support systems. The real-time communications environment of the traditional classroom is maintained because these systems allow full interaction among participants. The instructor is free to be spontaneous and to present information both orally and visually; students can participate in classroom discussions, ask questions of the instructor and their peers, and can create, view, and discuss graphic and other visual materials. To understand how this technology is being used and to develop an ideal model of how best to use it for course delivery, the Annenberg/Corporation for Public Broadcasting Project and the University of Maryland University College sponsored a research project. Interviews were conducted with students, faculty members, administrators, and technicians from nine institutions in the United States and Canada which were using audiographic conferencing. The report summarizes the interviews and direct observations and explains what seems to work and what does not. Appendixes include descriptions of audiographic systems; institutional contacts; a project evaluation report for Audio-Plus; two research papers on the instructional effectiveness of audiographic conferencing methods; and professional guidelines for a Teleteaching Project in Pennsylvania. (Author/GL)

INTERNATIONAL UNIVERSITY CONSORTIUM

A CRITICAL REVIEW OF THE USE OF AUDIOGRAPHIC CONFERENCING SYSTEMS BY SELECTED EDUCATIONAL INSTITUTIONS

A CRITICAL REVIEW OF THE USE OF AUDIOGRAPHIC CONFERENCING SYSTEMS BY SELECTED EDUCATIONAL INSTITUTIONS

by

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and

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The University of Maryland University College

Office of Instructional Telecommunications

A project jointly sponsored by the Annenberg/CPB Project
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Over the last decade, North American institutions of higher education have been faced with increasingly vociferous demands for educational services from individuals who do not fit the traditional mold. These new learners are adults, motivated in part by the necessity of upgrading their skills to keep up with changes in the technological work place. They are helping to redefine higher education from an intense, concentrated "rite of passage" for 18 to 20 year olds, to a lifelong process of learning. Comprising more than 50% of today's college population, these "nontraditional" students are not able to take time off from their jobs or family responsibilities to sequester themselves for long periods of time on residential college campuses. They require a new educational ethos -- one that allows them to study at a distance.

Similarly, many secondary schools are having to provide educational resources to small groups of students. As it is frequently economically infeasible to hire a teacher, or impossible to find one who is qualified, to provide the instruction each small group of students requires, secondary schools are also needing to develop an educational ethos that will allow their students access to a teacher who is at a distance.

Many institutions have turned to technology as a means of addressing these problems. The students themselves are comfortable with the developing communications tools, such as personal computers, television and videotapes, and do not have a hard time accepting their use for instructional delivery although they may not initially understand how to make full use of these resources. Many institutions, on the other hand, are tied philosophically and practically to the classroom model and are drawn to technologies that can incorporate this model, such as live, interactive, full-motion instructional television and audiographic conferencing systems. Instructional television systems have been used with varied success by educational institutions for nearly thirty years. The use of audiographic conferencing technologies for instructional purposes is relatively recent. It is only within the past three or four years that educational institutions in North America have begun to incorporate this technology into their distance education programs. However, educational use is escalating rapidly since these technologies offer the potential of serving distant students at a reasonable cost[1], without requiring instructors to radically modify their classroom behavior, and without requiring extensive new institutional support systems. These technologies remove the major barriers to faculty and institutional acceptance and show enormous promise for the distant learner.

Because these are live communications systems, they maintain the real-time communications environment of the traditional classroom: the instructor is free to be spontaneous and to present information both orally and visually; students can participate in classroom discussions, can ask questions of the instructor and their peers and can create, view and discuss graphic and other visual materials. Basically, audiographic technologies use ordinary telephone lines for two-way voice communication and transmission of graphic materials. Some systems integrate a personal computer and/or still frame video capability. (For a

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[1] Most of the audiographic systems described in this report cost between \$5,000 and \$10,000 per site. The number of sites per network varies, generally ranging from 2 to 10. More information on the costs of other live, interactive systems relative to audiographic systems can be found in Section III of this report.

detailed description of the various audiographic systems discussed in the report, see Appendix A). Figures 1 and 2 illustrate a typical audiographic classroom set up. An instructor is in a classroom equipped with a computer, graphics tablet and audio teleconferencing equipment (Figure 1). There may or may not be students in the room with him or her. If there are, each student has access to a microphone. This classroom is connected with one or more other classrooms through one or two standard telephone lines. Students in the remote classroom (see Figure 2) are seated around a monitor and have access to microphones, a graphics tablet, and computer keyboard. Students in each classroom see and hear the same material, which may come from any site, at the same time (see Figures 1 and 2).

Live, interactive instructional television differs from audiographic conferencing in some significant ways. With the former, the instructor is in a studio classroom that is equipped with video cameras. In a typical system, one camera is focused on the instructor and the blackboard, a second camera is used to pan the students who are present in the classroom, and the third is an overhead camera that can be used to focus in on graphs, charts or other materials that the instructor has prepared on paper or cards. Each student in the studio-classroom can see the instructor on video monitors as well as in person. The video and audio signals are transmitted via microwave, satellite or cable to remote classrooms that are equipped with video monitors and telephones. The students in these remote classrooms see the instructor in full motion on the television screens and can respond to questions, or ask questions, by using the telephone connection back to the studio classroom.

With audiographic conferencing technologies, the students in the distant sites do not see the instructor.

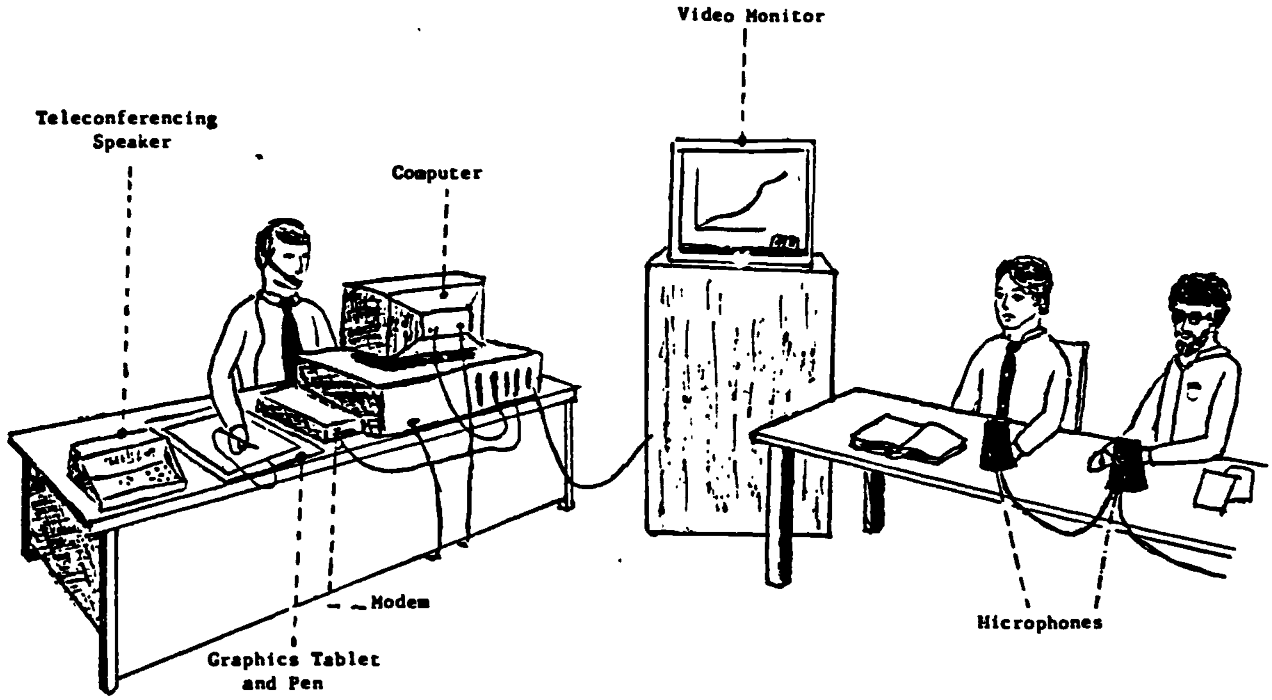

Figure 1. Instructor with students at origination site. Instructor speaks through headset microphone; students have table-top microphones.

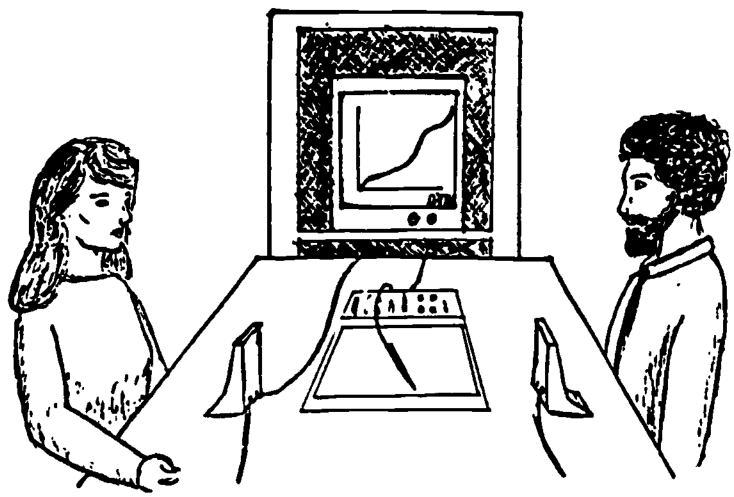

Figure 2. Students at remote site have table-top microphones and easy acce to graphics tablet.

Rather, they see instructional materials with which they can interact by pointing, drawing, and writing, and their annotations are seen immediately and simultaneously by everyone on the network. As with the instructional television system, students can also talk with the instructor and with other students.

In Spring 1988, The University of Maryland University College was awarded a contract by The Annenberg/CPB Project to conduct a study to evaluate and analyze the educational and operational characteristics of audiographic conferencing systems. A research project conducted by the Cambridge Teleteaching Group in cooperation with Harvard University, which was supported by the Annenberg/CPB Project through a contract with University TechTel, helped to define the parameters of this study. Their research had demonstrated that calculus classes could be taught successfully to students at a distance using an audiographic conferencing system. Both the Cambridge Teleteaching Group and the current researchers favor the interactive use of audiographic systems, based upon a conviction that the exchange of information between students and instructors enhances the learning process. In a review of studies that examine the teaching/learning process, McKeachie and his colleagues[2] report that while more interactive styles of teaching may not result in higher objective test scores, they do result in more critical thinking skills being developed by students than do less interactive teaching styles. To make the best use of the unique features of

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[2] McKeachie, W.J., Pintrich, P.R., Lin, Y., & Smith, D.A.F. (1986) Teaching and Learning in the College Classroom: A Review of the Research Literature. (Available from The National Center for Research to Improve Postsecondary Teaching and Learning, Ann Arbor, Michigan.)

audiographic systems, the instructors should use their interactive capabilities.

This research project was conducted by University of Maryland University College staff over a six-month period from March to September, 1988. Data was gathered during site visits and interviews with administrators, faculty and students at four institutions that are using audiographic conferencing systems for distant delivery of instruction, and extensive telephone interviews with administrators, faculty and students at five other institutions that are using the technology in different ways and/or with different types of learners than the core group. The interview questions were designed to assess the benefits and the problems encountered by users of audiographic systems for the distant delivery of instruction.

The sites were selected to represent the variety of applications and types of educational institutions that were using audiographic technologies during 1987-88. To the best of our knowledge, these institutions comprise over half of the educational institutions that were using audiographic technologies at the time the research was conducted.

Site visits were conducted at The Knowledge Network in British Columbia, Canada; The University of Calgary, in Alberta, Canada; Louisiana State University; and Mansfield University of Pennsylvania, original headquarters of the Pennsylvania Teleteaching Project. Telephone interviews were conducted with individuals at Utah State University, SUNY Farmingdale, Boston University School of Medicine, Rochester Institute of Technology, and the Chenango-Delaware BOCES (Board of Cooperative Education Services). It became apparent during the course of the Utah State interviews that the breadth and length of USU's experience with audiographic systems warranted more extensive telephone interviews than were necessary for the other institutions. Because of this, Utah State University is treated in the report as if it were one of the sites visited.

This report summarizes the research and is divided into three major sections. In Section I, there are brief descriptions of each of the institutions that participated in the study. Section II contains information about organizational, project management, and educational issues, organized by site visit institution, along with a summary analysis of each issue. The analysis draws upon information gathered through the telephone interviews as well as the site visits. The conclusions are presented in Section III.

It is the hope of the researchers that this report will be useful to educational institutions that are thinking of employing audiographic conferencing systems for instructional delivery. Many individuals who were interviewed for this study described mistakes that they made when they first began using audiographic conferencing technology and expressed their hope that others could benefit from their experience. Others had very good suggestions about how to design instructional materials to enhance the learning environment for students who could not see the instructor face to face. Both the triumphs and the failures of this group of pioneers are likely to be of great value to the novice.

SECTION I

This section contains descriptions of the institutions that were surveyed for this study presented in the order the visits were conducted. The names, addresses and telephone numbers of the primary contact at each institution can be found in Appendix B.

Site Visit Institutions:

The Knowledge Network, A Component of The Open Learning Agency, British Columbia, Canada.

The Knowledge Network was begun in 1980 as a project funded by the government of the Province of British Columbia to use satellite technology to broadcast instructional television programming. The Network works closely with the two-year colleges and four-year universities in the province to facilitate the development of credit courses for broadcast. Funds for production are provided by the provincial government and are allocated through The Knowledge Network to support particular projects. Projects proposed by more than a single institution have a competitive advantage.

In 1987, legislation was enacted to merge The Knowledge Network with The Open Learning Institute (OLI), British Columbia's degree-granting "university without walls," to create The Open Learning Agency (OLA). The OLA combines course development and delivery functions into a single organization that takes a systemwide approach to increasing access to higher education for residents of British Columbia. OLA staff work with students to evaluate the post-secondary credits they have earned and to identify systemwide resources from which students can draw to meet their educational objectives.

For the past four years, The Knowledge Network has been making its 20-port Darome teleconferencing bridge available for instructional support and delivery. Faculty schedule audio teleconferences outside of broadcast time to answer questions from students who are enrolled in their televised courses. In addition, audio-teleconferencing is used for direct instruction, for tutorials to supplement print-based independent study courses offered through the Open College and Open University components of the OLA, and for professional development activities.

In 1986, The Knowledge Network began exploring the distance education potential of three "audio-plus" technologies: the Optel Telewriter 2-PC, Telesketch, and Colorado Video Slo-scan[3]. These technologies were selected because they represent different interactive multipoint communication capabilities and each could be connected by telephone lines to The Knowledge Network's teleconferencing bridge.

At the conclusion of the six-month Audio-Plus project, The Knowledge Network selected the Optel Telewriter 2-PC system for future projects and evaluation because it proved to be the most flexible of the three technologies, offering the greatest options for instructional delivery, and because it was the only one that could provide simultaneous voice and data transmission using a single telephone line. Consequently, The Knowledge Network has worked with

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[3] See Appendix B for a full description of the project and the technologies involved.

interested educational institutions throughout British Columbia to develop projects using Optel Telewriter 2-PC and to conduct summative evaluations to determine the learning outcomes of these projects. The information presented in this report is drawn from the experiences of the several institutions in British Columbia that have been involved in Knowledge Network-sponsored projects using the Optel Telewriter 2-PC technology.

The University of Calgary, Faculty of Continuing Education, Alberta, Canada.

The Faculty of Continuing Education at The University of Calgary is equivalent to a department or college of continuing education in universities in the United States. As such, it is charged with the development and delivery of a wide range of programs to serve working adults, many of whom are not able to attend classes on campus. Since 1979, The University of Calgary has been using audio teleconferencing to deliver university credit and non-credit courses to students throughout the province and to facilitate seminars and meetings for a variety of professional associations.

The audio teleconferencing system serves nearly seventy sites throughout Alberta. Learners come to the local teleconference center, which is supplied by a school or library, to participate in class sessions. Local teleconference assistants supervise the proceedings at each site, while administrative and technical personnel in the Faculty of Continuing Education handle programming, coordination among sites and educational institutions, and operation and maintenance of the Darome 2020 bridge and other equipment.

In 1982, the Faculty of Continuing Education received a grant from the provincial government to integrate videotex into the existing audio teleconferencing system and test it through the delivery of three language arts courses. University of Calgary administrators were unhappy with videotex for several reasons. The system was not fully interactive. For example, graphic materials could be created and transmitted by only one site and individuals at other sites could not annotate or point to portions of the graphics. Second, the creation of the graphics proved to be expensive since the work had to be done by a trained technician. Finally, without a second telephone line, voice communication was disrupted for 10 to 20 seconds each time an image was transmitted. Consequently, the University of Calgary discontinued use of this technology at the conclusion of the grant.

In the continuing search for an effective enhancement to audio teleconferencing, the Faculty of Continuing Education, in cooperation with Athabasca University (Alberta's nontraditional distance education university), developed a pilot project with funding from the provincial government, to test the Optel Telewriter 2-PC. During the Fall of 1987, a faculty member offered weekly tutorials via the Optel technology to students in six sites to augment an Athabasca University correspondence course in introductory statistics. The following semester, a faculty member from The University of Calgary offered a staff development education course to graduate students in seven locations throughout the province. The information presented in this report is based on these experiences.

Louisiana State University, Division of Continuing Education, Baton Rouge, Louisiana.

Louisiana State University's Division of Continuing Education brings the resources of the university to nontraditional students in many delivery forms ranging from face-to-face meetings to the use of electronic media. The Division is comprised of eleven departments that collectively serve over 50,000 students annually throughout the state.

The Department of Extramural Teaching, established in 1919, has as its primary goal providing college-level instruction for students who are unable to attend regular classes on the Baton Rouge campus. Working in cooperation with various colleges, schools and departments of the University system, the department offers, in off-campus locations, as many of the courses from the LSU catalog as student demand and practical considerations will allow. During the 1986-87 academic year, the Department of Extramural Teaching enrolled more than 4,000 students in 199 credit courses, the vast majority of which were taught by instructors who drove to the off-campus centers.

In 1985, increasing pressure on faculty for research and on-campus teaching, and their resultant reluctance to teach off campus, combined with declining student enrollments statewide, led the Dean of Continuing Education to begin exploring alternatives to face-to-face instruction. At the same time, AT & T was attempting to develop new markets following the divestiture, and approached LSU to see how the two organizations might work together. AT & T was marketing their bridging service and device, by which several different locations can be connected simultaneously to a single teleconference. Corporate trainers at AT & T had been using audio teleconferencing, enhanced by an electronic blackboard, to support distance delivery of their own employee training programs. This technology, which allowed for the transmission of black and white hand-drawn graphic images and words, appeared to the Dean to be a viable solution to the problems LSU was facing, so he allocated funds to purchase the necessary equipment. However, before the order could be filled, he read about the audiographic system that Optel had just begun marketing, and decided that this technology better met LSU's needs. He authorized purchase of two units for the Extramural Teaching Division to pilot test the system as an alternative to instructor travelling.

The initial experience was successful enough to convince the Dean to purchase additional Optel Telewriter 2-PC units. LSU currently has ten complete units and offers up to eight courses per term to students in one to five different locations. The information provided in this report is drawn from the varied and extensive experience of LSU over the past three years.

<u>The Pennsylvania Teleteaching Project, Mansfield University of Pennsylvania, Mansfield, Pennsylvania.</u>

The Pennsylvania Teleteaching Project is an outgrowth of two prior projects funded by the Pennsylvania Department of Education and the State System of Higher Education. In 1984, a faculty member at Mansfield University of Pennsylvania attended a presentation at a Rural Education Conference sponsored by the Secretary of Education where a Utah school superintendent described a project in his district that used a computer-based audiographic system to deliver courses to high school students in rural areas of the state. Similar needs had been identified in northern Pennsylvania and the Mansfield professor and the Utah superintendent agreed to replicate the Utah delivery system in Tioga County, Pennsylvania. The Mansfield-Utah Teleteaching Project targeted three distinct populations: college-bound high school students, elementary school students, and EMR (Educable Mentally Retarded) high school-aged students. This project successfully demonstrated that the system could be used with different kinds of learners at different age levels, and the Pennsylvania Department of Education agreed to fund the statewide Pennsylvania Teleteaching Project for 1986-87.

The purpose of this project was to develop a high quality-low cost distance delivery system capable of providing specialized courses to rural students who were unable to get this instruction in their home schools. The delivery system was to be computer-based and, since the schools in the state had both IBM and Apple computers, the Pennsylvania Department of Education required that the system function in both Apple IIE and MS-DOS environments. Mansfield University contracted with a Florida firm, Technical Services National (TSN), to develop two versions of the software. Mansfield University provided the project with unlimited use of this software for all Pennsylvania Teleteaching Project sites. The project purchased all of the teleteaching equipment for the participating agencies including public schools, private schools, and two teenage prisons. Communication costs in this two-line system have been kept at a minimum by using telephone bridges owned by the project.

Mansfield University designed, developed, and implemented the 1986-87 Teleteaching Project in fewer than

95 days. During that year, nineteen courses were taught over the audiographic system within the state, and one was taught on an interstate basis to Utah. The Pennsylvania Teleteaching Project was continued for 1987-88 under the administration of the Riverview Intermediate Unit, one of 29 regional agencies that provide comprehensive support programs to the state's public schools. The Mansfield professor who had initiated the project served as the chief consultant to the project during that year.

The information presented in this report is drawn from the varied experiences of teachers, administrators and students throughout Pennsylvania who have participated in teleteaching during the past two years.

Utah State University, COM-NET Services, Logan Utah.

Utah State University is the land grant institution of the state of Utah with a mission to serve citizens throughout this very large and rural state. To do so, USU has developed a network of extension centers that are located within commuting distance of the majority of citizens (see figure 3, following page 18). The centers are staffed by directors who live in these rural communities and who work closely with the local population to identify educational needs and with the University to develop appropriate programming to meet these needs. Utah State has transported faculty, frequently by air, to these off-campus centers to teach courses. However, beginning in 1979-80 off-campus enrollments escalated and the University experienced difficulty in finding enough qualified faculty willing to travel, and in covering their travel costs. In 1984 Utah State University added an electronic distance educational delivery system to the existing face-to-face delivery mode, to serve students in rural areas of the state.

Dubbed COM-NET, this electronic delivery system initially used telephone lines, facsimile machines, electronic writing boards, and slow-scan video to deliver four bachelors and masters degree programs over a two year cycle to students in seventeen outreach centers. In the last few years, the COM-NET system has evolved and now encompasses other technologies, including a computer-based audiographic system (the Optel Telewriter 3-PC) for instruction and information retrieval, microwave and broadcast video, and vertical blanking interval (VBI) transmission resulting in 7-second color video images. In addition, students have electronic library access from all COM-NET sites. These technologies are frequently used in combination to reach over 30 sites throughout the state, during daytime and evening hours, to deliver credit and non-credit courses.

From its inception in the fall quarter of 1984 until the summer of 1988, 862 credits were offered resulting in 8,444 enrollments (1,300 each quarter) and 7,990 hours of delivery. Nine degrees are now available over the system.

Since the COM-NET system is so complex, its several components are described below.

