DOCUMENT RESUME

ED 457 841 IR 020 911

AUTHOR	Strudler, Neal, Ed.; Niederhauser, Dale S., Ed.
TITLE	Technology Diffusion. [SITE 2001 Section].
PUB DATE	2001-03-00
NOTE	174p.; In: Proceedings of Society for Information Technology & Teacher Education International Conference (12th, Orlando, Florida, March 5-10, 2001); see IR 020 890. Figures may contain very small and illegible font.
PUB TYPE	Collected Works - General (020) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	College Faculty; Computer Uses in Education; *Educational Technology; Elementary Secondary Education; Faculty Evaluation; Faculty Promotion; Higher Education; Information Technology; *Partnerships in Education; Preservice Teacher Education; Public Schools; Teacher Role; Technology Integration; *Tenure
IDENTIFIERS	*Technology Utilization; Technology Utilization

ABSTRACT

This document contains the following papers on technology diffusion from the SITE (Society for Information Technology & Teacher Education) 2001 conference: (1) "A Response to Technology Integration in Teacher Education for Merit, Tenure, and Promotion" (Cindy L. Anderson and David Starrett); (2) "Online Technical Support Database for Educators" (Cathy Cavanaugh); (3) "The Digital Divide Found in American Education: The Increasing Technological Disparity in America's Schools" (Linlin Irene Chen and Jane Thielemann); (4) "Real-Time Learning in a Virtual World" (Patricia Donohue and Coy Ison); (5) "Operationalizing a Technology Standards with Proficiency Skill Sets" (David Georgi); (6) "Using Intelligent Agent Tutors" (Steve Knode and Jon-David W. Knode); (7) "Integrating Videos into a Business Calculus Class" (Bob Richardson and Brian Felkel); (8) "Use of FrontPage 2000 To Develop and Manage a Teacher's Educational Web Site" (Armand St-Pierre); (9) "Successful Mulidisciplinary, Thematic Curriculum Activities: Development, Implementation, and Impact" (Neal Topp, Cecil Doshier, and Carolyn Schlager); and (10) "ADOPT-A-SCHOOL" (Liezel Wilkinson and Guillaume Nel). Most papers contain references. (AA)

TECHNOLOGY DIFFUSION

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Everett Rogers (1995), in his renowned book, *The Diffusion of Innovations*, established a framework that helps us understand the complex process by which new ideas and practices are adopted by individuals and organizations. Simply stated, an innovation presents people with alternative ways of doing things and solving problems. Individuals and organizations must then decide whether to adopt these alternatives and change their practice or reject the innovations in favor of more "tried and true" approaches. Rogers asserts that the "diffusion of innovations is essentially a social process in which subjectively perceived information about a new idea is communicated" (p. xvii). The meaning of an innovation, he explains, "is gradually worked out through a process of social construction" (p. xvii). Under favorable conditions, a "critical mass" of users will eventually adopt the innovation and it becomes an accepted practice. In the absence of supportive conditions, however, many innovations fail to take hold and are abandoned for more established approaches.

This section consists of papers that examine efforts to promote the diffusion of technology in a variety of educational settings. The first six papers are research reports on the adoption and integration of technology in K-12 classrooms. The next four papers address efforts to infuse a technology emphasis throughout university programs. The following four papers provide descriptions of collaborative partnerships between universities and K-12 schools—followed by four reports of professional development models. A group of nine papers then examine the use of Internet-based learning environments. The next two papers focus on issues pertaining to standards for technology use, followed by four papers that give insights into the various facets of technology integration. Finally, the remaining four papers address theoretical issues involved in technology diffusion efforts.

The first set of papers examines the technology diffusion process in K-12 schools. Cavanaugh describes an online technical support database for educators. This resource provides troubleshooting tips, hardware upgrade procedures, multimedia tutorials, and links to additional resources and vendor updates. Gibson examines the effects of providing laptop computers for K-12 students in a rural community. He addresses issues such as the influence of having access to the technology on the learning process and teachers' pedagogy. O'Rourke highlights a key element in the diffusion process in elementary schools—opinion leaders who exert influence on their peers. Implications of her findings are discussed. Rodriquez and McDonald evaluate a Web-based middle school science curriculum and identify factors that are related to effective implementation of the curriculum. Scagnoli and Willging describe efforts to integrate various subject areas via a Web-library. Topp, Doshier and Schlager's paper focuses on the development, implementation, and impact of multidisciplinary, thematic units used within the school curriculum.

The second group of papers reports on efforts to diffuse technology components in university programs. Ferguson and Mahoney discuss issues associated with their PT3 sponsored project for revising their two required preservice technology courses. Brown and Appleman describe the formation of an organization for education students who are interested in instructional design. This group, Students in Multimedia Studies (SIMMS), was created to support people interested in expanding their skills beyond those required for standard instructional design situations. Snelbecker, Slesaransky-Poe, Fitt, Miller and Gallo describe a variety of strategies to infuse technology in a large, urban teacher education program. Cereijo, Mortensen and Holcomb report on distributed learning models used in their Department of Technology and Cognition.

The papers that follow document university/K-12 collaborative partnerships. Kemker, Schullo and Fitzpatrick describe the services provided by the Florida Center for Instructional Technology Preview Center located in the College of Education, at the University of South Florida. The center offers opportunities for K-12 teachers to examine over 3000 software and multimedia titles, hardware devices like Smart Boards and digital cameras, and provides workshops for using the technologies and integrating their use into instruction. Sugar, Parke and Pedersen present details about the development of a collaborative network that supports their university-school partnership. Wilkinson and Nel describe efforts in South Africa in which the Technicon Free State launched its Adopt-a-school program to provide professional development and other technology assistance to a secondary school in need of these services. Wolfe, Ashley, Nancy, Taylor and Wolff tell about a collaborative project in which content and teacher education faculty as well as elementary and secondary teachers redesigned curricula for implementation at their various sites.

The next cluster of papers focuses on models for professional development with technology. Jenks and Strickland describe the implementation and evaluation of a program designed to train technology mentors for rural school districts. The Technology Integration Mentors in Education (TIME) is a "train the trainers" model aimed at diffusing technology throughout a rural western state. Bailie examined data from a survey to see how results from local educators compared with results from a nationally normed survey. One focus of the survey was professional development. Anderson and Starrett describe the process whereby a university's retention, promotion and tenure guidelines were revised to value professional development associated with professors' infusion of educational technology into their university courses. Finally, McCurry explores inservice teacher education through the lens of two theoretical constructs—Rogers' Diffusion of Innovations theory and Vygotsky's constructivist concept of Zone of Proximal Development.

Following is a group of papers that documents the proliferation of learning environments enhanced by the Internet and related technologies. Hsu, Cheng, Chiou and Chen examined the use of the Internet in a High School in Taiwan. Teachers' attitudes and use of the Internet in instruction were compared before and after an intervention by the researchers. Findings indicate Internet use increased after the intervention, and that teachers recognized an increased need for assistance in teaching with the web as they progressed. Donohue and Ison describe how they quickly and easily get teachers to design slide shows and interactive quizzes and construct online curricula using a series of online tools. Gareau discusses how Javascript can be used to develop interactive online applications and Eckert describes a system that allows instructors and students to manipulate the same computer over a network. Pemberton, Tyler-Wood, Cereijo, Rademacher and Mortensen assess the effectiveness of the EnVision System as a tool for monitoring practicum students from a distance for their Educational Diagnostician Program. In a related paper, Pemberton, Cereijo, Tyler-Wood and Mortensen describe further efforts to use distance technologies in this program. Richardson & Felkel tell about their work with Web-based video in a business calculus class and St-Pierre focuses on practical suggestions for building and using Web sites to support teaching. Finally, Maraschin, Smith, Tamusiunas, Costa and Rickes describe a project in Brazil in which a group of teachers used web-based collaborative writing tools in a distance learning seminar.

The next two papers focus on issues related to standards for technology use. Georgi examined similarities between California technology standards and standards developed in the ISTE NETS project. Baines and Belvin looked across a technology standards and content area standards to find areas of overlap. They hope to distill the multiple standards documents into a unified set of standards.

Technology integration is the common theme in the next cluster of papers. Dias examined the relationship between teachers' pedagogical practices and the ways that they integrated technology into their instruction. She found consistency between constructivist teaching methods and instructional uses of technology as a tool to support student learning. In his paper, Foster explored connections between integrating technology into the classroom and teachers' self-efficacy, motivation and the perceived utility of the technology. Baylor and Ritchie identified factors that influenced several issues associated with technology integration (i.e., technology's influence on developing higher order thinking skills and teachers' technological competency).

In her paper, Lim shares a framework for integrating technology in teaching and learning that she believes will guide institutions in adopting innovative educational practice.

The last set of papers all address theoretical issues pertaining to technology diffusion. Duffield, Grundmeier, Stocker and Raymond provide a review of the literature in which they examined the ISTE Essential Conditions for Implementing NETS for Teachers in light of theories of diffusion, innovation, and adoption. Knode and Knode discuss how developments in artificial intelligence are enabling the creation of software-based tutors and teaching assistants. Chen and Thielemann describe how a lack of technology has contributed to the digital divide and suggest ways that teachers can access resources to promote equity. Remidez, Laffey and Musser address another issue—that of open source software development and how it can benefit teacher educators. Finally, Szabo describes what he believes is a major revolution—the information communications technology revolution—and hypothesizes how educators can minimize the shock and turmoil that we are likely to face.

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A Response to Technology Integration in Teacher Education for Merit, Tenure, and, Promotion

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Abstract: An effort by a committee at Southeast Missouri State University to provide support to faculty infusing technology into their teaching led to the creation of a document that provided suggested guidelines for judging these efforts in merit, tenure, and promotion. This paper describes the guideline document and the efforts that were taken to develop it. This paper also outlines the technology infusion efforts of two faculty involved in training teachers at the university, one in education and one in biology, and describes how they used the document to file for merit recognition.

Teacher education institutions are being asked to respond to the changing career market faced by today's public school students. Predictions for these students indicate that many jobs will require expertise in technology. In 1996, statistics predicted that five of the ten fastest growing jobs would require computer experience (College Planning Network, 1996). As a consequence, businesses are asking the public schools to produce students who are comfortable in the use of technology (USDL, 1991). Parents too, are demanding that their children be trained to use technology as a part of their school program (Trotter, 1997).

In response to these conditions, teacher education institutions are increasingly integrating technology into their teacher training programs in an effort to produce future teachers who are comfortable using technology in their classrooms. Both education faculty and those responsible for the arts and sciences courses that support the training of teachers are being asked to infuse technology into their university courses (NCATE, 1997). Recent research has demonstrated a correlation between the modeling of appropriate use of technology in college courses and the successful training of technology-using teachers (ISTE, 1999). Indeed, professional organizations whose job is to judge college and university teacher education programs for continued certification are now requiring the infusion of technology into teacher preparation courses (NCATE, 1999).

While the infusion of technology into teacher education is now required, the merit, tenure and promotion guidelines of many universities have failed to respond to this requirement. Though technology infusion is expected by professional organizations, many education colleges, while expecting written publications from their faculty, fail to award publication credit to the technology products of their faculty for merit, tenure and promotion (Johnson, Johnson, and Epstein,1998). Facing the choice between traditional requirements for continued employment and using technology, faculty might opt to focus on the former activities over technology infusion efforts in their teacher training courses. These choices can pit the desire of the teacher education administrators to receive positive NCATE approvals that includes technology infusion requirements against the desire of the faculty to succeed in their teaching positions.

Facing this dilemma, Southeast Missouri State University made an effort to reward the infusion of technology into the university and its teacher education program. The effort began with a motion in the Faculty Senate to revise the wording of the Faculty Handbook tenure and promotion guidelines to recognize these efforts. This motion was not successful. In 1999, in order to provide recognition for the technology efforts for those who were using technology while not threatening those who were not infusing technology, the Interim Provost brought together representatives of all of the colleges of the university. This included those colleges involved in the training of teachers, the College of Education and other colleges in the arts and sciences that support teacher education. The task of this committee, the Information Technology Faculty Roles & Rewards Action Team, was to design a document that would act as a series of recommendations to the promotion and tenure-granting committees on campus, acknowledging the technology efforts of those faculty who were infusing it while still maintaining the current language of the tenure and promotion guidelines.

The committee began by researching the rationale for creating the document. Together, they collected university mission statements that focussed on the inclusion of technology within instruction at the university. In addition, the committee felt that a mission statement and charge from the provost was not adequate rationale, that substantiation of these technology efforts with successful student learning was also necessary. To collect this part of the rationale, the literature of learning with technology was researched for its instructional benefits. This information was also included in the document, providing a strong motive for the document's use when making decisions about merit, tenure and promotion. Next the committee collected examples of technology initiatives within the university. These initiatives were compiled and sorted within the three traditional areas of tenure: research, service and teaching, with a description of the interpretation for each area. The resulting document, *Information Technology Faculty Roles & Rewards Action Team Information Technology Promotion, Tenure, and Merit Guidelines* (manuscript in preparation), was then distributed to the Dean's Council where it was accepted. Subsequently, it was distributed to the faculty where it is currently in its first year of use.

Description of Document

The ITFRR Promotion, Tenure, and Merit Guidelines document that was produced by the committee was divided into three parts. The introduction provided the rationale that led to the creation of the document. Included in this part is a synopsis of the mission statement of the university which includes the infusion of technology. Included also is a summary of the benefits of using technology in teaching. Finally, included in this part of the document is a statement that governmental officials and parents want their students to be exposed to appropriate technology in their education program.

The second part of the document is a description of the three areas commonly judged for merit, tenure and promotion. The document describes common faculty technology uses that might fit within each of these three categories. For example, it elaborates on a description of how class Web pages might be included within the teaching category.

The final portion of the document is a listing of the common technology initiatives that faculty engage in and how they might be classified when filling out papers for merit, tenure and promotion. It provides an outline of where these initiatives best fit within the three traditional areas as described in the faculty handbook. The list can then be a guideline for faculty who use technology to develop their papers for merit, tenure, and promotion. It also acts as standards for those faculty who make judgements about merit, tenure and promotion awards. A copy of this document is available on the Internet at http://cstl.semo.edu/itfrr.

Case Study of Biology Faculty

The Department of Biology at Southeast Missouri State University prides itself on being current in educational practices and being a forerunner in acceptance of new techniques and technologies. The faculty member described here was hired into the department in the fall of 1995 as a plant physiologist. During his five years of teaching within the department, his teaching was determined to be very effective based on peer-review, student ratings of instruction, and anecdotal evidence. He also developed a successful research program involving many students. During those five years, he published five peer-reviewed journal articles, obtained a research grant from the US Department of Agriculture, and was in general active within his field as evidenced by attendance and presentations at numerous professional meetings in his area. His record in the area of service included active participation on department, college and university level committees, including two years on Faculty Senate. Also, he became heavily involved in faculty development via his collaborative work with the Center for Scholarship in Teaching and Learning. His use of technology to enhance teaching led to his being chosen to facilitate workshops that provided training in the area of technology to other faculty on campus.

The involvement in faculty development became very heavy as he continued to be involved in the planning and development of the training workshops and continued to facilitate many sessions. This quickly led to his inclusion as a Technology Associate, an advisory committee that advises the center on directions the University should take in the inclusion of instructional technology into teaching and learning at Southeast Missouri State. This heavy commitment to the use of technology led to him being appointed Director of the center at the end of his fourth year at the University, a 3/4 time position leaving him 1/4 time in the Department of Biology. Based on his achievements in Teaching and Scholarship, he was encouraged to go up for promotion and tenure a year early, during his 5th year at the University.

The Department heartily approved his Record of Service in the areas of Teaching and Scholarship with strong evidence of effective teaching and the peer-reviewed publications and outside grant funding leading the way. Interestingly, Service was rated the lowest of the 3 traditional areas. Much of the evidence documented for service related to the faculty member's involvement in faculty development in the area of integration of technology into teaching and learning. This was ironic in light of the Department's stated position on being openly accepting of new technologies and being a fair judge of faculty accomplishments, etc.

The guideline document described had not been released to the campus at the time of the promotion and tenure process described above. However, some of the justification and approach used in the document were included in the record of Service. Nonetheless, it was apparent that the heavy involvement in the integration of technology was not considered with as great a weight as other more traditional pieces of evidence were. It is hard to say what effect the document might have had had it been circulated previous to this process. The document had however been circulated when the described faculty member submitted his merit report for CY 1999; a time frame which included six months of service fulltime in the department and six months as Director of the center. In this case, the heavy involvement in technology was recognized and rewarded. It is hard to say whether the document was responsible for this in any part, but it is likely that it had some impact.

