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ABSTRACT

Project OWLink is a teledistance project linking Rice University (Texas) to five Texas schools (one K-8 and four high schools) with a two-way audio/video and Internet connectivity, creating an interactive electronic community of teachers and students. Initiated in June 1994, the project has experimented with nontraditional models of distance learning. Working with Southwestern Bell representatives, the project developed a network architecture that facilitates the delivery of video and audio, both live and prerecorded, into the traditional classroom. This network is controllable from any site, allowing any instructor at any site to lead and participate in a presentation; each site is also equipped with the audio/video equipment typically found in traditional distance learning classrooms. Principles were asked to select two teachers each (four for the K-8 school) for the program, basing their choices more on innovation and collaboration efforts than on technological skills. The collaborative work programmed by instructors was based on four models of interaction: "teacher-to-students," in which one teacher instructs classes throughout OWLink; "expert-to-students," in which guest speakers could present to more than one classroom at a time; "teacher-to-teacher," in which teachers exchange information among one another; and "student-to-student," in which older students make presentations to younger students. (MAB)

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Project OWLink: Distance Learning in Electronic Studios

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Project OWLink is a teledistance project linking Rice University to five Texas schools with two-way audio/video and Internet connectivity through an ATM network, creating an interactive electronic community of teachers and students. Initiated in June 1994, the project has experimented with non-traditional models of distance learning. The interdisciplinary and multi-age uses of the technology have been generated, in large part by teachers in response to their instructional goals.

What are alternative models of distance learning and what is the "value added" to education by the combined use of videoconferencing and Internet technologies in the K-12 setting? These are the central questions which Rice University has been addressing since the inception of Project OWLink in June of 1994. Starting with the metaphor of an *Electronic Studio* for this new technology-rich environment, we began to build the infrastructure and the cultivation of teacher dynamics, in partnership with Southwestern Bell Telephone (SWBT).

A Point of View

The Center for Technology for Teaching and Learning (CTTL) at Rice University came to this opportunity, provided by seed money and technical expertise from Southwestern Bell, with a definite "point of view." This point of view has guided our beliefs about what is possible in educational settings and influenced the approaches we have taken.

Many advocates of change, particularly those who are the object of the change, would argue that small incremental changes make for the best outcomes. Strategic plans which build from the present to the future typify the way most organizations conceptualize change. Yet, the opportunity to invent the future rather than wait to be absorbed by it seemed a more compelling course of action. Conceptualizing the "system after next" is the part of the philosophy of the Center for Technology in Teaching and Learning (Gorry, 1996). This idea promotes the divergence from more conventional utilization of technology, to do what we have always done (i.e., making a process faster or more efficient), to use technology as a means of "re-thinking" the processes itself.

The term Electronic Studio entered the vocabulary of the Rice University campus from a report by a technology committee. This simple but powerful metaphor has spawned great interest and has been useful in designing classrooms and instructional content. The term, like the technology, is evolutionary and organic and is being defined as we proceed through stages of imagining, experimenting and refining. Originally conceived as a digital analog to the architect's studio in which all of the tools an architect needs are within arm's reach, the electronic studio envisions a networked computer that provides all of the tools one needs to find information, interact with others, explore, and synthesize knowledge.

The three ingredients in the "electronic studio" are the technology, the people and the processes. Despite the apparent power of computing and telecommunications, the technology alone is not sufficient to change the educational process. Therefore, in this project we attempt to find the best handshake between the technology (video conferencing and Internet connectivity)and the two other ingredients.

The Technology

With SWBT representatives, we developed a network architecture that facilitates the delivery of not only text and image resources, but also video and audio, both live and pre-recorded, into the traditional classroom. This architecture consists of fiber optic-based ATM connections among the five Houston settings, and more traditional copper "T1" connectivity to the two campuses in the Rio Grande Valley. State-of-the-art ATM switch technology allows data, video, and audio to be delivered simultaneously over a single high-speed network connection. A network diagram (figure 1) follows showing in general terms the network architecture:

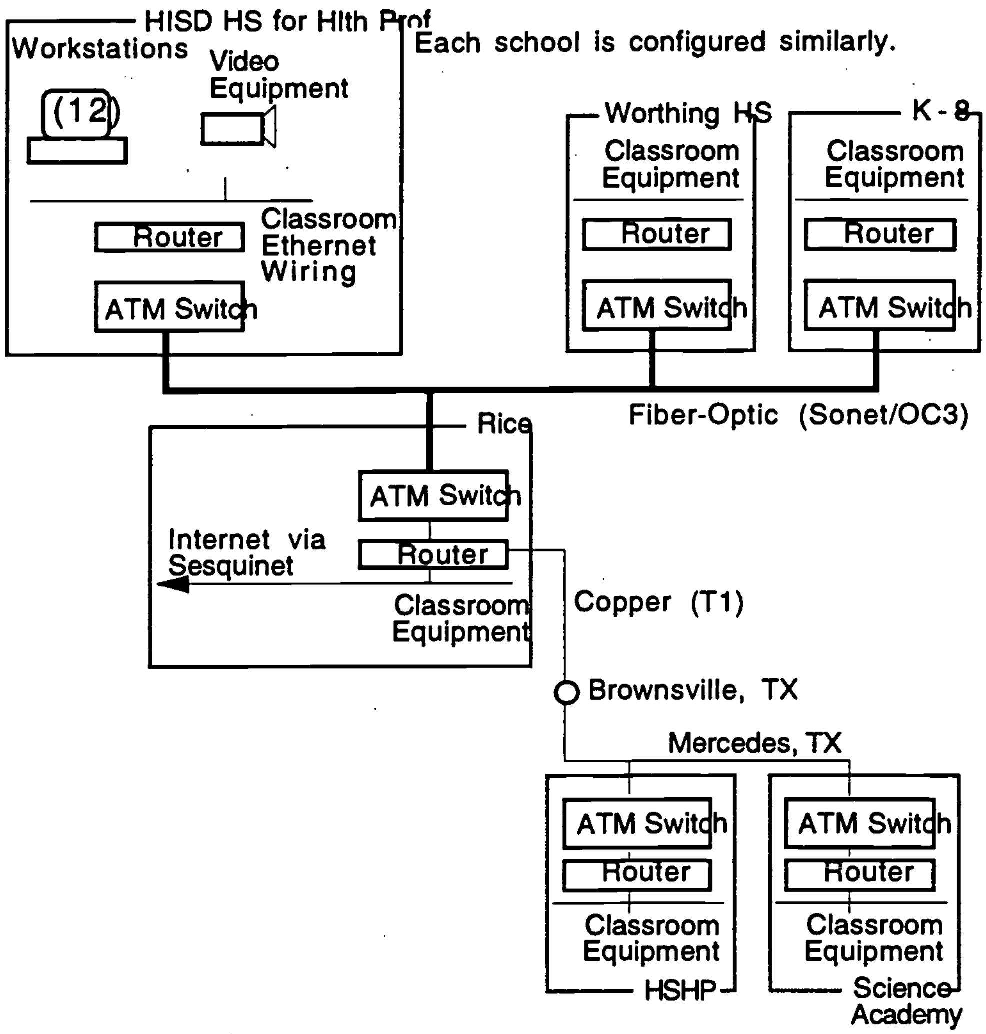

Figure 1. OWLink Architecture

Each OWLink site has a room-based video teleconferencing system (two-way, full-motion) and a local area Ethernet network connected at high speed (768Kb/s for the Valley, 10 Mbps for Houston sites) back to Rice University. All incoming video and audio signals are routed to a nearby Southwestern Bell facility for switching and routing, and the classroom data connections are aggregated at Rice and connected to the Internet by Sesquinet (a regional connectivity provider) at T1 speed (1.544Kb/s). The audio/video network is controllable from any site, allowing any instructor at any site to lead and participate in a presentation.

Each site is equipped with the audio/video equipment typically found in traditional distance learning classrooms. For our sites, this includes two student and one instructor 27-inch television monitors, and a podium with a preview monitor, control panel, VCR, an ELMO video overhead projector, all of the microphone and amplification equipment, and an instructor workstation. For the students' use are 12 high-end Internet-connected PCs or Macintoshes, a flat-bed color scanner, a laser printer, and an assortment of software installed on each workstation for compatibility. Schools were allowed to select the computing platform, thus there are 3 Macintosh sites and 2 Compaq/PC sites. The physical placement of the "OWLink" room was also a site-based decision with many variations on the rationales for one location over another, but all but one school elected to house the OWLink resources in a "lab" type setting as opposed to a particular teacher's classroom. This has afforded the "lab" schools a greater degree of flexibility in sharing the facility among disciplines, and among school communities, including visiting instructors, community speakers, and evening and weekend-use classes.

Given the opportunity to integrate video and data transmissions within a classroom, and mindful that teacher shortage issues were not the problems we were trying to address, we intentionally asked "what value is added to education by the use of these resources" and "how can we use a participatory design process to encouraged teachers to 're-think' their curriculum in light of these opportunities?" Here is where the people and processes enter the picture and make technological accomplishments pale in light of the challenges on these two fronts.