A-Net: Audiographic Network

This is the original network, the backbone of which consists of two leased telephone circuits in a star configuration going to 17 sites. The basic components are:

a. 2-way[4] audio - Darome audio system

b. 2-way print - Canon facsimile machines

c. 2-way writing boards - AT&T Gemini boards (electronic blackboards)

d. 2-way black and white still video - Colorado Video slow scan

e. color motion video - VHS recorders, tape sent to site

f. audio recording - cassette recorder

V-Net: Vertical Blanking Interval

The vertical blanking interval (VBI) is a series of lines between the frames of a live video broadcast. As these lines are broadcast, but unseen, during a regular telecast, they can be used for the transmission of non-motion information. V-Net uses the VBI to transmit still video images simultaneously and underneath the broadcast of a live television program. The addition of the VBI in no way affects the quality of the standard television image, but reaches the same area served by the television station. V-Net uses the VBI supported by a dedicated 4-wire audio telephone circuit in a star configuration consisting of 10 sites located in technical

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[4] Throughout the discussion of the COM-NET system, the term "2-way" should be understood to mean "point to multipoint" or "multipoint to multipoint" rather than "point to point."

schools in small rural communities. The basic components of the system are:

a. 2-way audio - Darome audio system

b. 2-way print - Canon facsimile machines

c. 1-way color video - Colorado Video, Inc. still image 7-second fast-scan

d. color motion video - VHS recorders

e. audio recording - cassette recorder

<u>E-Net: engineering telecommunications</u>

This system was designed to serve the engineering-intensive industry along the Wasatch Front and was discontinued after two quarters. A broadcast video channel is supported by a dedicated 4-wire audio telephone circuit in a star configuration linking five sites. The basic components of the system are:

a. 2-way audio - Darome audio system

b. 2-way print -Canon facsimile machines

c. 2-way graphics - Optel Telewriter 3-PC

d. 2-way color still video - Optel Telewriter 3-PC

e. 1-way color motion video - KULC-TV Channel 9

<u>M-Net: microwave-based video</u>

This system uses the state microwave network to link the major educational institutions statewide. Each site is equipped to receive microwaved full motion video transmissions. The basic components of the system are:

a. 2-way audio - Shure audio system

b. 2-way print - Canon facsimile machines

c. 1-way graphics generation - Optel Telewriter 3-PC

d. 1-way color motion video - microwave-based

O-Net: Optel Telewriter 3-PC (under development in 1988)

This system was designed and developed to network programming interactively between strategic county extension offices within the state and the Utah State University campus for training, diagnostics, and education. Additional O-Net sites are located in the states of Montana, Wyoming and Colorado. The basic components of the system are:

a. 2-way audio - Darome audio system
b. 2-way writing tablets - Optel Telewriter 3-PC
c. 2-way color graphics - Optel Telewriter 3-PC
d. 2-way color slow scan video - Optel Telewriter 3-PC
e. motion color video - VHS recorder
f. audio recording - cassette recorder

I-Net: Information network

This system uses IBM-compatible micro-computers and ordinary telephone lines to link sites in Colorado, Montana, Wyoming and Utah. It was designed to provide University Library support to participating rural community libraries and is used for both real-time and time-delayed communication. The basic components of the system are:

a. 2-way data - IBM-compatible micro-computers, modems and communications software

ICLIS/COM-NET Cooperative

This is an interstate system that combines I-Net and O-Net and is comprised of 3 sites in each of 4 states.

Maps showing the sites served by the various systems follow as Figures 3 and 4.

The lines between these systems have blurred over time, and they are now frequently used in conjunction to deliver programming to the sites each serves. The information presented below is drawn from conversations with administrators, faculty and students who have worked with one or more of these systems. It became clear during the course of these conversations that the issues are essentially the same, no matter which version of the COM-NET system is used.

Telephone Interview Sites:

Rochester Institute of Technology.

Rochester Institute of Technology (RIT) is a private technical university located in upstate New York that offers undergraduate and graduate degrees in a wide variety of technical disciplines through its Colleges of Applied Science and Technology, Business, Continuing Education, Engineering, Fine and Applied Arts, Graphic Arts and Photography, Liberal Arts, Science and the National Technical Institute for the Deaf. RIT's primary mission is to serve traditional on-campus students. However, since 1980 the institute, using a mix of communication technologies, has been involved in a concerted effort to offer instruction to students where they live and work. The colleges work with RIT's Instructional Media Services to identify the best means for serving learners in industrial organizations and small communities located throughout western and central New York State and northern Pennsylvania that require part-time technical programs but are unable to travel to the campus for classes.

During the 1987-88 academic year, the School of Engineering Technology began using an audiographic system

(Optel Telewriter 3-PC) to deliver courses to a site in Jamestown, New York, 130 miles southwest of Rochester. In the first of the two courses, the students viewed videotapes of the lectures either at the off-campus center or in their homes, then came together for weekly problem-solving and discussion sessions led by the faculty member using the audiographic system. In the second course, there were no videotaped lectures and the audiographic system was used to deliver the entire content of the course.

Delaware-Chenango BOCES

The State of New York funds over forty cooperative public education agencies to provide services to the K-12 public schools in their region. These BOCES (Board of Cooperative Educational Services) units offer support in six areas: special education, occupational education, adult education, administrative services, instructional support services, and instructional resource sharing. The K-12 schools that subscribe are able to pick and choose among the available services, for which they pay a fee that is partially subsidized by the state.

The Delaware-Chenango BOCES serves 18 school districts located in portions of four different counties in rural upstate New York. These school districts are faced with the problems of providing students with a full curriculum and offering them opportunities to get exposure to the world outside of their small communities. Since the 1984-85 school year, the Delaware- Chenango BOCES has been using an audiographic technology (Optel Telewriter 2-PC) to address both these issues. The system has been used to link students at 3 or 4 different locations for college level math and english courses, advanced foreign language, social studies and science instruction, and enrichment courses.

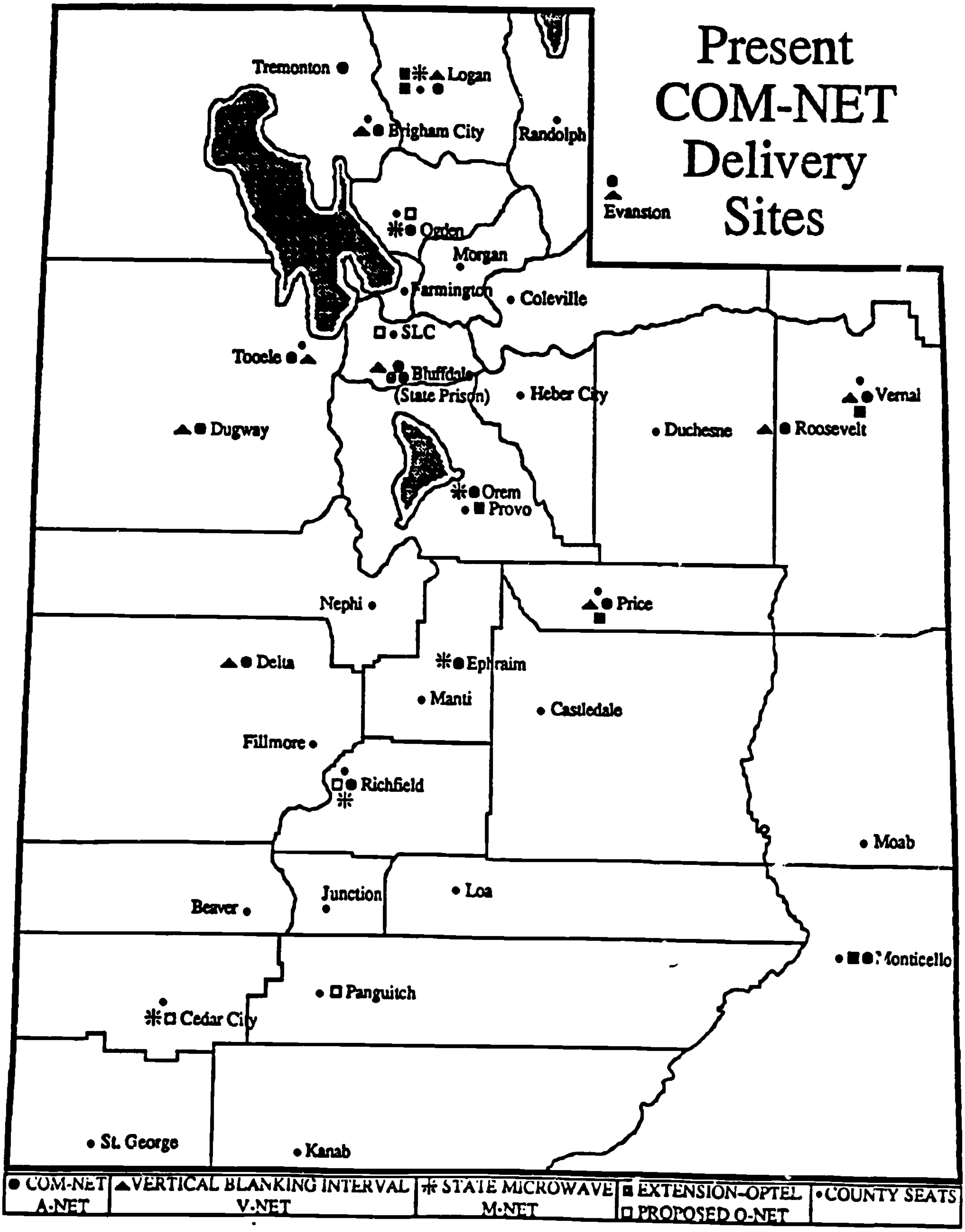
Present
COM-NET
Delivery
Sites
Tremonton
Logan
Brigham City
Randolph
Evanston
Ogden
Morgan
Farmington
Coleville
SLC
Tooele
Bluffdale
(State Prison)
Heber City
Vernal
Dugway
Duchesne
Roosevelt
Orem
Provo
Nephi
Price
Delta
Ephraim
Manti
Castledale
Fillmore
Richfield
Moab
Junction
Loa
Beaver
Monticello
Panguitch
Cedar City
St. George
Kanab
COM-NET A-NET
VERTICAL BLANKING INTERVAL V-NET
STATE MICROWAVE M-NET
EXTENSION-OPTEL
PROPOSED O-NET
COUNTY SEATS

FIGURE 3

Intermountain Community Learning
and Information Services (ICLIS)

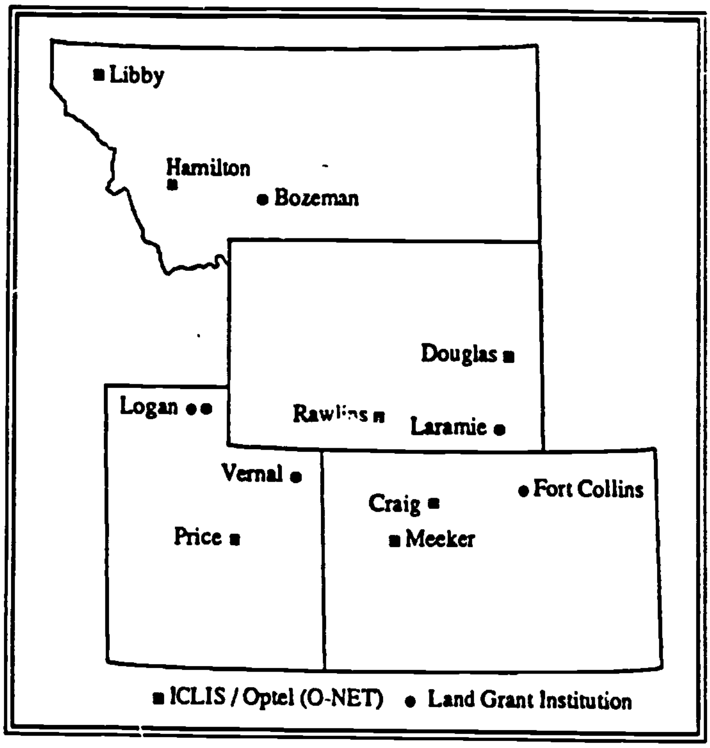

FIGURE 4

During the 1987-88 school year, the system was used to deliver 5 courses and several minicourses, and plans were to add professional development programs for teachers and two after school classes during the 1988-89 school year.

<u>State University of New York (SUNY) College of Technology at Farmingdale.</u>

Located near the center of Long Island, this campus of the SUNY system is being called upon to provide education and training to the rapidly growing number of area businesses, many of which are high technology firms. Whereas in the past the college has primarily offered on-campus training programs, there now is a demand for off-campus delivery of management and engineering education. The departments that offer these programs draw upon the resources of the Office of Learning Technologies to help them integrate new technologies into existing programs and use technology for the delivery of new programs.

In 1987, the Director of Learning Technologies identified an audiographic system (Optel Telewriter 2-PC) that he believed could be used to reach a new student population. The system met his criteria for a relatively inexpensive medium that allows for the maintenance of the natural classroom environment. He demonstrated the technology to the administration who saw its potential and approved the initial equipment purchase. He then looked for outside funding to support purchase of additional equipment and one or more empirical tests of its effectiveness in educational settings. During the 1987-88 academic year, SUNY faculty, supported by a grant from the New York State Department of Education, used the audiographic system to deliver Advanced Placement and enrichment programs to high school students in three sites on Long Island.

At the end of the project, it was determined that no real benefit was derived from using the audiographic system to deliver instruction to the three participating schools. The students were close enough to the campus to be easily bused in for classes after school and on Saturdays, so this model was adopted for the 1988-89 school year. The audiographic system will be used once or twice a month for technology demonstrations.

Boston University School of Medicine (BUSM):

The faculty at BUSM teach courses to medical students, conduct medical research, and provide diagnostic and other consultative services to practicing physicians worldwide. With the increased specialization in medicine, BUSM faculty members frequently develop expertise that they share with no one else on the faculty (and occasionally, with very few other physicians in the world). Because of this, many of the courses at BUSM are taught by several different faculty members, each teaching a single module. In order to make the best use possible of the faculty members' time, for some of the larger courses, the faculty teach from a studio through a closed circuit television system (one-way video, two-way audio) to students in several laboratories in the building. In many of these courses, the students are asked to look at specimens in the laboratory microscopes and compare what they see with 35mm slides of the same type specimen that the faculty member uses to illustrate the lecture. Students are able to ask questions about the specimens but, since the faculty member is not in the same room with them, they are unable to point out particular areas on the slide.

Likewise, when faculty members do consultations, they use x-rays, EKG's and other visually based diagnostic materials. It is difficult for the two physicians to adequately communicate unless they are in the same room and can point to particular portions of the materials.

The Educational Media Support Center at BUSM identified an audiographic conferencing technology (Optel Telewriter 3-PC TGA) that can be used for transmitting very high resolution still video images. People at any site on the system can annotate and point to portions of the images, while talking about what they are seeing. BUSM is now using this technology in a limited way to support their televised instruction and for consultation.

In the spring of 1988 BUSM faculty participated in the global classroom project, funded by the US Department of State with the cooperation of AT&T and Optel Communications, by delivering several lectures on spinal cord injury and cell biology to students in Beijing, China. They successfully demonstrated that audiographic conferencing technology can be used effectively internationally. Except for some difficulties with the audio transmission from China to Boston, the technology worked very well.

SECTION II

In this section, the experiences of the site visit institutions are reviewed in detail and are presented according to the particular issues they delineate. The issues themselves were selected early in the research and were refined as the interviews progressed. They range from extremely pragmatic (how institutions acquired the money to purchase equipment) to academic (how the technology affects interaction in the classroom).

The "discussion" segments contain summary analyses of each issue. Each analysis draws upon information gathered through the telephone interviews as well as the site visits.

I. Organizational Issues

These are the issues that arise in conjunction with the establishment of any new program or system. They center around the basic questions "why?" and "how?". Frequently the answers to these kinds of questions are influenced by those who are not directly involved in program or system development and administration such as the institution's top administrators, governmental officials or corporate executives.

A. Motivation for system development/technology adoption.

1. The Knowledge Network. The institutions that have been involved in the Optel project in British Columbia are faced with the challenge of providing instruction to very small groups of students in geographically isolated areas. In one project, for example, two

students based in a high school in Chetwynd are connected via the Optel system with a faculty tutor located in Prince George, 100 miles away. The students are the only two in their high school who are interested in taking Physics 12. Even if there were an instructor in Chetwynd capable of teaching the course, the enrollment figures could not justify the course being offered. As it is, these students are enrolled in a correspondence course and are meeting with their distant tutor three times a week via Optel for problem-solving sessions.

Northwest Community College has a an audio teleconferencing bridge that simultaneously connects the main campus to six regional centers. The system enables very good two-way voice communication between the various centers and the main campus, and NWCC faculty have been using it for several years to offer courses to small groups of students at each center. The Optel system was used initially to enhance the regular audio-teleconferencing Physics 040 course being offered to students in one of the institution's regional centers. Although this initial trial was not without problems, the potential of the Optel system to enhance audio-based courses was apparent, since it could support written, as well as verbal, interaction. NWCC administrators subsequently decided to seek funding to purchase enough Optel units to link the main campus to all six regional centers.

2. The University of Calgary. The primary motivating force behind the development of this system was The Faculty of Continuing Education's desire to increase the range of courses offered at a distance using the audio teleconferencing system. They had found that it

was very difficult for instructors to fully convey the material in some of their courses by the spoken word alone. They needed a way to communicate in writing, in real time, much as they would using a blackboard in a traditional classroom setting. The audiographic conferencing system provided a means for these instructors to teach their courses to students at a distance. It also had the potential to significantly enhance the quality of the educational interaction in courses already being taught successfully with audio teleconferencing.

3. Louisiana State University. Louisiana is in the unenviable position of being near the bottom in the nation for state support for public education. As a result, it is nearly impossible for the state to attract the new industries it needs to help overcome the high unemployment created by its economic dependence on oil and to begin to pull itself out of a severe economic depression. Considerable pressure is being put on university continuing education units to retrain workers. Over the past few years, however, University budgets have been cut back severely, and off-campus continuing education enrollments have declined. Financially, it has become too costly for the Division of Continuing Education to transport faculty to off-campus centers to teach fewer and fewer students. The Optel system allows LSU to continue to serve the students in off-campus centers since one instructor can simultaneously teach students in several sites. Similarly, the division can offer specialized courses that are likely to attract only a small number of students at any one site and can meet the minimum enrollment by aggregating students from more than one off-campus location.

4. The Pennsylvania Teleteaching Project. The Pennsylvania Department of Education, like many others around the country, is attempting to raise the academic standards and the quality of education in its public and private schools. Pennsylvania has the largest rural population in the nation and many of its 500 public school districts have scant resources and small enrollments. Many of these schools are unable to provide teachers for all the courses that their students need, either because they do not have qualified teachers in the school and cannot recruit them, or the classes are so small that it is not economically feasible to hire a new teacher.

The pilot project had demonstrated that audiographic technologies could be used effectively to redistribute instructional staff without relocation. The fact that communication costs of the technology were relatively low was also instrumental in the decision to adopt an audiographic system. The cost-effectiveness of audiographic systems for instruction was subsequently documented in a study completed in October 1987 for the Pennsylvania Teleteaching Project by E. Kent Ellertson. The study compared the cost of audiographic, live broadcast and microwave television, and conventional classroom delivery of instruction and correlated each with student performance (as measured by grades). (A copy of the complete study is available from the project contact listed in Appendix B).

5. Utah State University. In 1969, Utah developed a Master Plan for Higher Education that defined Utah State University's responsibilities for providing

education to rural communities throughout the state. The mission was outlined as follows:

> Except for the universities and even here to some extent, each institution is capable, under law and regulations, of offering less than a full array of educational services. Some areas of the state have little or no educational services available within commuting distance. By utilizing the concept of extension centers, virtually all educational services can be placed within commuting range of most residents of the state. Responsibility for organizing and administering this concept is delegated to Utah State University. The programs which embody this concept are open to the initiative of all institutions under this administrative structure (Utah Master Plan, 1969).

Initially, Utah State University was able to fulfill this mandate by having faculty either drive or fly to the various extension centers to teach their courses. However, beginning in the early 1980's, the demand for off-campus credit education escalated and Utah State began having difficulty staffing all the courses and delivering them in a cost effective manner. Administrators sought alternatives to face-to-face instruction and, after much research, decided upon an audiographic system as the best, most cost effective electronic means to deliver courses to the off-campus centers.

The following criteria were developed and used in selecting the telecommunications equipment and in designing the first system:

* Interaction. The system had to provide for both audio and video exchange between student and instructor to function as an educational setting.

* Near duplication of the traditional classroom environment. The objective was to keep changes in the accepted or learned pattern of traditional delivery to a minimum. This would make it easier to market the system to prospective students and would minimize the cost of course development, since an instructor could, theoretically, use existing materials and notes with a minimum of change.

* Simplicity. The instructor and the students should be able to use the system with ease and without apprehension. Media aids should be able to operate and troubleshoot the system quickly and effectively with minimal training.

* Multiple Site Origination. All sites should have the capability to originate programming.

* Cost effective. The system must be cost effective with delivery costs equal to or less than the traditional outreach delivery methods.

Discussion. Two very different forces motivated these educational institutions to use audiographic conferencing technologies. One group, consisting of The Knowledge Network, The University of Calgary, and

SUNY College of Technology at Farmingdale adopted audiographic conferencing systems out of a desire on the part of key administrators to experiment with a new technology. The remaining institutions were motivated primarily by the necessity of meeting strongly-felt demands for distance delivery of their educational programs.

The Knowledge Network, through the Open Learning Institute, and The University of Calgary had been using print-based self-study materials and straight audioconferencing for instructional delivery for several years. Audiographic conferencing was viewed by faculty and administrators as an enhancement to an already well-established and successful program delivery system. At SUNY-Farmingdale there was no such distance delivery system in place that was meeting a previously-identified educational need. The SUNY-Farmingdale administrator who spearheaded the institution's use of audiographic conferencing identified an educational need through his research into possible funding sources. New York State was interested in funding projects that would enhance educational opportunities in science and mathematics for high school students in districts with high minority student enrollments. The SUNY-Farmingdale project proposed using audiographic conferencing to deliver college level courses in physics, math, statistics, biology and astronomy to three such school districts.

In all three of these institutions, the instructors were willing to try the audiographic technology but they did not really need it to meet either personal or institutional objectives. The projects they were involved in remained on the periphery of their institutions and received minimal institutional support.

In contrast, most of the other institutions in this study turned to audiographic conferencing to meet important institutional objectives. Both Louisiana State University and Utah State University were charged with delivering courses to off-campus sites on a regular basis. With increased demand for particular courses for which there were not a sufficient number of skilled instructors, and escalating costs, both had to find some alternative to the traditional classroom model. Quite early on, the instructors recognized that the audiographic technology could help them do what they were expected to do. They could meet with students throughout the state without having to be on the road or in the air several days a week.

In the institutions where audiographic technologies are being used to meet institutional objectives, there is generally support from relatively high levels of the hierarchy and a long-term commitment to the distance delivery system. The audiographic technology has begun to alter the way these institutions do business.

B. Acquisition of resources for equipment purchase and use.

1. <u>The Knowledge Network.</u> After an unsuccessful attempt to obtain the Optel Telewriter 2-PC equipment from the distributor on short-term loan to conduct pilot tests, the project manager applied for funds from

the CEO of The Knowledge Network to purchase two sets of Optel Telewriter 2-PC equipment (software, modems, tablets and pens). The arguments that she presented to the management of The Knowledge Network to justify the expenditures included:

* The technology supports The Knowledge Network's objective of expanding its telecommunications potential and diversifying its delivery systems.

* The equipment is flexible and can be adapted to multiple uses (e.g., the computer can be used as a stand-alone unit for word processing, database management, or computation or linked with a mainframe for use as a terminal; the audio conferencing system can be used for teleconferences involving several individuals at one site).

* Many institutions within North America are purchasing Optel systems and it would be relatively easy to resell the equipment if it did not meet The Knowledge Network's objectives.

* The Optel system would enhance and increase use of the Knowledge Network's existing audio-teleconferencing service.

* The Knowledge Network would be one of the first statewide telecommunications systems to test the Optel technology.

2. <u>The University of Calgary</u>. The Faculty of Continuing Education received support from the Alberta provincial government to fund a pilot project to test

the feasibility of enhancing their educational audio teleconferencing with the addition of Optel Telewriter 2-PC technology. The government typically funds cooperative ventures, involving more than one educational institution. The project director had difficulty in convincing another institution to participate and in working out the details of the collaborative endeavor. An agreement was eventually reached with Athabasca University (which provided the course, the students and the instructor) and The University of Calgary (which provided the technology and technical support) for the initial trial.

The Optel Telewriter 2-PC technology was selected to provide visual enhancement to the audio teleconferencing system for a number of reasons:

* it has the unique capability of supporting simultaneous aural and visual communication.

* each center can annotate existing images, and create and transmit new ones.

* all messages and images may be viewed simultaneously in all centers in real-time.

* the system is able to support the transmission of computer messages between teleconference sessions, computer-based learning, and computer graphics.