The Department of Biology serves Science Education majors as was well as Secondary Education majors in other fields. The above-described faulty member has taught classes for majors and non-majors both and thereby has taught many students majoring in some form of education. Technology was integrated into many of his courses in the form of PowerPoint presentations, course-enhancing web materials, and even technology-oriented activities in biology. He has even taught a non-majors course completely on-line. Technology has also played a role in his scholarship as he has attended and presented at technology-in-education-oriented meetings and conferences and has recently submitted a book chapter on the creation and maintenance of web sites. The role of technology in service has been described above. Given that education students learn not only by content but also by example, the integration of technology into the classroom is an important aspect of the education received by these students. In order to promote effective use and integration of new technologies, it is important to teach by example. To this end, it is essential that the use of technology by faculty be recognized and rewarded by colleges and universities. The development and use of the guideline document described is one step in moving toward a more just recognition of the use of technology in the classroom by faculty teaching the teachers of tomorrow.

Case Study of Education Faculty

In the College of Education, the document, *Information Technology Faculty Roles & Rewards Action Team Information Technology Promotion, Tenure, and Merit Guidelines* served as a tool for classifying technology infusion activities according to the three traditional areas of merit, tenure, and promotion. One education faculty member's technology activities were spread across the three areas of teaching, research, and service. Using the document as a guide, most of the technology activities of the education faculty member fell into the area of improvement of teaching, followed closely with the area of service. However, the efforts in both of these areas led to technology-infusion activities that fell into the area of research.

The education faculty member taught courses that included instructional methods courses in special education, educational theory courses for regular education graduate students, and instructional technology courses for both regular education and special education. The technology infusion efforts in her education courses included many uses of computer-based technology ranging from simple email assignments to demonstration of sample technology-integrated lessons for her students.

In teaching courses in special education, the education faculty member infused technology by requiring Internet searches in several areas. These searches included such things as searching for information on different disabilities, searching for communication methods to use with diverse parents, and information on different education theoreticians. The students worked in groups and were taught to use chat rooms to enable them to communicate within their groups as they searched for information on their disabilities.

Another introductory course in special education that this faculty member taught was accomplished entirely online. Students in this course were required to communicate using several technology methods. They used a bulletin board to post case study assignments, communicated via email and chat lines for group research papers on different disability areas and used instructor-created Web pages for information. These activities were identified by the guidelines paper as teaching effectiveness efforts.

In teaching educational theory courses, the education faculty member infused the use of email, searching the Internet, educational software demonstration, and production of multimedia projects. In this course, the instructor introduced a variety of cognitive educational theories and the theoreticians who developed them using PowerPoint slides. As a part of the course, the instructor required her students to develop a research paper on one of the cognitive theoreticians and to teach a lesson that reflected that theory and infused technology. The students were taught *Hyperstudio* to do the presentation. To accomplish these projects, the students searched the Internet for information on the theorists and emailed a draft to the instructor. As each of the theories was discussed in class, the instructor demonstrated educational software packages that reflected that particular theory, followed by the student presentation on the theory and their sample lesson that infused technology. All of these technology efforts were identified by the guidelines document as efforts to improve teaching.

Two technology emphasis areas were created by the faculty member for the elementary and secondary programs, one at the undergraduate level and one at the graduate level. In these courses, the education faculty member used many methods of technology infusion. The education faculty member demonstrated technology-infused lessons, using a variety of software packages and relevant Web sites for a variety of subject areas. For each subject area, in addition to the software, she had the students create lessons for their students that used the Internet and then required them to find relevant Web sites to direct their students to use in their lessons. She provided hands-on use of special education technology, even requiring her special education graduate students to make a switch for their students. She used PowerPoint to present methods of making Web sites accessible for people with disabilities and then had students make accessible Web sites. She used email pen pals for her students to keep in touch with students in a K-12 classroom. Students looked up lessons on the Internet and turned them into lessons that were authentic activities using graphing software. Again the guideline document identified these as teaching improvements.

These teaching activities led to other opportunities that the guidelines document placed into the service and research categories. Several of the teachers in the courses that this faculty member taught requested her to come to their schools and provide an in-service for their faculty. She became a regular in-service provider to train their teachers to use the new technology. She served the university on several technology committees, at the departmental level, the college level, and the university level. She was asked to provide several in-services for faculty at each of these levels also.

Research and publication efforts also emanated from the technology activities that this faculty member used in her teaching. She was able to write and serve as primary investigator for several grants that used technology. She was primary investigator for an Eisenhower grant that purchased software for the regular education and special education teachers who participated in the courses she taught. These teachers developed technology-infused activities to prepare their students for state assessments. She was co-investigator and primary investigator for two grants that purchased hardware and software for regular and special education teacher candidates to use in their field experiences. The guideline paper suggested to her that these activities were properly placed into the research category.

Also in the research category, this faculty member provided several peer-reviewed state, regional and national presentations on technology use. She published five peer-reviewed articles about technology use in education, as well as a chapter in a textbook. Each of these activities were identified by the document as research activities.

Thus the guidelines document provided suggestions about the listing of technology infusion activities in this education faculty member's record of service. This education faculty member had technology infusion activities that fell within the categories of the improvement of teaching, service to the region and university, and research activities. These technology infusion efforts allowed this faculty member to achieve the highest level of merit offered by her department in the College of Education.

Conclusion

The *Information Technology Faculty Roles & Rewards Action Team Information Technology Promotion, Tenure, and Merit Guidelines* document was developed to provide guidelines to faculty at Southeast Missouri State University. These guidelines were designed to serve both as recommendations for classifying technology efforts for those faculty infusing technology and as suggestions for those involved in making judgements about these efforts for merit, tenure, and promotion. Future plans for this document include the collection of data from faculty members at Southeast Missouri State University and evaluation of its impact on the merit, promotion and tenure process there.

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Comparing a Local School District's Teacher Use of Computing With National Survey Results

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Abstract: Funded by the National Science Foundation and the U.S. Department of Education, the Center for Research on Information Technology and Organizations conducted a national survey of schools and teachers entitled, "Teaching, Learning, and ill discuss a modified local version of this survey administered to a large diverse suburban school district. The purpose of this local survey was to provide a comprehensive needs assessment focusing on the usage patterns and opinions of teachers toward computing. This paper will summarize the local survey results and then go on to compare the local results with the national survey results drawn from selected reports posted on the Internet. An outline of district plans to use the survey results in guiding the implementation of its technology plan will also be presented.

Introduction

In his State of the Union Address in 1996, President Clinton established the goal of technological literacy for all students as the nation prepared for the 21st century (Pepper 1999). Now that we have reached the new millennium, the educational community is still struggling to meet the President's challenge. Numerous surveys have been conducted to determine how schools and teachers are using computers and the Internet to advance learning. For example, surveys conducted by the U.S. Department of Education, the Office of Technology Assessment, the National Center for Education Statistics, and Education Week document the problems teachers face when trying to integrate technology into the curriculum: hardware and software that are out of date, classrooms that are not wired for the Internet, technical support that is not always available, staff development programs that are not adequate, and lack of time required to use technology effectively (Frank 1999, Oldenburg 1999, Pepper 1999).

Teaching, Learning, and Computing

Funded by the National Science Foundation and the U.S. Department of Education, the Center for Research on Information Technology and Organizations conducted a national survey of schools and teachers entitled, "Teaching, Learning, and Computing 1998." More than 4,000 teachers in grades 4 through 12 in over 1,100 schools throughout the country completed the survey questionnaire. The teacher survey posed questions on teaching philosophy, teaching practice in a single class, use of computers, general teaching experiences, and work environment. The analysis investigated the possible relationship between a constructivist philosophy of teaching and computer use. Possible correlates were computer experience, teacher responsibility and experience, educational background, and support for use of technology and constructivist practices. The survey was administered in 1998 and results were posted on the Internet starting in 1999. The availability of national results from such a comprehensive survey provided an excellent opportunity to conduct the survey on a local level and then compare the local results to the national results.

Local District Survey

The New Rochelle School District is a large diverse suburban district with a high school, two middle schools, and seven elementary schools. As is the case with most districts, New Rochelle is held accountable by its Board of Education and the New Rochelle community to develop and implement a comprehensive technology plan. The city of New Rochelle recently passed a technology bond to fund advances in computer technology in the schools, primarily in the form of improvements to the infrastructure. Looking beyond the hardware and wiring additions to their schools, district leaders felt that a comprehensive needs assessment, focusing on the usage patterns and opinions of their teachers toward computing, would be an valuable tool in guiding future technology decisions. One method of gathering data was to survey the teachers in the district to determine their use and level of expertise with technology. To that end, a modified version of the Teaching, Learning, and Computing Survey was developed that drew questions primarily from the sections on use of computers and work environment. The survey also contained other questions, including demographics (such as subjects and grades taught) and general opinions about computing and the Internet. These additional questions were based on a survey conducted by the Texas Center for Educational Technology, entitled "Teachers & Technology: A Snap-Shot Survey." The newly designed survey was distributed in September 1999 to all teachers in the district; participants were instructed to base their responses on their teaching practices during the 1998-1999 school year. After the completed surveys were collected, the data were coded and entered into SPSS for analysis.

Local Survey Results

Responses were received from 270 teachers in the district (a little more than 50%). Demographics revealed that over one quarter of the teachers had been teaching for over twenty years. The survey revealed a moderate indication that younger teachers have a higher level of comfort with computers than their older peers; only13% of the respondents rated themselves at the highest level of computer use. Over 80% of the teachers reported that they needed more time to use computers and the Internet, more training in technology integration, more curricular-based software, computers and Internet access and more technical support. This was a disturbingly high percentage, given the fact that the district had been very diligent in providing computers, staff development opportunities, as well as technical and instructional support to its teachers for many years. Yet, despite these efforts, teachers still appear to feel inadequately prepared when it comes to exploiting the power of computers in the classroom.

Fewer than half of the teachers reported using computers in class. The most popular objectives teachers cited for using computers in class were learning to work independently, mastering skills and remediation; word processing and games for practicing skills were the software most often assigned. It was encouraging to find that a number of teachers have a computer at home and some have Internet access. However, their competencies lie primarily in searching the Internet as opposed to more demanding tasks such as preparing a presentation or a multimedia document. Teachers reported that Internet access was the most valuable technology needed in the classroom.

Only 16% of teachers reported that they discussed computers and software on a regular basis with their colleagues; contact with teachers from other schools was rare. Despite the district's efforts to provide staff support, only 29% of teachers believed that staff development activities were followed by support for implementation, 26% of teachers believe that teachers play an important role in defining staff development activities, and fewer than 20% of teachers report that the Internet and its use were a central topic of discussion. The lack of classroom Internet access and useful curriculum-based software were notable deficiencies. Teachers further reported a lack of instructional (77%) and technical (70%) support.

Comparison to National Results

While some of the preliminary results were encouraging, many of them appeared alarming on the surface. The question to be answered was how they compared to the results of the national survey on Teaching, Learning, and Computing. As mentioned above, the national survey results were posted on the Internet. Two reports, "Internet Use by Teachers: Conditions of Professional Use and Teacher-Directed

Use" and "Teacher and Teacher-Directed Student Use of Computers and Software" and two snapshots, "Technical and Instructional Support for Teachers" and " Professional Development" formed the basis of the comparisons described below. Since the national survey included only teachers from 4-12 grades, results from lower grades in New Rochelle were eliminated from the comparison tests. For the reports that were of particular interest to the New Rochelle School District, local data was analyzed to align as closely as possible with the national data. Not all questions of interest could be compared because in several instances questions had too few responses to formulate a valid comparison.

Internet Use

One of the major areas of concern in the New Rochelle School District is the lack of classroom Internet access, particularly at the middle and high school level. The survey shows that 95% of middle school classrooms and 90% of high school classrooms have no access as compared to 60% and 61% nationally, yet 83% of teachers rated classroom Internet access essential to their teaching. The situation at home appears to be no better, with only 11% of New Rochelle teachers having home access as opposed to 59% of teachers in the national survey. However, it is encouraging that despite their lower access rate, New Rochelle teachers report about the same (email use and posting information) or higher (lesson plans) percentage of use of the Internet.

Computer Use

New Rochelle teachers (45%) lagged behind their national counterparts (71%) in the use of computers in the classroom. One reason for this may be the higher student to computer ratio in the New Rochelle schools. The ideal ratio appears to be about one computer for every four students. Only 6% of New Rochelle teachers reported this low ratio as compared to 13% of national survey teachers. According to the national survey, the average student to classroom computer ratio is 6 to 1, whereas the average in New Rochelle is 12 to 1. It is important to note that most of the computers in the district are currently located in computer labs rather than in classrooms. While important, the number of computers is not as crucial an issue as how teachers are using them. Another area of concern for New Rochelle is that 79% of their elementary school teachers rely heavily on games and drills. A possible explanation is that most New Rochelle teachers report remediation as an important objective for computer use. In fact, 63% of New Rochelle teachers who assign games and drills value remediation as an objective, as compared to 39% nationally. Elementary school teachers in New Rochelle are to be commended for a higher mean number of computer skills (3.7 out of 7) than the national elementary school teachers (2.6 out of 7). Middle school teachers in New Rochelle, however, came in lower (2.6 out of 7) than the national middle school teachers (3.4 out of 7).

Work Environment

New Rochelle can take pride in the fact that twice as many elementary school teachers (61%) report staff development sessions in critical thinking than the national survey teachers (32%). Yet staff development sessions in computer related topics are slightly lower in New Rochelle (21%) than they are nationally (32%). Technical support in New Rochelle appears to be better than in national schools. New Rochelle teachers report that when they need support, it is available over 68% of the time, whereas national teachers report that it is available less than 23% of the time. On the other hand, instructional support in New Rochelle might be improved since it is available only 9% of the time as compared to being available 25% of the time nationally.

Discussion

It appears that the New Rochelle school district has made great strides in providing effective computer use for its teachers and students. The level of technical support that is provided is also commendable by comparison to national survey results. Perhaps the area in which New Rochelle is most deficient in comparison to the national survey is in the number of classroom computers and classroom Internet access, particularly at the middle school and high school levels. There is wide agreement that despite the fact that most students have their own computer when they go to a computer lab, having four or five computers in the classroom significantly increases the number of computer assignments and the number of contact hours a student receives. Moving computers from the labs into the classrooms would be a significant improvement. Of course, wiring costs need to be addressed, especially to provide Internet access in the classrooms. Teachers themselves need more computer access for themselves. As compared to the national survey teachers, very few of them have computers at home to help them prepare lessons for their students. Perhaps purchasing laptop computers that could be assigned to teachers, particularly over the summer, would help to alleviate this problem.

Survey results seem to indicate that the elementary school teachers fare better than the middle and high school teachers in their use of computers in the classroom. Many more of them seem to have classroom computers so they are able to make more frequent assignments. They are also using software that addresses higher order thinking skills, such as simulations, presentation software, and multimedia authoring. It is unfortunate that they are also using games and drill and practice as the overwhelmingly predominant use of computers. This could be attributed to the fact that this is the most readily available resource that they have. Survey results indicate that teachers, particularly middle and high school teachers, could use more training and improve their computer skills.

Conclusion

The district has already begun to address a number of the concerns the survey revealed. The technology bond allowed the district to plan a single network that could be accessed by all schools, providing increased Internet access that was sorely needed. Each third and fourth grade classroom has received four computers, with a fifth computer for the teacher planned in the near future. This influx of computers will reduce the student to computer ratio to 6-1 for the third and fourth grade. They will be phasing out the dual platform of Macs and IBMs to standardize the interface for teachers and students. The New Rochelle School District has recently hired two Technology Information Specialists to work on staff development and curriculum integration in the elementary and secondary schools. Using this survey as baseline data, the district hopes to repeat the survey at the end of the next phase of the technology plan to show evidence of the strides students and teachers have made along the path of technological literacy. It is hoped that the data provided by this survey and comparison analysis will assist them in moving closer toward the goal that President Clinton proposed nearly five years ago to prepare our students with the technology skills mandated by the twenty-first century economy.

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Rage Towards the Machine: Technology and Standards in 2001

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Abstract: With the burgeoning movement to establish standards, many organizations have developed expectations for what a teacher should know and be able to accomplish through technology. We examined standards from accrediting agencies (NCATE, INTASC, and TEAC), professional organizations (NCTE, NCTM, NCSS, NAME, and ISTE), and state departments of education (Florida, Georgia, Tennessee, and Texas). We discuss and evaluate the standards promulgated through these agents in terms of clarity, complexity, coherence, adaptability, measurability, and desirability. Accordingly, the standards of NCATE, INTASC, TEAC, NCSS, NCTE, and ISTE were found wanting, while the standards of NCTM, NAME, and especially the technology standards being developed by the state of Georgia were more fully articulated, logical, and useful for teachers. In general, the more precise standards were stronger, but they were also more temporal.

