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ABSTRACT

Five case studies of instructional two-way interactive video in rural small schools provide a model for successful implementation in other communities. Site visits and extensive interviews were conducted in schools and communities served by the Oklahoma Panhandle Shar-Ed Video Network, the New Mexico Eastern Plains Interactive TV Cooperative, the TeleCommUNITY Network in central Texas, the North Texas Educational Network, and the Dell City Initiative in far west Texas. Each case describes the school and community setting, the technology used, implementation efforts, and key elements in the project's success. All projects were local community initiatives with little, if any, governmental funding; originated with one or two visionary, dedicated individuals; had the support of the local business community; and were enthusiastically supported by small rural telephone cooperatives or telephone companies, who provided loans and other funding. Some teachers were initially fearful or resistant toward the new technology, and teacher training was very important to the success of implementation. The technology tends to make teachers more organized and more conscious of the teaching process, and projects cannot survive without teacher support and commitment. The technology was used for a variety of educational configurations, including Chapter 1 and community adult education. The projects studied were considered successful and educationally effective, were strongly supported by all participants, and are likely to continue. (SV)

IMPLEMENTING TWO-WAY INTERACTIVE VIDEO IN RURAL, SMALL SCHOOLS

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PURPOSE OF THE STUDY

The purpose of this study is to describe how citizens implement two-way interactive video in rural, small schools and communities. Intended audiences are educators committed to rural, small schools; state departments of education; rural citizenry; educational organizations with a rural focus; teachers' organizations; and rural school administrator groups. The results of these descriptions:

(1) detail procedures for implementing two-way interactive video in schools in rural, small communities;

(2) provide guidelines and suggestions for implementation.

RURAL FOCUS

The role of rural schools is beginning to extend well beyond the basic education of a community's youth. There is a growing trend for rural schools to serve as a focal point and resource for the rural community at large. Rural schools often function as the local clearinghouse for the dissemination of information, health care, counseling, and community support services. Thus, the closing of rural schools has frequently spelled the doom of surrounding communities. Concerned, enlightened rural citizens have recognized that their schools must survive to insure the survival of the rural community, as well as its unique culture, and have sought ways in which to keep rural schools alive and communities intact.

Rural leaders have begun to consider the application of new technologies, particularly telecommunications, to rural education and community services, which they envision as a means to secure the continuing viability of the rural lifestyle. The recent development and rapid growth of telecommunications technologies have been instrumental in making educational opportunities and social services available to rural communities. Potential services are medical and EMS training; medical diagnoses and treatment regime; community planning and networking; professional training for firefighters, policemen, lawyers, and citizens interested in improving their professional status. As new technologies continue a near exponential evolution and costs continue to decline, hi-tech accessibility to rural schools and attendant communities, can be expected to increase dramatically.

While the promise of expanding course offerings through telecommunicated classes may further neutralize arguments for consolidation of rural districts, this technology will also broaden opportunities for sharing and cooperating with other rural districts in partial reorganizational arrangements. Rural districts, making use of new technologies, will be involved, by the very nature of the medium, in cooperating with other districts or organizations.

New telecommunications technologies, now available to the rural community, can offer a unique opportunity to reshape the educational environment, as well as have impact on the social, communication, political, economic, and recreational aspects of rural life.

RESEARCH DESIGN

This study of the process of implementing two-way interactive video in rural, small schools utilized a descriptive multiple case study design (Yin, 1984). The case unit was the two-way interactive video projects, which link participating schools within a given region. Distance between schools can be as far as 200 miles.

Case study sites

In order to focus on varying phases of the implementation process, one of the projects selected was in the early phase of development, one was in the intermediate stage, while three had been on-line for varying periods of time. In addition to temporal distinctions, the three relatively mature projects were chosen because each has unique characteristics that inform upon the two-way interactive video process. These projects, specifically the mature projects, are among the few in operation throughout the United States, and have been visited by many other educational entities interested in considering this technology.

All schools in the project were considered to be at risk because they were not able to provide education comparable to larger and less isolated schools. Sites were selected from the southwestern states of Texas, Oklahoma, and New Mexico, states that were hit hard by economic setbacks in the oil and agricultural industries. Sites had little, if any governmental funding at national, state or local level for implementation of innovative technologies. Selected projects were conceived and funded (at least in the pilot phase) from within the community, primarily from non-governmental sources.