The People

The schools selected for this were chosen because they represent diverse sites geographically and demographically.

	Site Descriptors	
Site	Grades	Community/Demographics
1. The Rice School	K-8	New laboratory school, ethnic mix, urban
2. Worthing High School	9-12	Predominantly black student body, urban
3. High School for Health Professions	9-12	Magnet school, ethnic mix, urban
4. Med High	9-12	Magnet school South TX, Hispanic, rural
5. Science Academy	9-12	Magnet school, South TX, ethnic mix, rural

At an initial meeting with administrators from each campus, the profile of the type of teachers we were seeking was described as:

- works well with others
- desires to learn about and use technology
- eager to re-envision curriculum
- willing to host visitors in classroom
- previous experience in integrated curriculum
- willing to use new assessment techniques
- has time and energy for training schedule, conferencing, and extra preparation.

Principals were asked to select two teachers, with the exception of the K-8 school which in our minds required four teachers-two from grades K-5 and two from grades 6-8. The characteristics stressed were not knowledge of technology per se, but rather a willingness to "imagine and experiment" and devote extra time to planning curriculum in collaboration with others.

A stipend of $4,000 over an 18-month period, a fully-configured laptop computer of the same make as the classroom machine, and a dial-up Internet account (to allow the teachers to connect from home or other remote locations) were provided as important elements to ensure that the teachers were equipped to take on this challenge. The selection process resulted in 12 teachers in the following combination:

1 High School English Teacher
3 Secondary Social Studies Teachers (2 High School, 1 Middle School)
4 Secondary Science Teachers
2 Mathematics Teachers (1 High School, 1 Middle School)
2 Teachers of multi-age classes (Grades 3-5)

Administrators played a significant role in the project, albeit, a subtle one. Although the principals had made the initial selection of teachers, the degree to which they continued to support the participants in acknowledging their contributions, in allowing them to train other faculty, and in some cases, offering them some degree of control over how the OWLink Rooms were scheduled, varied greatly.

When the usual stage of project momentum shifted from "uniformed optimism" (i.e., "I am so lucky to be in this project") to "informed pessimism" (i.e., "Why did I ever volunteer for this project?"), the principals' methods of handling this transition differed considerably. Also the level of the OWLink project administrators' desire to invest training in participants who found themselves with little affinity for the project was also a factor. A final factor was the demand made on several participants' time from other innovations for which they had also been enlisted. At the end of twelve months, a "letter of affirmation to continue" was sent to all participants, stating the specific accomplishments of the first phase and the expectations for the next phase of the project. Teachers were asked to affirm continuation or alternatively, indicate that other demands on them did not allow then to continue. Hence, the initial twelve participants dwindled to eight.

At the conclusion of the school year, as the project was moving into the "informed optimism" stage (i.e., "This is really getting easier and I see new ways to vary what we are doing."), three of the participants were offered promotions to other positions, two of them in technology roles for their districts, one to an instructional supervisor role. A fourth teacher also left the project due her spouse's change in jobs and relocation to another city. Once again, attrition reduced our numbers to four teachers.

Thus, the human elements played an important role. And the dynamics changed again with regard to collaborative planning and content expertise represented by the remaining participants, but because we were now into the informed optimism stage, many of the creative elements were added by this small, but active group of teachers.

In the background, while the teachers were moving through their stages of concerns, so too were the university staff. Providing extra training to those who requested it, and encouraging those who were being pulled in other directions or simply finding the task too ambiguous, were concerns. Maintaining the equipment and responding to technical problems were the other components which absorbed the management team's time. Integrating the project's technical support resources and requirements into the university's existing problem tracking system and consulting services groups helped to get the project through major and minor hurdles.

The Process

If the technology were to be embraced in the culture of the school, it was necessary to construct a community of practice, beginning with 12 participants and radiating out from this base to others in the school community. Previous work by Cuban presents the view that technologies that are not sufficiently flexible to adapt to current classroom practice would find little chance of adoption. Yet, we wanted to re-invent or diversify classroom practice by unleashing the power of this integrated media. Could teachers re-orient their conceptual frameworks about what is best practice in their disciplines to incorporate the strengths of technology--particularly a model of technology which called for them to tailor the content and teaching style in a new way?