Over the past twenty years, billions of dollars have been spent on computers, networks, and training. The E-rate program alone has provided America's schools with more than $3 billion worth of Internet access (Riley 2000). Concomitantly, there has been a surge of interest in national standards. Over the past decade, almost every professional organization even slightly related to teacher education has formulated, promoted, and distributed their own particular set of standards. Every state except Iowa has developed standards in at least some subject areas. Forty-four states have standards in the four core areas -- English, math, science, and social studies. Often the core standards contain explicit expectations for a teacher's technological expertise as it relates to his/her teaching field. For example, in Florida an expectation for a high school language arts teacher is that he/she be able to "select and use a variety of electronic media, such as the Internet, information services, and desktop publishing software programs, to create, revise, retrieve, and verify information" (Sunshine State Standards 2000). Forty-one states require prospective teachers to pass an exam connected to these standards (Education Week 2000).

So many standards, so little time. The array of standards vying for the attention of a teacher can lead as much to confusion as enlightenment. To what extent are the standards compatible? How do they differ? Which standards promote the "highest and best uses" of technology? To answer these questions, we examined a variety of standards as follows:

1) Teacher education accrediting agencies--the National Council for the Accreditation of Teacher Education (NCATE), Teacher Education Accrediting Council, and (although it is not an accrediting agency) Interstate New Teacher Assessment and Support Consortium (INTASC).

2) Professional subject area organizations--the National Council of Teachers of English (NCTE), the National Council of Teachers of Mathematics (NCTM), the National Council on the Social Studies (NCSS), and the National Association for Music Education (NAME).

3) Selected state standards--Texas, Georgia, Tennessee, and Florida.

In the following discussion, we will use italics to emphasize when we are citing a standards document verbatim.

Teacher education accrediting agencies

What is new about NCATE 2000 is the emphasis on candidate performance. Supposedly, no longer will a college of education be able to pass NCATE accreditation by amassing impressive volumes of data on the conceptual framework, faculty accomplishments, and sequence of courses. Instead, NCATE 2000 requires that institutions furnish the accrediting teams with information concerning the performance of candidates in classroom settings. Although technology is not explicitly mentioned in the six broad standards, under *standard I. Candidate Knowledge, Skills, and Dispositions*, there is an indicator called *Pedagogical Content Knowledge.*

The "target behavior" for pedagogical content knowledge is a teacher who *"has an in-depth understanding of subject matter that they plan to teach, allowing them to provide multiple explanations and instructional strategies so that all students learn. They present the content to students in challenging, clear, and compelling ways and integrate technology appropriately"* (NCATE 2000 Standards, p. 4). With regard to the professoriate who teach prospective teachers, under *standard 5. Faculty qualifications, Performance, and Development*, the standards mandate that facilities should allow faculty to *"model the use of technology...to practice its use for instructional purposes."*

TEAC, which was created, in part, as a reaction against the complex, politically-correct gauntlet of NCATE, takes an understandably briefer view. According to TEAC standards, "*special attention should be given to assure the technologies that ease the teacher's work and the student's learning are firmly integrated in the curriculum."* The only other mention of technology in TEAC documentation is that they consider it advantageous if *"graduates have acquired the basic productivity tools."* One assumes that technological tools would be included in the definition of basic productivity.

INTASC, an organization formed to forge a consensus concerning model teacher behaviors across state lines (which could lead to more reciprocity among states), lists ten standards. Technology appears only under principle #4. *"The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills."* Unlike the similar standard in TEAC, INTASC's "instructional strategies" specify technology: *The teacher knows how to enhance learning through the use of a wide variety of materials as well as human and technological resources (e.g. computers, audio-visual technologies, videotapes and discs, local experts, primary documents and artifacts, texts, reference books, literature, and other print resources.* (INTASC 2000)

The technology standards promulgated by NCATE, TEAC, and INTASC are brief, vague statements that ask that a teacher use technology as part of a kind of instructional toolkit. While such breadth lends itself to adaptability, the technology standards in these accrediting organizations seem neither measurable nor particularly desirable. Technically, a teacher could fulfill each of these standards by flipping the switch on a transparency machine. Nothing wrong with a transparency machine, mind you, but it would seem to exist some distance from "highest and best use." In practice, NCATE and TEAC accrediting teams converse with faculty and students about the availability of computers on campus and peruse syllabi to determine whether or not an institution meets the indeterminate standards in technology.

Professional Organizations

The table below contains expectations for technological competence by organization. The table lists the total number of standards (including supporting standards), the number related to technology, and provides sample, illustrative standards. The professional organizations surveyed include the National Council on Social Studies, National Council of Teachers of English, National Council of Teachers of Mathematics, the National Association for Music Education, and the International Society for Technology in Education.

Organi-zation	Total standards	Number of standards that explicitly mention technology; sample standards
NCSS (K-12)	10	0; The NCSS standards are content-centered. *Standard VIII. Science, Technology, and Society* advocates the study of the history of technology from a variety of perspectives. However, there is no standard directed at using technology in the social studies classroom.
NCTE (K-12)	10	1; *Students use a variety of technological and informational resources (e.g. libraries,*

		databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
NCTM (has stds. for K-12. We examined grades 9-12)	21 major standards, 67 supporting standards	5 supporting standards; *compute fluently and make reasonable estimates: develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.* *understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions* *write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases;* *judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology* *for bivariate measurement data, be able to display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools*
NAME (has stds. for K-12. We examined grades 9-12)	26 minimal, 12 desirable	NAME has a specific set of "technology standards for high school" that is separate from its other standards. NAME specifies minimal and desirable levels for each of four areas: *curriculum and scheduling* (9 minimal, 5 desirable), *staffing/equipment* (7 minimal, 4 desirable) , *materials/software* (8 minimal), and *facilities* (2 minimal, 3 desirable). An example of a minimal level under *curriculum and scheduling: "4. Learning experiences in the curriculum include the use of computer-assisted instruction, MIDI sequencing, music notation software, Internet music resources, and electronic musical instruments to help students acquire the knowledge and skills listed in the National Standards."* An example of a desirable level under *curriculum and scheduling: "3. The school offers a specialized course in which students utilize appropriate music technologies in composing and arranging, recording, and producing multimedia."*
ISTE (K-12)	6 major standards, 23 supporting standards	The 6 major categories are: *I. technology operations and concepts; II. planning and designing learning environments and experiences; III. teaching, learning, and the curriculum; IV. assessment and evaluation; V. productivity and professional practice*; and *VI. social, ethical, legal and human issues.* Examples of supporting standards: *IB. demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.* *IIIB. use technology to support learner-centered strategies that address the diverse needs of students.* *IVC. Apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity.* *VIC. Identify and use technology resources that affirm diversity.*

Table 1: Technology Standards in Selected Professional Organizations

In analyzing the usability of the standards of professional organizations, we were struck by the variance among subject areas. NCSS mentioned NOTHING about the competence of a teacher (let alone her/his prowess in utilizing machines in the classroom) and NCTE boasted a single standard related to technology. On the other hand, both NCTM and NAME set forth expectations that are relatively clear and precise. One could readily discern whether or not a prospective teacher of mathematics could *"display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools"* so that he/she could teach his/her students to do this. Likewise, a music teacher will not be able to fake knowing "*how to use MIDI sequencing, music notation software, Internet music resources, and electronic musical instruments*" if these skills must be taught.

In comparison to the NCTM and NAME standards, the ISTE standards are trendy and ponderous. Would any sane teacher ever decide to go online to "identify and use technology resources that affirm diversity?" Surprisingly, the ISTE standards are warm and fuzzy, obscure, immeasurable standards that do not offer a teacher much in the way of guidance. For example, according to standard VC., a teacher should *"apply technology to increase productivity."* Does that mean a teacher should stop giving essay exams and put everything on SCANTRON?

State Standards for Technology

Florida's Sunshine State Standards include expectations for technology skills by grade level and subject area. In grades 9-12, language arts has 14 standards, math-6, science-4, foreign language-5, social studies-7, the arts-11, and health/physical education-4. Most of the technology skills are implicit rather than explicit. For example, in the language arts, a student should be able to *"synthesize information from multiple sources to draw conclusions"* (Sunshine State Standard LA.A.2.4.8). In math a student should be able to *"analyze real-world data and make predictions of larger populations by applying formulas to calculate measures of central tendency and dispersion using the sample population data, and using appropriate technology, including calculators and computers."*

In addition to subject-area standards, Tennessee has created a set of Instructional Technology Standards for Teacher Education Licensure. Instructional Technology standards are to be *"infused throughout the teacher preparation program."* These 28 standards range from the vague, ISTE-like *"ability to integrate instructional technology into the classroom to facilitate interdisciplinary teaching and learning,"* to the more concrete, *"can load and install programs; create, find and manage files; create and use a database; create and use a spreadsheet; utilize a software presentation package to create presentations for use on a computer technology projection system."*

The Texas Education Agency recently devised a comprehensive K-12 curriculum, called Technology Applications, that focuses on technology skills and the use of computers. Technology Applications specifies a grade level by which a student must attain competence in a certain technological skill. The TEA proposes eight courses in high school: Computer Science I and II, Desktop Publishing, Digital Graphics/Animation, Multimedia, Video Technology, Web Mastering, and Independent Study. In addition to the separate set of courses, technology is to be integrated across courses. However, the details of ensuring that a prospective teacher can use technology effectively have yet to ironed out. Currently, the only requirement for a prospective teacher of English is that he/she *"be able to use several forms of technology without anxiety or fear."* Unfortunately, fearlessness does not always equate to "highest and best use."

In Georgia, a set of Technology Integration Standards have been developed as an accompaniment to the state standards, called the QCCs (Quality Core Curriculum). The Technology Integration Standards were developed along the lines of six competencies: *basic skills, productivity, communication, societal and ethical issues, research,* and *problem solving*. Each of the competency areas lists several expectations. There are 20 standards in all with 83 supporting standards for grade 12. Basic skill, standard 1 is *"Demonstrates the essential skills for understanding, using, and managing technology tools."* Supporting standard 1.1 is *"Demonstrates appropriate and effective uses of operating systems functions (Graphical User Interface)."* Productivity standard 8 is *"Creates documents using most desktop publishing functions."* Supporting standard 8.5 is *"Converts desktop publishing documents into html/web documents."*

Unlike the wide range of expectations expressed in the standards of professional organizations, the standards of these four states are more consistently pro-technology and less prone to "educationese" and hyperbole. It is encouraging that Georgia's draft of the Technology Integration Standards attempts to spell out what is meant by "technology integration." The complex list of standards and supporting standards could be used by organizations such as NCATE or TEAC to determine whether or not a student's performance in the classroom adequately satisfies the technology requirement. Most of Georgia's Technology Integration Standards are clear, attainable, measurable, and sufficiently adaptable.

Conclusions

Individuals who create standards face innumerable pressures and must make hard decisions based upon the best interest of students. The difficulty with formulating standards, and particularly technology standards, is that innovation never rests. As Drucker (1999) notes, "What the new industries and institutions will be, no one can say yet. No one in the 1520s anticipated secular literature, let alone the secular theater. No one in the 1820s anticipated the electric telegraph, or public health, or photography." Creators of standards must feel the impulse to formulate benchmarks that will stand the test of time, irrespective of future developments or technological breakthroughs. NCTE, NCATE, TEAC, and ISTE created broad sets of standards, ran them by innumerable focus groups, and wound up with bland, yet cryptic sets of statements. To be sure, the standards of NCTE, NCATE, TEAC, and ISTE are more akin to proclamations of the particular organization's political leanings than genuine guidance for teachers. The advantage of such mealy-mouthed standards is that teachers may interpret and achieve the standards in innumerable ways. The disadvantage is that they are so broad as to be virtually meaningless.

On the other hand, the standards of NAME, NCTM, and the developing technology standards of Georgia seem more practical, achievable, and desirable. Of course, the specificity of expectations for teachers will require that these organizations revisit and revise their standards as older technologies vanish and new products emerge. To move teachers towards "highest and best of technology," they need to be given advice beyond the edict to "integrate technology into instruction." As we continue to "rage towards the machine," it is useful to keep in mind that nothing lasts forever, most especially standards in technology.

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FACTORS INFLUENCING TECHNOLOGY INTEGRATION: A QUANTITATIVE NATIONWIDE STUDY

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Abstract: Based on a comprehensive study of 94 classrooms from four states in different geographic regions of the country, this quantitative study investigated the impact of seven factors related to school technology (planning, leadership, curriculum alignment, professional development, technology use, teacher openness to change, teacher non-school computer use) on five dependent measures in the areas of teacher skill (technology competency and technology integration), teacher morale, and perceived student learning (impact on student content and higher order thinking skills acquisition). Step-wise regression resulted in models to explain each of the five dependent measures. Teacher technology competency was predicted by teacher openness to change. Technology integration was predicted by teacher openness to change and the percentage of technology use with others. Teacher morale was predicted by professional development and constructivist use of technology. Technology impact on content acquisition was predicted by the strength of leadership, teacher openness to change, and negatively influenced by teacher non-school computer use. Technology impact on higher-order thinking skills was predicted by teacher openness to change, the constructivist use of technology, and negatively influenced by percentage of technology use where students work alone.

Over the past decade, many articles have appeared in popular and educational journals providing anecdotal evidence of changes that educational technology can make in schools. Even though other empirical articles have provided quantitative and qualitative evidence of these changes, most schools rarely base their technology decisions on specific published research findings. Instead, school leaders often start by thinking about the intended results that technology should provide within their school environment. Next, these leaders take certain actions regarding the attainment, allocation, use, and support of technology. Consequently, this study was framed along this line, to consider the question "What actions most effectively lead to desired results regarding the integration of technology in schools?" We considered seven factors (planning, leadership, curriculum alignment, professional development, technology use, teacher openness to change, teacher non-school computer use) and five outcomes in the areas of teacher skill (level of teacher technology competency, technology integration), teacher morale, and perceived student learning (impact on content acquisition, impact on higher order thinking skills) which will be described in the next sections. Data was collected through structured interviews with teachers and administrators, teacher surveys, and examination of school technology use plans. The following sections will describe how each variable was operationalized. For a comprehensive literature review of these variables, see Ritchie & Baylor (1999).

Operational Descriptions of Factors

In this study, *technology planning* was operationalized from the *teacher's* perspective to include the teacher's role in creating the technology use plan, his/her familiarity with the published vision, and the belief that the plan considers his/her needs. From the *administrator's* perspective, it was operationalized to include three components: strategic, teaching/learning and operational. In terms of the strategic component, this included the extent to which the plan stated a vision and involved stakeholders, which may be the most important action regarding technology planning (Anderson, 1996). The teaching and learning component of the TUP covered instructional innovation. The operational component of the TUP included technology maintenance and support, the presence of an action plan and timeline, and facility infrastructure, configuration, and funding issues. Also included were the extent to which technology decision are based on the official TUP, the extent to which records are kept regarding the type and number of technology activities, and the extent to which purchase and use of technology has closely followed the details as described in the TUP.

Technology leadership was operationalized from the *teacher's* perspective to include the presence of positive technology-using role models, such as the principal, and the presence of incentives for teacher use of technology. From the *administrator's* perspective, it was operationalized to include the principal's ability and work with the school community to formulate, articulate, and communicate a school's vision (Dede, 1994; Raizen, Sellwood, Todd, & Vickers, 1995; Rhodes, 1994; Sergiovanni, 1995). The principal's use of technology is also included as part of the leadership component since s/he fosters credibility and respect by communicating to the staff via email, demonstrating the use of desktop presentation to the faculty, showing a student how to keep a writer's journal with a word processing program, or describing a technology-enhanced teaching strategy (Maurer & Davidon, 1998). Further, the principal's belief that technology can be integrated into teaching and learning, his/her participation of the principal in school technology training sessions, and the evaluation of faculty and/or school in reaching stated technology goals are also factors. The extent to which the schools' technology knowledge and leadership is shared by a variety of faculty is important given that a successful technology leader shares leadership by empowering other school members (Maurer & Davidson, 1998). Also included in the operational definition were the vision of the technology use plan to promote technology for teaching and learning, and the presence of an action plan and timeline within the technology use plan.