The partnership between local schools and indigenous, private businesses provides a unique perspective in terms of the implementation of innovative technologies in education. These "grass roots" initiatives contrast markedly with projects in Wisconsin, Minnesota, Kansas, Iowa, and Mississippi that received funding almost exclusively from public sources such as tax bonds, state departments of education, and district funding.

Data collection

Data sources for each case study included:

(1) face-to-face interviews during site visits; many interviewees were recorded on video and/or audio tape
(2) observations and video recording of interactive video classes during site visits;
(3) community, school, telcom, and government documents;
(4) community, school, telcom, and government records.

Documents include newspaper articles, memos, letters. Records include minutes of meetings or financial reports.

Interviews were conducted with such individuals as superintendents, principals, school board members, telcom liaison representatives, interactive video coordinators, parents, teachers, and learners who have made use of the technology for learning. Participants were selected through a process of snowball sampling (Patton, 1990) by which interviewees nominate others to be interviewed. To help ensure that multiple viewpoints are represented, the principle of maximum variation sampling was observed in selecting from among individuals nominated (Lincoln & Guba, 1985).

Although formal interviews were conducted on-site with key individuals, additional data was collected through informal discussions and conversations with other community members, and follow-up interviews were conducted by phone.

Data was collected by four investigators located in Austin, Texas, during a minimum of two site visits of from two to three days each. In light of the distance between the research center and the sites, as well as the number of sites, additional site visits were impractical. However, numerous phone interviews were made before and after site visits.

Data Analysis

Each site's development occurred both in ways unique to a specific location and in common with the other locations. Although all projects began by local initiative, federal and state participation emerged (to varying degrees) during the course of site development, allowing for further description and clustering of variables. Emergent commonalties have been synthesized and presented in the findings, as well as in an edited videotape.

THE TECHNOLOGY

The development of two-way interactive networks, permitting the transmission of full motion video with simultaneous audio for educational improvement in the teaching of students in rural, school districts is emerging as a viable option of instruction for rural schools.

Two-way interactive video and audio is essentially a networking of media production points or classrooms that have the capability to transmit and receive audio and video from other classrooms similarly equipped. This interaction is particularly relevant to rural, small schools where populations are typically sparse, and human resources are severely limited.

Two-way interactive full motion video and audio has specific characteristics that make it attractive and feasible for rural, at-risk school populations.

1. *Immediacy*. In contrast to multipoint video which is typically disseminated by satellite or videotape and originates from a distant learning authority with severely limited reciprocity, two-way video and audio allows constant interaction between students and teachers who are typically located in the same or a nearby community. This immediacy of feedback allows students who have limited attention spans to maintain active contact.
2. *Relevancy*. Two-way tends to work best with a clustering of several small student populations with teachers who may or may not be located in targeted classrooms. Such configuration allows teaching to be specially designed to the needs of students involved. A typical configuration might be two or three pre-algebra classes with teachers linked with a master teacher originating from a university or community college. Another configuration could be three separate student populations with a teacher in each classroom serving as the master teacher in her/his particular area of expertise.

3. *Stimulating Learning Environment.* Two-way video enables the teacher to present a variety of perspectives and images via multiple cameras from different angles and variable fields of view, videotape, and computer display. Images and sound are close in quality to those found on professionally produced, commercial television. Such credible imagery, with the additional stimulation of multiple visual and aural fields, complemented with concurrent student feedback, has the potential to engage students, including students with learning disabilities, in ways unique to current classroom methodology.
4. *Affordable Cost.* With dramatic advances in media technology, and use of consumer oriented video and audio production equipment, ISD's can equip classrooms (media centers) with a moderate amount of cost.
5. *Telcom Participation.* There are increasing incentives in the form of grants, profit opportunities, public relations and deregulation to motivate telcoms, particularly small, regional telcoms serving rural populations, to be major participants in making two-way video available in schools.
6. *Access to Information.* Once linked with two-way video, a classroom has the potential to receive any other mediated information available within the network. Information from videos, laser discs, satellite feeds, computer networks can all be easily transferred from one classroom to another.
7. *School/Community Production Center.* Originally, television was viewed as merely a means to chronicle live news events. It has become much more. So too, does the electronic classroom have the potential to exceed the expectations of its original intent. In essence, each classroom equipped with two-way video becomes a fully functioning television studio, complete with a capacity for a studio audience, that can either go live to other schools and/or be recorded for videotape distribution. And once a two-way video system is in place, linkage into distribution modes such as community cable systems becomes relatively affordable, creating the potential for shared community meetings, guest lecturers for the school/community, adult education, live school news production, dramatic presentations and much more.