In designing the training sequence, we attempted to learn lessons from the body of research by Hall and Loucks (1979) and others who have focused on Stages of Concerns when an innovation is introduced into an educational setting. When installing and innovation such as OWLink we wanted to be sensitive to the teachers experiences. As Hall, et al.(1991) describe it, "The concept of concerns is a useful way to understand the highly complex and dynamic state of emotion and thought that people have in relation to a given change or innovation" (pg. 13). The body of research posits that during initial implementation, concerns center on the details of the innovation and how it will impact one's role within the culture of the school. At some later stage, concerns about management (i.e., efficiency, organization, scheduling) are followed by consequence issues (impact on students, relevance to curriculum). Ultimately, issues of collaboration and cooperation with others regarding the use of the innovation and ideas about improving the innovation or re-directing it are considered.

We did not use the Stages of Concern Instrumentation in the first year of the project for evaluation purposes; however, we designed the training presented in two week sessions over the summers and on single days or one-on-one during the school year covered areas in ways which we felt would be anticipatory of the stages of concern:

- How does technology support me as a teacher?
  Administrative functions
  Instructional functions
  Professional development functions
  Personal satisfaction functions

- How does technology support learning theories?
  Collaborative learning
  Constructivist theory
  Multiple intelligences
  School reform

For the technology to succeed we felt there must be strong underpinnings to learning theory and a spirit of collegiality among the participants must be fostered. The face-to-face intensive summer sessions were enriched and extended over the duration of the project by the constant communication possible through electronic mail or videoconferencing.

We were targeting a model of collaborative, project-based instruction which reflects the "shared space" commonly used by scientists, historians, engineers, and other professionals. The initial projects which were put forth by the teachers involved Teacher A presenting to Teacher B's class or an expert presenting to several classes simultaneously.

In his book *Shared Minds*, Schrage (1990) outlines the rules of collaboration. The concept of a "shared space" is central to this process of working. Common examples of shared space include a blackboard, a rehearsal room, a prototype model or as in this case, a classroom environment which has both a physical place and a shared cyberspace. How could we capitalize on this environment to cultivate a model of teaching and learning that exploited the technology to achieve student-centered learning? The teachers themselves, as they moved into the collaborative stage, generated some examples.

Teacher to Students

Symmetry
High school Geometry teacher to students in grades 3-5
TAAS Preparation Skills

Algebra teacher to students in her class and another high school class

Local heroes

Rice English graduate students teaching high school students TAAS writing skills by using "local heroes" as a theme.

Expert to Students

Publishing on the Internet

University staff teaching to two high school classes

Writers in the School

Professional writer using collaborative software to produce an anthology of work from students in two different sties.

David Levy, Co-discover of the Shoemaker -Levy Comet

Teaching live from Rice to all OWLink sites with slides and video

Nicholas Negroponte, MIT Media Lab Director, Author of "Being Digital"

Talking live from Rice to all OWLink sites

Interview with Former Mayor (One of the OWLink teachers happened to be mayor)

Government students interview former mayor of suburban area about how local government works

Preventive Medicine in Health Care

Research scientist presenting to one class live and talking with another class

What are Viruses

Physician from Medical Center presents to three schools simultaneously

Reptiles - Snakes in nativity and captivity. Live Snakes Online!!!

Guest speaker and her snakes presented live in one school and to two others simultaneously

Teacher to Teacher

AP Statistics

AP Statistics is being offered for the first time in the State of Texas. Dr. David Lane, Associate Professor, Departments of Psychology and Statistics will assist an AP Statistics teacher at Science Academy in South Texas with her AP Statistics course.

Macbeth

David Truitt and Bob Riggins will be exploring Shakespeare with their respective students between the Rice School and South Texas.

Teacher Training Sessions on electronic mail issues and HTML

University staff teaching to OWLink teachers at high school sites

Attention Grabbers

Mary Hayes and Rosamaria Ynfante explored "Attention Grabbers" with their students. They covered concepts that are instrumental in TAAS writing.

Students to Students

Presidential Presentations

High School students presented histories of US Presidents' to 3-5 graders.

Presentation Software: How to Design your own presentation

Geometry teacher's high school students presented to elementary school students

SAT Courses by Princeton Review to all Houston Sites

Taught by Rice Students using the Princeton Review materials after school two days a week for six weeks

Integration of two way audio/video with high speed Internet

To answer the question related to the integration of technology within the electronic studio environment we can point to a more detailed example. The first was a multi-disciplinary unit on

Mandalas. Instructional objectives developed by the high school geometry teacher and an elementary teacher for grades 3-5 were:
1) Develop an appreciation of geometry as a mean of describing the physical world,
2) Recognize and appreciate the connections between geometry, modern psychology and ancient history,
3) Describe the symmetry of mandalas,
4) Discuss the important aspect of Aztec culture and the significance of the calendar stone to their culture,
5) Find and view information on the World Wide Web, and
6) Share data and information using distance technology.