* with some additional hardware it can also support freeze-frame and other ancillary media.

* it allows instructors and students physically distant from one another to have an opportunity to discuss and explain problems both aurally and visually -- a process that closely simulates the conventional educational process.

3. Louisiana State University. The Dean of Continuing Education oversees all the budgets of the division and can reallocate funds during the fiscal year if necessary. This is what he did to finance the initial equipment purchase. However, over time, the use of the Optel equipment has significantly reduced the division's expenses connected with instructor travel, so the Dean has been able to shift money from the motor pool account into the telelearning account. The division has had to purchase only one new car since the inauguration of telelearning, and the Dean foresees going out of the car pool business entirely within the next few years.

The Dean commented that from the perspective of his overall budget, the telephone bridge and line charges approximately equalled the driving costs for face-to-face delivery. In instances where the instructor simultaneously teaches more than a single remote site, the institution realizes savings with the audiographic system over face-to-face course delivery.

4. The Pennsylvania Teleteaching Project. The State System of Higher Education provided a $10,000 seed grant in 1984-85 to initiate and develop the Mansfield-Utah Teleteaching partnership. The Pennsylvania Department of Education provided $47,000 to test the Mansfield-Utah Teleteaching model in Tioga County in

1985-86 and another $526,000 to fund the full project for 1986-87 through its Office of Basic Education. The Department of Education had money available through the Secretary's Task Force on Small Schools and through Chapter 2 to support projects that addressed the gap between increased academic standards and the inability of many districts to provide teachers to some students in some courses. Pennsylvania educational institutions apply for these funds by submitting formal written applications.

The grant money was used to purchase equipment and software, to pay for the installation of telephone lines and long distance telephone charges, to fund inservice workshops for administrators and teachers, to fund project evaluation, to acquire rights to the courseware, and to cover administrative costs. Participating school districts paid for the teachers' and associate teachers' salaries, nominal computer supplies, and the cost of substitute teachers for the teleteachers, both while the teleteachers were receiving training and while they travelled to the remote classrooms to meet face-to-face with those students and teach back to their home schools.

5. Utah State University. The COM-NET system has been financed out of the University budgets that support the delivery of courses in the extension centers, and student tuition. With an increase in off-campus credit enrollment of 110% since the 1979-80 academic year, the institution has been finding it increasingly difficult to find enough qualified faculty to teach at the various off-campus centers, and to finance their travel to these sites. Telecommunications technology allows a single faculty member to teach students located in

several different locations without travelling from the campus. In Utah State's case, faculty who teach over COM-NET generally instruct students located in 9 or 10 different extension centers. Students are not charged a higher tuition rate for the off-campus courses but some of the tuition funds come back to COM-NET to defray off-campus delivery costs. Together, the centers generally enroll enough students in a particular course to cover instructional costs. The fees and the savings in faculty travel offset the cost of the equipment and transmission charges for all the delivery systems.

The interstate system was developed with the support of a $2.9 million grant from the W.K. Kellogg Foundation. The four-year funding supports salaries for Community Learning and Information Specialists, personnel support at Land Grant universities and State Libraries, technology acquisition, and program support for state and multistate delivery. IBM provided significant discounts on IBM technologies and personnel support. This project is named ICLIS - Intermountain Community Learning and Information Services.

The microwave system was financed by the state several years ago to link the institutions of higher education in the state. The Utah State Board of Regents funded the development and testing of prototype equipment to transmit and receive data through the vertical blanking interval (VBI). This was a joint effort of Utah State University and Colorado Video, Inc.

Discussion. It is not surprising that there are as many funding models as there are institutions since each responded to its own unique set of circumstances. Most projects, at least in the start-up phase, have required extra-institutional seed money. This came most often from government grants (The University of Calgary, Pennsylvania Teleteaching Project, BOCES, Boston University School of Medicine, and SUNY-Farmingdale). A few institutions were successful in getting foundation and/or corporate support (Boston University School of Medicine and Utah State University) and others got funding from within the institution, either from special project development accounts (Rochester Institute of Technology and The Knowledge Network), or through a reallocation of internal funds (Louisiana State University and Boston University School of Medicine).

Administrators at all of the institutions studied mentioned they were drawn to audiographic technologies because they are relatively inexpensive (both in terms of the initial investment, and also in on-going communication costs) and because they are easy to use. Most institutions were able to run their systems with existing personnel and without any space renovations. As the systems mature and increasingly become integrated into the institutions, they can be shown to save money (in faculty travel, for instance) and to generate income (primarily from student tuition) and good will (from individuals who are finally able to get educational services).

Several administrators had made the argument that the computers that were part of the audiographic system they had selected could be used for other applications. However, with the exception of some of the schools in the Pennsylvania Teleteaching Project, the computers were not made available for student and instructor, or even administrative, use outside of class. This was because they were equipped with hardware and software that an inexperience user might inadvertently impair and most administrators were not willing to risk having this happen.

C. The decision-making process for specific applications.

1. The Knowledge Network. The project manager at The Knowledge Network discussed the capabilities of the audiographic system with administrators at educational institutions throughout British Columbia who are involved with distance education. She then identified those institutions that were experiencing specific problems in their distance education programs that could be addressed with this technology and invited them to submit project proposals to The Knowledge Network. No formal evaluation and selection process was established. The administrators at each institution were responsible for enlisting the support of faculty, technicians, and other administrators for their project and for providing the computer and other hardware.

2. The University of Calgary. The project director is the Director for Distance Education in the Faculty of Continuing Education. In this role, he has regular contact with faculty who teach via the audio teleconferencing system and it is from among this group that he recruits individuals for special projects such as this. Since only one course was being offered each term during the pilot phase, there was no formal decision-making structure established. Faculty who

were willing to experiment, and who already had been successful in teaching over the audio teleconferencing system, either volunteered or were asked to adapt their course to the telewriter system.

3. Louisiana State University. The Dean of Continuing Education and the Director of the Extramural Teaching Department both have contact with faculty who regularly teach off-campus courses. Initially, they recruited individual faculty members who, they believed, would be able to adapt their teaching to the new delivery method. After the initial trials, they began considering the use of the Optel system to offer courses to students at sites where enrollments were too low to justify sending a faculty member, but where there were sufficient potential enrollments in a couple sites to meet the minimum of 15 students. They then offered the faculty member the distance delivery option. After the system had been in use for a couple semesters, faculty who preferred not to drive every week to meet with their off-campus classes asked to use the Optel system to teach their course. Approximately 10% of the faculty presently deliver their courses over the audiographic system.

4. The Pennsylvania Teleteaching Project. At the completion of the pilot project, the project director needed to recruit additional sites to participate in the statewide project. The Department of Education identified school districts that had previously sought assistance in serving rural schools and the project director and others who had participated in the pilot phase went to these school districts, demonstrated the technology, and described the Telelearning Project. This process yielded a sufficient number of sites for

the first year of the project. A more formal process has now been developed for selecting sites. The superintendent of each school district that wants to participate in the delivery or receipt of a particular course must complete a course proposal form. The forms for each course are then submitted in a single send/receive package to the administrator of the Teleteaching Project who, in cooperation with the Pennsylvania Department of Education, decides which proposals should be supported during a particular semester. Decisions are based on a number of criteria including whether or not the course is required for graduation, the number of credits, the involvement of more than one school district, the number of sections offered, and the level of support that the school is willing to provide (i.e., teacher preparation time, student or secretarial assistance for the teacher, and financial remuneration for the teacher).

5. Utah State University. Each extension center has a director who serves as a liaison between the population the center serves and the University. The center directors identify programming needs and inform the administrative unit that is responsible for off-campus instruction at Utah State (Life Span Learning, of which COM-NET is a part) of the needs. Discussions are then held with the departments and colleges that would provide the needed programming. Utah State is committed to off-campus delivery of primarily upper division and graduate course work that can lead to the completion of full degree programs, so an effort is made to get the department or college to commit to delivering a full degree program. After the department or college has made this commitment, it is the

responsibility of the department head or dean to recruit the faculty.

Discussion. The institutions studied fall into two groups: those that are still in the pilot project phase of their use of audiographic conferencing systems and those that have mature systems. In the first group are The Knowledge Network, The University of Calgary, Rochester Institute of Technology, Boston University School of Medicine, and SUNY-Farmingdale and in the second group are Louisiana State University, The Pennsylvania Teleteaching Project, Utah State University, and BOCES. During the pilot phase, institutions do not have any formal decision-making process in place for selecting particular courses or applications. Generally, the project director asks particular instructors to participate in the project, either because the instructor is known to the project director or because he or she teaches the subject matter that is needed at the receive site(s).

As the system matures, selection criteria begin to develop. Administrators come to understand what personal characteristics of the instructor contribute to a successful experience and what level of support is needed at potential receive sites. Generally the following criteria emerge:

* the need for a particular course

* the commitment of resources by the potential receive site

* the flexibility of the instructor

Any one of these criteria may be dominant at any institution, but all interact and none can be completely ignored.

D. Evaluations -- formal and informal

This section reviews the various evaluation reports and materials provided by each of the institutions surveyed. These vary greatly in type and scope and were a product of the internal evaluation needs of the institutions. They do not necessarily provide a systematic and thorough examination of all relevant variables. Further information relating to evaluation can be found throughout the section of this report entitled "Instructional Issues." Some references to evaluation can also be found in the section entitled "Project Management Issues."

1. The Knowledge Network. The evaluations conducted thus far have been qualitative in nature, based upon written and oral comments of three groups of users:

* students or participants
* instructors or tutors
* coordinators or administrators

The qualitative results are based primarily on reactions of the three groups of users to two basic issues: How easy was this technology to use? and Would you want to use it again?

The Knowledge Network project did not involve a large enough sample for researchers to examine learning outcomes in any meaningful way. This is an area targeted for more systematic evaluation as the use of the technology becomes more prevalent. The complete evaluation report for the Audio-Plus Project is presented in Appendix C. The evaluation reports for more recent applications were not available for inclusion in this report.

In general, instructors and students agreed that the visual dimension and capacity for interactivity with voice and data/image transmission provided by the Optel system enhanced the instruction. Some problems were encountered with adapting lessons to the features of the technology and all users expressed concern regarding the amount of initial instructor time required to develop and deliver lessons.

Two drawbacks of the Optel Telewriter 2-PC system that were identified by users -- the inability to run the Optel communications software simultaneously with computer applications programs (such as LOTUS 1-2-3), and the lack of still video transmission capability -- have been addressed in newer versions of the Optel software.

Based upon the results of the Audio-Plus evaluation, The Knowledge Network decided to commit its resources to support further work with the Optel Telewriter 2-PC technology. The qualities that recommended Optel to Knowledge Network administrators include:

* it is not activity-specific;

* it is based on readily available technologies;

* it requires only one telephone line for transmission of voice, graphics, data, and video

images thereby significantly controlling communication costs;

* the users can toggle back and forth between on-line and off-line use, allowing students to work on problems using the computer, invoking the communication system at the completion of their task;

* it is democratic -- each location can both initiate and receive;

* it is highly portable.

The two primary lessons that The Knowledge Network administrators have learned are:

* the applications should exploit the inherent power of the technology; the primary objective should not be to try to use the technology to emulate face-to-face or other delivery methods. The most successful application in this project was the use of the Colorado Video Slo Scan system for an art history course. The instructor was able to transmit images of particular paintings and art objects while she discussed them and could call up images that had been stored previously if she or her students wished to make comparisons between particular works of art.

* faculty must be adequately trained both in how to use the technology and in how to design effective instructional materials.

2. <u>The University of Calgary.</u> The University of Calgary initially used the Optel system to augment a print-based home study introductory statistics course. Students were asked to complete a questionnaire at the beginning of the course that asked about their expectations regarding the course and the Optel system. They indicated that they believed the major advantages of studying statistics through the Optel system would be: personal contact with the instructor; personal contact with other students; and pressure to keep up in the course. At the conclusion of the course, the students were interviewed to determine whether or not these expectations had been met. An overwhelming majority were dissatisfied with the level of personal contact with the instructor and with the other students, but did feel that the regular classes and fixed assignment due dates helped them to work at the course on a regular basis and to complete it.

The instructor found that the Optel system made supporting the delivery of the statistics course much easier and more convenient than either individual telephone tutoring or group audio-teleconferencing sessions. He was disappointed that he was not successful in making the sessions interactive and subsequently fell into the trap of lecturing. The majority of students was very dissatisfied as well with the style of presentation and the rate of pacing, and questioned the benefit of using materials on the Optel system that they had in their text and student manual.

In the following semester, a second instructor from the University of Calgary offered a staff development education course to a diverse group of educators and graduate students using the Optel system.

She had planned the course to be highly interactive, but found that the students were insufficiently trained to be able to use the technology in the way she had envisioned, and the site administrators were also inadequately trained so they could not provide assistance (see Section III, B for a fuller explanation). Student evaluations of the first several sessions were very negative. The instructor then decided to use the system as a glorified overhead projector to support her presentation and to provide information. Following this change, the weekly student evaluations were extremely positive. The instructor was very disappointed that she had not been able to use the system interactively. Student performance did not differ significantly from that of students taking the same course in a traditional manner.

3. Louisiana State University. During the Spring semester, 1986, two LSU researchers compared two approaches to the teaching of an education course to determine which produced the greatest student satisfaction. The two approaches were a traditional, face-to-face classroom and Optel-mediated distance delivery of the same material by the same instructor. The study revealed that "students using the computer telelearning approach rated the technique and instructor significantly higher than did students in the traditional face-to-face approach. Telelearning students appeared to appraise the instructor as significantly more successful than students in the traditional classroom setting" (Maxcy and Maxcy)[5]. The questionnaire items rated higher by

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[5] D.O. Maxcy and S.J. Maxcy, Computer/Telephone Pairing for Long Distance Learning, Journal of Educational Technology Systems, Vol. 15(2), pp. 201-211, 1986-87.

teleconferencing students than by traditional classroom students included instructor pacing, organization, and student participation. Maxcy and his colleagues have continued to do research on the impacts of this medium on instructors and students and have several articles pending publication.

Not all instructors used the system to encourage student participation or to present materials visually. One instructor, for example, could have taught his graudate course with only the audio teleconferencing system since he lectured throughout each class meeting and used the graphic capabilities of the system only to send lists of reference materials. Overall, the student evaluations for this course were not very positive. Most of the faculty who have taught over the system have not received training on how best to use the technology and on instructional strategies for distance education. The Dean feels strongly that this is a significant weakness and that, as a result, faculty have not used the system as effectively as they could.

LSU sometimes uses the audiographic technology to link an on-campus class with one or more off-campus classes. The reaction of the on-campus students is generally negative. In the case when the instructor is in the classroom with them, they are unable to see that they gain any benefits to offset the fact that they have to share their instructor with one or more distant groups of students. In cases where the instructor is not present with them, they resent being taught by someone who is not in the classroom with them. These students argue that they have made the sacrifice to come to campus and that they should be offered all the advantages of on-campus classes. The Dean feels that the technology can offer real advantages to on-campus students -- access by telephone to national experts on a particular topic, for instance -- and that these advantages have to be exploited by the faculty and made clear to the students.

4. <u>The Pennsylvania Teleteaching Project.</u> A qualitative evaluation of the Teleteaching Project was conducted by the Rural Services Institute at Mansfield University by its director, Dr. Dennis Murray, and his colleague Michael Heil. They concluded that teleteaching provided several benefits to the students, including:

* An opportunity to receive instruction in a subject area otherwise not available to them.

* Development of independent learning skills. Students had the opportunity to become active learners, not just passive recipients of information.

* Increased communication skills: listening, oral expression and assertiveness.

* Positive experiences with meeting and working with "strangers" in a mutual educational endeavor. Many students learned to cooperate and understand individual differences through their involvement in joint problem solving activities.

* Acquisition of enhanced self-esteem and self confidence.

The teachers who were involved in the project also benefitted in a number of ways according to Murray and Heil:

* Many teachers were stimulated and excited by the opportunity to pioneer new teaching techniques, to learn new technologies and to work in a team relationship with another teacher.

* Many developed more organized and better-planned class presentations and increased their communication skills.

* In one case, the associate teleteacher (who was present with the students in the remote site) learned the subject matter being taught well enough to teach it to another class later in the day. This school-based staff development was an unforeseen benefit of teleteaching.

* Several teachers found that they were able to cover more material in a shorter amount of time through teleteaching than in their traditional classroom. They attributed this to better organization and planning on their parts prior to each class.

The researchers made a number of recommendations that point to some of the less positive elements in the teleteaching project:

* More attention needs to be given to the relationship between the teleteacher and the associate teleteacher and to the roles of each team member. These individuals need to have the

opportunity to plan the implementation of the course together prior to the first class meeting and to periodically evaluate their progress during the semester.

* Teachers need adequate exposure to and training on the equipment and software and assistance with defining appropriate uses of the system in their course.

* Some teachers require communication skills training, particularly in regard to encouraging the distant students to participate in their learning and to become verbally engaged with the teleteachers.

* Teachers and teleteachers need to devise ways to bridge the gap between students at the different sites. Students who had an opportunity to meet each other face-to-face, or got to know each other in some other way, said they felt more comfortable participating in class.

* Students who are present with the teacher in the classroom need to be adequately prepared for the possible disruptions they might experience due to the logistics of teleteaching.

* Teachers should be consulted in the software development process. Many teachers have constructive ideas about changes in the software and the need for more documentation concerning the capabilities of the system.

The project director gathered quantitative data to evaluate whether the distant students performed as well as those on site in the classroom with the instructor. In the majority of classes offered during 1986-87, the distant students received somewhat higher grades than did their peers and in no instance were their grades appreciably lower. The project manager speculated that this is a result of the support that they provided each other and the fact that they assumed more responsibility for their own learning. (For more information on this part of the evaluation see Section III, D).

5. Utah State University. Alan Seamons, Director of COM-NET, has been involved in studies to determine to what degree faculty teaching styles and instructional techniques influenced student satisfaction and student performance in courses delivered over the COM-NET system. In one such study, he gathered data on teaching style and instructional methods from 37 instructors who taught 45 courses over the A-Net system during the Fall quarter 1985 and Summer quarter 1986, and on student satisfaction and performance from course evaluation forms and final grades of the students who took these courses (the complete study can be found in Appendix D). Some of the pertinent results of the study were:

* The COM-NET students were generally satisfied with their courses as measured by responses on the course evaluation form. The mean student satisfaction score was 3.27 (on a scale of 0-4) for all COM-NET courses as compared with the mean on-campus student satisfaction score of 3.5 for the same period.

* The COM-NET students performed nearly as well as the on-campus students, as measured by final course grades. The mean GPA for COM-NET students was 3.04 as compared with the mean on-campus GPA of 3.14.

* There was no measurable relationship between teaching style and student performance. Teaching styles were characterized on an organization continuum from random to sequential and on a processing continuum from abstract to concrete according to the Gregorc Style Indicator.

* Student satisfaction was higher with faculty whose test scores indicate they have high levels of spontaneity and adaptability (the Abstract/Random teaching style).

* There was a relationship between instructional techniques (discovery or expository) and student performance. Student performance was higher in COM-NET courses where faculty employed the discovery technique, engaging students in problem-solving and solution-seeking activities, than in other COM-NET courses where faculty employed the expository technique.

Seamons also collected written comments from the instructors that form the basis of a qualitative assessment of the COM-NET system. There were no negative comments about the system itself. Faculty were pleased with the opportunity the technology presented to teach classes to students in remote locations from the University campus. Many commented that they were certain their presentation would improve if they were to teach on the system a second time. They also suggested that they would benefit from training in how to adapt their courses to the COM-NET system and how to use the available modes of communication.

The instructors' negative comments had less to do with the system and more with the lack of administrative and financial support. Instructors felt that they were not adequately compensated for the additional preparation time required to modify their on-campus courses for COM-NET delivery, and many confessed to devoting less time to preparation than would have been ideal. Although they valued the teaching assistants in each class, many instructors stated that course delivery would be improved if there were a closer interaction among the TA's, the COM-NET office and the center directors.

Qualitative evaluation of the E-Net system led to its being abandoned. During the fall 1987 and winter 1988 quarters, the College of Engineering offered graduate engineering courses over the public television station. There were two potential audiences for these courses: the general viewing audience of the public television station and students seeking academic credit. Members of the general public could view the courses in their homes as they would any public television program. Students seeking academic credit came to the outreach center nearest their home where they viewed the broadcast and had access to an audiographic conferencing system (Optel Telewriter 3-PC) for two way communication with the faculty member.

There were also some students in the studio with the instructor.

Graduate engineering courses turned out to be poor programming for the general viewing audience. Even more significant, however, was the negative reaction of the faculty to the system. The instructors frequently froze up in front of the full-motion video camera and never felt comfortable with the equipment throughout the entire quarter. Although they had initially thought that full-motion video was essential for the delivery of their courses, their experience convinced them that it really was not. On the other hand, they were very impressed with the ability to bridge audiographic images (created using the Optel Telewriter 3-PC) into the broadcast video feed. The on-campus students were displeased since, in order to meet FCC broadcast requirements, the studio had to be very dark, which made them extremely uncomfortable. Based upon these reactions, and the expense of broadcasting over the public television station, the College of Engineering decided against using any technology to offer courses to students at a distance, at least for the time being.

Discussion. Each institution used different types of evaluation that ranged from simply asking instructors and students whether they enjoyed their experience with the technology to administering a series of inventories and correlating the results with student grades and interview data. The more complex research was done by individuals who are associated with the most mature systems (Utah State University, Louisiana State University, and the BOCES system). Nonetheless, it is clear that even in these systems there is room for much more systematic and rigorous examination of the learning process and learning outcomes.

All of the institutions did some type of evaluation of student and faculty satisfaction. In general, the most satisfied faculty were those who felt they had clear support from the individuals whom they defined as important (these might be the school principal, department chairperson, or significant colleagues) . Another factor affecting faculty satisfaction was their level of comfort and familiarity with the environment. At least in one case, when Utah State University used broadcast video in conjunction with the audiographic system, the teaching environment was so radically different from what they were accustomed to that the faculty chose to quit using the system entirely.

Virtually all the evaluators indicated that the faculty needed, and for the most part wanted, more systematic training. This training should not be limited to the technology, but should also encompass an examination of the learning environment, development of communication and presentation skills, and suggestions of ways to adapt courses for distant delivery.

The only comprehensive student evaluation was done at Utah State University. The dominant factor affecting student performance was the instructional techniques employed by the teacher. Students performed better when their instructors helped them discover answers and solutions on their own. The dominant factor affecting student satisfaction was the flexibility of the faculty member.

All the institutions reported that they found little difference in student performance (as measured by grades) between those students who received their instruction through the audiographic system and those who received instruction in a traditional classroom. In most cases, students were more satisfied with their experience when they felt they were getting individual attention. However, even when they said they were satisfied with their experience, students stated that, if given a choice, they would prefer taking their course in a traditional classroom than through an audiographic system, unless there was a much better instructor on the electronic system.

More information relating to evaluation can be found throughout the next two sections of this report that focus on project management issues and instructional issues.

II. Project Management Issues

These are the issues that are related to design and implementation. Individuals most closely associated with the day-to-day operation of each system provided the most insight into these matters.

A. Parameters of efficient and effective course delivery.

1. The Knowledge Network. All but one of the Knowledge Network-sponsored applications have been with small groups of learners (2 to 5) in only one remote location. The one exception to this pattern was a remote class of 16 students where one student sat at the terminal and all others viewed the computer data

and graphics as they were simultaneously projected onto a large screen. The student sitting at the terminal found the class very interesting. All of the others, however, were extremely bored and passive.

There was also only one trial where students were present in the same room as the instructor. In this case, three students sat beside the instructor and participated actively in the class, occasionally doing presentations to the students at the remote site. The instructor and the students felt that this arrangement worked very well.

The project manager at the Knowledge Network believes that the Optel system could be used ideally with a total of 20 students, equally divided among 4 or 5 locations. She is not supportive of trying to use it to teach students in remote locations when there is a large class on site with the instructor.