Typical configuration

The typical classroom is equipped with three video cameras, an overhead that can display teacher and student work, as well as serve as an electronic chalk board, a camera to capture the teacher (when present), and a camera to capture the class.

All cameras can be manipulated to cover varying fields of view. The teacher or student has the ability to switch from one camera to the other, via a switching board generally located at the teacher's work station which also houses other multimedia equipment.

Two banks of three to five monitors are situated to provide both students and the teacher visual access to other classrooms in the cluster as well as the electronic chalk board. Both banks of monitors display the same images. One monitor shows the teacher or the image from the overhead camera. The other monitors displays the students at remote sites. The difference between the teaching classroom and the remote classrooms is that the students in the teaching classroom see the teacher both on video and live.

Audio is captured by placement of multiple microphones throughout the classroom. The teacher has an attached microphone (lavaliere) to capture her voice while interacting with students.

All video cabling within the classroom and school is coaxial, carrying an analog signal. Transmission between the sites is digital via fiber optic cable. The video and audio signals generated by classroom cameras and microphones are routed to a control panel and split, one set of signals routed to the originating classroom and the other converted to digital information for transmission to other classrooms via fiber optic cable.

Each class is equipped with a fax to distribute materials and assignments. Frequently, a teacher or staff member lives in a neighboring community and transports materials to a school when returning home or coming to school.

Transmission of video and audio signals is achieved by the digital conversion of conventional analog information via video codec (coder/decoder unit) which passes the digitized signals at 45 megabits/second (DS-3) to a fiber multiplex terminal (FMT-150) which then combines the digitized signals and transmits over one fiber optic pair, to other locations, permitting full-motion, multiple site (continuous presence) video, with simultaneous voice and computer data signals among networked sites. During transmission, all signals remain digital, which ensures integrity, regardless of distance or number of times multiplexed.

Until recently, the costs of implementing two-way video have precluded diffusion on a large scale. However, new policy incentives, the dramatic increase in telecommunications innovation, concurrent with decreasing

technology costs, the aggressive expansion of fiber optic telcom lines, and collaborative efforts between private industry and progressive educational entities have made it possible for districts with extremely limited resources to plan and implement an effective two-way electronic education environment.

THE STUDY

This study is important in that it documents the successful implementation of a technology that can potentially overcome the curricular and faculty limitations that put isolated small rural schools at-risk. The stories told by educators and other citizens in these communities can provide a powerful model and numerous suggestions for citizens of similar communities in implementing their own systems.

Research report

The research report was written to inform an audience of citizens and educational professionals interested in implementing interactive two-way video systems in their own schools. Before writing, an outline was developed to include the following components: purpose of the study; methodology, presentation of the data; validation and verification of the findings; and conclusions and recommendations (Patton, 1980).

Data are presented in three parts:

(1) A description of the technology with some technical data provided
(2) The story of each site's efforts to implement the technology;
(3) A comparison of the similarities and differences among the sites on issues salient to the intended audience.

Included in the presentation of data are:

(1) A thorough description of the setting for each case;
(2) A description of the key elements studied in-depth both case by case and comparatively;
(3) A discussion of the "lessons to be learned" from the study (Lincoln & Guba, 1985).

In composing the report, a preference has been observed for writing thick description rather than highly abstract and inferential analysis by the researcher. An attempt has been made to allow the study participants to tell their own story as much as possible (Denzin, 1989).

The Projects

This study has tracked five two-way full motion video and audio projects in Oklahoma, New Mexico and Texas, that are in varying stages of development during an eight month period. In order to alleviate redundancies the description of the first study will be much more detailed than subsequent ones. Only events unique to a specific project will be dealt with in detail and commonalties will be abbreviated.

1. **The Oklahoma Panhandle Shar-Ed Video Network** is the most mature network in the study, having come on line at the beginning of the 1988-89 school year with four schools in one county being linked. Although the current configuration of the Shar-Ed Network involves 13 schools across a three county area, the original initiative involved only the four schools in Beaver County, the eastern most county in the Panhandle. Initiatives for Beaver County began in 1985 in response to funding cutbacks as a result of declining tax revenues, as well as state mandates to provide additional courses. Further, the Oklahoma College Board came out with minimum competencies for six subject areas that required additional courses for college bound students. County schools were advised by the Dean of the Department of Education at Oklahoma State University (OSU) that their college bound students were not fully prepared for higher education.