In this study, *curriculum alignment* was operationalized from the *teacher's* perspective to include teacher perception as to whether technology activities are covered through the curriculum documents.

Professional development was operationalized from the *teacher's* perspective to include the applicability of the professional development programs, incentive provided to attend programs, access to technical support, and appropriateness of technology equipment. From the *administrator's* perspective, it was operationalized to include the extent to which the school supports faculty to attend workshops or conferences, the listing of professional development activities in the TUP, and the support of school activities to learn to use technology. The latter is important given that teachers require prolonged exposure to new ideas and skills before classroom behaviors change; specifically, to feel in command of educational technologies and to know when and how to use them, can take five to six years (Brunner, 1992; Elmer-Dewitt, 1991). In addition, the extent to which teachers are responsible to determine in-service technology training topics is an important consideration given that to encourage faculty to embrace the concepts delivered during the workshop, it is important to involve them in the selection of the topic (Rubin, 1989). Given that there are varying abilities and knowledge of faculty in a school, seldom will there be agreement on the need for any one in-service topic; consequently, the best strategy would be to identify multiple topics and then involve only people who have needs in the specified content domain (Picciano, 1998). The presence of incentives for incorporating technology was also considered as part of professional development.

For this study, *technology use* was delineated according to nine subcomponents, each of which were considered separately in the regression models: 1) how often technology was used for preparing for or during classroom instruction; 2) the percentage of time that subject-matter content was the focus of the technology use; 3) the percentage of time that higher order thinking skills (HOTS) were the focus; 4) the percentage of time technology literacy was the focus; 5) the percentage of time technology was used alone by students, responding to questions, 6) the percentage of time technology was used alone by students, creating; 7) the percentage of time technology was used with others; 8) the percentage of constructivist use of technology; and, 9) the perceived success of technology use by teachers.

Based on this research, in this study *teacher openness to change* was operationalized from the *teacher's* perspective to include his/her predisposition for trying new instructional innovations, and the belief that s/he can take risks in teaching. From the *administrator's* perspective, teacher openness to change was operationalized to include whether the technology use plan promotes instructional innovation with technology implementation.

Teacher non-school computer use was operationalized in this study from the *teacher's* perspective to include the number of times technology (e.g., word processing, database, spreadsheet, graphics, multimedia, telecommunications) was used at home for non-school activity.

In the previous sections, we examined the factors that may determine the success of technology in a classroom. But what are the areas that schools want to impact? The dependent measures are explained in the next sections. Note that several of the factors described previously could be considered interchangeably with the desired outcomes (e.g., it could be argued that high teacher morale should be an independent variable that affects the degree of success in using technology). However, the factors were purposely selected to serve as predictors, and the outcome measures as dependent variables.

Description of Dependent Measures

Impact on content acquisition was operationalized from the *teacher's* perspective to include the relative impact/importance of technology in terms of the content acquisition, in other words, the extent to which the use of technology added to the class performance in content acquisition. From the *administrator's* perspective, it was operationalized to include the role of the Technology Use Plan's vision in promoting technology for teaching and learning, and the reflection of the plan in describing the use of technology by students to enhance learning based on current knowledge of cognition.

Impact on HOTS was operationalized from the *teacher's* perspective to include the relative impact/importance of technology in terms of higher order thinking (i.e., thought processes); specifically, the extent to which the use of technology added to the class performance in higher order thinking. From the *administrator's* perspective, it was operationalized to include the role of the technology use plan's vision in promoting technology for teaching and learning, and the reflection of the technology use plan on current knowledge of cognition in describing the use of technology by students.

Given that the integration of technology in education should be have the goal to change the nature of instruction rather than just using technology to perpetuate traditional teaching and learning methods (Hawkins & Collins, 1992), *technology integration* was operationalized from the *teacher's* perspective to include the extent to which the use of technology fits into the overall unit of instruction, whether there are transitions before and after the activity with the rest of instruction, and the extent to which technology use is not a separate activity from other instructional activities.

In this study, *teacher morale* was operationalized from the *teacher's* perspective to include his/her enjoyment of using technology, his/her perception of colleagues' morale regarding technology use, opportunities for collegial sharing of technology ideas and uses, satisfaction with work environment, and extent to which s/he believes that position provides professional growth and is satisfying. From the *administrator's* perspective, it was operationalized to include the extent to which faculty are rewarded for intent to use technology, the promotion of innovation/creativity within the technology use plan, specific plans for teacher technology maintenance and support, and incentives to participate in professional growth and for incorporating technology as stated in the technology use plan.

Teacher technology competency was operationalized to include teacher-perceived confidence in the following areas: using a variety of software programs (e.g., word processing, database/ spreadsheet, email, internet), file management, solving general software or hardware problems, use of terms associated with computers, identifying and explaining basic computer components, operating technology equipment, selecting and implementing appropriate technology to support curriculum, incorporating technology (e.g. telecommunications, word processing, spreadsheets, computer based presentations, email, internet) in instruction, and teaching students to use technology (e.g., graphics, internet, word processing, spreadsheets/databases, electronic encyclopedia, and use of appropriate vocabulary).

Considering all of these factors and outcomes together, the primary research question is as follows: Which combination of factors best predicts each of the five desired outcomes?

Sampling

Through purposive sampling we selected schools that were known to be effective users of technology in four areas of the country. A set of schools was nominated from each of four regions of the country that researchers believed to represent highly technology-integrative schools. From this process, twelve schools were selected: five from California, two from Florida, three from Virginia, and two from the state of Washington. In return for their assistance, the schools were provided with a grant for the purchase of instructional materials and a report of the data collected from the school.

Of the twelve schools, five were urban, four were suburban, and three were in rural settings. The percentage range of white to non-white students ranged from 5% to 95% with the mean percentage of non-white students as 32%. Five of the schools were elementary, five were middle schools, and two were high schools. Once the schools were selected, the principal of the school provided the researchers with list of "classrooms" meeting the three following requirements: 1) the teacher is the primary provider of instruction (not part of a teaching team); 2) the teacher is using technology in his/her teaching; and, 3) the teacher has been teaching the class since at least the prior school year and is intending to teach at the school through the next year. From this list of classrooms, we selected at random ten to twelve classrooms for each school. Following this, the principal asked each of the randomly selected teachers whether they would be willing to participate. If a teacher declined to participate, a replacement from the pool was randomly selected, until there were at least ten participating teachers per school.

The resulting sample included a total of ninety-four teachers and correspondingly ninety-four classrooms from the twelve schools, with the classroom as the unit of study.

Instrumentation

Given that there were no existing instruments that matched the sources of the data with the independent and dependent variables, we developed four new instruments to collect school, classroom, teacher, and administrator information. The four instruments included the following: administrator structured interview, teacher structured interview, technology use plan evaluation, and teacher survey. Each instrument was created to consist primarily of Likert items on a five-point scale. As appropriate, each instrument was evaluated by a panel of experts for content validity, reliability, and usability, as will be described below. Triangulation was an important component to gather data from multiple sources to gain multiple perspectives. Data was collected according to the following schedule: Administrator interview (Spring, Summer), Technology use plan analysis (Spring, Summer), Teacher survey (Fall), and Teacher interviews (Fall). The instruments were implemented by researchers in each of the four geographic regions.

A structured *administrator interview* was conducted and tape recorded with each chief school administrator to gather information regarding the following variables, as shown in Table 1: technology planning, leadership, professional development, and teacher morale. The transcripts of all of the interviews were then analyzed and scored by one researcher. A sample question from the scoring instrument was as follows: "The principal believes technology has the potential to be transparently infused and integrated into the entire spectrum of teaching and learning. (1- strongly disagree; 2-disagree; 3- neutral; 4- agree; and 5- strongly agree)"

A structured *teacher interview* was conducted with each of the 94 teachers to identify the teacher's perception of technology in the classroom regarding the following variables, as shown in Table 1: curriculum alignment, technology use, impact on content acquisition, impact on HOTS, and technology integration. Part of the interview required the teacher to list all activities in the prior school year that involved technology. From this list, three activities were randomly selected to focus upon and were scored according to Likert- scaled items. All researchers in the four geographic areas were trained via video together with detailed structured interview questions, all on a Likert 1-5 scale. The interviewer's guidelines for assessing the level of technology integration for an activity is as follows: "To determine the level of integration of the activity, ask questions such as the following: In a typical day in which this activity was conducted, what would normally be taught right before and right after this activity? How did the activity fit into the unit of instruction? What are transitions like between the different components of the activity with the rest of instruction? Is the activity separate from other instructional activities?" Following the interview questions, the interviewer would then rate the activity according to the following scale: "The technology-related aspects of this activity are integrated into classroom instruction. (1-strongly disagree; 2-disagree; 3-neutral; 4-agree; 5-strongly agree)."

Technology use plans from each of the 12 schools were obtained and evaluated according to how well the plan established a vision for the incorporation and integration of technology by the school's faculty. Analysis of the plan contributed to the following variables, as shown in Table 1: planning, leadership, professional development, teacher openness to change, technology use, integration, content acquisition, HOTS acquisition, and teacher morale. The TUPs were scored by a trained team including one researcher in each of the four geographic areas. Inter-rater reliability was conducted by evaluating sample TUPs until the researchers scores reached a reliability coefficient of .85. At that point the researchers each independently evaluated the technology use plans in their geographic areas. A sample rating question regarding instructional innovation is as follows: "The plan promotes instructional innovation and/or creativity with technology implementation. (1-strongly disagree; 2-disagree; 3-neutral; 4-agree; 5-strongly agree)."

A take-home *teacher survey* was given to each teacher to collect information on the following variables, as shown in Table 1: planning, leadership, professional development, teacher openness to change, teacher non-school computer use, technology use, teacher technology competency, and teacher morale. A sample question regarding teacher morale is as follows: "My teaching position is satisfying. (1-strongly disagree; 2-disagree; 3-neutral; 4-agree; 5-strongly agree)"

Results

Using the four instruments described above (with a combined total of 148 items), data was collected from 94 classrooms. A total of 15 independent variables (technology use was broken down into 9 subcomponents) were considered as predictors for regression models for each of the 5 dependent variables.

Given that nearly all of the items were on a 1-5 Likert scale, a process of aggregation was used to average the scores and provide one score ranging from 1-5 for each classroom, where 1=low and 5=high for a given variable. Aggregation was performed by averaging all related item values so that each variable was reduced to one score per variable per class. For example, Mr. Lang's classroom could be rated 1.24 on technology planning, 2.45 on leadership, 4.56 on curriculum alignment, etc. A strength of this method was that multiple sources of information (via the four instruments) contributed to the overall variable scores. Variables that were not on a 1-5 Likert scale (e.g., the technology use subcomponents) were not aggregated, but entered into the model separately as-is. Descriptive statistics are listed in Table 2.

The primary means for analyzing the data was through step-wise regression analyses to identify what combination (if any) of the independent variable(s) predicted the results of the dependent variables.A statistically significant model of independent variable(s) predicted each of the five dependent variables via a forward step-wise regression.

Technology impact on student content acquisition was predicted by 1) the strength of technology leadership at a school; 2) openness to change; and 3) (negatively influenced by) teacher non-school computer use. (R^2 = .589). All independent variables were entered in a forward stepwise regression model. See Table 3.

Technology impact on higher-order thinking skills was predicted by 1) the degree of teacher openness to change; 2) (negatively influenced by) the amount of technology use by students working individually in situations where they were "creating"; and 3) the level of constructivist modes of technology use (R^2 = .608). All independent variables were entered in a forward stepwise regression model. See Table 4.

Teacher morale was predicted by professional development and constructivist use of technology. (R^2 = .559). All independent variables were entered in a forward stepwise regression model. See Table 5.

Teacher technology competency was predicted by teacher openness to change. (R^2 = .164). All independent variables were entered in a forward stepwise regression model. See Table 6.

Technology integration was predicted by teacher openness to change and technology use with others. (R^2 = .391). All independent variables were entered in a forward stepwise regression model. See Table 7.

Conclusion

The degree of teacher openness to change was repeatedly found to be a critical variable as a predictor in our study. Teachers who are open to change, whether this change is imposed by administrators or as a result of self-exploration, appear to easily adopt technologies to help students learn content and increase their higher-level thinking skills. It also appears that as these teachers incorporate these technologies, their own level of technical competence increases as does their morale. Because this one variable has such an important influence on how well technology and its subsequent influences are embraced in a classroom, administrators and policymakers may wish to encourage further development in this area. Unfortunately, given that it is a personal trait, it is difficult to influence.

Another variable with high predictive influence was the level of technology leadership and support for professional development. It appears that administrators who promote the use of technology, not only in words but also in action, lend credence to a technology culture. Our interview was designed to look beyond administrators who superficially endorse technology, and identify those who actively use, model, and reward teachers who infuse technology into their classroom. The bottom line appears to be that administrators who wish to nurture a technology culture need to figuratively "roll up their sleeves and join in" rather than sitting by the side.

Although we found that administrators contribute to the positive interactions of technology in a school, of greater importance were teacher attributes. Long-range planning for software developers and schools of education should include a vision that nurtures decision-making and development by teachers, rather than implementing systems solely from the level of policymakers. Currently many technology initiatives rely upon policymakers to communicate the value of technology to teachers, instead of involving teachers from the start. By helping teachers find ways to actively infuse technology, investments in time and money will pay off in greater content acquisition and higher-order thinking skills for students and greater teacher competence and morale.

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Advanced Technology Opportunities for Education Students: The SIMMS Example

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Abstract: In a department or school of education, how does one set up an environment that acknowledges the importance of developing simple instructional design solutions, while simultaneously offering students opportunities to experiment with cutting-edge technologies? One approach is the creation of an extra-curricular organization that focuses on exploring technological innovations and the development of a supportive atmosphere for people interested in expanding their skills beyond those required for standard instructional design situations. The organization of Students in Multimedia Studies (SIMMS) at Indiana University is one example of this approach; the recent creation of the SIMMS 'be Washington State University is a second example. Both groups face interesting challenges in administration of the organization, and developing and maintaining activities of interest to the membership.

Introduction

Instructional Design program coordinators are often faced with a dilemma. How does one promote an attitude of parsimonious and judicious design and development, following adages like "less is more" and "form must follow function," while at the same time promoting and fostering an atmosphere of enthusiasm for experimenting with new and innovative computing technologies? How does one set up an environment that acknowledges the importance of developing instructional design solutions in the least obtrusive manner, while simultaneously offering students the opportunity to experiment with cutting-edge technologies where "obtrusiveness" may be an acceptable starting point? Schon writes,

> In the varied topography of professional practice, there is a high, hard ground overlooking a swamp. On the high ground, manageable problems defy technical solution. The irony of this situation is that the problems of the high ground tend to be relatively unimportant to individuals or society at large, however great their technical interest may be, while in the swamp lie the problems of greatest human concern. The practitioner must choose. Shall he remain on the high ground where he can solve relatively unimportant problems according to prevailing standards or rigor, or shall he descend to the swamp of important problems and nonrigorous inquiry? (Schon, 1987. p.3)

Indiana University's graduate programs in Instructional Systems Technology and Education, and Washington State University's undergraduate and graduate programs in Education focus on the theory and practice of instructional design and delivery. The programs offer students course work on the history and current practice of instruction in corporate, K-12 and higher education settings, curriculum development and theory, and opportunities to pursue research in these areas. Classes within these programs include basic instruction in innovative technologies and multimedia production. Courses with titles such as "Educational Technology Used in the Schools" and "Instructional Development and Production Process" ensure that upon completion of the program, students will have had some basic training in multimedia production (e.g. making simple web-sites).

A small but significant portion of students involved in these programs would like to find opportunities to go beyond the basics of multimedia production. Currently in vogue is digital multimedia development, (using software to create computer-based experiences with graphics and sound). In other words, they would like to go mucking about in the swamp, to which Schon refers, but using new tools to do it. Responding to this need, Indiana University's Department of Instructional Systems Technology developed an extra-curricular organization that offers students an opportunity to explore multimedia development well beyond the essential requirements of their degree program.

The following sections articulate the types of activities appropriate for developing increased skill in media production and the development; the subsequent dissemination of a student organization designed to explore possibilities in multimedia production; the administrative challenges these organizations face; and concluding remarks.

Developing Media Production Skills

Experienced and competent instructional design (ID) professionals recognize a difference between the instructional design process and the production process (Brown, 1999 p.1). While the instructional design process involves the identification and development of objectives, activities and evaluation protocols in order to promote learning, the production process is a phase within the instructional ~~design~~ development process (Appelman, 2000); it focuses on the creation and design of tangible products identified as necessary to the overall instructional design. Research conducted at Indiana University suggests that incorporating the following activities into an instructional design program helps facilitate students' development of media production skills (Brown, 1999 pp 201-202).