2. <u>The University of Calgary.</u> The University of Calgary has designed its teleconferencing system (including the Optel enhancement) so that the faculty member is alone in a small studio communicating with students in the various remote locations. In the first trial there were 19 students, located in 5 different sites and in the second, there were 17 students in 7 different sites. The number of students at each site ranged from 1 to 6. One instructor felt strongly that it is not possible to do small group-based interactive activities with only one student at a site, in spite of the fact that two small sites could be linked for this purpose. She recommended, therefore, that there be a minimum of four to six students at each site. None of those who have worked with the system at Calgary has

determined what the upper limit would be; the technician did feel that it would not be a problem to have as many as 10 students at one site.

3. Louisiana State University. Over the past three years, LSU has used the audiographic system in a wide variety of ways. Sometimes the faculty member is alone in Baton Rouge, communicating with one or more remote sites. At other times, faculty have students in the class with them while they simultaneously teach to students in off-campus locations. One economics class was taught to 25 students in a single off-campus site. The instructor commented that this was too large a group, particularly since the students were undergraduates who were not always attentive. In another instance, a teacher education course was taught to 24 students in six locations, including three students on-site with the instructor. No systematic analysis has been done to determine the ideal number of students overall and in each location.

4. Pennsylvania Teleteaching Project. Classes were offered in two different formats: either the teacher instructed a class in the room while simultaneously instructing one or more groups of students in remote locations or the teacher was alone in a small conference room instructing one or more groups of students in remote locations. The Teleteaching Project has linked three sites simultaneously; however, the usual model is to link only two sites. Up to 23 students have been in the classroom with the teacher and there have been as many as 12 students in a remote site. Typically, there were 5 or 6 students in each distant classroom.

Drawing on the varied experiences of teachers and students during the past year and a half, the project administrator recommended that there be no more than 35 to 40 students participating in a single course, and that there be no more than 10 students in each site.

5. Utah State University. The average COM-NET class has a total of 30 to 40 students distributed among 9 to 10 different sites. There are usually several students in the classroom with the faculty member, although this was not part of the original system design. One instructor had 25 students in the room with him and another 25 in the outreach centers, which caused some significant problems. The in-class students were resentful that they had to share the instructor with the remote students, and the instructor found it very difficult to pay attention to the students he could not see. Overall, the faculty reported that they like having some students in the room with them to gain visual clues about how well they are being understood.

All the faculty interviewed agreed that having only one or two students at a remote site was unsatisfactory. Groups of 4 to 10 students are best, since there is then some diversity in each group and the students are able to support one another. The faculty did not agree upon an overall limit to class size. One instructor found it very difficult to teach more than 30 students while another was comfortable with as many as 60.

Discussion. The number of remote sites and total number of students is dictated less by the technology than by the instructional design of the course. When the instructor uses the system primarily for one-way communication (e.g., lectures supported by graphic materials), then it is immaterial how many remote sites are in the network. The instructor can be as effective with one site as with a dozen. In this model, the maximum number of students at each site is dictated by considerations such as the ability of class members to maintain a quiet and controlled environment, or the presence of an effective on-site monitor. Finally, the total number of students is limited only by the amount of written materials that have to be read and graded and the time and resources (such as teaching assistants) the instructor has available for this task.

The majority of faculty prefer having some students in the classroom with them from whom they can get visual clues to determine whether or not they are making themselves clear and if the pacing of their presentation is appropriate. When the system is used non-interactively, it does not matter how many students are present in the classroom with the instructor.

If the system is used interactively, then different guidelines apply. All the instructors interviewed agreed that having a single student at a remote site is not very effective since the student either tends to dominate the interaction or to withdraw completely. Ideally, each remote location will have at least 3 students, but no more than 10. There need to be enough students in each remote location to allow for small group interaction, but not so many that individual students do not have ready access to the tools for interaction with the larger group and with the instructor (microphones, pen, graphics tablet, and/or computer keyboard).

The consensus is that there should be no more than 10 remote sites for the most effective interactive use of audiographic conferencing systems. However, none of the institutions included in this study had ever tried more than 10 locations at one time. The total number of students should not exceed 35 or 40.

Having students on-site with the instructor is not as critical with interactive use of the technology as it is for the non-interactive applications. If there are students on site, there should be no more than 15 or 20. If there are too many, then they tend to view the off-site students as interlopers in an already full class. If there is a smaller group on site, then they more easily perceive the off-site students as part of the class.

Decisions about class size are, of course, frequently influenced by economic and political factors and creative instructors have often used audiographic conferencing systems effectively with other than the ideal number of students and remote sites.

B. Level of support (financial and otherwise) offered to instructors

1. The Knowledge Network. Faculty involved in Knowledge Network-sponsored projects have not been compensated for the additional preparation time that use of the system requires. Since most of the projects have lasted for no more than one semester, the issue of additional compensation has not been addressed.

However, one faculty member indicated in his evaluation report, that if his institution decides to adopt the technology for regular course delivery, administrators "must expect to receive requests for considerable instructor preparation time which will have to be accommodated in one manner or another before programs get underway" (Jack Perry, NWCC).

The Knowledge Network provided faculty with access to a technician who set up the system at each site, spent several hours training each instructor in how to use the technology prior to the beginning of the course and who was on-call for troubleshooting. However, the technician was based in Vancouver, a considerable distance from most of the faculty who used the system. With sufficient lead time, he could arrange visits to the site during the term if the technical problems were significant. Otherwise, all consultation was done by telephone.

At all times when the system was being used for instruction a telephone bridge operator was present to facilitate the audio teleconferencing.

2. The University of Calgary. Faculty were not given extra compensation for their services when they worked with the Optel system. They were, however, given access to a full-time technician who would create all the screens they designed for their courses. The technician was able to work with instructors to decide how they might best meet their objectives, given the capabilities of the system. This technician also ran the audio bridge during each course. The bridge equipment is housed right next to the teleconferencing studio, and the technician and instructor can see each

other through a window. The technician was immediately available, therefore, to assist the instructor with any technical problems. The technician was also able to provide assistance to the students and site administrators by telephone. This level of technical support was highly valued by the instructors.

3. Louisiana State University. In addition to the regular extramural teaching stipend, LSU faculty are paid a one-time fee of $1,000 to compensate them for the additional preparation time required to adapt their courses to the Optel technology. They are paid $750 for preparation of each additional course that they adapt, on the theory that it takes them less time as they become more familiar with the capabilities of the system. Faculty are also paid a small premium for teaching to more than one remote site.

The director of the Extramural Teaching Division, the Dean of Continuing Education, and the first LSU instructors to teach over the system attended a two-day AT & T training program on strategies for teaching successfully in an environment where the instructor and students are unable to see each other. The course, originally created to support audio teleconferenced instruction, covered the following instructional strategies: lecture, tandem teaching, celebrity guest, interview, panel discussion, brainstorming, question and answer, reactor panel, buzz groups, group work session, role play, and case study. Subsequent telelearning instructors have not received this formal training. However, they are provided with written materials adapted from the AT & T program that contain many suggestions for planning and implementing the various strategies. They are also given written instructions for using the Optel system.

Each faculty member is offered the option of having a graduate student prepare the screens for their course. However, none of them has exercised this option. They are also provided with the services of the Optel technician who monitors each class from Baton Rouge. Some are very grateful for this service; others feel that it is not necessary and that the technician is more distracting than helpful.

4. Pennsylvania Teleteaching Project. Teachers who participated in the project during the 1986-87 school year attended a day-long (9:00 a.m to 3:00 p.m.) in-service workshop designed to introduce them to teleteaching and to begin their training. Following presentations about the project and the history of teleteaching, several experienced teleteachers provided tips on how to be effective as a teleteacher and how to develop a good team teaching relationship. In the afternoon, the new teachers were given a demonstration of the technology, information about the evaluation process, the logistics of interdistrict teleteaching, and the professional guidelines on teleteaching being developed by the teachers' union.

Teachers received individual hands-on instruction on the system after the phone lines and computers were installed in their particular schools. This frequently meant that they had very little time to really become comfortable with the technology before they were expected to begin instruction. Frequently, this hands-on instruction was done on the system itself, with the project manager conducting the training from Mansfield

University. He was assisted by the EMR special education class that had experience with the Apple-Dos system.

Teachers who began teleteaching after the 1986-87 school year, when project management shifted to the Riverview Intermediate Unit, were provided with less systematic training. One teacher was drafted to teleteach shortly before the beginning of the term, and was given an introduction to the equipment and software by a teacher in the same school who had used the system to teach a couple classes. The experienced teleteacher was very comfortable with the technology and used it well. However, the new teleteacher felt very inadequate and was very unhappy with her performance.

When they experienced technical problems, or had questions about the system, teachers could call the project manager, or the software developer on a toll-free line. No one was available on-site to handle technical problems.

During the 1986-87 academic year, teachers were paid $1,000 for the rights to each of their semester-long teleteaching courses. Eighteen teleteaching courses were produced that year.

In some instances, teachers were able to get some help in preparing the slides for their classes, usually from students who like working on the computer. In one case, a teacher arranged to give a few students academic credit for the work they did for him in preparing an introductory computer class. Usually, however, teachers did not have this kind of assistance and found that they needed to put in an enormous amount of uncompensated preparation time. In recognition of this, and similar problems, the Director of Basic Education from the Pennsylvania State Education Association worked with a participating district superintendent and a law professor from Mansfield University to draw up professional guidelines for the teleteaching project (see appendix E). These guidelines have been operational for the past two years. However, in the second year, no agency monitored compliance.

5. Utah State University. During the 1987-88 academic year, faculty who taught on the COM-NET system were paid $400 per credit hour on an overload basis. If more than 40 students registered for the class, the instructor was paid an additional $25 per student. Instructors who elect to develop an extended course syllabus, with learning objectives and detailed class-by-class outline, were paid an additional $50 per credit hour to compensate them for the time required to do so.

There is a teaching assistant in the classroom with the instructor and one in each of the remote classrooms. The TA who is with the instructor provides basic technical support for the system, and will troubleshoot any problems that arise. The TAs in the outreach centers are responsible for getting the class started, monitoring the equipment, proctoring exams, and providing any support the instructor requests. Since each TA supports several classes, in different discipline areas, they will not always be able to act as content resources for the students and most faculty do not use them in this way. One instructor did rely upon the TAs to lead group discussions at each site.

He prepared a set of questions, some appropriate answers, and instructions to help the TAs manage the weekly discussion sessions and was quite pleased with the results.

Graduate students on the COM-NET staff are available to create graphics and other materials for the instructors and an instructional designer is available to assist them in translating their course for COM-NET delivery and in developing extended syllabi.

The COM-NET director conducts an orientation and demonstration session for new and returning faculty prior to each term. Instructors share ideas and experiences and have an opportunity to try the equipment. Instructors who are unable to attend this session can arrange for an individual overview and demonstration. Each instructor also is given a manual with information about the system and distance education issues.

Discussion. A variety of types of support are available to instructors. These include additional compensation for preparation time, teaching assistants or student aides in each remote classroom, technical assistance, the services of an instructional designer, and training on the system. All of the institutions included in this study provided some level of technical support to the instructors. If they had technical problems, there was either someone with them in the classroom who could solve the problem, or they knew who to call for assistance. Several institutions also offered instructors the services of a technician who would create graphic materials for their classes.

However, relatively few instructors took regular advantage of this service, particularly after they became comfortable with the technology. No matter how much support they were given, the instructors all believed that they were not given enough compensated preparation time.

Utah State University has devised the most extensive support system for faculty of any of the institutions studied and The Knowledge Network offers the least support. The level of support services appears to be a function of how established the audiographic system is. Utah State University is one of the most mature systems examined in this study, while The Knowledge Network is one of the least mature.

C. Level of Support Offered to Students

1. The Knowledge Network. No formal mechanism was established to train students on the system. When the technician traveled to the site to set up the equipment, he spent an hour or so with the local contact (an administrator or technical support person) orienting them to the technology. If students were present, the technician instructed them how to get onto the system and how to use the pen. Otherwise the local contact provided this training. As the students used the system, their instructor provided them with additional training as the need arose. The Knowledge Network technician recommended that students be given more formal instruction covering 3 basic kinds of information: an introduction to computers and data

communication, an overview of how modems, phone lines, and operating systems work, and training on the Optel system itself.

Instructors and students used the mails to send homework assignments back and forth. When printers were available, instructors has students print out copies of the screens that were used during class for their future reference. Otherwise, the students called up the screens on the computer when they wished to review them.

No special student support systems were developed by users of the Optel technology in projects supported by The Knowledge Network. This is not surprising since these were only short-term trials, lasting no more than the length of a single semester, and since the Optel technology was frequently grafted onto an already existing distance delivery system, such as audio teleconferencing or print-based correspondence courses that had established student support elements.

In each of these projects, the participating institutions determined where the Optel system would be placed. In some instances, this resulted in less-than-ideal learning environments. In one institution, for example, the students were seated at a computer located in the middle of a very busy school library where groups of students came and went, conversing loudly. The class was held after school, and occasionally the custodial staff vacuumed the area during the class session. The instructor was not aware of the setting, and commented that there was frequently a great deal of background noise.

2. <u>The University of Calgary.</u> The students did not receive training in how to use the Optel equipment, nor was there a trained facilitator on site. The students were able to talk with the technician in Calgary who was operating the bridge and, as much as possible, he talked them through problems that they encountered. Nonetheless, the students were frustrated when they had to deal with technical problems and the faculty were also frustrated because they could not use the system as interactively as they had hoped to do. The majority of students in both courses had prior experience with audio teleconferencing and were familiar, therefore, with some aspects of distance education.

Students in the statistics course were participants in an existing distance delivery system and, as such, were able to take advantage of whatever support is built into that model (i.e., written source material and study guides, sending and receiving back homework assignments, etc.) In addition, the instructor encouraged the students to telephone him between class meetings with any questions. However, none of the students did so during the thirteen weeks of the class.

The education course was part of the core curriculum for a masters degree in Staff Development and was offered regularly on-campus. In adapting the course for distance delivery, the instructor put together packets of handouts and articles, color-coded for each class session, and had them mailed to the students by the continuing education office. Homework assignments were exchanged via mail and students had the option of ordering textbooks by mail as well. The instructor urged students to telephone her at her office or home with any questions, although few students actually did so.

3. Louisiana State University. One or two students at each remote site were given very basic instructions on how to use the Optel technology. These students were then the "designated communicators" for that site and were the only ones who used the keyboard and graphics tablet. There were no trained technicians at the off-campus locations. If students experienced technical difficulties, they asked the technician in Baton Rouge to talk them through the solution.

The disks containing the screens for each week's class and corrected homework assignments were mailed to the off-campus site. At the conclusion of the class, all of the newly-completed homework assignments were collected and were mailed, along with the used disk, back to the faculty member. This method has not caused any great problems for either the students or the instructors. On those occasions when the class materials were not ready far enough in advance to be safely mailed, the overnight mail service was used. The mailing costs in all cases were covered by the Extramural Teaching Division.

Each faculty member tried to visit the remote site(s) at least once during the semester to meet the students. Some made it a point to initiate the class from the remote site once every month. Faculty reported that this occasional face-to-face contact enhanced the dynamics of the class. No system has been widely employed to bring the students together. However, one instructor did build two field trips into the course, one near the off-campus site and the other in Baton Rouge. The students seemed to value this opportunity to see and get to know their classmates.

4. <u>The Pennsylvania Teleteaching Project.</u> Students in the remote sites had the continual support of the associate teleteacher who was present during each class and available throughout each school day. The associate teleteacher helped them print off copies of the screens, informed the teleteacher if they were having difficulty understanding what was being said, or if there was a technical problem at the receive site, and helped them make up the work that they missed. Ideally, the associate teleteacher created and maintained a good learning environment.

Since the associate teleteachers were not usually knowledgeable in the content of the course, students had to try to speak with the teleteacher if they had particular questions. Several students from remote sites mentioned they felt disadvantaged by not being able to speak with the teacher between classes, or before or after school, to discuss problems they were having. Some teleteachers set aside a portion of each class for answering questions or encouraged the students to call them during the hours they were not teaching. Several students reported that their schedules were not free during those times and that they couldn't contact the teacher after school since they had to catch the bus. during those times. Many of the remote students were also reluctant to ask questions during class even when they were told that it is perfectly acceptable to do so.

The teleteacher and associate teleteacher handled all the logistics of sending and receiving lesson disks and administering examinations. They also trained the students in the operation of the equipment and usually permitted the students to do the remote connections themselves. All lesson materials and lab equipment were normally available in the teleclassroom. In some instances students completed their assignments in normal school labs. The students were able to use the library resources and all student support services in their home schools.

5. Utah State University. The students taking courses through the COM-NET system were supported in a number of ways. Most visibly, there was a teaching assistant present during each class who took roll, distributed and collected assignments, handled book sales, and operated and managed the equipment. Each outreach center is equipped with a facsimile machine to support rapid, efficient hard copy communication between the instructor and the students, and with IBM PCs that are linked to the library for two way file services. AudioCcssette tapes are made for each class and can be used by students who missed the class or who wish to review. As the system has expanded to encompass different technologies and new sites, an effort has been made to build in as many of the support mechanisms of the original system as possible. At present, however, not all sites have the full range of services.

Instructors generally gave students their office telephone numbers and encouraged them to call if they had any questions or needed personal attention. The outreach center directors were available to provide information about other courses and to do individual counseling.

Discussion. The institutions that integrated their audiographic systems into existing distant education networks (in particular, Louisiana State University, Utah State University, and, to a lesser extent, The Knowledge Network, and The University of Calgary) had a number of support systems in place that were readily available to the students receiving instruction via audiographic technology. Both Louisiana and Utah had a network of education centers throughout their states that were set up for the off-campus delivery of instruction. The new delivery system did not radically change the kind of support that students required, nor the ways in which it was provided. The situation at The Knowledge Network was somewhat different in that their distance education system was designed for single learners in their homes. They did not have a network of education centers established with separate classrooms and support services, and the students involved in the audiographic projects were much less well served than those at LSU and Utah State. The University of Calgary offered the same type of instruction as the Knowledge Network (print-based self-study materials), but with the regular use of audioteleconferencing, had moved toward the education center model. As a consequence, they offered somewhat better support to the students involved in their audiographic classes than did The Knowledge Network. The three systems that operated at the high school level -- The Pennsylvania Teleteaching Project, the BOCES system, and the SUNY-Farmingdale project -- also had some critical student support systems built in.

None of the institutions had adequately solved the problem of student communication with the instructor outside of class time. None of the institutions made the audiograhic conferencing equipment available to students and instructors outside of class time. All the instructors told their students that they could call them at their offices during particular hours, and several even encouraged students to call them at home, but virtually none of the students did either. Utah State University has begun experimenting with asynchronous computer conferencing as a way to address this problem, and RIT, which has an extensive computer-conferencing network operating on their Rochester, New York campus, is also seeking ways to incorporate this into their audiographic system.

D. Types of Technical Problems Encountered

1. The Knowledge Network. The Optel Telewriter 2-PC system is designed specifically for an IBM XT or AT with a CM1 or 2 serial port and colour graphics adapter. The Knowledge Network supplied participating sites with the Optel Telewriter 2-PC software, Voice-Too modem, graphics pad and pen, but not with the IBM-compatible computer. This led to an enormous number of problems since all IBM compatible computers are not created equal and many required major adjustments to the boards and the program before they would work.

Several of the users complained about the fragility of the Optel pen and its tendency to freeze from time to time as well as the sometimes poor coordination between the Optel Telewriter 2-PC communications program and the Pendraw graphics program that produced a "system aborted" message for reasons that were not clear. They also found the system awkward to use for text-based applications (such as the teaching of Lotus 1-2-3 and Basic). The Optel Telewriter 2-PC system converts text pages to graphic or pictorial representations for its manipulation and transmission. When subsequently trying to return to text mode, the system frequently locked up, requiring a system re-start. In some instances, the system could be returned by re-programming the I/O ports, but on other occasions it required a complete re-boot.

One instructor complained that it took him over 20 minutes to get the system to print out a copy of a screen for the students in another site. He explained that the Optel Telewriter 2-PC software does not have a print function. It is necessary to run a second, resident program and transfer the screen into it for printing. Sometimes this worked and sometimes it did not.

2. The University of Calgary. The technician used a high speed modem to send screens to each of the sites prior to the class meetings. This required using a communication software package other than Optel Telewriter 2-PC. Sometimes the information was not present in each of the centers at class time. Either it was not received, or the material was lost when people played around with the equipment between classes. Neither the students nor the site administrators ever figured out how to retrieve the material.

One instructor was irritated by the poor performance of the Optel Telewriter 2-PC software for word processing. In particular, there is no word wrapping function, so it is necessary to watch the screen at all times and hit the carriage return at the end of each line to avoid typing over an existing line of text.

For the most part, technical problems were readily solved by the bridge operator/technician. However, there was occasionally a glitch that affected the simultaneous use of the pen and voice that the technician was not able to rectify. He attributed it to an incompatibility between the Optel software and the Darome speaker phones.

3. Louisiana State University. LSU experienced difficulties when using the University's bridging system for one course and federal telephone system lines for another. In the first instance, switching to an outside (Darome) bridge solved the problem. In the second case, the modem locked up repeatedly during one class and would not transmit data. In subsequent classes the problem did not recur. The technician speculated that the relatively low quality of the federal telephone system was responsible.

Another difficulty was traced to the fact that the control band of the Optel Telewriter 2-PC software can be triggered by a high pitched voice, causing the screen to clear. Similarly, if a student or the instructor spoke too loudly, the communications link was broken and the system had to be re-booted. During this break in communications, a STOP message appeared in the lower right hand portion of the screen. However, the instructors did not always notice the message right away, and were unaware for some time that communication with the other sites was broken.

Several instructors found it very difficult to do selective erasure of portions of the graphic image. To do so, they had to use the background color and retrace the line to be erased with the pen on the tablet while looking at the screen, which required excellent eye-hand coordination.

4. <u>Pennsylvania Teleteaching Project.</u> Almost all participants, even those with little or no computer background, noted that the TSN system was easy to learn and easy to use. Both versions of the software -- an Apple-DOS version for the Apple IIE and an MS-DOS version for the IBM compatible computers -- were effective for delivering instruction.

The project director reported that the Apple version was slower than the IBM, had less memory and file storage, and used 1200 baud modems as opposed to the 2400 baud modem of the IBM version. The Apple light pen was slower than the IBM light pen and frequently locked up, particularly during the very dry winter months. He discovered, however, that daily cleaning of the monitor screen and treatment of the screen and floor around the computer with an anti-static spray solved this problem.

Both versions of the software were able to perform in a nearly identical manner when operating on-line. Teachers could change lesson screens in one to three seconds at all sites simultaneously, using regular telephone lines, regardless of the distance. The MS-DOS lesson disk could hold 23 separate screens, which was usually enough for a single lesson. Because the Apple lesson disk could hold only 14 screens, Apple IIE users often needed to put a single lesson on two disks.[6] They found this easy to do, and were able to switch disks and activate the second series of screens within seconds. The system allowed users to display the screens in order, as one would a slide show, or call them up randomly. Not all teachers were aware of the random access capability and some complained that they found it awkward and time-consuming to go back one screen at a time to review an earlier image.

Users reported that in both versions, the light pen was awkward to use since it had to be used directly on the screen, which required the user to write on a vertical plane. In some sites this problem was overcome by employing a custom-build cart that allowed the monitor to be recessed so that the screen was on a nearly horizontal plane.

Two single business telephone lines were installed at each site to support the audiographic system. The Pennsylvania Teleteaching Project experienced significant difficulties both with the line installation and with subsequent performance. More than 60% of the line installations had problems that included dead lines, low voltage, reversed polarity, noisy or dirty lines from the school to the local telephone company, and wrong numbers. In many instances, the telephone companies provided inadequate service and support and made errors in billing, usually through charging federal or state taxes to tax-exempt entities (the participating schools and agencies).

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[6] Instructors who use systems that will store up to 99 screens per lesson disk, such as the Optel Telewriter 2 and 3-PC, report that they use between 25 and 50 screens per class.