   In response, Beaver High School developed an innovative School Before School Program where college bound students would come to school an hour before regular classes began and concentrate on college preparatory classes. A curriculum was developed and classes taught in conjunction with OSU faculty. The program became very successful and gained national recognition as one of fifteen schools cited throughout the nation as being an exemplary school. Although this innovative program did not use new technologies, it gave local educators the confidence and community support to try other educational innovations.

   Beaver High began taking foreign language as well as other courses from OSU via satellite. While county students tested well and the initiative was successful; area educators felt that inability of students to directly interact with teachers didn't provide the best learning environment possible. There were good foreign language teachers in the county, and in the other five areas of competencies, but not enough teachers for all four schools. Ideally, the country would share teachers within the county, thus providing college preparatory courses tailored to the specific needs of their students. County superintendents

attended a demonstration in rural, western Wisconsin relating to interactive television distributed via microwave. Two of the four superintendents were impressed by the interactive nature of the system and students' ability accept the technology and learn from it. Their first selling job was convincing the other two superintendents to join the quest. The result was the formation of the Beaver County Interactive TV Cooperative.

Upon returning from Wisconsin, county superintendents reasoned that "...if they can do it, why can't we?" and began the long odyssey of getting support and funding for the implementation of two-way interactive video in their county. Local support for the program was not difficult since the county's schools had already gained considerable credibility from the School Before School and the satellite program. The attitude of the community can best be summed up by a caveat issued to one school board member: "Wiley, you go ahead with this thing. Just make sure you do it right. I don't want to see egg on your face." However, support for the program didn't extend to financial contribution. Budgets were already stretched tight.

The superintendents started knocking on doors. Some doors opened and many didn't. Fiber optic cable was beginning to be installed by phone companies and was being heralded as a revolution in the field of communications. A member on one of the county's ISD's was also a board member of the Panhandle Telephone Cooperative Inc. (PTCI), a rural coop that provides telephone service to the Panhandle and surrounding areas. He suggested approaching the PTCI for the following reasons:
(a) Although the PTCI was relatively small, it was progressive and had been installing fiber optic cable in the area, as well as upgrading many of its other services.
(b) Being a federally mandated cooperative, it is required to reinvest profits back into the community or to issue capital credit funds to customer-members. Supplying the schools with interactive television made sense, because fiber optic lines necessary could be used to carry signals other than those necessary to link the schools.
(c) The PTCI had a vested interest in the survival of the schools because it believed that the school was essential to the survival of the community, and without the community their subscriber base would dissipate.
(d) Use of the technology allowed the PTCI to work with a cutting edge technology that would place them in a strategic position when broader applications of the technology were sought.
(e) It was good public relations both within the community and without.
(f) PTCI employees and board members were a part of the community with family members attending local schools.

The relationship between the Beaver County Educators and PTCI proved to be fruitful. Indeed, this liaison between county ISD's and the small, rural telephone company proved to be a model for all projects described herein. Small telcos have been much more responsive to the needs of their communities than larger telcos, and generally when small telcos have attempted to extend an educational network into areas controlled by larger companies, they have had little cooperation or success.

Meetings ensued and an accord was reached. PTCI, having a three county service area, wanted to provide the same educational opportunity to the schools in Texas and Cimarron counties that wished to participate. But for the first phase, PTCI would connect the four schools in Beaver County. Negotiations resulted in PTCI linking the four schools with 52 miles of fiber optic cable, providing maintenance, transmitting equipment, and transmission access. The Beaver County ITV Cooperative through its accumulation of grant moneys would partially reimburse PTCI over a five year period at the rate of $45,000 a year and would cover the costs of facilitating media labs with cameras, TV monitors, microphones, etc. in the four schools, costing about $20,000 per lab. Currently, each school in the network is paying PTCI $11,000 a year for maintenance and transmission access.