1. Offer a number of production experiences, allowing learning to occur through a set of iterations. This gives students an opportunity to learn from their own mistakes as well as a chance to apply good general practices to a variety of production situations. This should help particularly with the goal of generating increased respect for what should and should not be accomplished given specific materials, time, and skill.

2. Hold critique sessions. These allow students to focus on function and design issues in a formal setting that allows for greater focus on the project itself, de-emphasizing distractions like course grading.

3. Offer opportunities to "Show and tell." Students get to see how others have met specific production challenges and can share ideas on how best to approach similar challenges. There is also a "level element within this activity that is beneficial to those students who may fear that they are not performing up to the standards of their peers as well as students who may mistakenly believe they are more advanced. In order to capitalize on this leveling effect, care must be taken when choosing sample work for show and tell sessions in order to show a reasonable range of products, not just a sampling of the very best or very worst.

These activities can be incorporated into a course of study, if media production courses are offered. What happens, though, when few (or no) advanced media production courses are offered within a program of study? How can students with an interest in advanced media production receive departmental, faculty and peer support?

An Extra-Curricular Solution

Indiana University's Department of Instructional Systems Technology (IST) developed an extra-curricular organization that focuses on exploring technological innovations and the development of a supportive atmosphere for people interested in expanding their skills beyond those required for standard instructional design situations. The organization of Students in Multimedia Studies (SIMMS) at Indiana University has an active membership of students not only from IST, but from other departments and programs around the Bloomington campus as well. SIMMS members meet multiple times during the academic year to share projects individuals and groups on working on or completing; to share information about new or updated media development hardware and software and to socialize with people who share their interest in multimedia production. The recent creation of the SIMMS 'beta chapter' at Washington State University performs the same function in Pullman, Washington. Washington State University has no Instructional Systems Technology programs presently, but it does have a number of students on campus who take an active interest in multimedia development and instructional design.

There is an element of fun to all of this, which can be more easily addressed since SIMMS is an extra-curricular organization. As Landauer writes:

> Here is the hypothesis. We have taken to computers not because they made us more productive, not because they bring us better products or services, but because we like them. Being able to charge my groceries by swishing a card through a machine that automatically debits my bank account is neat. I get a kick out of it. The store manager does too. We are a world of people who like the new, the cute, and the ingenious. (Landauer. 1995. p. 193)

There is nothing wrong with enjoying "the new, the cute and the ingenious," especially if taking some pleasure in this promotes students' keeping a watchful eye on the horizon of technological innovation. It is plausible that even the recipient of this "innovation", the learner, might find this novel form of instruction motivational, engaging, and even fun.

Administrative Challenges

Both SIMMS groups face interesting challenges in administration of the organization, developing and maintaining activities of interest to the membership and bridging the gap between group members who are highly technologically proficient and those who aspire to greater technological proficiency.

At Indiana University (IU), Dr. Appelman of the Instructional Systems Technology Department, initially conceived of the SIMMS organization in 1995 as functioning similarly to the Medieval Craftsmanship Guilds. Just as those early practitioners focused on quality and growth in the execution of their craft, so was SIMMS to focus on quality and professional development with multimedia. Through the submission of a portfolio, students were classified into apprentices, journeymen, and masters of a specific aspect of multimedia such as video, imaging, audio, or graphic design. By delineating such a hierarchy, leadership for each group was made clear, and growth objectives for apprentices and journeymen were targeted at becoming a master within a group.

This rigid structure worked well to create a positive esprit de corps among the students, but the administrative overhead was considerable. Extensive faculty involvement was necessary to set standards, provide support for missing skills, and to keep meetings and workshops happening on a regular basis. Following a couple years of rapid growth, the "charter members" graduated and a decline in membership prompted a redefinition of SIMMS. It was clear that the goal of reaching a mastery level in the hierarchy of SIMMS was not desirable for most students, but what they wanted instead was simply exposure and guidance into new media domains.

The current iteration of the SIMMS organization at IU is almost entirely student run. The IST Department, along with generous alumni, have invested in a high-end digital space called the SIMMS Lab. Equipped with sophisticated Macintosh , PC, SGI, video, scanning, and audio tools, this lab is only accessible by SIMMS members and their trainees (called SIMMlets). Each semester focus groups are formed around leaders within SIMMS who then send out a call to the entire IST body for anyone interested in a particular focus of study. The focii may be 3D modeling, digital video editing, authoring, media research, and in general anything that the IST Department is limited in attending to in depth within its curriculum. A goal for each focus group is to put together a "SIMMinar" for the IST student body that describes what they have learned and discovered. The development of tutorials and job aides are very much encouraged, such that learning curves may be shortened for others that follow in their footsteps.

Finally, it is worth mentioning the view of SIMMS from the standpoint of faculty. At IU, the Alpha chapter of SIMMS provides an avenue for faculty to find resources for projects, both individual and departmental. Countless media elements need to be created for the web and other products, and many of these needs have been met within the SIMMS organization. As the faculty find out that things can happen in both areas of production and research by simply saying "find a SIMMS member and see if you can work something out", the SIMMS organization becomes strengthened. Care should be taken NOT to look at SIMMS as a production unit unless considerable faculty mentorship and funds are available to compensate students. SIMMS members must feel free to follow their own directions for multimedia development since the time commitment is considerable. Imposing pressures of time and faculty rank have proven to cause loss of interest and the sense of experimentation that is at the heart of the SIMMS concept.

At Washington State University (WSU), Dr. Brown of the Department of Teaching & Learning has taken a lead role in contacting other professors around campus to develop interest in a "beta chapter" of SIMMS. Responses from faculty members in a variety of departments, including Fine Arts, Architecture and Management Information Science have expressed interest. Initial meetings with professors and graduate students has indicated there is an enthusiasm for developing and maintaining a SIMMS organization at WSU.

One means of maintaining SIMMS activity is to develop within the organization a network that provides information about professional development opportunities for its members. At WSU, Dr. Brown and Dr. Darcy Miller have received funding from The Arc of Washington to support the development of three "knowledge objects" designed to teach essential concepts. The concepts are to be determined by -service special education teachers; the target learning audience is students with mild mental retardation. In offering significant funding as well as an opportunity to develop a computer-based knowledge object, the SIMMS organization finds a very compelling reason to meet with regularity.

Conclusion

The focus of any education or instructional design program must remain the judicious application of both "soft" and "hard" educational technologies. It is easy for students to get sidetracked by glamorous new technologies that may or may not be used to create effective instruction. However, in stressing the importance of simple technologies that have proven effective, it is possible to create a situation that limits students' abilities to experiment with the new and different.

Offering students opportunities to work with advanced media; to share their efforts with peers and mentors; and to critique each others' work can be accomplished through organized extra-curricular efforts. The SIMMS organization at Indiana University has enjoyed multiple years of success, the nascent beta chapter of SIMMS at Washington State University is enjoying a similar success as the organization begins to coalesce into a working entity of students and faculty from around the campus. Projects like The Arc of Washington knowledge objects initiative help to support the organization by providing both projects to focus upon and funding to complete those projects.

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Acknowledgements

The Indiana University SIMMS chapter is supported in part by the IST Department, technology fees assessed from IST Students, and donations from IST Alumni. Special thanks to Elizabeth Boling who was instrumental in the initial development of SIMMS and Jalin Huang who designed the SIMMS Logo.

The Washington State University SIMMS chapter and instructional multimedia development activities are made possible in part by the financial support received by the U.S. Department of Education for its funding of "teach.edu," a PT3 (Preparing Tomorrow's Teachers to use Technology) initiative at Washington State University. Multimedia development facilities at Washington State University are also supported by CO-TEACH, a project underwritten by the U.S. Department of Education.

Funding for the knowledge objects, currently in production at Washington State University is made possible by The Arc of Washington Trust Fund.

Dr. Brown would also like to acknowledge and thank Ian Quitadamo for his help with the organization of SIMMS WSU.

Online Technical Support Database for Educators #61

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Abstract: As educators depend more on technology, demand has grown for school technical support. Timely, convenient support is needed for schools to most effectively use technology. An online database was developed to provide immediate easy access to technical assistance. Developed for Florida educators, TLC: Tech Links for Classrooms, is a searchable web archive of assistance. TLC offers troubleshooting tips for hardware, software, operating systems and networking; steps for performing hardware upgrades; multimedia tutorials; and access to updates from vendors. Existing web resources were linked from the database and additional materials such as tip sheets and help files were created. Presentations related to using school computer networks, and tools to streamline the work of school technology coordinators were developed. Users may view all resources, or search the database by selecting from a list of six broad categories of resources: hardware, software, networks, general technology information, technology management, or technology training. Keyword searching locates specific topics. Search results list the resources with a link to the full resource, and a link to more detail about the resource. Resources are available as web pages, PDF files, PowerPoint presentations, database files, spreadsheets, word processing files, or multimedia SMIL presentations.

As students and teachers depend more on computers as teaching and learning tools, demand will grow for school technical support. Schools continually deploy additional classroom, lab, and research computer stations to allow greater access to computer resources by students. Not all users and school technology coordinators have skills in troubleshooting, problem-solving, maintaining, or upgrading computers. In order for the computers in schools to be maximally effective, they must be maximally operational. Keeping computer operating well requires access to instructions, hints, and techniques applying to a wide variety of hardware, software, operating systems, and infrastructure.

An effective educational technology technical support resource must have a specific combination of features. It must support the array of legacy and cutting edge technologies in use in schools, and it must be updated to reflect the constant changes in school technology. The technical support service must be available to schools at low cost, preferably in each location where technology is present. The resource must offer rapid access to the knowledge needed to address the situation, and the information must be useful to audiences with a range of technology experience and ability.

Current technical support resources tend to fall into two main categories: niche, vendor or product related information; and information tailored to the systems found in a particular school or district. Neither category constitutes a convenient one-stop clearinghouse for users. The resources are generally distributed as books, CD-ROMS, or web sites. Books and CD-ROMs have the highest cost to the user due to the physical nature of the media, and due to the distribution process the information tends to lag behind the most recent technology in use. Web sites tend to be less expensive to develop and distribute, are very comprehensive, and can be very current, but few address the needs of education.

To begin to address the growing need for educational technology technical support, one of Florida's instructional technology centers created an online database of information designed to provide immediate and easy access to assistance. The center worked with state grant funds to design, develop, and publish a searchable web archive of resources called "TLC: Tech Links for Classrooms." The center collaborated with area school district technology specialists to identify the highest priorities for the types of resources to make available in the database. Priorities included troubleshooting tips for the most commonly used hardware, software, operating systems and networking; steps for performing simple hardware upgrades; multimedia tutorials; and access to updates from vendors.

The next stage in the development of TLC involved creating and gathering the resources for the database. The project staff performed web searches to locate and evaluate existing resources that could be linked from the database. About 100 such web resources were included in the initial database. An evaluation of the selected resources revealed incomplete areas of need, including troubleshooting, hardware upgrading procedures, and tools specific to school technology management. To fill in these gaps of knowledge, the project staff wrote tip sheets and help files as web pages to add to the database. University graduate instructional technology classes agreed to do their semester projects to contribute to the database. The students in the classes, Advanced Multimedia and Advanced Design, teamed up to create multimedia tutorial job aids. The job aids illustrated the steps in hardware installations and upgrades. Two additional university classes in School Networks provided materials to the database. These materials were presentations about procedures and practices related to using school computer networks, and tools to streamline and organize the work of school technology coordinators. Almost 100 additional original database resources were added from these activities.

As the scope and content of the TLC database was developed, the options for placing the information online were evaluated. The web database involved three main decisions: choosing the database application; selecting a server configuration; and selecting a web based user interface. The database options included Filemaker Pro or Microsoft Access databases. The databases could be accessed from a server using FrontPage extensions, a server set up for Filemaker Pro, or a Cold Fusion server. The tools available for writing the user interface for the database were HTML, FrontPage, Macromedia Dreamweaver, Cold Fusion Studio, and Claris Homepage. The skills and interests of the project team led to the selection of an Access database residing on a Cold Fusion server queried from a Dreamweaver web page.

The interface web page was deliberately kept simple, open, and light, with a few clear options. Users may click a button that shows the entire list of resources in alphabetical order by title. Users are able to search the database by selecting from a list of six broad categories of resources: hardware, software, networks, general technology information, technology management, or technology training. Keyword searching was also made available to enable users to search for resources related to specific topics. After launching a search, a new page appears listing the resources in digest form: the title, a short description, a link to the full resource, and a link to more detail about the resource. The full URLs of resources are included to facilitate printing a useful results list. Resources that are not available as web pages are provided in alternative formats such as PDF files, PowerPoint presentations, database files, spreadsheets, word processing files, or multimedia SMIL presentations.

The TLC database has received very favorable responses from educators in its first year of use, and it is subject to regular review and update. The possibility of having work included in the database has been a motivational factor for students in the contributing university courses, and they've appreciated having access to samples of work from previous classes for their own learning. The maintenance of the database includes checking that existing web links are valid and still useful, adding newly discovered web links, adding newly created original university projects, and updating the corresponding project contributors list. The contributors' list shows all project developers and materials developers by name accompanied by the link to their resources.

Modeling and Implementing Effective Technology Practices

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Abstract: Faculty in the department of Technology and Cognition at the University of North Texas have identified several strategies to enhance students' use of technology and students' level of technology proficiency. In our instructional technology classes, future teachers are being introduced to the effective use of old and new technologies to deliver their lessons. In other courses in the department, innovations in the faster delivery of video on the Internet have allowed department faculty to store portions of videotaped class lectures on the department's server and make a sample of these available to prospective students. Thus, students may read about a class and also view a lecture before deciding whether or not to enroll in a course. Distributed learning models being used in the department make use of multiple platforms. One approach the department has developed is a program for the delivery of asynchronous and synchronous class-lecture videos with the use of streaming media and the Internet.

Infusing Technology in Our Teacher Education Courses

Students interested in the technology aspects of being a classroom teacher have several course options available in the College of Education at the University of North Texas. There is an assumption that most students will bring some level of computer proficiency with them into their coursework. For those whose skills are weak an introductory course on computer literacy and basic computer applications (in this, Microsoft Office) is suggested. This course can be taken on-line in an independent study mode supported via technology such as email, on-line testing, and discussion forums. A traditional, on-campus classroom section of this course is also offered for those that require more structure and guided instruction. Outcomes of this course, either distance delivered or the on-campus offering, meet the necessary prerequisites for other courses in the technology sequence. In addition, this course provides many students their first exposure to distance delivered instruction and technology-based instruction.

Instructional Technology

In our Introduction to Instructional Technology classes future teachers are being introduced to the effective use of old and new technologies to deliver their lessons. Within the first weeks of the semester, students are introduced not only to different learning theories and teaching models but also to hands-on modules integrated with each new chapter. These hands-on modules demonstrate real world technology applications and provide the connection to appropriate uses and inclusion of both old and new technologies of instruction. As soon as learning theory is reviewed, the classes concentrate on several book and multimedia modules that overview the system's process (instructional design, etc)... then progress to non projected and projected media elements that are demonstrated and then reinforced via subsequent lab experiences (i.e. a chance to learn how to dry mount, rubber cement, and create non-computer transparencies...) for a taste of the old which is still in use today. But immediately, students are also taught how to create and enhance transparencies with the use of a flat bed scanner, computer, drawing software and a color printer. In order to create these transparencies students exchange the old cardboard frames for the word processor or the power point program, and the scissors and glue for the new cut and paste features found in both programs. Students are taught the basic uses of both software packages and the features that could help them enhance a presentation and a handout. The scanner and features of graphics software are also demonstrated to teach students how to include pictures when the clipart library found in the software is not enough. The use of a digital photo camera provides the students skills at obtaining additional illustrations. In subsequent modules students are given a chance to understand and use digital video cameras and create a "how to" team video, use the Internet for specialized searches, evaluate educational software and web sites given a criteria, create a web page, attend and participate in a hands-on videoconferencing demonstration, learn about filtering software, virus scanning, web based courses and much more. Although each skill is addressed at only an introductory level, students' awareness of all these tools and teaching methods gives our future teachers enough guidance on the use of the tools and inclusion methodology, thereby enhancing and enriching their skills as a teacher. The hands-on approach seeks to prove that, although complex in their inner workings, the tools themselves are easy to use and have a very short learning curve. Familiarity should result in a relaxed understanding and eventual use of technology mated with creative ideas.