Another source of technical problems was intentional sabotage of the system. In the pilot project, several instances of intentional sabotage were documented. In the Statewide project, 75% of the computers at the 40 sites were intentionally locked. No sabotage occurred at any of these sites; however, a variety of sabotage procedures were employed at the sites with unlocked computers. No computers were locked in 1987-88 and, again, there was evidence of sabotage.

To address this and related problems, the project director strongly recommended that a special room be selected as the teleclassroom in each participating school. Ideally, this room would be one that had not already been claimed by another teacher or other school personnel, to avoid possible staff resentment and room inaccessibility during certain hours. He has also recommended that each teleclassroom be acoustically treated to overcome room echo that caused problems with the wireless infrared remote mike speakerphones.

5. Utah State University. Instructors and students reported that they experienced very few technical problems with A-Net. This is the original COM-NET system and there has been sufficient time to work out the bugs. There are still occasions when a thunderstorm disrupts communication, or when the quality of the voice connection to a particular site is very poor, making it difficult to conduct class because of the necessity of repeating things.

Most of the technical problems with COM-NET arise when two or more of the systems are used simultaneously for a single class. In one instance, a hybrid system was created that used V-Net (two-way audio, and color slow-scan video) to reach some sites and the microwave system (two-way audio and full motion video) to reach other sites to deliver simultaneous instruction. During the first quarter, there was no direct communication between students using the two different systems. They could communicate only through the instructor who had to repeat questions and comments so that all students could hear. In the second quarter, however, the two systems worked well together, the quality of the audio was much improved, and the instructor was able to teach without having to repeat information several times. Other instructors had similar experiences with hybrid systems (V-Net and O-Net, and A-Net and I-Net), and reported being very frustrated initially, but satisfied after the technical staff had had an opportunity to work out the problems.

Discussion. The vast majority of technical problems arise during the early stages of any institution's use of audiographic technologies. The technical problems are very intrusive during these early stages, and often significantly disrupt the learning process. After the first year, the problems diminish and the technology becomes virtually transparent when it is used by experienced instructors. Technical problems resurface, however, if the system is changed in any significant ways. A case in point is the experience of Utah State University as technicians attempted to integrate the various components of the COM-NET system.

Because it is the major communication component, high audio quality is absolutely critical to the success of audiographic systems. Exclusive reliance on speakerphones has caused some problems. Students are unable to hear the instructor clearly and complain that they have to concentrate so hard on hearing that they cannot devote any effort to understanding what is being said. Institutions would be well advised to invest in good conferencing equipment and microphones, including a headset or other close microphone for the instructor. In addition, institutions should seek the support of their local telephone companies in troubleshooting audio problems.

All the institutions traced a significant number of technical problems to the users themselves. The instructors often did not fully understand the technology and either caused technical problems through their actions, or attributed their inability to perform certain functions to technical difficulties when this was not actually the case. If more instructors had involved students with interactive use of the technology, there would undoubtedly have been an even greater number of "technical problems" that could be traced to user errors.

III. Instructional Issues

These issues arise from the interplay between the technology and the educational process. In many ways they are simultaneously the most important and the most elusive of the issues examined in this report. Virtually all the information about these concerns was provided by the students and instructors and much is, of necessity, subjective in nature.

Instructional issues are less discrete than either organizational or project management issues. Instructional methods, content and interactivity, for instance, are all interrelated and there were times when a decision was made to discuss a particular finding under one rubric when, arguably, it could have been discussed under another.

A. Impact of the technological delivery system on course (or lesson) content

1. The Knowledge Network. In those cases where the audiographic conferencing system was used to enhance correspondence courses, the content of the courses was not affected by the technological delivery system. Each student had a complete instructional package consisting of printed materials, textbooks, assignment files and, occasionally, audio and video cassettes that provided all the course content. The purpose of the audiographic conferencing sessions was to provide a forum for group discussion and problem-solving.

When the course itself was delivered through the audiographic system, as with the computer applications course, the technological delivery system did have an impact. The instructor was unable to see his students' terminal screens while they were running the applications software. Because he had to have the students describe orally what they saw before them and then attempt to help them solve their problems on the basis of the oral description alone, he didn't have time to cover the material fully.

2. <u>The University of Calgary.</u> Both instructors found that they did not appreciably change the content of their Optel-delivered courses from that of the audio-teleconferenced or face-to-face delivery of the same subject matter. They did have to plan each class very carefully in advance to the point where they timed the interactive portions, and even did some limited scripting and rehearsing. They were somewhat less willing to "wing it" than they would have been in an audio teleconferenced course or in a traditional classroom since they had to coordinate themselves, the screens, the course materials, and the students. One of the instructors commented that he had to operate at two cognitive levels -- dealing with the content and communicating with students, and dealing with the mechanics of how to use the pen and pad. This was an extremely exhausting experience since it required such a high level of concentration.

3. <u>Louisiana State University.</u> The majority of LSU faculty reported that they organized their presentation better for Optel delivery than for traditional classroom instruction, but that the content of the course remained essentially unchanged. One faculty member commented that because he tried to get interactive communication going in his Optel-delivered classes, he was unable to cover as much material as he ordinarily would, which placed more of a burden on the students to be responsible for their own learning. However, he was pleased with his students' understanding of the material and felt that what was possibly sacrificed in terms of quantity of information

learned was offset by an increase in the students' depth of understanding.

A philosophy instructor was very concerned that the technology led him to focus excessively on concepts that could be reduced to iconic representation on the screen. After presenting a great deal of information in this manner, he found it was nearly impossible to change the nature of the discourse from the concrete to the abstract. He used an analogy to explain this dilemma -- A man goes to the motor vehicle department to renew his driver's license. At the first window he is handed a form to complete. He stands in line to hand in the completed form and to receive a copy of the written test. After his completed test is scored, he stands in another line to have his picture taken. When he has completed all of these tasks, the official asks him "What is the essence of driving?"

4. Pennsylvania Teleteaching Project. The content of courses taught over the audiographic system was nearly identical to that of the same courses taught in the traditional manner. Teachers commented that they were better organized for their telelearning classes. They had to plan at least a week in advance so that they would have time to prepare and mail disks to the remote sites.

Teachers of lab sciences had less control over the laboratory experiences of the remote students than that of students in their home school. Administrators of each participating school were expected to provide the necessary laboratory equipment and supplies and the associate teleteachers were responsible for setting up and monitoring the experiments. Since the associate teleteachers were not necessarily trained in the science being taught, they were not always able to provide the same level of support to their students that was available to those who were in the same school as the teleteacher.

5. <u>Utah State University.</u> The Dean for Continuing Education, Life Span Learning Programs has insisted that all extension courses be comparable to their on-campus counterparts and that the readings and texts be the same. The instructors who have taught over the COM-NET system, therefore, did not appreciably change the content of their courses. One instructor did have to change his course somewhat because he could not use films during his COM-NET courses. In his on-campus classes, he would show a film, stopping it periodically to discuss particular points. Another reported that he did not use as many guest speakers when he taught his course over the COM-NET system as he did when teaching the same course on campus. The system could have been used for guest speakers, but because the classes were taught during evening hours, and because many people are nervous when faced with new technologies, he did not feel comfortable asking them to participate in his COM-NET classes.

<u>Discussion.</u> Instructors typically do not change the content of their courses for delivery via audiographic systems. The technology so closely approximates the traditional classroom environment that the instructors usually find that they can teach the same material in virtually the same manner. It is also the case that many institutions require that the courses that are offered to off-campus students be directly comparable to those offered to their on-campus counterparts.

The technology does cause instructors to plan their presentations more thoroughly, which occasionally has an impact on course content. In their planning, the instructors may think more carefully about the objectives for each class session and, as a result, may cover different amounts or even different kinds of material than they have traditionally covered. This usually carries over into their traditional on-campus offering of the same course.

Those instructors who changed their teaching style to use the interactive capabilities of the audiographic system commented that they were able to cover less material than usual. This phenomenon was shown to be independent of the technology since it was repeated when they increased interaction in their traditional classes.

B. Impact of the technological delivery system on the method of instruction.

1. The Knowledge Network. Instructors who were experienced with using audio teleconferencing did not find that they changed their pacing for Optel delivery. However, instructors who were unaccustomed to teaching students whom they cannot see reported that they significantly altered the pacing of their instruction when using the Optel system. When they can see their students, they pick up clues to tell them whether or not the students are comprehending the material. When they cannot see the students, they wait for a voice clue or ask "do you understand?" This slows down

their presentation and causes them some frustration and anxiety.

In a related area, instructors of computer applications courses found that the technology limited their interaction with students especially when attempting to provide individual feedback They were able to see the students' work upon completion of assigned tasks but were not able to view the students' "work in progress."

2. The University of Calgary. Instructors of the two courses that had been offered using the Optel system prior to the site visit in Spring 1988 both rated the system as superior to straight audio teleconferencing and correspondence formats. However, each cited significant difficulties with their particular applications. One instructor used the system to support the delivery of an introductory statistics course. The course was designed as a home study course, augmented by thirteen 2-hour discussion and problem-solving sessions mediated by the Optel system. The instructor initially used the system in three ways: 1) to work through solutions to problems; 2) to present content in note-like, abbreviated form; and 3) to visually illustrate points of elaboration and to work through questions and problems spontaneously. Because the screens for the first two of these uses had to be prepared in advance, the sessions were pre-scripted to a high degree.

The instructor found, however, that it was extremely difficult to initiate and maintain interactive exchanges. The students did not seem to come prepared for class and the instructor's questions, and his request for questions from the students, were met with silence. As a result, he fell into using the sessions for lecture style presentations, that were not satisfactory from his point of view. "Some lecturing led to more lecturing and more apparent passivity among the students; and in addition this led to psychological pressure to cover all the course material - this, in turn, resulted in a rate of pacing that students found difficult to keep up with." (Shale) This instructor attributed much of the difficulty in initiating interaction to the subject matter rather than the Optel system. He explained that mathematical subject matter is mostly factual and inherently highly structured and is, therefore, much more amenable to question-and-answer than to discussion. In this class, the students were not all equally familiar with all the mathematical terms and symbols, so it was extremely difficult for them to find a common language for discussion.

The instructor who taught the education course also found that the technology required her to change her methods of instruction. She had worked with the technician to develop slides for each remote site with a different discussion question across the top and a box below the question for the students to enter their answer. She wanted the students in each site to work with one another (in cases where there were only one or two students at a particular site, they were to be connected with a mini telephone bridge with one or two other sites to form a small group of 5 or 6 students). Each group was supposed to discuss the question and to reach consensus on an answer. They would then make an oral presentation to the rest of the class while entering text or graphics on the screen. Unfortunately, the students were not trained sufficiently to be able to use the system in this way. As a result, the instructor had to abandon this instructional method and revert to using the Optel system as a glorified overhead projector.

3. Louisiana State University. Most of the faculty reported that they changed their instructional methods to a certain degree, but not dramatically, when using the Optel system. Instructors who were accustomed to lecturing continued to do so, although they were likely to develop some visual materials to enhance the lecture. Those who preferred to have students involved interactively in the traditional classroom devised ways to encourage this interaction in their telelearning classes. Whatever their style, the majority of faculty members said that they have to be better organized for their Optel-delivered classes than for their traditional classes and that they spend much more time in preparation.

One faculty member who has taught five different courses on the system still has never fully used the graphics capability of the technology. He does not prepare any slides in advance, nor does he have the students do so. He uses the tablet during class only to scribble notes and comments. However, he has altered his instructional methods considerably from the pure lecture mode with which he is, by his own admission, most comfortable. He consciously "changes gears" every 20 minutes, and tries very hard to promote interactive verbal communication. He said that he is enjoying teaching much more, partially because he doesn't lecture and can do such things as stage interviews between two historical figures and record them on an audio cassette, but also because he is teaching fewer students and is able to involve them more in what is happening in the classroom. He believes that he is becoming a better teacher, not only in the telelearning classes, but also in the traditional classroom.

Another faculty member who has had a considerable amount of experience with the system concurred that he is a better teacher as a result of his telelearning experiences. He said that he is much better organized and creates screens with particular objectives in mind. He does find, however, that he is less able to get abstract discussions started, both because he and the students cannot see each other and also because the use of screens leads to very concrete thinking on his, and the students', parts.

4. Pennsylvania Teleteaching Project. Most of the teachers found that they could easily adapt their usual teaching methods to the audiographic delivery system. The teacher with the most experience with the audiographic system used essentially the same methods to deliver the same material to his traditional classes and his teleteaching classes. His normal style is to lecture during the entire class period and use the blackboard extensively. In making the transition to teleteaching, he had only to put on disk the same information he ordinarily would write on the blackboard. The one difficulty he encountered was in the unit on graphing polar coordinates. The graph matrix was so complex that it was difficult to reproduce in full detail on the computer screen. The simplified matrix he was able to create for the

computer was fine to support the lecture, but not detailed enough for students to use in plotting their solutions. Both classrooms were equipped with picture phones that could be used to transmit still black-and-white images through the telephone line. The teacher mailed copies of the matrix to the remote students and had them hold their completed graphs up to the picture phone so that he could see whether or not their solutions were correct.

Another teacher, who characterized himself as very interactive, has devised ways to use the audiographic system to support his teaching style. For his introductory computer class he prepared screens as he would prepare overheads for his face-to-face teaching and used them to support the concepts he was trying to teach. He also devised ways to have the students help build these concepts and to apply them through discussion and problem-solving activities. He called on students by name, whether they were in the classroom with him or in the remote classroom, to answer questions or to come to the computer to complete various exercises (such as matching items from one column with items in another). The students then worked on the several computers in each classroom that are not part of the audiographic system to apply the concepts. The associate teleteacher was available to help the remote students with any problems that arose, and the teleteacher helped the students who are in the room with him. These methods worked very well when the associate teleteacher was able to maintain order and help the students in the remote classroom, but were much less successful when the associate teleteacher was unable to provide the needed support.

One teacher, who was given last-minute notice that she would be teleteaching, felt that she was unable to adequately adapt to the audiographic system. One of the limitations of the system that she found particularly onerous was the necessity of staying near the computer and the speakerphone. She was accustomed to moving around the classroom while teaching and found that she couldn't easily change this style.

5. Utah State University. Virtually all the instructors interviewed reported being much better organized for their COM-NET classes than for their traditional classes. One instructor said that he prepared discussion questions and gave them to the students in advance of each class. These provided the basis for class discussion and could be used by the students for review. Another said that he developed a workbook, giving week-by-week assignments so that the students would have a better understanding of the structure of the course and the requirements.

A faculty member who had been warned that he would not be able to use humor in his COM-NET classes as he had in his traditional classes was pleased to find that this was not the case. Because his humor is not visually based, he was not constrained by the system but was able to project the same personality to students who could not see him as he did to those in the classroom with him. It was not so easy for another instructor to establish the same rapport with distant students as she did with those in the classroom. She is very concerned with creating an aura in her classes that conveys the message that she is teaching to individuals rather than to an amorphous mass. To accomplish this when the students could not see her, she worked consciously on making her voice much warmer than usual.

On the whole, however, the COM-NET instructors did not radically change their instructional methods. Those who lectured in the traditional classroom did so in their COM-NET classes, using the graphics tablet as a blackboard and as few or as many visual aids as they ordinarily would. Those who were more inclined to involve students in discussions and projects found ways to get their COM-NET students similarly involved.

Discussion. The vast majority of instructors do not change their instructional methods significantly when they use audiographic technologies. Those who are accustomed to lecturing and using the blackboard or overhead transparencies find it particularly easy to make the transition. A few very good instructors do try to take advantage of the unique capabilities of the technology by staging audio interviews with historical figures, having experts participate in the class via telephone, preparing graphic materials that support small group problem-solving activities, and requiring students to make presentations or solve problems using the audiographic system.

Many instructors have difficulty making the adjustment to teaching students they cannot see. Sometimes they are helped by having photographs of the distant students to refer to, or, when the technology allows it, by teaching from each of the distant sites early on during the course. The faculty who had the fewest problems in this regard are those who had prior experience with audioteleconferencing.

All instructors reported that they had to be much better organized for the classes that they taught using audiographic technologies than for their traditional classes. Although this had its positive aspects, some instructors regretted the loss of spontaneity. Because they had put a lot of time into creating graphic materials for each class, they were eager to use them all, even if this meant they had to avoid following an interesting, but unanticipated, turn in the discussion. This problem was most acute for the novice user.

Two instructors had differing opinions about the effect of the audiographic technology on their use of humor. One, whose humor is essentially verbal, found that he could continue to incorporate it into his presentations. Another, however, felt inhibited by his inability to "be theatrical" as he put it, since his theatrics were visually based. His presentation suffered as a result and he recognized that he would have to devise an acceptable, non-visual, means of being theatrical. Another visually based medium -- film -- was sorely missed by at least two Utah State University instructors. In their traditional class they would show a number of films, stopping them at particular points for discussion. The Utah State system does incorporate video cassette recorders. By transferring the films to tape, the instructors could have used them in their COM-NET classes.

C. Impact of the technological delivery system on interactivity

1. <u>The Knowledge Network.</u> The integration of Optel into the existing correspondence and audio teleconferencing courses changed the instructional environment and the nature of student interaction. Students were no longer sitting at home, isolated from other students. They came together in small groups at designated learning centers to participate in the Optel-delivered lessons. Students and instructors alike indicated that this is a positive aspect of their experiences with the technology.

Instructors commented that the necessity of preparing the majority of the lesson screens in advance resulted in the "pre-programming" of instruction and sometimes led to a decrease in spontaneity during the lesson itself. The instructor had to try to anticipate which particular problems or issues the students might wish to discuss and then prepare materials to foster that discussion. This was fine as long as he or she guessed correctly, but served to squelch discussion of those problems or issues that were unforeseen.

The quality of the audio element of the system also had a major impact on the instructional process. When the audio quality was particularly bad, instructors resorted to communicating exclusively by means of the computer and graphics tablet. The level of instruction deteriorated under these circumstances and users of the Optel system were adamant about the importance of using high quality audio equipment, including a headset for the instructor. Some recommended using headsets for the students as well, but expressed concern about how this would affect the interaction among students at each site.

As it was configured, the Optel system could not access data banks. One instructor found that this inhibited students' interaction with resource materials. He would have liked to access articles of topical relevance, download them into his computer, and send them to the students at the same time he was transmitting other support materials.

2. The University of Calgary. The experiences of University of Calgary instructors described in section III, B above seem to support the premise that this technology adversely affects interaction between students and the instructor and among students. However, on close examination it becomes clear that it was not necessarily the technology that caused the decrease in interaction. In the statistics course, the instructor cited the subject matter and the unequal levels of student preparation as the primary obstacles to interaction. In the education course, students were not trained sufficiently on the equipment to be able to participate as the instructor had planned.

3. Louisiana State University. Not all sites in the LSU network were equipped with graphics tablets, which limited in-class interactivity to oral exchanges or computer text entry whenever one of the tabletless sites was involved. One student at each site, the "designated communicator," entered all the data for that particular site. These students were not provided any particular training on the system and were not called upon to do anything very complex. The majority

of time, it was the faculty member who used the graphics capabilities of the system.

Interaction, when it did occur, was usually oral. Some students said that they did not participate in discussions because of their unwillingness to speak into the microphone. Others said that it was very difficult to interject questions while the instructor was lecturing, particularly if the instructor did not pause between sentences, paragraphs or ideas. Students then missed much of what the instructor was saying as they began listening hard for pauses long enough to allow them to break in with a question.

4. Pennsylvania Teleteaching Project. In many instances, the teleteacher was in front of a large class (up to 23 students) and was simultaneously instructing a small group of 5 or 6 students at one or more distant locations (not exceeding 4 sites and 35 students in all). The large number of students, and the fact that each classroom had only one set of equipment, served to limit interactive use of the technology. One teacher, for instance, said that he would have liked to assign specific homework problems to students and have them prepare screens outside of class illustrating how they would solve the problem. They could then present their solution to the entire class. He felt that this was unworkable for the majority of students since there was only one system in his school and that was stored in his classroom, a room that was used every period of the day.

Students who were in the remote classroom were often unwilling to ask questions because they "felt funny" trying to interrupt and were worried about appearing stupid to the students in the other schools. Many of the students were not used to using computers and felt intimidated by the technology.

5. Utah State University. When A-Net, the first network of the COM-NET Services, was designed it was made to be completely interactive. Each site was equipped with 2-way audio, 2-way print, 2-way writing boards, and 2-way black and white still frame video. The vast majority of instructors used only the voice element interactively during class, and the print element (facsimile machine) noninteractively outside of class time. While the instructors regularly used the writing boards to support their own presentations, they almost never asked the students to use either the writing boards or the still frame video element.

In response to this information and the higher costs associated with fully interactive systems, the designers of the COM-NET system retained the requirement that there be interactive audio and interactive facsimile in any new networks they developed, but abandoned the requirement for full interactivity. The V-Net and M-Net, therefore, do not have interactive video and graphics and any hybrid system of which they are a part also lacks this level of interactivity. O-Net, on the other hand, is fully interactive, but it is infrequently used for credit instruction as part of a hybrid system where the level of interactivity is defined by the lowest common denominator, thereby limiting interaction to voice and facsimile.

Even when interaction was limited to voice, instructors reported that they found it difficult to get discussions going without the visual cues they were used to. One was successful in using the teaching assistants at each site to lead group discussions for 20 minutes at the beginning of each class. The groups worked independently, but could call the instructor if problems arose. Another made every effort to create a relaxed environment and to motivate students to participate. During each class she kept track of which sites she had heard from and called directly on those that had not participated. She found it more difficult to instigate interaction between sites during class since the students did not know one another and had no way of communicating with each other outside of class.

The COM-NET designers had considered establishing an electronic mail system so that students and instructors could communicate between classes. However, the majority of faculty and students were uncomfortable using computers in any way diferent from the particular audiographic applications for which they were trained, so facsimile machines were chosen instead. These are used primarily for sending and receiving assignments and examinations and not for student/student or student/faculty communication. E-mail capabilities are incorporated as part of the I-Net library access system on a limited basis.

Discussion. Every one of the institutions studied chose to use audiographic technologies because they allow for full aural and visual interaction between sites. Very few instructors, however, took full advantage of these capabilities, for a number of reasons. The primary reason was that many of the instructors were not accustomed to teaching in an interactive way in the traditional classroom and they retained their basic instructional style when they used the audiographic system. If they were not encouraged to adapt their teaching style for distant delivery, they generally continued to do whatever they were most comfortable doing in the traditional classroom, even after teaching on the system more than one or two times. However, if they were encouraged by other faculty, instructional designers, or administrators to use a more interactive teaching style, they often did so and generally the students were more satisfied. The instructors frequently carried this more interactive style back into their traditional classrooms.

A lack of training and familiarity with the equipment on the part of the students also hampered interaction. At Louisiana State University several of the students interviewed said that they were reluctant to use the touch-to-talk microphones so they did not participate as fully in discussions as they would have done in a traditional class. The students at The University of Calgary were unable to complete the small group activities that the instructor had planned for them because they did not know how to go on- and off-line or how to enter information onto the screen.

Faculty at Boston University School of Medicine encountered cultural factors that inhibited interaction when they taught a group of Chinese students. In China, teachers are <u>the</u> authorities who, in teaching, pass on truth to their students. The students cannot have anything worthwhile to contribute to a discussion and to ask questions implies that the teacher has failed to convey the information clearly. So when the

Boston University doctors asked their Chinese students for their opinions or questions, they were met with silence.

More subtle cultural factors are operative in all classrooms through the conventions that have been used for years to govern interaction. When the students and instructor cannot see each other, the conventions of raising one's hand to be recognized, or putting a puzzled expression on one's face, will no longer work. Instructors have to establish clearly what the new conventions are in order to encourage interaction. One of the most successful teachers in the BOCES audiographic network, Michael Foor-Pessin, devised a simple method that was very effective. If a student had a question, or wanted to participate in the discussion, he or she would use the graphics tablet to write an X on the screen. The instructor would circle the X to let the student know that the request to talk had been recognized. At the next break in discussion, that student would have a chance to talk.