In addition to reaching an accord with PTCI, Beaver schools had to reach an accord among themselves in terms of aligning schedules. This turned out to be one of the more difficult obstacles to overcome. In order for schedules to match precisely, school days had to begin and end at the same time. Class periods had to be coordinated. Holidays had to be the same. This "electronic consolidation" ran counter to the independent nature of the Panhandle superintendents. However, with a lot of hair pulling, concessions, and cajoling a unified schedule was hammered out that would allow courses to be taught over the interactive system.

Another obstacle encountered was a state regulation requiring a certified teacher to be physically present in every classroom. The model for Beaver County and subsequent expansion was to have one teacher for all four sites. There was some skepticism within in the community as well regarding control of students in satellite classes and cheating. State authorities and the community were ultimately satisfied by the

requirement that each student and his parent participating in the interactive classes had to sign a contract stating that the student must comport himself properly, and must maintain satisfactory academic progress. If not, the student would be removed from the class. Also, classrooms were monitored by the principal or superintendent in each school via an office television that was connected to the system. Surprisingly few disciplinary problems have been reported since the inception of the program.

Courses began being exchanged over the Beaver County two-way ITV network in the fall of 1988. Classes offered were advanced placement English, Spanish, art, and accounting with all classes originating from different schools. Few glitches were encountered. PTCI's installation of the complex system functioned well from the onset. Teachers selected were among the best in the county and were enthusiastic about the possibilities teaching over the network and embraced the technology. Other teachers expressed strong reservations, fearing that the sharing of teachers might phase out teaching positions. Training was minimal, generally limited to familiarizing the teacher how equipment operation. Very little information about teaching on this new technology was available. Teachers who subsequently gained experience on this network have helped train and advise educators implementing other networks.

During the 1990-91 school year three schools in Texas county, Beaver's western neighbor, were added to the network to form a second cluster of schools. The cost to connect to the network was $17,000. These schools shared their own classes, including Advanced Placement English, Spanish, college level general Psychology, and advanced math. At this time there was no sharing between clusters.

Beginning in January, 1991, the network offered its first course from an institution of higher learning, a Northwestern Oklahoma State University graduate class in education administration. The class was transmitted from a site in Texas county and available in both Beaver and Texas counties.

Also, beginning in January, 1991, Region 5 Rural Technical Assistance Center out of Denver, Colorado, undertook a three month study to explore the feasibility of using distance education as a means for providing Chapter I remedial courses to eligible children. Math instruction was provided to third and fourth grade students via interactive television with one teacher at the sending site and three facilitators at the remote sites. Four network schools in Texas and Beaver county were selected for the first phase of the study. The second phase selected four sites in southeast Kansas and took place in the summer of 1991. This study was of particular interest because distance education has been has traditionally been used for college students and self-motivated high school students.

Authors of the study made the following observations:

- Chapter 1 math instruction for third and fourth grade students can be effectively delivered via two-way interactive video.
- Classes were at least as effective as a traditional instruction delivery system in producing student achievement.
- Interactive television was successful in actively engaging the students for the entire program.
- When the technology is already in place Chapter 1 delivery is no more expensive than the cost of a traditional Chapter 1 program.
- Advantages of using two-way interactive video include the sharing of human and material resources, increased teacher support through networking, visual clarity of objects, and staff development through modeling.
- Issues that could be problematic are the commitment of time and money, the need for specific teleteaching training, the difficulty of establishing a schedule, the possible limitations of the classroom environment, and the differences in classroom management.
- Teleteachers, facilitators, superintendents, and parents responded positively to the distance education project in surveys and interviews.

During the 1991-92 school year two more schools were added to Texas county making a total of five in that cluster. Panhandle State University, located in Texas county, came on line in the summer of 1991. The university began offering college courses in English, history, economics, sociology, and government to qualifying high school students (seniors with a 3.0 or better grade point average). These courses were dual enrollment, meaning that passing students would receive college and high school credit at the same time. These courses are available in all three counties. However, Beaver county has had difficulty in participating because of a full network schedule.

Three schools were added in Cimarron county, just west of Texas county, to form a third cluster. This cluster offers a nearly full schedule via the network including mechanical drawing, trig/calculus, AP English, Spanish, and speech from within the cluster; art from the Texas county cluster; and economics, a dual enrollment course from Panhandle State University.

By the 1992-93 school year, all three planned phases of the network had been completed. Area schools concentrated on upgrading teaching of existing courses. There has been somewhat more sharing of courses among clusters, but essentially school networking patterns stabilized. Community access was expanded in the form of non-credit courses, paraprofessional training, and inter-community meeting opportunities.