Other Technology Courses

Also in the sequence of preservice technology courses is Computers in Education. This course stresses the use of technology in the classroom with an eye toward integration of technology into the curriculum. Students in the course increase their knowledge of technology and its impact on teaching and learning. In addition, topics such as development of student portfolios, evaluating software, creative activities using the Internet by students are investigated. If students follow the entire sequence, they place well on a "Teachers Using Technology" continuum developed by the Technology & Cognition faculty. That is, they demonstrate the skills necessary to meet the standards of ISTE/NCATE.

We also try to offer a diversity of learning systems for our students to use in the acquisition of the course materials. Although we do believe that the sage still needs to be on the stage for some of the class materials, we also strive for interactivity through a variety of delivery systems. Our courses range from standard class schedules that are approximately ½ lecture and ½ lab work... to fully asynchronous, wedelivered sections. Our most popular model (with both teachers and faculty) is a combined class during which the students come to campus 6-8 times a semester for high tech labs, specialty lectures, and teacher-learner/learner-learner interactions. The other 8-10 classes have all materials delivered via the web (both our own server/web sites and a university-based WebCT system). Most testing is web based. We feel that this model gives us opportunities to serve both as 'sage' and as

Delivery of Courses via Distributed Learning Models

In the Department of Technology and Cognition at the University of North Texas, new technologies are being used and tested to deliver class instruction across the Internet. Each program area in the Department maintains a comprehensive Web site (i.e. www.cecs.unt.edu) that provides course syllabi, degree requirements, course objectives, faculty information, etc. Streaming media (discussed later) is used to give prospective students a brief sample of the course before they register. In addition, students get a brief introduction of what taking a course via the Internet may entail. For instance, in order to take advantage of some of the extras on the Web site, they have to download players and plug-ins. This serves as an example of the types of skills necessary to receive a course delivered via streaming media.

WebCT is supported at the university level as a deployment tool for distributed learning. The software is used in several different models of delivery in the department. Some courses only use the on-line testing, email and chat functions. Other courses utilize the entire functionality of WebCT. Most of the distributed learning courses are at the graduate level. As mentioned earlier, several course delivery models have been developed. For instance, several VTEL equipped classrooms are available for traditional, synchronous distribution of two-way audio and video. While optimal for delivery of courses at satellite university locations, the equipment is in high demand resulting in a waiting list for use. Due to this limitation, faculty gravitated towards Internet distribution as an alternative. This has also proven to be problematic as discussed later.

The use of streaming media was an early attraction to faculty delivering instruction via the Internet. As a result, we have developed several models of delivery based on streaming media technology. As an aside, we have found the software solutions offered by Real Networks best meet our requirements.

Course Delivery Models Using Streaming Media

Several models of course delivery via streaming media have been developed with the department. The next section describes those models. As will be seen, some of the models deliver content synchronously and some were designed to deliver content asynchronously. While not the focus of this paper, the creation of streaming media requires some audio and video production hardware in addition to the related software (in our case, Real Producer Plus by Real Networks). We have found this hardware to be inexpensive and readily available. Figure 1 shows a mobile cart developed to record video and audio, convert to streaming media and deliver "live" via the Internet. Files can be stored immediately on a local hard drive or a streaming media server. While a convenience, a high-speed or powerful computer is not a necessity to capture, store and play streaming media.

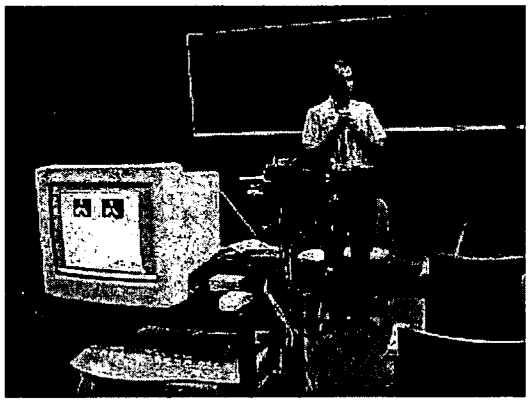

Figure 1 – Portable Streaming Media Production Cart

Streaming Audio

Two graduate level courses have been taught using streaming audio. The instructor lectures to an on-campus section of a course and streams the audio live. Students can listen to the lecture in real time. Viewing web pages as directed enhances the audio portion. This method of instruction requires a microphone, computer with sound card and encoding software. Each lecture is also archived on a server so that students can review it at a later date. This is also a great convenience for those that could not attend the on-campus lecture or "tune in" to the live streaming lecture. The faculty member using this technique has also recorded the live lecture on videotape, converted it to streaming video and archived it for future use.

Live Streaming Audio and Video

This approach uses streaming audio and video to deliver instruction in real time via the Internet. Students access a website and view the live broadcast. Basically, the course content is captured using a video camera and microphone, digitized, converted to streaming media, transferred to a streaming media server and delivered to the end user. There is a very brief lag, measured in seconds, between the time the content is actually created and when the user finally receives it. This approach is the most elaborate implementation from a hardware and software perspective. Typically, the live course content is also archived for later use by students. The advantage to this technique is obvious.

Archive Streaming Media

Faculty members have found that recording course content (audio, video or audio and video) and converting to streaming media for future use is a viable approach to distributed learning. This technique allows for content editing. As is often the case, the first several minutes of a course are devoted to local business, conversation, or other mundane topics. There is little or no benefit to this information for a student not attending the on-campus class. In essence, postproduction editing and archiving creates an efficient module. Using this approach, a faculty member typically has all of their on-campus meetings videotaped. These sessions are then edited for content and prepared for distribution at a later date. This, in essence, is the equivalent of preparing a telecourse. The only difference is the mode of distribution. In lieu of broadcasting each session on a schedule basis, the student accesses the course lectures at their convenience. Faculty using this technique also has to be attentive to updating the content each time it is offered.

Archive Streaming Media with Graphics

One of the advantages of the Real Networks software is the ability to synchronize graphics with the audio or video stream. This technique requires post-production work in order to create and synchronize the graphic elements with the streaming content. Figure 2 shows an example of what the student sees while viewing the archived content. This technique is somewhat time consuming but the effort results in an efficient delivery of the content. Again, editing allows for the removal of any activity that is not directly related to the content of the lecture.

Real Networks refers to this technique as SMIL Technology. Graphics are synchronized with the streaming media using time. For instance, simple code is used to instruct the software to show a graphic so many minutes and seconds into the file.

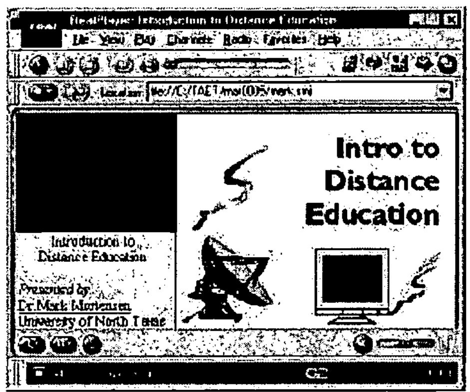

Figure 2 – Sample SMIL screen. Video plays in black box upper left in the frame.

Streaming Audio with 3rd Party Software

Several faculty members have found Screen Watch by Optx (www.Optx.com) to be a unique tool for the delivery of instruction. Screen Watch is a screen capture program similar to Lotus Screen Cam. The Optx product has great advantage because of the large amount of compression applied to the capture resulting in files that easily stream over the Internet. Procedurally, the user narrates his/her on screen activity. The audio portion is recorded and the screen movements, mouse movements, etc. are synchronized to the audio track. This is an ideal platform for teaching computer related topics, how-to's etc. The student can hear the instructor reciting the procedures and see the result of those procedures on screen at the same time. Similar to Real media, this software requires the user to download a browser plug-in in order to view the presentation.

Issues Related to Streaming Media

As can be seen from above, we have extensively used streaming media in various implementations as alternatives to traditional on-campus instruction. Being a high tech, high touch department, students have come to expect technological approaches to course content. There are graduate courses in the creation of digital audio and video and creation of streaming media. Students enrolled in those courses have the advantage of both taking a course in this fashion and learning how to create streaming media and other delivery approaches at the same time. In addition, undergraduate courses using the technology are also in various stages of development. Again, students will learn how to create streaming media while taking courses delivered by streaming media. We feel this represents the highest possible form of modeling technology.

With the advances in streaming technology, a user can view an audio and video clip on the computer within seconds of clicking on its link. The video and/or audio files no longer need to be completely downloaded before viewing can begin. Now only a small portion of the media file is downloaded, buffered into the user's PC RAM. When an approximately 20 second buffer has been created, the streaming media starts playing. The rest of the content is buffered and readied for playing "on the fly."

Buffering speeds are mostly limited by the students' modem or other connection. While the majority of the users may have a 28.8Kb or 56Kb modem, the students with a DSL, T1 or higher connections will experience more continuous viewing. Also, the advent of Sure Stream Technology by Real Networks, allows for the server and student's computer to negotiate what speed to use for playback depending on the highest available bandwidth at connection time. This process is transparent to the student. While offering courseware via the Internet is the biggest advantage of streaming media (whether live or archived), the Internet itself is the biggest disadvantage. Graduate courses in the department are offered in the evenings during peak Internet traffic times. Streaming media requires a large (but not outrageous) amount of bandwidth. Problems have been reported at both ends of the distribution. Students report that streaming media continually pauses and buffers during peak Internet usage times. As a result, an archived file that should play smoothly for perhaps 45 minutes may take over an hour to stream. Another problem also exists at the origination end. In our case, the bandwidth of our connectivity at the university is "maxed out" except between two and 6 am. This builds in a delay before the signal leaves the facility. Oddly enough, most of the bandwidth allocation has been traced to the dorms where students are downloading files from Napster.Com! The magnitude of this phenomenon is great – we have the equivalent of seven T-1's running at full capacity. To circumvent this problem, a faculty member that originates live streaming video each week, has moved to a satellite campus to teach. This location has available bandwidth. In addition, production equipment and a server also were relocated. As a result of problems related to bandwidth, many faculty members have abandoned streaming media. Unfortunately, this reduces the amount of distributed learning courses offered by the department. It also reduces student's exposure to this technology.

Other Approaches to Implementing Technology Delivered Instruction

As mentioned earlier, the "high tech" nature of the faculty in the Department of Technology and Cognition results in many approaches to course delivery. As streaming media proved to be problematic, hybrid approaches have been developed as solutions. For instance, the instructor of a Cognitive Psychology course and an Instructional Design course decided to asynchronously distribute streaming media files via CD-ROM instead of the Internet. This approach provided the same content using streaming media with none of the limitations of the limited bandwidth of the Internet. In addition, on-campus sessions are offered on several weekends for those students that prefer some contact with the instructor or other class members. Web enhanced activities are offered with the help of WebCT software which has proved to be viable for providing online testing, email, chats, download sites, etc. for these course models. This hybrid approach has been well received by students enrolled in those courses.

Since the Internet has posed some problems with distribution, other faculty members have rediscovered multimedia technology as a method of creating distributed learning courseware. One project under development will use multimedia (from CD-ROM) to help preservice special education teachers to understand the concepts of gifted and talented students. The project uses video-based case studies, information pages and web links to create an information source for students. The value of this project is that it will provide an alternative to on-campus instruction.

Synchronous and Asynchronous Class Formats

Web based courses are being offered synchronous and asynchronously. In the synchronous setting, the student attends classes live but in the space independent setting of their own choosing (home, office, library, other) wherever a computer with an Internet browser and Real Player client software is available. Students in this setting can hear and see the lecture, follow the power point slides released by the teacher, and interact with other students through a chat room (see Figure 3). Also, using the chat room the students can ask the teacher questions live during the lecture. Synchronous Web based lectures are recorded and saved in the school's server for later viewing. Students are then given the URL and password of the server to access these and other class materials (syllabus, schedule, assignments, handouts, class slides, bulletin board and email) at a later time.

The asynchronous setting of "attending" classes on the Internet is not only space independent but also time independent. Students from anywhere and at anytime can access the University's server and view any of the pre-recorded classes, saved and labeled by chapter number and topic. After choosing a video clip, students can hear and see the class lecture, and follow the power point slides much like in the synchronous setting, except for two variants. First, and most obviously, there is no one to interact with in the chat room while viewing the lectures. And second, while viewing the video the student can pause, rewind and view over and over any or all of it as needed, using the VCR like controls on the screen (see Figure 3). Also, since the live lectures are recorded in the classroom with the teacher and students present, part of the teacher-student interaction such as questions and anecdotes, can be "experienced" by the students Web viewing the class in synchronous and/or asynchronous mode.

While many advantages and disadvantages maybe cited for the asynchronous class format, two characteristics are indisputable. Asynchronous classes are time and space independent. Students may "attend" classes at any time from anywhere. On the other hand, synchronously delivered courses are live and so students are time dependent. Those students may also benefit from the live interaction with the instructor and other peers as the lecture is taking place. Because Web based courses are the new instructional phenomena, new research is being conducted to determine its effectiveness and new methodology is still being tested to determine adjustments in the pedagogy of such courses. These areas of research have been intriguing to faculty using distributed learning technologies. In addition, graduate students have been exposed to research and research methodologies related to distributed learning.

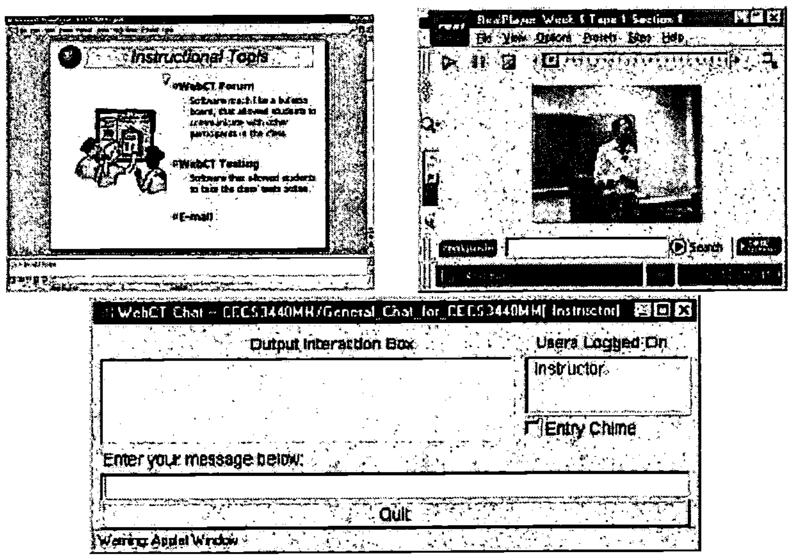

Figure 3 – Synchronous Web based class setting

Conclusion

Presently, studies indicate that students with very busy lives that hold full time jobs, have a family, live over 30 minutes from the university campus, travel in job related assignments and have many commitments, like to "attend" classes in some fashion other than coming to the main campus of the University of North Texas. As is often heard, students say "anything is better than driving to Denton!" Certainly, more research is needed to determine if the virtual classroom, or whatever hybrid approach is used, is as effective as our traditional classrooms.

In the Department of Technology and Cognition not only are teachers being trained to appropriately use technology, but also technology is being tested in new ways in the delivery of these courses. Technological innovations are being introduced and tested from our classrooms' podiums while research is conducted to establish their effectiveness. As long as this continues, faculty will benefit professionally by investigating different distributed learning approaches. Students will certainly benefit by being exposed to the techniques. And new viable ways of instruction may in the very near future allow educational institutions to adapt to the changing life style characteristics of the student population they serve.

Understanding the "Digital Divide" - the increasing technological disparity in America; Implications for Educators

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Abstract: Within the past decade, a growing body of evidence supports the ever-widening technological gap among American school children (U.S. Department of Commerce, 1998). The "Digital Divide," a leading economic and civil rights issue, is defined as the divide between those with access to new technologies and those without. Disparity in computer use can be found among rural, urban and suburban students, with the division drawn upon socio-economic lines. This trend indicates that the "haves" possess increasingly more information and economic opportunity, -nots" are lagging even further behind. Groups that lack access to information resources include: minorities, low-income people, less education people, children of single parents, and residents of rural areas or inner-cities (http://www.ntia.doc.gov/ntiahome/fttn99/contents.html). Since many people do not have knowledge of technology to pass onto their children, schools will serve as the catalyst for preparing America's youth for the age of technology. Data indicate that outside of work, schools are the second most frequent place where people access the Internet, 33% of access is made from schools (http://www.digitaldivide.gov). Since schools are so important for technological education and access, the U.S. Department of Commerce has arranged for additional funds to aid American schools in purchasing technology. These funds are now available for nonprofit educational organizations and public school districts. Educators must recognize the manifestations of the technical inequality as it affects the lives of America's school children and must become aware of initiatives, both federal and private, that will provide the means and methods to narrow this gap. The purpose of this paper is to describe the "Digital Divide" and explain the steps needed to be taken by America's educators to close this gap.