Several institutions found that the use of audiographic technologies enhanced interaction irrespective of the instructor's style. At the Knowledge Network, students who in the past would have completed the print-based self-study courses in isolation, came together in small groups for the discussion and problem-solving sessions. They found that this helped them to pace themselves and put them in touch with classmates with whom they could study. In Pennsylvania and New York, the students in rural high schools were exposed to their peers in other schools in an academic setting for the first time, which they found to be both stimulating and challenging.

D. Effect of the technological delivery system on the quality of instructor's performance

1. <u>The Knowledge Network.</u> Each instructor used the audiographic system for a single course lasting one semester at which time the equipment was moved to another location. Most instructors felt that they were less well prepared to teach via Optel than in their usual audio teleconferencing or traditional classroom delivery mode. This was due to the length of time required to prepare screens in advance and the difficulty of using the Optel tablet as a blackboard (it is cumbersome to draw on the tablet while looking at the screen and it takes too much class time to transmit the completed screens). In the two physics classes for instance, both instructors found that students invariably had questions about a problem for which they had not prepared a screen in advance. The instructor then had to attempt to prepare the screen as he talked through the problem, or had to rely solely on audio communication. Neither of these alternatives was completely satisfactory. The history instructor usually incorporates maps into his lessons but was unable to do so with the Optel Telewriter 2-PC because of the amount of time required to draw the maps and translate them to screens.

In addition, they contended that they were not given sufficient training in how to use the system, or enough time before the beginning of their project to become familiar with the technology. One faculty member estimated that if an instructor was not already trained to do audio teleconferencing, he or she would need about six weeks of training and practice. For those with previous teleconferencing training and experience, two weeks with the Optel technology would suffice. Another instructor, who is proficient in computer use, said that he would have liked at least 10 hours of practice after introductory training on an operating system.

Instructors who attempted to use the graphics pad as they would a blackboard found that they are unable to do so but instead had to prepare visual materials in advance and transmit them to the remote sites prior to the class time. This resulted in a substantial increase in preparation time. One instructor estimated that for a regular class he spends the equivalent of the length of the class in preparation time. With the Optel-delivered instruction, he spent the equivalent of twice the length of the class in preparation time.

2. The University of Calgary. Both instructors felt that they had not done as good a job as they had hoped. Each had taught courses successfully via audio teleconferencing, and had seen the addition of graphics as a very positive enhancement. They spent a great deal of time before and during the course working with the technician to create the screens and in thinking about how they could encourage interaction with and among the students. Each was comfortable with the equipment and felt well supported by the on-site technician. However, the students were provided with insufficient training and information which, the instructors felt, contributed directly to the quality of the instructors' performance. As one of the instructors indicated, it is "essential to provide

students with sufficient information to temper the expectations they bring to the situation. At a minimum students need to be aware that despite many similarities, telewriting sessions are different in important ways from going to a traditional class" (Shale).

The instructors put in an enormous amount of time before the course developing screens (nearly 200 for the statistics course, and about 60 for the education course) some of which they either did not, or could not, use. The advanced planning that the system required made it difficult for one instructor to avoid feeling as if he had to "get through" a certain amount of material in each class session, which he believed to have a negative effect on his performance.

3. Louisiana State University. Most LSU instructors were pleased with the quality of their performance and several stated that they are better teachers when using the telelearning system than in the traditional classroom. The Dean, however, felt that more of the faculty should modify their delivery systems to make the telelearning classes much more interactive. He contended that the faculty have been given too little guidance and encouragement to restructure their courses and that, as a result, the overall quality of instruction is lower than it could be.

4. Pennsylvania Teleteaching Project. The project director commented that almost all the principals noticed an improvement in the performance of teachers who were involved with the teleteaching project. The teacher who had been associated with the project the longest was very positive about the audiographic system

and about his ability to teach effectively using this technology. He reported that he had a new enthusiasm for teaching and that the opportunity to teleteach led him to postpone his retirement for a couple years. Another teacher, who had had limited experience with the technology and who was given very little time to prepare for her teleteaching class, reported being dissatisfied with the quality of her performance.

5. Utah State University. Many COM-NET instructors expressed concern that they had too little time to prepare as adequately as they would have liked for their COM-NET courses. This lack of time adversely affected their performance, particularly the first time they taught a particular course on the system. Several instructors commented that their performance improved each time they taught a COM-NET course because they knew more what to expect and were less nervous about the technology. They also characterized themselves as better classroom teachers. "Better" in this case refers to both organization and presentation. Faculty who teach over the COM-NET system generally organize their courses more tightly over time and become more interactive in their presentations.

Discussion. At institutions such as Utah State University, where instructors are regularly encouraged to teach interactively and are given support to do so, the instructors consciously evaluate their performance on the basis of the level of interactivity in their classes. At other institutions, where interactivity is not a stated value, instructors are more likely to judge their performance on the basis of the degree to which they are able to replicate their usual classroom presentation and become comfortable with the technology than on the level of interactivity in their classes.

Instructors at every institution commented that it took them much more time to prepare for their courses for audiographic delivery than for traditional classroom delivery and that they could have done better if they had had more time. Those who have used the system to deliver more than one course felt that their performance improved the second time around. After they became more comfortable with the technology, they could begin thinking more creatively how best to conduct their classes.

In several cases, instructors feel they are better teachers as a result of their experiences with the audiographic technologies, and that this carries over into their regular classrooms. They are better organized and, because they have had to assess (or reassess) what it takes to be a good teacher, they have developed more effective teaching styles. The lack of direct visual contact with their students has also forced several instructors to improve their communication and listening skills.

E. Effect of the technological delivery system on the quality of student's performance

1. <u>The Knowledge Network.</u> To date, the number of students involved has been too small for Knowledge Network researchers to draw any conclusions about student learning outcomes. However, anecdotal information suggests that students perceived that the quality of their performance was higher than in a

correspondence course where contact with the instructor is not systematic. Students who had experience with audio teleconferencing indicated that the addition of a visual dimension enhanced the instruction. They gave mixed assessments of their performance in the Optel-delivered course compared with that in a traditional classroom.

2. The University of Calgary. In their evaluations, students who took the statistics course indicated that they did not value the problem-solving sessions very highly. They were dissatisfied with the limited interaction with the instructor and with the other students and were irritated that the material appearing on the screen duplicated what was in the print package they had already received. Many felt that they could have done as well studying on their own at home. Eleven of the students had previously taken a course via audio teleconferencing and had found that experience to be very satisfying partly because of the opportunity they had to work with other students who were studying the same material. The technology, the subject matter and the different levels of mathematical preparation and anxiety of the students may all have contributed to the negative evaluations.

Students enrolled in the education course, on the other hand, positively evaluated the Optel-mediated sessions after the instructor abandoned the effort to have them use the technology interactively (see Section III, B). They indicated that the method of presentation had a positive effect on their learning.

3. Louisiana State University. During the Spring semester, 1986, a faculty member taught the same course

at different times to two groups of students: one group was taught via the Optel system and the other in a traditional face-to-face setting. At mid-term, students in both groups were asked to complete a questionnaire to determine their impressions of the course and the instructor. Students in the telelearning course gave much higher ratings on items asking their overall impression of the course and the instructor, instructor pacing, organization, and student participation than did those in the traditional classroom. The instructor/researcher speculated that the strong sense of comradeship the telelearning students developed, and their inclination to help each other answer questions and frame generalizations, may have had a positive effect.

Anecdotal data from other students and faculty members is somewhat less positive than this research would predict. One group of students in Baton Rouge, who were taking a course taught by a faculty member based in New Orleans with another group of students, gave very mixed evaluations of their experience. Several indicated that they believed their performance suffered (although the instructor said that the students in the remote site were performing a little better than the students who were in the classroom with her), that they had a very hard time paying attention to the instructor since they could not see her, and that they had to make a much greater effort to learn in this class than in traditional classes. They did like the more relaxed atmosphere of the telelearning class, however.

Other instructors reported that in general the distant students said they preferred having the instructor with them in the classroom, but that they found telelearning acceptable when that was not possible. There does not seem to be any direct correlation between student performance and method of instruction (telelearning or traditional classroom) at LSU.

4. <u>Pennsylvania Teleteaching Project.</u> The project administrator has gathered statistics each semester that he contends show that students in the remote classrooms performed better (i.e., earned higher grades) than their peers who were present with the teacher. The data does not include information on how many students are included in each sample, nor whether all students had the same opportunity to enroll. In one school at least, the students described a competitive admission process into the teleclass based on grades and work habits.

The students reported that they had to work harder when they were not in the same room as the teacher, but did not look upon this as negative. They concentrated very hard on the computer screen and tried to write everything down so that they wouldn't miss anything (in spite of the fact that they could print out the screens for review). These students felt some competition with the students in the other site(s), but not with each other, which they found to be a pleasant change from their usual experience. They formed study groups and helped each other out. This phenomenon happened both among groups of students whose teachers had interactive styles and whose teachers did not systematically encourage interaction.

The students who were present with the teacher in the classroom also had to concentrate to avoid missing any of the information that was presented on the screen. In one large classroom where there were many students viewing a single 25-inch monitor, the students seated near the back of the class reported having difficulty seeing the material on the screen, a problem that the teacher did his best to correct by creating larger graphics, and by changing the location of the monitor, and adjusting the light level in the room. Some of the students noted that they took much better notes in the telelearning class than in their other classes. In one class, where the teacher primarily lectured, students complained that they found it very monotonous to come to class every day and stare at a monitor.

5. Utah State University. The attrition rate[7] of students taking courses via COM-NET is low due to the programming of full degrees. Those students who complete their courses perform as well or better than the traditional on-campus students. Since the COM-NET students tend to be older and more mature than traditional students, they are often more faithful about doing the reading and homework assignments. They also are frequently taking courses to meet certification or other professional requirements so their motivation is very high. The opportunity to take these courses in locations that are geographically convenient more than compensates for the lack of face-to-face instruction.

[7] Utah State University is the only institution among those studied that provided any information about attrition rates. This would be a fruitful are for further research.

In interviews conducted by staff of the Kellogg Center for Adult Learning Research, Montana State University, the feeling of most students was that the instructor was much more important than the delivery mode. "Characteristics of the good professor frequently mentioned were an awareness of how to use effectively the delivery system, ability to give practical application to the content, willingness to help individual students, and, of course, interesting, organized, involving approach to teaching" (Fellenz, Blackwood, Seamons).

Discussion. The use of audiographic conferencing systems for instructional delivery had no effect on the students' performance as measured by comparing grades with other students in traditionally taught sections of the same classes. The environment in which the students receive their instruction does affect their attitudes about the classes. The most salient affective elements include: the level of ambient noise in the classroom, clarity of the audio component, ability to easily see and read the graphics, availability of technical support, and the ease of reaching and using the equipment (microphones, computer keyboard, graphics tablet, etc.).

In addition, the students need a mechanism for sending and receiving written materials and a way to reach the instructor outside of class time. Students also requested easy access to support services (advising, library materials, registration services, etc.).

Some students reported having a harder time paying attention to a screen than to an instructor in front of them. Others, however, said they found it easier to concentrate since all of their attention was focussed on one spot (the screen) and they were less easily distracted than in a traditional classroom. This comment was made by students who were in the same room as the instructor as well as those who were in remote sites. The style of the instructor did not seem to be a relevant variable in this regard.

Students who recognize that they are benefitting from the use of the technology (e.g., they are able to take a course they otherwise would not be able to take, they are being spared a long commute, they are getting individualized attention, etc.) will make allowances for less-than-ideal learning environments and will perform as well as they would in the traditional classroom. However, given the choice, nearly every one of them would elect face-to-face instruction unless there were a superior instructor on the audiographic system.

SECTION III

CONCLUSIONS

The number of experimenters with audiographic networks for educational course delivery is growing each year. Most of these pioneers have not had the benefit of the information gathered by their predecessors. The general result is that each of these experimenters is carrying out his or her efforts in isolation. This isolation has both positive and negative effects. On the positive side, innovative and creative solutions to problems develop. It is unlikely that this would occur if the experimenters were aware of how others had solved the same types of problems. However, on the negative side of this situation, the same problems have to be solved over and over again. Not all institutions are able to come up with good, workable solutions to some of the typical problems, and consequently whole projects are abandoned.

While we do not wish to stifle creativity, it does seem that having guidelines on which to base some of the decisions involved in setting up an audiographic network would be very useful. On the basis of the information we gathered from the institutions we contacted, we have developed a picture of what seems to be working.

There are three major areas of concern that affect the success of an audiographic network: administrative issues, the faculty's use of and satisfaction with the system, and the students' use of and satisfaction with the system. We have extracted some generalized principles and information that can have a critical effect in each of these areas. Based on this information, anyone considering the implementation of an audiographic network can devise a development strategy that has a higher probability of success than would otherwise be the case.

Administrative Issues

The most successful projects have all developed in institutions faced with acute problems of needing to deliver their courses to distant sites, and being forced to find technological solutions. The less successfully developed projects have resulted from the desire to experiment with new technologies and the problem becomes finding an institutional use for the audiographic delivery system.

One reason why the former situation results in more successfully developed projects, is that the need itself is an obvious justification for the start-up costs. However, most schools still need some level of outside funding to finance the start-up costs of their audiographic networks. These start-up costs include purchasing or renting some or all of the following: the audiographic equipment itself, the audioconferencing equipment, personal computers, cables, optional video recording and playback equipment, optional camera stand for creating digital screens, and cabinets for all the equipment. The start-up also involves: initial telephone line setup charges, salaries and travel expenses for technical support personnel, a lot of administrators' time, and ideally some initial extra compensation for the faculty involved in the project.

State, provincial, federal, and intra-institutional grants, as well as corporate sponsorship can all be sources for the initial start up funds. Once the project is started, however, there are on going costs that must be considered. The largest of these ongoing costs is salaries for personnel who support the project. The most successful schools offer some level of technical assistance to the faculty for preparing the materials for the courses, and some level of support for the off-campus students. If a school is not already working with off-campus students and providing registration, academic advising, library access and similar services to them, these support services will have to be developed.

The next largest ongoing cost for an audiographic network is the communications charges. If there is only one off-campus site then the only charges would be for the telephone line or lines depending on the type of system used. As soon as multiple sites are linked, then a telephone bridge must be used, and if the institution does not have its own, a commercial bridge will have to be employed.

In addition to the expenses of the equipment and the communication charges, an audiographic network cannot be run without extra cost to an institution that is not already delivering courses to students at a distance. These extra costs are for the development of student and faculty support services. The cost of adding an audiographic component to a delivery system that already uses audioconferencing or live, full-motion video to reach students clustered at learning centers is not too much more than the actual cost of the equipment.

Other operational costs are very similar to those involved in any distance learning situation. Examples of these are: the costs of transporting homework and tests back and forth between the faculty and students, local site administration, and faculty compensation. These costs can usually be met by the same support structure used for teaching any ordinary class (i. e., student fees or tuition, state or provincial student support funds).

In general the audioconferencing option is currently the lowest cost alternative for distance delivery of real-time, interactive classes that include both voice and a visual component. A complete send and/or receive station can be put together for well under $10,000. To accomplish the same range of high-quality communication with regular video systems, the individual stations (or studio-classrooms) are at least triple that amount. The communication charges are also radically different. The audiographic systems require simple analog telephone lines, while the television alternatives require construction of cable or fiber optic links and/or microwave towers, the renting of expensive satellite transponder time, or the purchase of digitalizing and compression equipment as well as the rental of higher capacity telephone lines. An estimated comparison of simple communication charges between an audiographic delivery system, a microwave delivery system, a compressed digitalized video delivery system, and a satellite delivery system was developed at The University of Maryland.[8] If the audiographic system is used as a baseline, compressed video delivery would cost four times more, microwave delivery would cost six times more, and satellite delivery would be eight and half times the cost of audiographic delivery.

Faculty Issues

It is not surprising that faculty members who volunteer to teach on an audiographic system are more satisfied and

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8. This model was originally put together by Dr. R. L. Larsen from The University of Maryland System's Central Administration in February, 1988.

more successful than faculty who are assigned to teach on the system. It is also the case that the volunteers who are given greater amounts of preparation time seem to feel better about their performance than those with less time. Other critical variables that affect the instructors' attitudes include: availability of on-going technical assistance, help in "translating" their courses into distance modes, prior practice on the system, good quality audio equipment, administrative or peer recognition for their efforts, and the level of training that the student users of the system have had.

Almost all the faculty prefer some formal training sessions that include information relevant to encouraging interaction with students at a distance. All faculty spend more time preparing for the audiographic classes than they would for a traditional class. Those faculty who begin to change from straight lecture style classes to include more interactivity with their students report enjoying teaching more. There is also a tendency for these changes in teaching style to generalize to the traditional classrooms as well.

There are some unique and sometimes difficult elements of audiographic teaching to which faculty must adapt. One of these is the lack of eye contact with distant students. Since eye contact is one of the ways an instructor is usually aware she or he is being understood, other ways of getting feedback must be developed. Some suggested alternatives are to pause frequently to allow students to ask for clarifications, to ask students specific questions that will give feedback on understanding, and to begin listening for changes in students' voices that give indications of levels of understanding. Most instructors do prefer having some students in the classroom with them to give them some traditional feedback cues.

Another difficult element is the students' reluctance to use the microphones or otherwise interrupt the instructor in order to ask questions. In addition to student training sessions set up and run by the network administrators to help the students overcome this tendency, the instructor must take an active role. He or she can help the students develop classroom conventions for asking those questions. Two conventions that seem be useful are:

1. The students says, "Question." The instructor then verbally responds to the student and lets him or her know to wait a moment or to go ahead and ask the question. The student then identifies her- or himself and the location and asks the question.

2. The student draws a "?" in the corner of the graphics tablet to indicate he or she has a question or comment. The instructor circles the "?" to acknowledge the question, then allows the student to talk as soon as it is appropriate.

The instructor can also encourage this interactivity by getting students to make responses over the system early in the class sessions before the students begin to develop passive listen habits.

Creating the graphics to be used during the class sessions is somewhat complex and very time consuming. Offering the faculty some assistance with that task seems quite successful. This results in more prepared graphic screens being available during the actual class session, so the instructor can concentrate on the presentation of the material and not have to worry about the technology.

Most faculty who receive technical training and have a chance to practice using the equipment, find the audiographic systems easy to use. The more experienced they are, the easier they find it.

Student Issues

Students taking their courses at a distance with an audiographic system perform just as well as their peers in more traditional classroom settings. Their test scores are the same. Most students prefer face to face instruction, but when that is not possible, they adapt to the audiographic environment. There are several factors that affect that adaptation process, and the greatest factor is the attitude and instructional style of the faculty member. If the instructor is comfortable using the technology, and involves the remote site students fully in the class sessions, the students seem much less resistant to the new learning environment.

One of the most easily remedied problems that students and faculty have encountered in using the audiographic systems interactively is the lack of technical training offered the students. A number of very good ideas suggested and implemented by faculty to more effectively involve distant students failed simply because the students were unable to use the equipment properly and had no technical support on hand to assist them. Training and practice sessions for the students seem vital.

The remote site environment is another critical factor affecting the students' level of satisfaction with the audiographically mediated classes. If the room is too small to accommodate them comfortably, if the video/computer monitors are not large enough to be read easily and clearly, or if there is a lot of extraneous noise that interferes with hearing the instructor, the remote students are discontented.

While all these environmental factors affect the number of students that can be comfortably accommodated at a particular site, there are other concerns to be considered when determining the ideal number of students at each location. While no formal research has been conducted on this issue, there was a consensus among interviewees that suggests small groups working together were preferable to individual learners. The ideal size of the small group varied from about 4 to 10. Larger groups were not as satisfactory in part because the larger number needed more equipment to support them and there was never a case where multiple sets of the audiographic equipment was available at any one site.

When small groups of students share one graphics tablet there are a couple of configurations that can be used to allow everyone the opportunity to respond graphically to the instructor or to students at different sites. One method involves training only one student to use the equipment. He or she then becomes the "gatekeeper" and everyone else explains to that student what should be written on the tablet. This method saves wear and tear on the equipment and works fairly well for everyone except the student "gatekeeper." She or he spends so much effort in translating other students' comments into written graphics material that he or she is unable to comprehend what the instructor is trying to teach. Another method is a little more democratic. Each student is trained how to use the tablet, and the room is set up so each student can reach the tablet with as little effort as possible. Then each student is required by the instructor to occasionally use the tablet.

While the number of students per site may be mostly an environmental issue, the ideal number of sites seems to depend on the teaching style of the faculty member. If the instructor simply lectures and does not have any interaction with the off-site students, the only limit to the number of sites would be the limits of the audio bridge. If the instructor tends to use a more interactive style of teaching, the consensus was that more than about 10 sites would be overwhelming.

Summary

The ideal audiographic teaching/learning environment would have the following elements:

* The project has the support of the top decision makers in the institution and is strongly supported by institutional resources (both financial and academic).
  [This is more likely to be the case if the technology is being adopted to meet some real institutional need than just as an experiment with a new technology. This support is necessary to develop all the systems that are needed to assist faculty and students who will be using the technology.]

* There is a technician who is fully trained and takes full responsibility for all the components of the system.

[In the few cases studied that had fully trained technicians, it seemed to be a major factor in reducing the number of problems that users of the system experienced. The technician is able to help train faculty and students properly, and when a problem arises, can act as a troubleshooter quickly and efficiently. The equipment is also kept in a better state of repair because someone feels responsible for it. In addition, the administrator in charge of the system has an in-house expert who is available to consult on decisions that might be affected by the limitations of the technology.]

* Instructors receive training on the technical aspects of the system as well as techniques for teaching students at a distance. They also have an opportunity to practice using the equipment before they have to teach with it.

[The most frequent suggestion made by faculty was to provide them more training on how to use the technology to communicate most effectively with their distant students. This involves training and practice on the actual equipment, and some instruction on how to work with distant students, which is usually also a new experience. Training needs to be available for both of these novel elements involved in audiographic teaching.]

* Instructors receive assistance in developing the graphic materials for use in class.

[All faculty commented about the time-consuming task of developing the classroom materials. Having someone available to the faculty to take over this task seems to lessen the resistance of faculty to get involved with the technology and to use it to its full capacity. It can also be a cost savings to the administrator to have all the special graphics prepared at one central location so that only one graphics generating program needs to be purchased.]

* Instructors are compensated for the first time they develop their courses for the audiographic system.

[In addition to creating graphics, it does take extra time to translate a course that has been taught in a traditional face-to-face method into one that is taught to distant students using an audiographic system. Faculty whose time and effort are formally recognized by the institution (and compensated) tend to be much less resistant to using the new technology. If the compensation releases the faculty from other tasks, they have more time to spend translating their course.]

* Instructors have some students with them in the on-campus class. These students are informed before they sign up for the class that they will be part of an audiographic network.

[Most faculty are uncomfortable teaching to an empty room and prefer some students physically present when they teach. The students need to be aware that they will be "sharing" their instructor with other students who are not present before they actually walk into the classroom. If this is not done, there is sometimes a tendency for the on-campus students to feel like they are being cheated out of the full attention of their faculty member. All the students need to be aware of what they are gaining by being part of an audiographic class (smaller cla s size, ability to interact with a new group of students, special attention, etc.).]

* If no technician is available at the same site as the off campus students, there are easy-to-follow printed instructions on the use of the equipment including everything from start-up to printing, and the telephone number of someone who can provide assistance.

[Problems can always arise, and the distant students need to know exactly what to do when they have a problem.]

*There are small groups of students working together at the off campus locations.

[All the students interviewed said they preferred this arrangement as it gave them colleagues with whom to discuss the points the instructor was making and any problems they were having with the technology. Most of the faculty also preferred this arrangement as they were able to assign small group activities more readily than in situations where students were alone at their off-campus site. In addition, administrators find it easier to supply the technical and academic support services to small groups of students clustered ir learning centers as opposed to supporting a larger number of sites with individual learners.]

* Student support services (such as advising, registration, and library access) are readily available to the off campus students.

[The need for this is self-evident. When these services are not easily available to the distant students, there is a great deal of justified dissatisfaction among the students and the faculty.]

* There is system that fosters student/student and student/faculty communication outside of class time.