This unit wove together interdisciplinary content and technological innovations. The teachers shared their expertise and facilitator roles using both the video and data access. The high school teacher highlighted the geometric aspect of Mandalas and showed the students how to make their own. She also touched upon how mandalas are being used in psychology and its ties to Hinduism. The elementary teacher led the discussions via the two-way video on the very famous mandala, the Aztec Sun Calendar, and the history of this ancient civilization. All of these lessons were enriched by the transmission of photographs using the ELMO and video clips using the VCR. The teachers had prepared Power Point presentation also and transmitted them suing the workstation on the podium to transmit them to both classrooms. The teachers counted this unit among one of their greatest successes both from an instructional standpoint because, in their words " the students learned not only the geometry, but the cultural and historical perspective of the topic," but they also expressed satisfaction in having "tapped the richness of the technology for learning."

A second instance of collaborative, technology-rich instruction was also conceived by another group of three teachers--a high school science teacher, an elementary teacher from grades 3-5, and a high school math teacher. Using the Golden Ratio as the theme, the teachers planned a six week unit. The instructional objectives focused on encouraging students to explore and realize the mathematical aspects of the world that surrounds them. At the three schools the students took various measurements on their own bodies. This information was entered into a spreadsheet so it could be easily manipulated. When the measurements were entered, some ratios were calculated and some comparisons made within each classroom and then between each of the 3 classrooms. The students found that some of their ratios were very close to each other. After more investigation, they found that they were close to the golden ratio. Based upon this discovery, one of the teachers shared the historical importance of the golden ratio, its presence throughout nature, and its impact on architecture, art and mathematics in general.

The teachers' generated these objectives:
1) Measure lengths to the nearest millimeter;
2) Enter data into a spreadsheet;
3) Manipulate data within a spreadsheet;
4) Express ratios in simplest form;
5) Express ratios as decimals;
6) Apply properties of similar figures;
7) Discuss the existence of the golden ratio in nature, history and art;
8) Find and view information on the World Wide Web; and
9) Share data and information using distance technology.

As teachers moved toward integrating the video and data-rich technology into the curriculum, there also developed a parallel interest at each of the campuses on being producers as well as consumers of information on the World Wide Web. One of the first and most frequent requests was for HTML training. The video network was used to deliver much of this training and in some cases other members of the faculty beyond the OWLink teachers were also part of the training audience.

Over the course of the project four of the five schools created their own home pages. (One school was named "school of the month" for its web pages by the Franklin Institute of Science.)

This interest in creating Web pages as a teaching tool points towards another important process--one is the use of asynchronous mode of delivering learning which overcomes the temporal barriers currently inherent in inter-school collaborations. Traditional class intervals militated against many of the inter-school and cross-disciplinary work encouraged by OWLink staff. No two schools had the same bell schedule or teacher conference periods; therefore making real-time connections between schools was a major logistical, administrative, and personal imposition--another instance where the technology was the forced to accommodate the culture of schools rather than any problem inherent in the technology.

The other important process is the role of the students in pushing the technology forward. In two of the high schools, the students created on-line newspaper for exchanging information about their schools. The demand to use the OWLink room came from students who felt empowered by the technology. After-school Internet clubs and classes were spontaneously generated by student interest. In one school, a student is the school-wide resource for operating the OWLink room due to his level of expertise and willingness to take on the responsibility.

The demand for knowledge about the World Wide Web among the schools we have worked and others with whom they have communicated about Project OWLink has motivated the offering of OWLink Web Camps for a variety of different audiences--students, teachers, and librarians, and parents. Many of these sessions are taught collaboratively with instructors at different sites via the two-way video.

The applications and issues surrounding use the World Wide Web in educational settings have been discussed in numerous other forums so we will not digress here, except to mention that publishing is now a cottage industry with the advent of the Internet and the OWLink students and teachers alike are contributing to that industry.

Summary

The power of distance learning via video and Internet access holds may promises which are closely tied to what most educators believe to be "best practice" in schools. It is possible to create the classroom after next, but one should not underestimate the factors which mitigate its impact. The technology coupled with people and processes form a dynamic and often idiosyncratic system which requires a long-term view and dedication to influencing the capacity building among the participants. We intend to use the lessons learned from the first 18 months of this project as we continue to imagine, experiment with, and refine the notion as well as the execution of the classroom after next.

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