Introduction

Two hundred years ago "The Great Divide" that threatened the destiny of many Americans was the geographical challenge of crossing The Continental Divide. Only by crossing the treacherous Rocky Mountains could the desperate pioneers partake in the economic benefits westward expansion offered. Two centuries later, "The Great Divide" for Americans is no longer geographical, but technological. Many Americans find themselves unable to meet the challenge of the technological demands of the 21st Century and feel left behind. This "Digital Divide" for modern-day Americans divides those with access to new technologies and those without. Data suggest that the "haves" possess increasingly more information -nots" are lagging further behind (http://www.digitaldivide.gov). The "Digital Divide" has become a critical issue for America; one that if left unchecked, threatens to increase economic inequality and sharpen social division. America's educators must recognize the manifestations of this technical inequality as it affects the lives of America's youth and must become aware of initiatives, both federal and private, that will provide the means and methods to narrow this gap.

Federal Initiatives

To determine means for reaching out to people at risk of falling behind in the Information Age, President Clinton called upon both the government and the private sector to support policies and initiatives that will work to bridge the divide. During the "Digital Divide" discussion in President Clinton (2000) stated:

> ... No one has to be bypassed this time around. The choice is in our hands. We can use new technology to extend opportunity to more Americans than ever before; we can truly move more people out of poverty more rapidly than ever before, or we can allow access to new technology to heighten economic inequality and sharpen social division. (http://www.pub.whitehouse.gov/uri-res/I2R?urn:pdi://oma.eop.gov.us/2000/4/18/16.text.1)

During a recent "Digital Divide Summit" Secretary of Commerce William M. Daley introduced a new federally sponsored web site. This web site, digitaldivide.gov was developed by the National Telecommunications and Information Administration of U.S. Department of Commerce (NTIA) to inform American citizens of federal programs designed to close the "Digital Divide" (see Figure 1, Source: http://www.digitaldivide.gov). This web site also provides information on a range of grant and loan programs including private sector educational and funding initiatives.

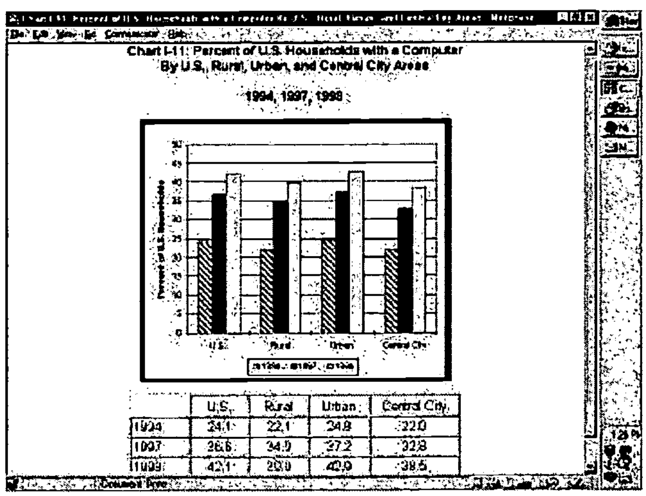


Figure 1: The Digital Divide Homepage

Private Sector / Corporate / Higher Education Initiatives

The public media has tried to raise public awareness of the issues manifested by the "Digital Divide". PBS has aired a series of programs, the Digital Divide Series, that address the "Digital Divide" and how technology affects classroom, gender, race and work issues (http://www.pbs.org/digitaldivide/).

Several universities across the country have formed partnerships with corporations, private educational foundations, and non-profit organizations to seek solutions to the growing problems presented by the "Digital Divide". A recent conference hosted by Delaware State University focused exclusively on how to bridge the "Digital Divide" in spite of growing limitations (http://www.bridgingthedivide.org/). Non-profit organizations such as Alliance for Technology Access have also been formed to make sure small groups, such as children and individuals with disabilities were not left out in the efforts to bridge the "Digital Divide" (http://www.ataccess.org/).

In the campaign for public awareness and support in seeking solutions to the "Digital Divide", corporate level participants play an important role. Many hi-tech companies devote products, service, and grants to give back to the local communities. Specifically, Microsoft and Sun Microsystems have teamed with the Black Family Network in order to host activities such as Black Family Technology Awareness Week. During the meetings, participants sought solutions to the "Digital Divide" dilemma (http://www.blackfamilynet.net/soon/). 3Com, one of the leaders in network technology, has established initiatives to help the nation's public schools bridge the growing "Digital Divide" among urban communities. In July 1999, 3Com, in partnership with The United States Conference of Mayors, created the Urban Challenge program, which is a partnership that rewards forward-thinking cities with $100,000 grants in 3Com systems and services for technology initiatives designed to improve residents' lives (http://www.3com.com/government/urbanchallenge/).

The "Have-nots" of the Digital Divide

America's educators must recognize the technical inequality as it exists in the lives of students both inside and outside of school. This inequality is tied to several important factors in the student's life, the region in which the student resides, available economic resources, family structure, and level of education of family members. According to the NTIA in the U.S. Department of Commerce (1999), the groups that lack access to information resources in the United States are minorities, low-income people, less educated people, children of single-parent households, and residents of rural areas or inner-cities (http://www.ntia.doc.gov/ntiahome/fttn99/contents.html).

One important determinant of computer and Internet use can be linked to a student's region of residence. The following chart (see Figure 2) describes the usage of computers in U.S. households (42.1% overall) by region: rural (39.9%), urban (42.9%) and central city (38% in 1998) (http://www.ntia.doc.gov/ntiahome/fttn99/FTTN I/Chart-I-11.html).

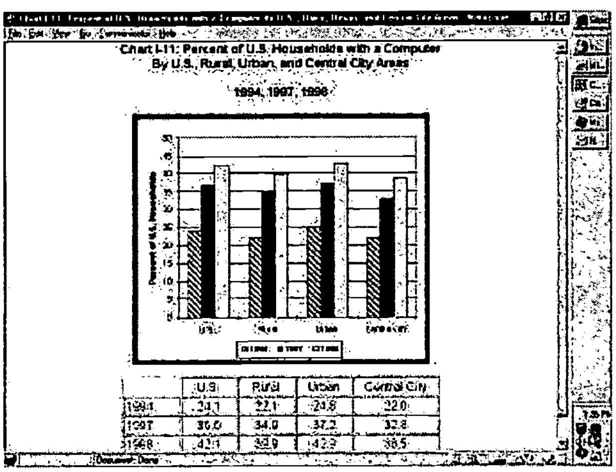


Figure 2: Computer Penetration Rates in different areas

Another important determinant of computer and Internet use can be linked to family income. The U.S. Department of Commerce (see Figure 3) reports that economic advantages in the form of family income increases a student's access and use of computers in schools (http://nces.ed.gov/pubs98/condition98/c9803c03.html).

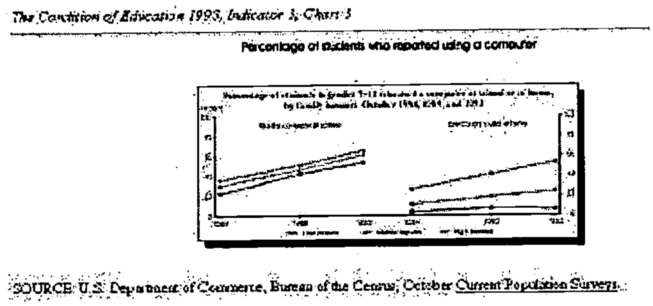


Figure 3: Family income increases a student's access and use of computers in schools

Recent data indicates that the penetration rates of telephone, computers, and Internet among the U. S. households are 94 percent, 42 percent, and 26 percent respectively (see Figure 4). A large discrepancy exists between the 94 percent telephone penetration rate and the 26 percent Internet use penetration rate http://www.ntia.doc.gov/ntiahome/fttn99/FTTN_I/Chart-I-1.html). Most households receive their Internet access through local or national Internet Service Providers (ISP) by paying a flat monthly fee. Figure 4 indicates that in 1998, among the U.S. households with Internet service, 69 percent obtained the connection through national service provides such as American Online or Microsoft Network, 14 percent from local phone companies and local service providers such as PDQ and Flash in the greater Houston area, and 4 percent from long distance companies such as Sprint and AT &T (http://www.ntia.doc.gov/ntiahome/fttn99/InternetUse_II/Chart-II-24ab.html).

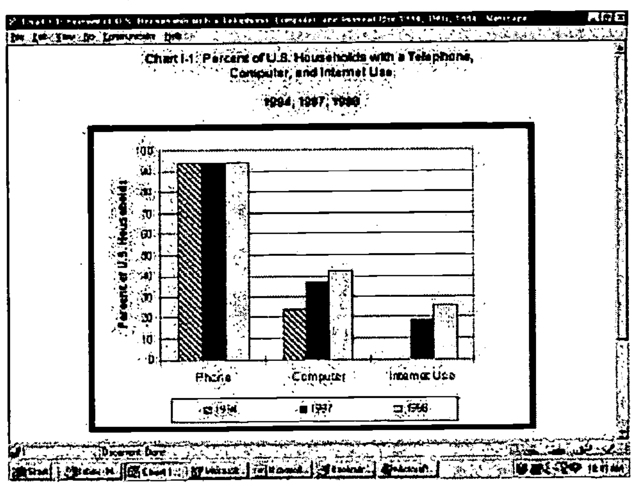
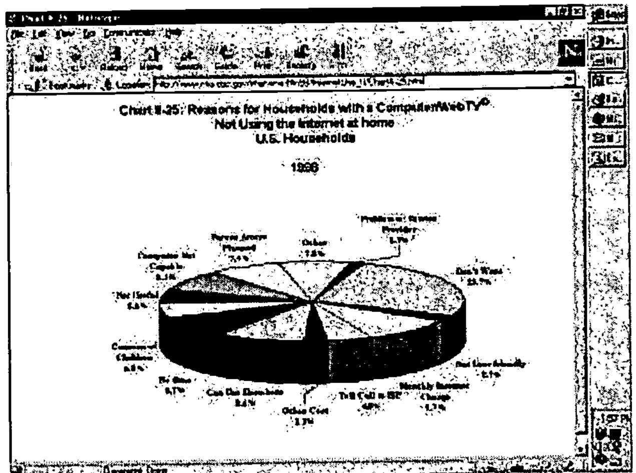


Figure4: Penetration rates of phones, computers, and Internet in US Households

In response to the question of why households with a Computer/Web TV do not use the Internet at home (see Figure 5), 25 percent answered they simply didn't want the service, 9.7 percent answered the monthly Internet Charge was the reason, 9.6 answered they can use other Internet connections available elsewhere, 8.3 percent answered their computers are not capable of the connection, 6 percent answered concern for children was the reason, 4.8 percent didn't want to pay the toll call fee to the ISP, and 2.3 percent didn't want to pay the other cost involved. In total, at least 25 percent of the reasons for not



connecting to the Internet were cost related; yet 7.5 percent of the surveyed population were planning for future Internet access (http://www.ntia.doc.gov/ntiahome/fttn99/InternetUse_II/Chart-II-25.html).

Figure 5: Reasons of households with computer/WebTV not using the Internet at home

Household structure is another important determinant of computer and Internet usage (see Figure 6). While 61.8% of households composed of married couples with children own computers, only 31.7% of female-headed households own a computer. Black families with two parents are nearly four times as likely to have Internet access as single- parent Black households. Married couples with children under 18 exhibit the highest rates of Internet penetration (inside and outside the home Internet access (37.6%) http://www.ntia.doc.gov/ntiahome/fttn99/InternetUse_II/Chart-II-24d.html).

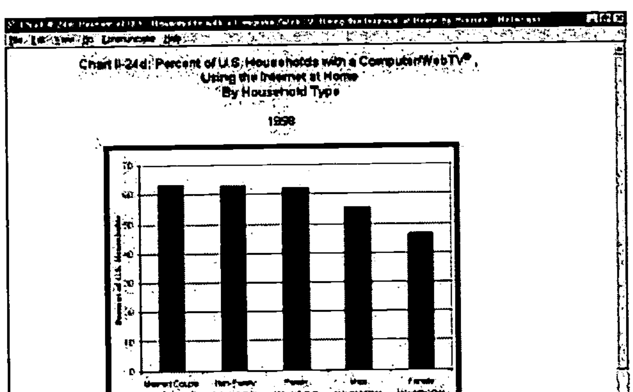


Figure 6: Percents of US households with a computer/WebTV using the Internet at home by household type

Education level appears to be another important determinant for computer and Internet usage (see Figure 7). Among the U.S. households using the Internet in 1998, 45 percent held a BA or higher degree, 30 percent had some college education, 15 percent had a High School diploma or GED, 6 percent had some high school experience, and 4 percent had only an elementary education (http://www.ntia.doc.gov/ntiahome/fttn99/FTTN_I/Chart-I-25.html).

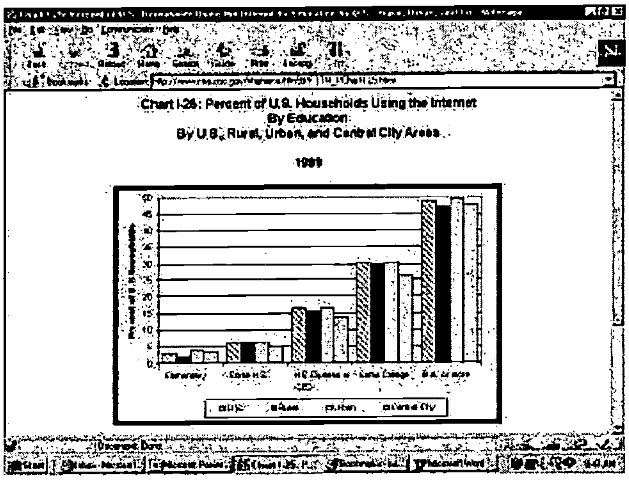
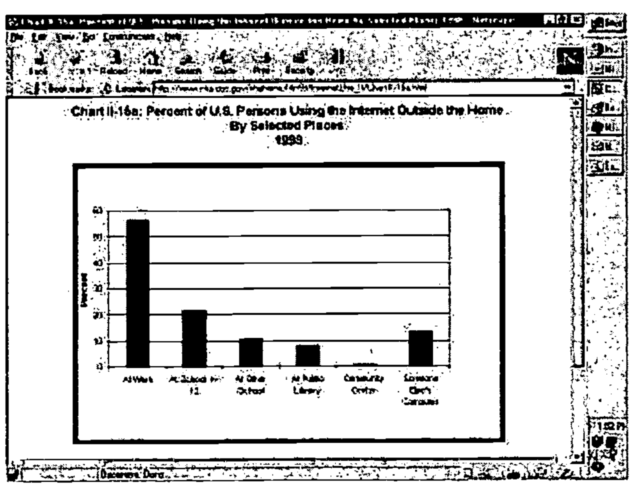


Figure 7: Percent of US households using the Internet by Education

The Importance of School in Closing the Digital Divide

Since many people do not have knowledge of technology to pass onto their children, schools are destined to serve as the catalyst for preparing America's youth for the age of technology. In 1998, in U.S., 35 percent of Hispanic, 27 percent of Black, 20 percent of White, and 19 percent of Asian/Pacific Islanders used the Internet outside the home and gained access at K-12 schools (see Figure 8, source: (http://www.ntia.doc.gov/ntiahome/fttn99/InternetUse_II/Chart-II-15a.html). The data reveal that school is the single most crucial entity for someone who cannot afford to have Internet at home gain access to the Web. Data indicate that outside of work, schools are the second most frequent place where people access the Internet, 33% of access is made from schools (see Figure 9).



Applications of a Best Practice Study: Implications for Technology Integration in the Elementary Classroom

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Abstract: This paper presents the results of a study on four elementary teachers' technology integration practices. Boyatzis' (1998) thematic analysis technique was used to examine interview transcripts, observation notes, and teacher-produced documents for pedagogical practices that accompanied uses of computer technology in these teachers' classrooms. Emergent patterns borne out by the data resulted in a general conclusion that best teaching practices and best technology integration practices go hand-in-hand. Educators should not be overly impressed by the mere use of technology in instruction. They need to be discerning about the pedagogy that accompanies its use.