[Another concern of both students and faculty is the ability to take advantage of opportunities for informal communication with others who are involved in the same type of learning experience. Students can help one another and, when necessary, get individual assistance from the instructor. In most cases studied, the usual method for achieving this informal communication is having students exchange telephone numbers among themselves and with their instructor. If the appropriate times to call are vague, or if the calls require the students to pay a fee for long-distance services, this method is not usually effective. Another suggestion is to have some electronic bulletin board system that students and faculty can easily use in whatever time frame is most appropriate for them and at no extra cost.]

* There is a single contact person for faculty and students who experience any problems with the system.

[In order for users of the audiographic network to have confidence in the technology and the institution that is supporting it, it is very important that problems or inquiries be dealt with efficiently. As long as they know exactly who to contact, the students and faculty are more likely to report problems than if their phone calls are transferred from one office to the next as they try to find someone who can help them. When this type of communication does work, it can allow the administrator to solve problems before they reach crisis proportion.]

Beginning in with the fall semester of 1988, the University of Maryland University College implemented an audiographic network based on these guidelines. Thus far we have been able to avoid many of the difficulties the earlier pioneers experienced.

APPENDIX A

AUDIOGRAPHIC SYSTEM DESCRIPTIONS

Below are brief descriptions of the four audiographic systems that are referenced in this report. While there are other kinds of equipment that can be used to deliver graphic images (e.g., videotex) or video information (e.g. compressed video) the systems described here are those that are currently in use that coordinate various components to achieve a full multi-modal information exchange.

<u>Optel Telewriter 2-PC</u>

Institutional Users: The Knowledge Network, University of Calgary, Louisiana State University, Delaware-Chenango BOCES, SUNY-Farmingdale.

Components:

IBM-compatible PC, XT or AT, 256K RAM with MS-DOS 2.0 or above
PC color monitor
Graphics tablet and pen
Conferencing software
Voice-Too Modem (300 baud or 1200 baud) or any half-duplex modem with asynchronous interface
Audio teleconferencing equipment (convener and microphones) or a speakerphone
One dial-up telephone line

Capabilities:

* Using a standard dial-up telephone line and audio bridge (for more than two sites), it is possible to transmit simultaneously graphic images, computer data, and voice signal to all sites on a network.

* Individuals at each site can point to portions of the images, or write on them using the graphics tablet and pen for simultaneous viewing at all sites.

* Annotations and graphics can be displayed in three colors, two line widths.

* Screens can be saved with and/or without the annotation.

* Graphic images can be created using a y graphics software or the software package that is marketed with the system.

* Up to 99 screens can be stored in a single directory and then called up in sequence or randomly within seconds by any site on the network.

* Images can be compressed for more rapid transmission.

<u>Optel Telewriter 3-PC and Optel Telewriter 3-PC (TGA)</u>

Institutional Users: Utah State University, Boston University School of Medicine, Louisiana State University, Rochester Institute of Technology

Components:

IBM-compatible PC, XT or AT, 512K RAM with MS-DOS 2.0 or above
PC Color monitor
Graphics tablet and pen
Conferencing software
Voice-Too Modem (300 baud or 1200 baud) or any half-duplex modem with asynchronous interface
Video Capture Board
Video Compression Board
Video monitor/projector or analog RGB monitor/projector
Audio teleconferencing equipment (convener and microphones) or a speakerphone
One dial-up telephone line

Capabilities:

* Has all the capabilities of the Telewriter 2-PC

* Allows for the transmission of high resolution, full color still video images through the dial-up telephone line in seconds. The TGA system allows even higher resolution images than the regular Telewriter 3-PC system.

* Individuals at any site can point to portions of the video images, and write on them using the graphics tablet and pen, for simultaneous viewing at all sites.

* Video images can be stored in a directory with other video images or with graphic screens and called up during class from any site on the network.

Pennsylvania Teleteaching Project/Technical Services National

Institutional Users: Pennsylvania Teleteaching Project

Components:

Apple IIE computer 128K or IBM PC, XT, AT or compatible 640K with MS-DOS 3.1 or above
Color monitor
Light pen
Conferencing software
Full-duplex modem (Promethius 1200 baud for the Apple IIE; Hayes 2400 baud for the IBM or compatible)
Audio teleconferencing equipment (convener and microphones) or speakerphone
Two dial-up telephone lines

Capabilities:

* Using two standard dial-up telephone lines and an audio bridge (for more than two sites), it is possible to transmit graphic images, computer data, and voice signal to all sites on a network.

* Individuals at any site can use the light pen to point to information on the screen and to create graphics.

* The graphics program is part of the communications software and is icon-driven. The available functions are: draw (in two different line widths, three different colors), geometrics, type/text, erase, and point.

* The IBM version of the software allows the user to store 23 screens on a single lesson disk; the Apple IIE version will hold 14 screens on a single disk. These can be called up in sequence or randomly within seconds by any site on the network.

Utah State University Audiographic Network

Institutional Users: Utah State University

Components:

Video monitor
Writing boards
Colorado Video Slow-scan
Video camera (black and white)
Audio teleconferencing equipment (convener and microphones)
Facsimile machines
One data-grade telephone line

One audio-grade telephone line
VHS recorder and color monitor
Audio cassette recorder

Capabilities:

* Using two telephone lines and an audio bridge (for more than two sites), it is possible to transmit still frame black and white video images or graphics, and voice simultaneously.

* Slow scan equipment can record and send 35-second black and white still images of premade materials or of the instructor over a telephone line to each site on the network.

* Individuals at any site can use the electronic writing boards as they would a blackboard for viewing at all sites.

* Facsimile machines can be used outside of class time to transmit written materials. Transmission time for copies ranges from 20-30 seconds per page depending upon the amount of information on each page.

* VHS recorders allow playback of pre-recorded materials.

* Audio recorders are used to record the classes with one track recording the audio and the other the data. Students can play back the session to hear the instructor and discussions and see the electronic blackboard and slow scan frames sent during the live sessions.

APPENDIX B

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APPENDIX C

AUDIO-PLUS PROJECT

EVALUATION

REPORT

Submitted By:

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Mike Potter
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June 19, 1987

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SECTION I

EXECUTIVE SUMMARY

INTRODUCTION

From November 1986 to April 1987 nine institutions in B.C. were involved in a project to test three audio plus technologies: Optel Telewriter II PC, Telesketch, and Colorado Video Slo Scan. The University of Victoria, B.C. Institute of Technology, Emily Carr College of Art and Design, and the Open Learning Institute developed and delivered distance education course materials to sites at Malaspina College, Nicola Valley Institute of Technology, Prince George Hospital, College of New Caledonia, and Okanagan College. At the conclusion of the project, coordinators, instructors, and students were involved in the project evaluation.

EVALUATION SUMMARY

Participants felt that all three technologies provided a visual dimension which enhanced the lesson and all agreed on the need for interactivity with voice and data/image transmission. Some problems were encountered with adapting lessons to the features of the technology but each user felt that the learning objectives had been met in their application. All users expressed concern regarding the amount of initial instructor time required to develop and deliver lessons, but felt that the experiment was worthwhile and could see extending the use of the technology within selected courses.

Telesketch, though the least expensive technology, is limited to word processing and graphics functions and as such was seen to have very narrow applications. The Colorado Video system tested extrememly well for the art application conducted by Emily Carr College but the system is limited to the transmission of slo scan images and requires that voice travel on a separate phone line. The Optel Telewriter II PC had mixed test results. Participants commented on the slow transmission time and identified the need to link computers together so that the instructor and student can view a common screen. However, the Optel system has the most options for instructional delivery and can provide simultaneous voice and data on a single telephone line. Additions which are now available for this system include slo scan transmission and a computer linking program.

CONCLUSIONS

Based on the information collected (see SECTION III) we can conclude the following:

1. The most successful uses tied the technology directly to an application which exploited the inherent power of that technology rather than trying to use the technology to emulate face-to-face or other delivery methods.

2. The type of equipment and interactive nature of the technology supports small group use.

3. Further testing is necessary to evaluate the impacts of audio plus on learning outcomes.

RECOMMENDATIONS

1. The Open Learning Agency works with interested educational institutions to develop applications for pilot projects using audio plus teleconferencing.

2. The Open Learning Agency works with interested educational institutes to conduct summative evaluations to determine the learning outcomes of pilot audio-plus teleconferencing projects.

SECTION II

PROJECT SUMMARY

The Knowledge Network, British Columbia's educational telecommunications authority, in cooperation with post-secondary educational institutions in the province, conducted a project to explore the distance education potential of three audio-plus teleconferencing technologies.

Beginning in June 1986, post-secondary educational institutions in the province were invited to attend demonstrations of the Optel Telewriter II PC, Telesketch, and Colorado Video slo-scan. These technologies were selected because they represent different interactive multipoint communication capabilities and can each be connected by phone lines to the Knowledge Network's 20 port Darome teleconferencing bridge.

Five institutions who attended the demonstrations indicated that they were willing to commit time and resources to hands-on trials of the audio-plus technologies. Each institution was asked to identify an audio-plus application which would enhance an existing distance education course.

The University of Victoria and British Columbia Institute of Technology selected the Optel Telewriter II PC for courses in, 'Computer Based Information Systems' and 'Business Administration'. The Optel Telewriter II PC is an IBM PC based communication system featuring simultaneous, interactive voice and data using one telephone line. The unit is capable of using standard IBM software packages to create pages which can be sent simultaneously to multiple sites. Interactivity is available through voice and annotation by using a graphics tablet, keyboard, and speaker phone attachment.

The Open Learning Institute identified applications for the Telesketch in Drafting and Electronics courses. Telesketch is a self-contained voice/graphics communication terminal with a built-in word processor and graphics package. Materials prepared in advance can be stored internally or in a main frame, and commands are activated from the monitor using a light pen. Text, drawings, and voice can be sent to multiple sites using a single telephone line.

Emily Carr College of Art and Design and the British Columbia Institute of Technology used the Knowledge Network's verticle blanking interval to test the Colorado Video slo-scan system for courses in Art History, and Dietetics respectively. Slo-scan is a freeze frame video transmission system which can use either a telephone line or the verticle interval of a broadcast signal to send images to multiple sites. The sending site requires an encoder while receive sites require decoders. Voice interactivity requires a separate phone line. A frame storer can be used to provide random access capability for images which have been prepared and stored in advance.

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The Knowledge Network identified the following project objectives:

1. To expand the market potential of the Knowledge Network teleconferencing service.

2. To determine the future impacts of audio-plus teleconferencing on the equipment and resources of the kNowledge Network.

3. To involve educational institutions in B.C. in innovative uses oftelecommunications systems.

4. To demonstrate the feasibility and methodologies involved in a combination of audio, computer, and visually enhanced teleconferencing in distance education.

5. To increase the potential of narrow band technologies to service the educational needs of non-traditional students.

A steering committee consisting of Mike Reddington, Ron Harrington, Mike Potter and Betty Mitchell, and a project team consisting of Mike Potter, Mark Nielsen and Betty Mitchell were formed to coordinate and evaluate the trials. The evaluation will be used by participating institutions and the soon to be created Open Learning Agency of British Columbia to determine the appropriate applications of each narrow band technology and to ascertain the degree of commitment of post-secondary educational institutions in the province to use the technologies. Data concerning ease of use, degree of satisfaction of users, fulfillment of instructional objectives, perceived advantages and limitations of the technology with respect to the particular application, and suggestions for further applications, was collected from institutional coordinators, instructors, and participants.

The Audio-Plus Teleconferencing Project ran from October 1986 to April 1987. Instructors received training on their selected audio-plus technology and meetings brought instructors and institutional coordinators together to share information on the progress of each application. During the February implementation period, Knowledge Network staff was sent to test locations to train site coordinators and students on the use of the technology before each trial session. A video, produced by the Knowledge Network, documents the entire project. Copies of the videc tape and the evaluation results are available upon request.

SECTION III

PARTICIPANTS COMMENTS

Evaluative Comments

Qualitative comments regarding the technologies were invited from three groups of users:

* Students or participants
* Instructors or tutors
* Coordinators or administrators

User's comments follow and are grouped according to interview topics and technologies under consideration.

A. Transmission and facilitation of the learning session

General comments: All technologies

Three comments were common to all users:

- Enhancement of learning: The addition of a visual dimension to audio-teleconferencing enhanced the lesson in all cases.

- Restrictions on lesson information: The capacity of the technologies sometimes restricted the amount of information an instructor could or wished to send. "Cutting of corners" or lesson adaptation were necessary. In particular, the Telesketch graphics package did not permit variable line thickness, freehand sketching, arc and circle drawing nor animation, features which would have been useful for the trials. For Slo-scan transmissions, the quality of color resolution and visual cropping were problems.

- Student enjoyment: Student reaction to the technologies was favourable, though it was noted that the "Hawthorne Effect" might be at work during initial trials.

General comments: Telesketch, Optel and Optel-Slo-scan Combination.

The following comments were common among users of these technologies:

- Limited feedback: Users reported that the technologies limited instructor interaction with students especially when attempting to provide feedback. Instructors indicated a desire to see student "work in progress" as opposed to receiving "snapshots" of student's work upon completion of assigned tasks.

- Increased preparation time: All instructors commented that, although each technology was relatively easy to learn, much preparation time was required for the lesson. One instructor speculated about the "pre-programmed" nature of the technology and whether it decreased spontaneity during the lesson as a result.

- Slow transmission: Transmission of information was deemed too slow, interfering with instruction of the lesson.

- Reduced effectiveness for large groups: Instructors felt the technologies adequate for one-on-one or one-on-few lessons but expressed reservations about using the technology for larger group settings.

General comments: Slo-scan

The users of the slo-scan technology did not report on the same aspects as users whose technology required a visual response from students. In general, their comments may be summed up as follows:

- Instructor control: The instructors felt very comfortable with the flexibility and control allowed by the system, especially when used in conjunction with a random-access laser disc for selection and transmission of still frame visuals.

- Greater student input: The users felt that the technology promoted student participation and discussion during the lesson.

B. Integration into institutions

General comments: All technologies

All users expressed concern over costs of acquisition of the technology. These concerns were sometimes expressed in terms of added workload required of instructors using the technology (viz. increased preparation time, increased time "on air")

C. Fulfillment of learning objectives

General comments: All technologies

All users (with one exception) reported that all lesson objectives were met; the exception reported that most lesson objectives were met.

D. Comments regarding the process

General comments: All technologies

All users felt the experiment to be worthwhile despite the technical glitches encountered.

E. Extended use of the technology

General comments: All technologies

Most users could see extending the use of the technology either within the present course (of which a lesson was used in the trial) or as part of other specific, similar courses. The major exception was users of Telesketch who saw only very limited applications within current courses or in other courses.

F. Improvement of the technology

General comments: All technologies

With respect to improvement of the technologies, the following comments were common:

- Improvement in speed of transmission: As noted previously, users (with the exception of Slo-scan) saw slowness of transmission as detrimental to the instructional process.

- Additional visual capability: All users noted that the visual capability of their technologies could be enhanced either through the addition of more sophisticated graphics packages or addition of video components.

- Improvement in interactivity: With the exception of Slo-scan, each technology had some features which appeared to hinder interaction between instructor and student: for Telesketch, one drawback was the lack of simultaneous voice/visual transmission; for Optel, a drawback was the lack of capability for simultaneous annotation. Many users summed up their feelings by calling for "improved interactive capacity" of the technology.

SECTION IV

TECHNICAL EVALUATION

A. Colorado Video 'VBI' Slo-scan System

For insertion of still-frame video images into the vertical blanking interval of our standard broadcast signal, the equipment required was a Colorado Video VBI transmitter (model 240), a Colorado Video VBI receiver (model 241) and a Leitch Vertical Interval Processor (model VIP-1101N). Selection of the intended line must be done before-hand, as tuning and adjustments are made to the transmitter and receiver by Colorado Video prior to shipment. Altogether, up to 10 lines can be used independently and for our test we chose to use line 20.

The equipment arrived well-packed and sturdy but would not work when first hooked up. Discussions with a Colorado Video technical rep in Boulder discovered the need for a special jumper to be soldered in to the Leitch processor, bypassing a signal cut-off resistor, and when this was done, the system worked flawlessly.

Still-frame images for input to the system were recorded and stored on a Panasonic OMDR Laser Disc Recorder which provided capacity for 24,000 images and instant random access. This was used in two of the tests but had to be passed through a time-base corrector to stabilize the images for transmission. It performed well, was extremely easy to use and was well-liked by the instructors. For a third test, images were stored on a half-inch VHS machine which required more time in the recording, was more difficult to use and fast-forward/rewind features had to be used instead of the random access. It, however, did work well, with substantially the same quality as the OMDR.

At the receive sites, the system was easy to set up and, operationally, worked well. The major problem involved the quality of the signal arriving, which was a function of both the cable company's distribution as well as the tuner/demodulator at the receive site. At Emily Carr College in Prince George, a rented VHS machine was used to demodulate and tune the signal and this, along with a fairly poor cable feed (from multiple splitting) resulted in a less than satisfactory picture. Noise frozen on a still-frame is much more noticeable than transient noise in a moving picture which the mind tends to filter out. For the second test at Emily Carr, a better tuner was used, a small amplifier put on the line and a superior monitor acquired. This improved the quality of the signal noticeably but sill well below normal viewing standards.

At the Prince George Hospital a high-quality Sony monitor/tuner was used and, with a better cable input, this resulted in an improved picture. Still, much of the writing on the images could not be made out at the receive site. Tests carried out at the offices of Central Interior Cablevision, using high quality equipment, revealed an acceptable picture quality being received at the head end, so I believe that with proper tuners, monitors and amplifiers the quality of the signal could be improved to an acceptable standard.

B. OPTEL Telewriter II - IBM PC Based Voice/Graphic Transmission System

The lesson learned here was: no matter how many people say they have an IBM clone, don't believe it until you've tried it. There were problems of computer Incompatability with a capital I. Designed specifically for an IBM XT or AT with a COM1 or 2 serial port and a Colour Graphics Adapter, only one of the computers that I came across would work with the Optel without adjustments. This was the Zenith pc at B.C.I.T. At Malaspina College there was a D.E.C. 'IBM compatable' which required major adjustments to the boards and the program bef^re it would work. At Nicola Valley Institute of Technology there was a Zenith, but with a different serial port and no Colour Graphics card. An IBM colour card was obtained which did work but problems were still experienced with the serial communications port. At Prince George Hospital, an A T &T 'IBM clone' did not work (the serial card would not talk to the modem) and eventually an IDM machine was found which worked well. Once again, no matter how many people say they have an IBM or compatable, the requirements for Optel are quite specific and I found very few people with the right equipment to make it work the first time.

Apart from computer problems, there were a few other hitches as well. The Optel is designed as a graphics or picture transmission system. Two of the sites, B.C.I.T. and U.Vic., wanted to use it for text-based applications (both Lotus 1-2-3 and Basic are text programs). The Optel software for this is clumsy and not fully de-bugged yet. Computers treat pages of text and pages of graphics very differently and the Optel software converts text pages to graphic or pictorial representations for its manipulation and transmission. When subsequently trying to return to text mode, the system would frequently lock up, requiring a system re-start. In some instances, the system could be returned by re-programming the I/O ports but on other occasions it required a complete re-boot. Discussions with the Optel people reveal this to be a program shortcoming that they are trying to remedy, so far without much luck. When the system was used with graphics based applications programs, such as Pendraw for Pat Wolczuk's dietetics course, it worked with no problems.

A definite need for audio headsets was found, as the Optel requires students and instructors to use their hands and on several occasions use of the push-to-talk convener mics was very inconvenient. A slight but definite data transmission hiss was also amplified considerably by the convener.

Training time for hands-on use of the system was minimal (about two hours for people with some computer background) but I felt a definite need for more training and thought in the design of programs, to take advantage of the strengths of the system.

C. Telesketch: A Self-contained Desktop Communications System

By far the easiest equipment to set up, the Telesketch simply plugs into any phone outlet. Because of its unusual technology and many functions it did, however, take the longest time to train and familiarize the users (about 10 to 15 hours to become comfortable with it). There were some problems with machine reliability at the beginning, as several pages of memory were lost from unknown power glitches and one machine burnt out a chip when the keyboard was plugged in, but these were fairly minor and may have resulted from unfamiliarity with the machine since they all happened early in the familiarization and page creation process.

One problem encountered was lack of space in the buffer, resulting in a 'buffer full' error message and an aborted transmission plus the accompanying 'dead time' lag of up to a minute when nobody could speak. This stems from the fact that, when storing into memory, the Telesketch stores not only the final page, but also all the steps required to get there, including all erases and re-trys information when transmitted. Also, subsequent tests show some problems with bridging three or more units because of the 'successful transmisson' check done. An 'acknowledge' on/off switch must be turned on by the transmitting unit and off by all but one receive unit for successful transmission.

Another problem encountered was quite poor audio quality, a result of a poor microphone and very small speaker.

Overall, much more thought was put into the structure and content of the lessons using the Telesketch, I think possibly because it is such an unusual machine, although many of its functions and features were never used.

SECTION V

COSTS

In each case all technologies are more expensive to acquire and maintain than the existing method of delivery. Of the technologies themselves, the most expensive are the Optel Telewriter II and the Colorado Video Slo Scan.

But when looking at cost we must also consider the long term potential of each technology. Although Telesketch is the least expensive it is limited to the unit's own telewriting, word processing and graphics functions. The Colorado Video system is more expensive than Telesketch but it too is limited to slo-scan transmission. By delivering slo-scan on the vertical blanking interval of the Knowledge Network signal we only increase the transmission speed. There is no other benefit to using the vertical blanking interval instead of using telephone lines. The Optel telewriter has the most options for instructional delivery. Based on the IBM PC the Telewriter can use any IBM software program to create pages for instruction. Additions which are now available for the Telewriter II include a computer linking program so that instructor and student can view a common screen and slo-scan transmission. Future uses can include linking expensive yet more versatile Optel. In short, audio-plus is not a cost saving but a qualitative improvement to existing distance education delivery forms.

We should consider not only the cost of the equipment but also the cost implications for implementing audio-plus. As seen from the demonstrations, audio-plus works best with smaller groups. But when you have groups you must also have a facility for the group to meet and someone to monitor that facility. Start-up and on-going site costs would be a major portion of the costs associated with audio-plus.

SECTION VI

CONCLUSIONS & RECOMMENDATIONS

A. CONCLUSIONS

Though the qualitative results of the Audio-Plus experiment are general and inconclusive, it appears that the Slo-scan application at Emily Carr College of Art enjoyed the greatest success, both in terms of user satisfaction and improvement over the current method of offering the course (by telephone and slide/tape package). One might speculate that the reason for Emily Carr's success was that the application exploited the inherent power of the technology rather than seeking to emulate or duplicate features of face-to-face instruction. (In some respects it was also the least complicated application.) This raises some interesting issues for future consideration of Audio-Plus applications, or indeed, any new technology:

- How to assess new technologies as unique forms of communication independent of the face-to-face communication paradigm?
- How to compare diverse technologies?
- How to determine selection criteria for diverse technologies?
- How to select a technology or technologies for a particular application?

It is clearly premature to speculate what types of applications lend themselves to Audio-Plus technologies without further study; however, the pilot trials provide some direction for new applications by beginning to ascertain limitations of these technologies.

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B. RECOMMENDATION

Further testing is required to evaluate learning outcomes when audio-plus technology is used as a major component of course delivery. The Optel Telewriter II is the most likely system to form the basis of the second phase of audio-plus due to the range of interactive delivery options it provides to both instructor and student. Optel can also be adapted with slo-scan to provide the pictorial capability which was so successful in Emily Carr's application and now this technology has the ability to link screens via a software package.