Future plans for the network possibly include:
- connecting with a southwestern Kansas interactive TV network, giving them access to Fort Hayes State University which has a strong graduate program;
- connecting with Oklahoma State University and/or Oklahoma University;
- offering foreign language awareness courses at the elementary level;
- offering vo-tech courses in Cimarron county;
- providing computer data transmission, including student access to Internet, and training from Panhandle State University;
- expanded community participation.

The New Mexico Eastern Plains Interactive TV Cooperative came on line for the 1990-91 school year. Although by inspired the Oklahoma Panhandle Shar-Ed Network, it evolved quite differently. The vision and subsequent implementation, rather than originating from educators, came from the manager and CEO, and the board members of the Eastern New Mexico Rural (ENMR) Telephone cooperative. That original vision included linking twenty schools together, both in New Mexico and in west Texas; access to medical training and technical support from the Lubbock Health Sciences Center; onsite training to outlying industries; and university courses and professional training for community members. ENMR's position was one of pragmatism. It was convinced that the viability of the rural school was essential to the survival of the surrounding population which was ENMR's subscription base.

ENMR approached schools that were already accessible by fiber optic and offered them the opportunity to participate in a pilot project whereby ENMR would assume all costs for setting up the network including installation of production gear for studio classrooms. ENMR had sought support from the state legislature, but was not successful. The only governmental support available was a no-interest loan from the Rural Electrification Administration (REA). Rather than wait for additional moneys to be allocated, ENMR decided to establish a successful program, then petition the state legislature for reimbursement. The obligation of the schools would be to coordinate schedules and classes so that the system could be effectively used.

From the inception, two clusters were conceived, one linking schools that had classes five days a week, and one that held classes on four days. Three five-day schools, spanning a distance of nearly 200 miles, shared courses in art and Spanish. This paucity of course offerings has proven to be problematic.

The second cluster, with only two four-day schools participating, shared art, physics, geometry, Spanish and algebra. A major problem occurred with one school closed on Friday and the other closed on Monday. The schools could not agree to be closed on the same day, so each had automated taping facilities that recorded classes transmitted on the day they were closed. Although both clusters had less than an ideal beginning, the project was deemed successful and attracted a lot of attention.

The 1991-92 school year witnessed the consolidation of one cluster and the weakening of the other. The five-day cluster lost one of its schools which converted to a four-day week and joined the other cluster, leaving only two schools at the extreme ends of the network, and only one shared class between them. The four-day cluster, in addition to the defection mentioned above, added another school, resulting in a total membership of five. All schools within the cluster agreed to a Monday-Thursday week, eliminating the necessity of students having to attend one day of taped classes. Each school supplied one course, with a network schedule including physics, algebra, Spanish, southwestern literature, and art appreciation.

A local community college, Clovis Community College, also joined the network this school year. The college was able to offer a number of dual enrollment courses to qualifying high school students, including psychology, sociology, algebra, English, Spanish, and art appreciation. These courses were particularly attractive to college-bound students, typically 40-60% of the school population, because there was no cost to the students with books provided. Students have been able accumulate as many as fifteen hours of college credit prior to graduating from high school.

For the 1992-93 school year a third and highly unique cluster was formed involving a high school and a remote elementary school in the same district some 45 miles away. Previously, students graduating from

the elementary school had to travel more than 100 miles a day to attend the ninth grade at the high school. That translated into more than 18,000 miles a year per student. Prior to leaving for the high school, most students, living in rural areas, also had to bus to the elementary school, further increasing travel time.

The president of the school board happened to be the local manager for the regional ENMR office in that area, as well as a graduate of the distant elementary school. He had assisted in the installation of media labs in other schools on the network, and was a strong advocate of technology in education. His first efforts to convince the ISD superintendent to install a remote ninth grade classroom wasn't well received. Other distance learning programs, courses via satellite, had not been successful in the area, and had been costly. However, after some persuasion, and the visiting of two-way interactive sites in operation, the ISD decided to implement the program.

This initiative differs from others in the network since the vision came from local inhabitants, rather than the manager and CEO at ENMR whose central office is located about 100 miles from the community. Not being a part of the pilot initiative, the ISD had bear the cost of equipping classrooms with production equipment.