Phase II of the Audio-Plus project would see the Open Learning Agency working with educational institutions to identify specific applications, and conduct research on learning and delivery impacts.[1]

1

Tony Bates, in his lecture of 87.06.04 to the Canadian Association For Distance Education teleconference, cites some useful starting points on which to base this research:

- Accessibility of students to the technology

- Costs and number of students

- Organizational and political factors

- Time required of instructors to use (and learn to use) the technology

- Amount of student control over the technology

- Pedagogical factors:

    - Presentational flexibility
    - Permanence of instruction
    - Structure/style of instructional material
    - Degree of interaction required with students
    - Learning responses encouraged
    - Distribution

A. EVALUATION PROCESS

1. Purpose of Evaluation

In support of the project objectives outlined in the Audio-Plus Teleconferencing Project Research and Development Proposal of November 7, 1986, the overall purposes of the evaluation are to:

* Determine appropriate applications of each narrow band technology
* Ascertain the degree of commitment of Knowledge Network clients to use the technology

More specifically, the evaluation will be used to:

* Provide data on the advantages and disadvantages of each narrow band technology under consideration from the perspective of the following user groups:
  - Coordinators
  - Instructors or tutors
  - Participants
* Determine barriers of integrating technology into existing institutional instructional delivery systems
* Identify some technology selection criteria

A secondary purpose exists, namely to:

* Provide feedback to equipment suppliers on their equipment
* Communicate results of the project to potential users (eg. through journal articles, professional development sessions)

It is acknowledged that due to the limited usage of the technology, the information derived from the trials will be limited. Decisions arising from the evaluation of this project will need to be made cautiously.

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2. Dimensions of the evaluation

The following broad dimensions will be the source of evaluation information:

* Ease of use of the technology with respect to:
  - Installation
  - Training of users
  - Transmission of learning session content
  - Facilitation of the learning session process
  - Integration into the educational setting

* Fulfillment of instructional objectives

* Perceived advantages and limitations of the technology with respect to the particular application

* Suggestions for other uses of the technology

* Potential of the technology for longer term applications (e.g., delivery of an entire course using the technology)

* Degree of satisfaction of users with the technology

3. The Evaluation Process

Formative evaluation would take the form of a user's log. In this log, the user would record observations about the technology during any interactive time spent with it. Observations would include:

* Amount of time spent

* Technology can/cannot do

* Likes/dislikes

Summative evaluation would take the form of a structured interview, based upon information recorded in the user's log. The information will then be compiled in the following manner:

* Description of each trial, from initial training on the use of the equipment to completion of the field test

* A summary of advantages and disadvantages of the technology for each trial from the perspective of:
  - Coordinators
  - Instructors or tutors
  - Participants

* A technology selection matrix comparing selection criteria against each narrow band technology

B. AUDIO-PLUS GROUP INTERVIEW QUESTIONS

1. OPENING

- Position the interview
  - You have completed trial and collected thoughts in your log
  - We now wish to consolidate information for an evaluation report

- Note confidentiality of information shared
  - Information will be used in aggregate - there will be no reference to individual comments in the report

3. GENERAL QUESTIONS: INSTRUCTORS

Preparation for the lesson:

- How long did it take you to learn to use the technology efficiently?

- Did you have any problems in learning to use the system? What was the hardest to learn? The easiest?

- Was it difficult for you to adapt your lesson to this technology?

Presentation of the lesson:

- Were the lesson objectives achieved?

- Was the technology an effective means of delivering your lesson?

- What do you like/dislike about instructing with this technology?

- Overall, how would you compare this technology to the way the course is being offered now?

- Did the technology interfere with student learning in any way? How did it help learning?

- What do you like/dislike about student learning with this technology?

- Overall, how would you compare this technology to other ways of learning?

Next steps:

- Would you like to see this technology used as a standard part of this course? If so, how often?

- Can you see other uses for this technology? In this course? In other courses?

- Do you have suggestions for ways in which the technology (application of the technology) could be improved?

2. GENERAL QUESTIONS: STUDENTS

Preparation for the lesson:

- How long did it take you to learn to use the technology efficiently?

- Did you have any problems in learning to use the system? What was the hardest to learn? The easiest?

Presentation of the lesson:

- What did you learn from your lesson?

- Did the technology interfere with learning in any way? How did it help learning?

- What do you like/dislike about (student) learning with this technology?

- Overall, how would you compare this technology to other ways of learning?

Next steps:

- Would you like to see this technology used as a standard part of this course? If so, how often?

- Can you see other uses for this technology? In this course? In other courses?

- Do you have suggestions for ways in which the technology (application of the technology) could be improved?

4. GENERAL QUESTIONS: COORDINATORS

Presentation of the lesson:

- Did the technology interfere with student learning in any way? How did it help learning?

- What do you like/dislike about student learning with this technology?

- How well does the technology fit into your current ways of delivering courses at your institution?

- Overall, how would you compare this technology to other ways of learning?

Next steps:

- Would you like to see this technology used as a standard part of this course? If so, how often?

- Can you see other uses for this technology? In this course? In other courses?

ψ Do you have suggestions for ways in which the technology (application of the technology) could be improved?

APPENDIX D

UTAH STATE UNIVERSITY

THE INFLUENCE OF TEACHING STYLE AND INSTRUCTIONAL DEVICE USE ON STUDENT SATISFACTION AND STUDENT PREFERENCE IN ELECTRONIC DISTANCE EDUCATIONAL (EDE) METHODS

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Over the last 100 years, the traditional face-to-face method has been the state of the art in delivering instruction to individuals. With the advent of new electronic communications devices and emergent Electronic Distance Educational (EDE) methods, questions of instructional quality, presentation, and delivery must be asked.

The purpose of this study was to gain insight into this emerging field of electronic distance education so as to improve and enhance the delivery of educational programs utilizing EDE. The study was conducted at Utah State University, using an EDE-method (COM-NET) as the research setting. Thirty-seven instructors taught 45 courses over the COM-NET system from Fall quarter 1985 through Summer quarter 1986.

The design of this study was based upon simple correlation coefficient matrices and the subsequent prediction models of multiple regression analysis. Contextual data were gathered from a solicited instructor self-reporting instrument. The objective was to identify potential relationships between teaching styles (Concrete/Sequential, Concrete/Random, Abstract/Sequential, Abstract/Random) and instructional utilities (Discovery--Expository/Techniques, and Abstract--Concrete/Device induced experiences) employed on student satisfaction and student performance in an EDE-based learning system. Teaching style data were gathered using the Gregorc Style Delineator (GSD). Instructional utilities data were gathered using the Instructional Utilities Inventory (IUI). Student satisfaction was

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measured using the USU course evaluation form and student performance assessments were made by using mean grades for those courses taught via COM-NET during the time period of concern in this study.

The following descriptive statistics emerged from the analysis of the courses taught. Of note was a mean student satisfaction score of 3.27 for all COM-NET courses studied as compared to a mean on-campus student satisfaction score of 3.5 for the same period. The student satisfaction score was a measure of students' agreement with the statements, descriptive of quality courses, as stated on the standard USU course evaluation form. The 3.27 score indicated a mean rating of "agree" to "strongly agree" with the course evaluation form statements, suggesting that the COM-NET courses had been successful. A mean 3.04 grade point average (GPA) was earned by students who were in the COM-NET courses studied. During the same time period a mean GPA of 3.14 was earned by students in on-campus courses.

There were six hypotheses tested in this study. The results were varied and although no cause-effect relationships were determined due to the correlational nature of the study, certain tendencies did exist. Hypothesis one, that teaching style had no effect on student satisfaction, was rejected. The Abstract/Random (AR) teaching style covaried slightly in a positive direction with student satisfaction predicting 11.6 percent of the relationship. Hypothesis two, that teaching style had no effect on student performance, was not rejected. Hypothesis three, that instructional utilities had no effect on student satisfaction, was not rejected. Hypothesis four, that instructional utilities have no relationship with student performance, was rejected. Discovery techniques explained 26.4 percent of the variable satisfaction. Hypothesis five, that teaching style had no effect on instructional technique employed, was rejected. The Abstract/Random (AR) teaching style predicted 12.7 percent of the variability of discovery techniques. Hypothesis six, that teaching styles had no effect on the instructional devices utilized, was also rejected. The Abstract/Sequential (AS) teaching style covaried with abstract devices in a slight to moderate magnitude predicting 17.5 percent of the variability.

Through the instructor self-reporting procedure the importance of instructional presentation and course redesign in EDE delivery was stressed. Insufficient on-campus administrative support with regard to time and materials for course redesign was identified as the major deterrent to course success. The lack of student participation also surfaced as a concern of instructors. The general chronological age and experiential maturity of the students were believed to contribute to course success. Devices make the distance delivery of the instruction possible; yet the human element of the system was emphasized as the crucial determinant for success. The interactive devices of audio, facsimile machines, and writing boards were considered essential items for EDE networks. Motion video was recommended for the presentation of motion pictures.

This study classified communication hardware as devices, in that they do not teach in and of themselves. It is the interaction of the human element with these devices which created sound educational methods. The development of a solid infrastructure with which to support the chosen devices becomes a mandate for those who plan to implement EDE methods. It was concluded that instructional presentations have a significant effect on student outcomes.

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THE EFFECT OF INSTRUCTIONAL PRESENTATION ON STUDENT SATISFACTION AND PERFORMANCE AS DEMONSTRATED IN AN ELECTRONIC DISTANCE EDUCATIONAL (EDE) DELIVERY SYSTEM

Utah State University, the land grant institution for the state of Utah, began a search for cost effective Electronic Distance Educational (EDE) devices with which to alleviate the financial and faculty shortfalls experienced due to a 110% increase in off-campus credit enrollment since the 1979-80 academic year. In response to this need generated by the residents of rural Utah, the EDE system or COM-NET was developed and implemented at Utah State University in 1984. Initially located at seven existing continuing education centers which were established in the mid 60s, COM-NET has now grown to 17 outreach centers, including 3 in the State prison, resulting in 780 total enrollments quarterly.

Currently there are four degrees on the system, each with a two year cycle, ie Bachelors in Psychology, Bachelors in Business Administration, Masters of Education in Instructional Technology and a Masters in Family Life.

The backbone of the network consists of two leased telephone circuits (audio/data) in a star configuration on which the following devices interact, (multiple usage of the lines is accomplished through switching):

1. 2 way audio - Darome public address system
2. 2 way hard copy - Cannon facsimile machines
3. 2 way writing boards - AT&T writing boards
4. 2 way video - Colorado Video slow scan
5. 2 way file services - IBM PC computers networked to library
6. System mobility - Westell Bridge/Mobile Units
7. System back up - Cassette taping of Audio/Data
8. Motion color video - VHS recorders

In order to bridge the gaps between instructor and students, key individuals and processes have been identified and established in order to guarantee the smooth functioning of the established devices. These key positions and functions are as follows:

1. CENTER DIRECTORS: liasons between the needs of the rural communities and the campus
2. COM-NET DIRECTOR: synthesizes the needs of the varying outreach centers and the needs of the University resulting in programming
3. TEACHING ASSISTANTS: they are the eyes and ears of the instructors during class, monitoring the needs of the students and communicating them to the instructor
4. INSTRUCTIONAL DESIGNER: adapts and modifies the existing courses and inservices those involved with the delivery
5. SYSTEM ENGINEER:

The objective of the study was to determine to what degree the varying teaching styles (Concrete/Sequential, Concrete/Random, Abstract/Sequential, Abstract/Random) in conjunction with the instructional utilities (Expository techniques, Discovery techniques

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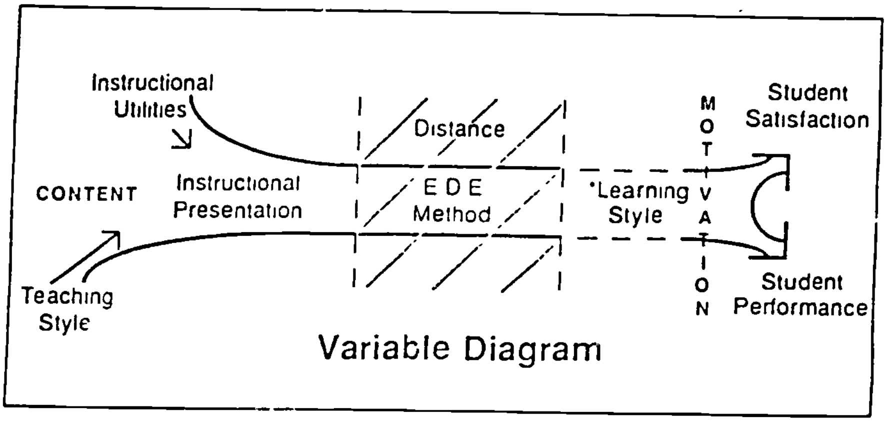
Abstract devices, Concrete devices) employed in Electronic Distance Educational methods EDE), influenced student satisfaction and student performance. The design of this study was based upon simple correlation coefficient matrices and the subsequent prediction models of multiple regression analysis. Contextual data were gathered from a solicited instructor self-reporting instrument.
The objective was to identify potential relationships between teaching styles and instructional utilities employed on student satisfaction and student performance in an EDE-based learning system.



Variable Diagram

The teaching style data were gathered using the Gregorc Style Delineator (Gregorc, 1982). Instructional utilities data were gathered using the Instructional Utilities Inventory. Student satisfaction was ascertained by using the standard University Course Evaluation Form. Student performance was assessed by using the mean final grades of the 44 courses taught by the 37 instructors on the COM-NET System between Fall quarter 1985 and Summer quarter, 1986.

The following descriptive statistics emerged from the analysis of the courses taught. Of note was a mean student satisfaction score of 3.27 for all COM-NET courses studied as compared to a mean on-campus student satisfaction score is a measure of students' agreement with the statements, descriptive of quality courses, as stated on the standard USU course evaluation form (scale 0-4). A mean 3.04 grade point average (GPA) was earned by students who were in the COM-NET courses studied. During the same time period a mean GPA of 3.14 was earned by students in on-campus courses (Utah State University Office of Instructional Research, 1986).

The first hypothesis, that there was no significant relationship between teaching style employed during the given EDE course and student satisfaction with that course, was rejected. Abstract/Random teaching style was statistically significant at the .05 level with regard to the variable of student satisfaction, predicting 11.6 percent of the variability of student satisfaction. The Abstract/Random individual, as defined by Gregorc (1982), as one whose world is abstract and non-physical. They are most comfortable when they characterize themselves as spontaneous and adaptive to circumstances depending on the goal, plans, and objectives.

The second hypothesis, that there is no significant relationship between teaching style employed during a given EDE course and student performance in that course, was not rejected. The third hypothesis, that there is no significant relationship between instructional utilities employed during a given EDE course and student satisfaction with that course, was also not rejected.

The fourth hypothesis, that there is no significant relationship between instructional utilities employed during a given EDE course and student performance in that course, was rejected. "Discovery technique" predicted 26.4 percent of the variability of "student performance" at the .001 level of significance. The discovery teaching approach is based on the philosophy wherein the learner is engaged in problem solving and solution-seeking activities thereby developing subsequent skills. The content of the course is viewed as a by-product of this problem solving skill development.

The fifth hypothesis, that there is no significant relationship between the teaching style and the instructional techniques employed in EDE methods, was rejected. The "Abstract/Random" teaching style predicted a significant portion of the variability of "discovery technique", explaining 12.7 percent at the .05 significance level. Faculty who used Abstract/Random teaching styles spontaneously dealt with, and adapted to, the environment using discovery techniques to encourage student involvement.

The sixth hypothesis, that there is no significant relationship between teaching style and the instructional devices employed in EDE methods, was rejected. The "Abstract/Sequential" teaching style predicted a significant portion of the variability of "abstract devices" explaining 17.5 percent at the .005 level of significance. Devices are communication channels which aid in the relaying of the experience between communicators. A major difference between the Abstract/Random individual as discussed previously and the Abstract/Sequential is the evidence of more structure in the information ordering process. Although still seeing their world as a very abstract, non-physical realm of thoughts and mental constructions, the ordering pattern in sequential individuals is represented by two-dimensional geometry. Through tree-like branching, starting with the common stem, the specific elements are sequentially linked to a base (Gregorc, 1986). The need for structure stimulated the planning and carefully considered utilization of devices prior to engaging in the learning experience while still maintaining the flexibility of the abstract perceptual style.

Instructors' comments and opinions were collected in written form. There were no negative comments toward the system in general. One of the major strengths identified was the ability to serve the informational needs of learners in remote locations without the instructor having to travel long distances. The COM-NET system challenged instructors and their comments suggested an appreciation for the opportunity to learn about the system. instructional insight and materials generated in the COM-NET experience have been utilized by many in on-campus classes. Instructors suggested that a second experience on COM-NET would result in better instructional presentation. Increased inservice education for instructors was proposed as a means to improve course adaptation and technique development to the available modes of COM-NET. Flexibility of instructional style was stressed as an important factor of COM-NET course success which facilitated spontaneous adaptation to the non-traditional nature of the system.

The major limitations of the experience as viewed by the

instructors were not directed at the system. They focused on the lack of on-campus financial support given to the system. Significant modification of on-campus courses is necessary to adapt them to this method. To do so requires time and money. As a result of the lack of administrative support, instructors confessed to devoting less than desired amounts of preparation time.
Another major limitation identified was the lack of student participation in courses taught over COM-NET. The absence of motion pictures was also identified as a limitation of the system. The teaching assistants)TA) were considered principle strengths of the system, yet it was suggested that a closer interaction with the COM-NET office and center directors might improve course delivery. Materials distribution caused some problems for instructors and students. Students were described as being different from the on-campus students in a positive way. Comments regarding grades, suggested similarity with on-campus performance, with one exception, indicating lower student performance via COM-NET. In general, the instructors were appreciative of the students' willingness and motivation. The high student "non-completion" rate was a concern of a few instructors.

Of the devices which are used to form the COM-NET EDE method, the audio and the writing board appeared to be fundamentally essential from instructors' perspective. Comments suggested that methods of information delivery which are not based upon a two-way interactive model could not be education. The facsimile machines were a major element in the delivery of course work in EDE methods assuring the timely exchange of tests and assignments. It was suggested that color video was content specific and not significant for most courses.

The results of this study indicated that consideration be given to employing and implementing the following conclusions: a. Empirical as well as contextual data, suggested the importance of instructor flexibility and spontaneous adaptability. Instructors with abstract teaching styles utilize participation-oriented techniques and devices. b. The creation of a program manual is a major element of any EDE project. The timely exchange of tests and assignments is also a mandatory element. c. Instructional presentations for EDE projects require significant course redesign to meet the distinctive needs of the distance learner and the EDE system involved. Resources must be provided to aid instructors in course redesign and program annual development. The employment of trained instructional designers coupled with faculty incentives in the form of released time and honorarium must receive demonstrated administrative support.

The challenge of the future for EDE delivery becomes the challenge of the educational technologist who must first identify the subtleties and differences between the varying methods created by these new devices. They then identify, analyze, and test a multitude of compound variables inherent in EDE-delivery methods. The more well-publicized programs, i.e., British Open University, National University Consortium and Learn Alaska use teams of specialists comprised of content experts, delivery mode specialists, and instructional technologists to develop the basic course print package. EDE systems have grown beyond the placement of a camera on a lecturer or professor who simply addresses a student audience. The overall function of any interactive EDE system is to be cost efficient with regard to resources of time and money, while at the same time duplicating, as best as is possible, the learning experiences of on-campus courses. As instructor travel time is eliminated and instructional duplication minimized, many resources are thus saved. The misconception is believing that hardware alone provides an answer to educational efficiency. This study strongly refutes this misconception, both empirically as well as contextually. Devices are a means of overcoming time and distance variables associated with EDE. Without an organizational infrastructure supporting both instructor and student, EDE may never succeeded as a method. Responses to needs, concerns, and problems must still be addressed through human ingenuity.

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APPENDIX E

PROFESSIONAL GUIDELINES
TELETEACHING PROJECT
COMMONWEALTH OF PENNSYLVANIA

prepared by: Dr. Donald Byerly, Superintendent
Loyalsock Township School District
Mr. Bill Steinhart, Director
Basic Education PSEA
Dr. Robert Swinsick, Professor
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I. PROGRAM PURPOSE:

The following constitute acceptable rationale for offering telecourses through the project:

1. Enrichment
2. Provide advanced offerings
3. Provide courses required by law, but which lack sufficient enrollment in a single district, or building within that district.
4. To be utilized where appropriately certified personnel are not available (i.e. may have chemistry and other sciences, but no-one with dual areas which include physics.)

Teleteaching and course offerings should not be utilized to; or:

1. Consolidate or reduce offerings
2. Reduce staff
3. Because of budget or financial exigency

II. PERSONNEL SELECTION:

Selection of Master Teachers to become involved in the teleteaching project can be implemented through the following or similar processes:

1. Establish a voluntary pool of teachers interested in involvement in teleteaching (i.e. Induction model process.)
2. Establish criteria and role model for a teleteacher and teaching associate.
3. The chief School Administrator will select teachers and associates from the pool.
4. All personnel participating should be certified:

   A. Teleteachers certified in the area of the course offering.
   B. Teaching Associates professionally certified.

III. PERSONNEL COMPENSATION:

The following guidelines should apply to those teleteachers designing a new course or offering already established telecourses:

1. First time teleteachers offer only one course.
2. Establish a two course maximum for second or third year teleteachers.
3. No limit on sections of each telecourse during the teaching day other than constraints within each district or local Collective Bargaining Agreement.
   Example: Teacher A may teach 3 sections of Chemistry II. This would be considered 1 preparation with 3 classes in the offering. In a normal 6 period day, teacher A could also teach a maximum of 4 sections of Chemistry II and have 1 period as a teleprep class and 1 period as a normal prep period consistent with guidelines found in item #4 below.
4. A teleteacher will have the following options for preparation assuming no other assignment is given to the teleteacher such as: (a) Homeroom, (b) Activity period, (c) Detention hall, (d) Study hall, or (e) other school duty or assignment:

   A. The teleteacher has the option of teaching with or without live students.
   B. The teleteacher will teach at a location approved by the Project Director.
   C. The teleteacher is given a minimum of one period for preparation, or, compensation for work done before or after the normal work day, or during the summer.
   D. The administration will provide either secretarial assistance each day, or design opportunities for students to participate in an advanced computer graphics production class to assist the teleteacher. This could be done with or without credit for the students.

5. The teleteacher will be responsible for preparing teleclass materials at least one week in advance of utilization and will mail no more than one package of materials per satellite site per week.

IV. SYSTEM DELIVERY POLICY

1. Teleteachers will not be permitted to send their lessons live during, before, or after the lesson except in special circumstances which include the following:

   Rural telephone lines are poor quality and lesson transmission may not be accurate.

Concerns of the project relating to this item include:

A. Teachers are utilizing excess time in sending and resending slides which creates ineffective use of the teachers scheduled time.
B. Schools will usually pay a double toll for this extra time and it may add $7.00 to $20.00 per lesson to the cost of each lesson transmitted.
C. Sending slides live during a lesson is ineffective use of student time and reduces the effectiveness of the teacher and the amount of material which can be covered during each class.

V. PROFESSIONAL SCHOOL BASED INSERVICE:

1. Teleteachers will be provided seven (7) days of substitute coverage in order that they may visit the satellite sites and receive advanced training.
2. Teaching Associates will be provided four (4) days of substitute coverage in order that they may visit the transmitting site and other satellite locations and receive advanced training.
3. Both teleteachers and teaching associates will be provided with appropriate travel funds.
4. Once a semester teleteachers will visit other teleteachers.

VI. OTHER FACTORS OF CONSIDERATION:

The following are considerations which are essential to the success of the project and course offerings:

1. Provide uniformity of compensation and work conditions within the district(s) participating in the project.
2. It is recommended that class size not exceed thirty (30). This could vary based upon unique circumstances within the setting of each district(s) and course(s) offerings. If a course normally has 12-15 students, the size of the teleclass should remain the same.
3. Establish criteria for student selection and participation in the courses offered. Input from the following relating to criteria:

    a. Administrators
    b. Teachers
    c. Guidance personnel
    d. Other appropriate personnel

4. Provide appropriate orientation program and time for new personnel participating as teleteachers or teaching associates.

VII. LONG RANGE CONSIDERATIONS AND NEEDS:

The following need to be given careful consideration:

1. Develop an annual study of project and district needs in terms of:

   A. Appropriate training for new personnel in the project.
   B. Competencies essential to being a teleteacher or teaching associate.
   C. Student selection procedures.
   D. Impact on the learning process with students involved in telecourses.

2. Develop an instrument to acquire generic and specific data of participating districts which identifies unique parameters of participating districts and may call for exceptions to the guideline policies.