Rather than providing an opportunity to share teachers, the technology served to set up a satellite classroom which delivered a full complement of ninth grade classes to students who would otherwise have to travel a great distance to attend the high school. A facilitator was on premises at the remote classroom during classes.

Although the program just began in the fall of 1992 with very little teacher preparation, there were indications of success. Students have the option of staying at the elementary school for the ninth grade or bussing to the high school with older students from the area. Eight out of the ten students who started the fall semester, elected to continue taking classes over the network. Grades for the ninth graders at the elementary school are as good or better than their peers at the high school. The English teacher, who was terrified at the prospect of using the technology at first, stated that her class with the network students was one of the best she has ever had.

Another development in the 1992-93 school year was the increased role of the community college in the network. Two schools in the four-day cluster were unable to offer a suitable course because of faculty changes. The community college was in a position to increase its participation and did so. Some school superintendents expressed a preference for courses offered by the college because of the dual enrollment advantages, and they felt that the accelerated pace of the college level courses was more consistent with the potential of the medium. Also, the community college began to offer a number of college level courses in the evening for community members with as many as 28 students enrolled at a given school. Courses offered were accounting, art appreciation, English composition, American national government, and psychology. The community college is currently writing a grant for nearly a half a million dollars to upgrade its network facilities in order to further expand course offerings.

The original vision of the manager and CEO of the ENMR has been scaled back for the time being. Originally, the company had planned to put as many as 20 schools on the network, and a number of schools have petitioned ENMR for network access. Although ENMR was partially compensated by the state for classroom installation, it is unlikely that it will make any further large scale investment unless the state and/or ISD's agree to support the initiative up front. Company officials state that only one other school is slated for network access in the near future. That would bring number of participating schools to ten.

3. **The TeleCommUNITY Network**, located in a small town in central Texas, began operations in the winter of 1992. Although the TeleCommUNITY Network came on-line recently, it was the first fully functioning two-way video and audio network in Texas. This project has perhaps the strongest community focus in that the first phase of implementation involved participants only from within the San Marcos community. Participants are: the local ISD, specifically the high school, a regional university, the local telephone company and a Job Corps Center located on the outskirts of town.

   The vision initially came from an assistant superintendent and a special education teacher who was a strong advocate of educational technologies. Quickly, support came from the local phone company who hired the special education teacher and a two-way interactive TV specialist, who had been trained on the system in Minnesota, to facilitate the program. This is the only instance among the projects studied where professional facilitators were brought in to develop and coordinate the program. The telco also

financed the installation of the technical network, including classroom equipment. The three on-line sites agreed reimburse the telco over a five year period.

TeleCommUNITY, with a 14 member planning team, started meeting in January 1990, and implemented its network in January 1992, linking three sites in the community. Through a series of grants and support from the telephone company and the university, TeleCommUNITY began a unique program called PATH (Partners for Access to Higher Mathematics) Math. This program introduced pre-algebra skills to students who had previously failed in mathematics and were at risk in other higher order skills related to computational tasks. The course was team-taught by a university math professor who was located at the university, and by an ISD math teacher who was on premises with the students. Over 80 per cent of the students passed the course. Students will be tracked as they continue on with math and other studies.

Currently, the university is offering dual enrollment calculus to high school and Job Corps students over the network. The Job Corps plans to offer specialized vocational training to high school students and residents.

Other future plans for the network are:
- expansion of the network to outlying areas;
- to construct an additional classroom site at the university which will feature fully-interactive video, audio, and data capabilities which will interface with other on-line class labs;
- participants in local literacy programs will have access to on-line teaching at the high school, and originating at the Job Corps;
- implementation of other community activities, including on-line computing and video for children and adults of family literacy projects;
- to connect with an ITV network that is developing in a nearby metropolitan area.

4. **North Texas Educational Network (NTEN)** is a partnership among three north Texas ISD's, a parochial school, and a rural telephone company. The vision came from the owner and general manager of the telco who had seen demonstrations of the Oklahoma Panhandle system and believed that an area network could strengthen area schools, thereby preventing further erosion of the rural population. The owner has been successful in getting participation from the ISD's mentioned above, and is seeking support from additional ISD's, as well as an area college. Contractual arrangements with the on-board schools include reimbursement for the classroom equipment, and an annual fee for fiber optic access.

   NTEN is in the development stage, and has not yet fully equipped classrooms to begin using the system. NTEN held a two-way video demonstration at an area college in the summer of 1992, whereby members from local communities could see how the technology works. N-TEN has also participated in technology workshops to promote its initiative, as well as learn about others.

   Fiber optic cable has been installed between ISDs, and all equipment for implementation has been purchased by the local telco. Classrooms are in the process of being equipped. Training is expected to begin soon to prepare for inauguration of the network in the Fall of 1993.

   Initial plans call for the sharing of teaching expertise among the schools. Expected benefits for the future are an expanded and enhanced K-12 curriculum, dual high school and college credit, job training workshops and symposiums for the rural communities, programming capabilities for health care in rural areas and other community services.

5. **The Dell City Initiative** originated in a remote, underpopulated school district in far west Texas, about 90 miles from El Paso, and is facing the specter of consolidation. The vision to reach out with technology to strengthen the school and the community was first articulated by the Dell City ISD superintendent who had seen and studied some of the programs mentioned above. The manager of the local telephone cooperative has promised support, but apart from laying fiber optic to the school and giving encouragement, has been waiting for further alignment to occur.

   Initially, the project hopes to link three ISD's and a community college in El Paso, although agreements among participants are yet to be forged. All institutions have access to fiber optic cable. However, two of them, located in El Paso, are served by another telco which makes coordination even more problematic.

   Dell City is in the unique position of having the technology in place, capacity to transmit and funding for a media center, but as yet has been unable to secure educational alliances. An alliance has been formed with the Rural Telephone Cooperative which includes a conglomeration rural and small community

Telcos that extend from Lubbock, Texas to El Paso, although not inside El Paso. The ultimate strategy is to connect rural, small schools in the region, The University of Texas at El Paso, and El Paso Community College. Plans also include connecting with the University of Juarez in Mexico. Such a link would provide a international test site and would be the first in the United States. For the present, however, the superintendent at Dell City ISD would be content to communicate her vision to just a few of those rural, small schools. She wants to be fully functional within a year.

Although Dell City ISD is just in the genesis phase of implementation, it has already made enormous progress in getting right-of-way agreements with many telcos, and getting authorization, as well as support for the installation of necessary fiber optic cable enabling dedicated signal transmission.

Findings

- Two-way interactive video is alive, well, and growing in the Southwest. In spite of devastating local economic conditions, this technology can assist in the delivery effective education to rural, small schools.
- The technology cannot be implemented without the support of an extremely dedicated local visionary or visionaries. In all cases cited, the vision originated with one or two individuals who tenaciously continued efforts until the technology was implemented.
- Although expensive, the technology is affordable, but not without support from the business community, typically a local telco.
- All projects had enthusiastic support from small, rural telephone cooperatives or telephone companies. None of the larger telcos participated. In fact, they proved counter productive in some cases.
- Although projects had grand ideas from the outset, they started small and grew as the project matured.
- The technology was resisted by many on the teaching staff who feared that their jobs would be phased out. The technology appeared to do the contrary in that it enabled the offering of more courses which reduced the threat of consolidation.
- Typically, community support was favorable as soon as the technology was understood and differentiated from other less successful distance learning applications.
- In general, the major costs of implementation were originally undertaken by the local telco with partial reimbursement occurring over a period of time by the ISD's or by state DOE's.
- Teacher training is very important to the success of implementation. Delivery over the technology is substantially different from conventional classroom teaching. However, good classroom teachers make good teachers over the network. Teachers must given time to train and develop curricula for their mediated courses.
- The technology tends make teachers more organized and more conscious of the teaching process.
- Projects cannot survive without support and commitment of teachers who use the system.
- Education via the technology is as effective as conventional education.
- While all projects started out with specific classroom courses, all projects viewed the technology as a community resource. As projects matured, community offering increased, particularly in the area of adult education.
- The technology was used for a variety of educational configurations. Many advocates said that use of the technology "was only limited by the imagination."
- In almost all cases, projects studied were considered successful and have a likelihood of continuation.
- More coordination and flexibility in terms of federal and state regulations is necessary to accommodate new communications technologies. Without adjustments, widespread use of the technology will not occur.
- Participants, including students, teachers and administrators, involved with the technology tended to be strong advocates, even those who originally had strong reservations.
- Although the novelty of the program could be a significant element in explaining a project's early success, the most mature program (five years in duration) grew stronger as time progressed and is currently an integral part of the curriculum.

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