Introduction

An emerging consensus in the current educational reform effort suggests that teaching methods based on constructivist principles promote learning in a way that teaching-by-telling cannot do. The social aspect of learning by collaboration and an individual's need to explore and experiment are best directed through pedagogies based on constructivist theory. Some of these strategies identified as "best practice" include student-centered instruction, experiential and holistic learning, authentic experiences, reflective exercises, social interactions that scaffold learning, collaborative grouping, problem-oriented activities, and integrated thematic units (Daniels & Bizar, 1998; Zemelman, Daniels, & Hyde, 1998). Many in the field of instructional technology (Grabinger, 1996; Jonassen, Peck, & Wilson, 1999; Wilson & Cole, 1996) also recognize that an instructional context based on these principles has significant implications for uses of technology that promote meaningful learning. As Clark (1983) indicates, "Media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (p. 445). It is not the media that influences learning; rather, it is the instructional design utilizing effective teaching strategies that makes an impact. Good teaching combined with appropriate and effective uses of technology makes for a dynamic, rich learning environment.

So, what might you expect from an elementary teacher who is using best practices as they relate to technology integration? From my observations and discussions with four elementary teachers who infuse technology into their instructional practices, it has less to do with the pizzazz of a PowerPoint presentation or graphics whizzing onto a web page and more to do with the lesson design and teaching methods selected when technology is being used (Dias, 2000).

The Study

The study began in the Fall of 1999 and concluded in the Spring of 2000. I used qualitative inquiry since this study sought to provide a "picture" of teachers' technology integration practices as they naturally occurred (Bickman, Rog, & Hedrick, 1998). Using the reputation case selection sampling technique (Miles & Huberman, 1994), 4 elementary teachers from a large metropolitan school district in the Atlanta, Georgia area were chosen. They were identified as "technology integrators." All were female. One taught third grade, another fourth grade, and two taught fifth grade. Two of the four teachers taught in the same elementary school. The participants' teaching experience ranged from 4 to 23 years. Their ages ranged from 34 to 45 years old. Their earned degrees included one Bachelor of Arts and three Master of Education degrees.

The schools in which the teachers worked served between 700 and 1,100 students. The average class size for these four teachers was 24 students. Two teachers had five networked, multimedia classroom computers with Internet access and the other two teachers had only one. A variety of computer-related technologies were available at these schools such as digital cameras, scanners, and various display devices. Each school had a computer lab with a fixed rotation schedule. The schedules varied at each site. Time allotments ranged from 25 minutes to 50 minutes approximately every 6 days.

I gathered data from multiple sources: interviews, participant observations, and documents such as lesson plans and web pages. Each teacher participated in four informal interviews with foci based on Seidman's (1998) interview protocol. Interviews followed observations, except in the case of the initial interview. I observed the teachers for four observations periods ranging in length from 40 minutes to six hours. On several occasions, observation periods continued into a second day depending on the activity that I was observing. Since the purpose of the study was to identify best teaching practices as they related to technology integration, I scheduled observations with the teachers so as to coincide with technology-connected lessons. The teachers provided me with lesson plans reflecting the activities I observed as well as others previously used along with artifacts such as web pages that they had created.

Through inductive analysis, categories, themes, and patterns emerge from the data (Janesick, 1994; Patton, 1990). Boyatzis' (1998) thematic analysis was employed as a means to interpret the data collected. This began as data was first collected and ran throughout the study. Triangulation was evident after a review of observation field notes and documents confirmed the trustworthiness (Lincoln & Guba, 1985) of the interview data.

Results

Emergent patterns borne out by the data resulted in a general conclusion that best teaching practices and best technology integration practices go hand-in-hand. It is sufficient to say that effective teachers adjust instruction to meet the needs of their students. In addition, they typically use a broad repertoire of approaches skillfully (Darling-Hammond, 2000). The participants in this study used a variety of methods while diffusing technology into the curriculum throughout the school year in order to achieve a balance of activities for their students. Their approaches to technology integration helped to foster a supportive classroom climate: one in which students made choices, took responsibility, expressed themselves and their knowledge in a variety of ways, and created a community of learners. The following are five best practices that emerged from my analysis of interview transcripts, observation field notes, and documents.

1. Multidisciplinary and Problem-based Units

Elementary teachers use technology best when it is done in conjunction with multidisciplinary, problem-based units. These units are typically contextualized for the students so as to simulate a problem that they might encounter outside of the school setting. Teachers in this study facilitated only one or two such units a year because of their in-depth and time-intensive nature. For example, one teacher created a stock market unit in which her fifth grade students collaborated with ninth grade students for a six-month look at how the stock market worked. Both classes researched a variety of stocks and used e-mail to exchange information once a week. With the fifth graders acting as stockbrokers and the ninth graders taking the role of investors, students worked in "firms" buying, selling, and trading shares. They computed costs, losses, and gains, prepared stock reports, and created investment portfolios. Using word processing tools, graphing software and Internet tools during this project helped to increase students' understanding and extend the learning environment.

2. The Ends Drive the Means

Teachers who are integrating technology are purposeful when using it. One of the best practices of teaching is focusing on what the students should have learned when the lesson is over. This is true of technology integration. Teachers in this study determined the objectives first and then decided *when* and *if* to use technology to help meet these objectives. In addition, they used technology with their students in a variety of places in the lesson: to introduce material, to extend understanding, to provide additional practice, to enrich learning, to provide closure, and to assess learning. Technology should play different roles in instruction depending on curriculum objectives and lesson design. Teachers who integrate are flexible and not single-minded in their placement of technology within a lesson.

Teachers also realize that the design of the lesson may cause their role to change. Both direct instruction and teacher-as-facilitator were instructional strategies used when integrating technology. Direct instruction was generally used to introduce material, clarify content-based misconceptions, or teach technology skills. Teachers I observed tried to keep these segments short, between 15-30 minutes. They also acted as facilitators of learning while students were engaged in cooperative group work or even during individual assignments. These teachers' end goals for their students help to determine the means needed to reach them.

3. Collaboration and a Community of Learners

I also observed these teachers building a community of learners. The Internet and e-mail make it possible to extend the classroom beyond its four walls. Students can participate in data gathering activities with schools locally and nationally. The third and fourth grade teachers in my study worked side-by-side in the same school and team-taught many units. In a unit focused on regions and the impact of people's needs and wants on the environment, they created surveys to find out the "ecological footprint" of other elementary classrooms in various regions across the United States. They e-mailed their surveys to schools throughout the country. After compiling the data using graphing software, the students constructed different scenarios depicting the potential impact of supply and demand on the environment of these regions.

Adopting "e-pals" was another way several of these teachers expanded their community of learners. One fifth-grade teacher and her class joined nine other classes across the United States for a "Cyber Quilt" project. Using e-mail and "snail mail," the classes exchanged information about themselves including the culture, lifestyles and climate of the area in which they lived along with fabric squares that they felt represented this information. Each class created a quilt with material that students brought in as well as the fabric squares from their e-pals. Through this project, students gained a greater understanding of the power of the Internet and e-mail as communication tools, made new "cyber friends," and considered the similarities and differences between themselves and people living in other parts of the United States.

The community of learners is not just about activities external to the classroom, but also about the teacher being a learner in the process and helping students to recognize each other as experts. Due to the limited number of computers frequently found in classrooms, collaborative activities are a natural fit as an effective instructional method. Problem-based activities or multidisciplinary units provide the perfect context for students to work together. Technology integrators use this best practice to capitalize on students' strengths, develop teamwork skills, and to scaffold learning. For example, groups of three or four students may gather around a computer to use *Inspiration* for a brainstorming session prior to starting on their group project. They also share and divide the work in such a way that all group members have task responsibilities so that each student has some individual time on the computer. While this works best in classrooms with three to five computers, I also saw it work in classrooms with only one.

4. Scaffolding For Understanding

During technology-connected lessons, technology-integrating teachers regularly and systematically scaffold learning for their students. Using this method, the teacher provides the student with some type of assistance to complete a task or learn a concept. Gradually, the "scaffold" is removed until the student is doing this on his or her own. The scaffolding strategies used in conjunction with technology by the elementary teachers in this study included the following: bookmarking websites, providing written directions for computer-related tasks, graphic organizers, note-taking guides to use while gathering information from on-line resources, verbal reminders, and peer tutoring. Pre-selecting appropriate sites allowed the students to begin developing information access skills in a somewhat controlled environment. It helped to eliminate potential problems that can result from inadequate search strategies, misspelled words, or poor keyboarding skills. Graphic organizers guided students as they gathered and recorded data from on-line sources as well as helped them organize ideas prior to using the computer to generate graphs, charts, reports and presentations. Written directions, demonstrations, verbal reminders and peer tutoring all served to assist students as they learned to use technology in the classroom.

5. Using Multiple Hard and Soft Technologies

Another best practice related to integrating technology is the use of multiple hard and soft technologies. These teachers who used technology effectively did not limit integration to a narrow set of technology tools, but rather chose from a variety in relation to their teaching goals. These included soft technologies such as the Internet, e-mail, word processors, graphing programs, databases, cognitive mapping programs and multimedia software. Of these, the availability and versatility of word processing and Internet tools resulted in more frequent use.

They also included hard technologies such as flex-cams, digital camera, scanners, and some type of display device (which is critical to whole class instruction). One of the fifth-grade teachers I observed used the digital camera throughout the year as a way to record the "class history." She and her students used the digital pictures in multi-media presentations that reflected what students had learned from a recent fieldtrip. They imported pictures into classroom newsletters as a way to communicate with parents about special events, and students printed out pictures to use in classroom art projects.

Conclusions

Computers and the Internet are more available now to teachers and students than ever before (Williams, 2000). In a recent study (Smerdon, Cronen, Lanahan, Anderson, & Angeles, 2000), 99% of teachers reported having computer access somewhere in their schools. Of these, approximately half used them for classroom instruction. 84% indicated that they had computers available in their classrooms. Accompanying this trend, is an increasing demand for teachers to make computers an integral part of their instructional activities. They are expected to integrate technology in ways that ensure that their students achieve success in learning, communications, and life skills as well as becoming technology literate in the process. Within the last few years, the International Society for Technology in Education (ISTE) and its partners have developed both the National Educational Technology Standards for Students (2000) and the National Educational Technology Standards for Teachers (2000). These documents clearly indicate expectations for effective computer usage in teaching and learning. Standards, competencies, assessment, and accountability for technology usage are upon us. It is important for school administrators and others in leadership roles to understand what constitutes best practice in technology integration. When administrators evaluate teachers using technology, it is imperative that they know what to look for. They should not be overly impressed by the mere use of technology. They should be discerning about the pedagogy that accompanies its integration. Based upon my research, and that of others, some of the questions that should be addressed when evaluating teachers' effective integration of technology into the school curriculum are the following:

- To what extent does technology bring additional value to multidisciplinary units?
- To what extent is the integration of technology driven by instructional objectives?
- To what extent does technology cut across different events within a unit or lesson?
- To what extent does the teacher adapt flexible roles and teaching/learning strategies in order to maximize learning outcomes through the integration of technology?
- To what extent does the teacher utilize the integration of technology to build a community of learners?
- To what extent does the teacher utilize various scaffolding strategies in order to maximize learning outcomes through the integration of technology?
- To what extent does the teacher utilize multiple hard and soft technologies in order to maximize learning outcomes through the integration of technology?

Computers in the classrooms are here to stay. Already a variety of assessments tools exist that help teachers determine their technical skill level, such as those based on the Mankato Scale (Computer Use Self-Assessment, 2000). There are others that attempt to measure teachers' instructional use of technology (Moersch, 1997). These self-reporting tools are valuable sources of information that can help teachers and administrators plan for staff development. However, as teachers become more proficient at integrating technology into their curriculum, we must begin to move beyond self-assessments. New evaluation models that include looking at pedagogical practices in relation to technology integration are necessary.

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Real-time Learning in a Virtual World

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Abstract This paper explores the feasibility of an Internet software known as "iMatrix" to enhance learning opportunities within the virtual environment of the *NatureShift! Linking Learning to Life* web world. The *NatureShift!* project, a US Department of Education Technology Innovation Challenge Grant, seeks to investigate the impact on learning when informal (free-choice) education methods are applied through technology to formal education curriculum. To build an effective technology delivery system, *NatureShift* chose iMatrix, an image and audio database software developed by Surweb (a TICG project), to provide instructional tools for users that allow on-line construction of slide shows, tests, and learning units. By adapting iMatrix tools to its *NatureShift Exploration Model*, an inquiry-based, constructivist learning model, learners gain creative control over their learning environment. They may create digital presentations or instructional media with minimal understanding of the technology. *NatureShift* is evaluating the iMatrix effectiveness in assisting learners to make learning meaningful.

Background

NatureShift! Linking Learning to Life (*NS*) is a five-year Technology Innovation Challenge Grant (TICG) funded through the US Department of Education and awarded in 1997 to the partnership of Dakota Science Center and Grand Forks Public Schools. Two primary objectives of the grant are the creation of an instructional web-based environment that reflects and evaluates the effectiveness of the *NS Exploration Model* as a learning strategy, and incorporation of appropriate and innovative instructional technologies throughout the learning process. In spring 2000, *NatureShift* accepted an offer from Surweb, another TICG project, to join a consortium of projects testing and adopting Surweb's software innovation known as "iMatrix." It was determined that iMatrix software might enhance *NatureShift*'s instructional capabilities, contributing a database to house informational resources and an on-line set of tools for creating custom learning events from those resources. One immediate instructional advantage was clear – iMatrix provided opportunity for users to collect resources from their world and then turn those resources into custom instruction. This advantage meant that a user (learner) could create meaningful learning events by studying information from the world they already understood (Brynes 96, Negroponte 94, Solis 97a, Papert 93) the prime goal of the *NS Exploration Model*. The iMatrix offered a second advantage to users, whether educators or learners – the opportunity to create a complete instructional sequence, including resource, instructional presentation, assessment and context, live on the web in real-time (Bills *et al.* 95). The advantage offered immediacy, feedback, and personalization of instruction, all critical elements of effective learning strategies. The critical and decisive choice was then made to integrate iMatrix tools seamlessly through the *NatureShift* construct rather than establish a standalone iMatrix web site as the consortium envisioned without educational application to member projects. Under this design, iMatrix and *NatureShift* each gained enhanced capability to utilize the powers inherent in the other.

NatureShift! Scope and Innovation

The *NatureShift* grant seeks to impact learning outcomes through integrating informal (free-choice) education approaches into the formal education experience (Sanford & Uyehara 97). In so doing, the grant calls upon innovative technology to aid instructional application and stimulate creative uses of technology throughout the learning environment.

Innovations of the Grant

Innovation 1

The grant developed an educational model, the *NS Exploration Model*, which culls best practices from free-choice education and formal education strategies and applies those strategies to both formal education classrooms and informal education settings. The goal of the model is to stimulate critical thinking and interpret meaning from personal discovery and understanding. The model has four structural elements which, together, are designed to bring the learner to the goal. (1) Engagement – stimulates inquiry and puts the learner in charge of the learning path. (2) A Web Adventure – provides free exploration through a *defined* instructional path and teaches research using new technologies. (3) A Real World Adventure – brings instruction into the learner's world and offers a path for knowledge application and understanding. (4) A *NS* Project – constructs a summative presentation or demonstration of knowledge gained, requiring the learner to interpret the meaning of the principles and/or skills acquired. Solis (Solis 98) explains, "a learning environment requires the development of two components: (a) a guiding philosophy and (b) a system that supports the philosophy in practice." Establishing a supportive system to deliver the *NatureShift* philosophy led to the second grant innovation.

Innovation 2

NatureShift disseminates its model, its curriculum framework, its resources, and its instructional practices through a robust networking system and a web site that uses advanced technologies to construct a learner-centered instructional environment. The *NS* world is a simulated exploration through five cross-disciplinary, integrated microcosms. It engages learners through inquiry and it gives them content for study, investigative methods, and tools for engaging content, critical components for motivating learners in project-based learning approaches (Blumenfeld *et al.* 91).

Innovation 3

Creative partnerships empowered an innovative educational program that linked information resource providers and expertise with schools, universities, and non-formal education providers. An unbroken *learning line* was established that could deliver information from an original source through instructional designers to educators and pre-service teacher training programs and into the hands of learners for construction of knowledge and meaning. The partnerships created a meaningful instructional medium and context for learning so that higher order thinking skills could be stimulated in target learner populations (Solis 97b).

Curriculum and Technology Contributions

Curriculum

NatureShift is unique in its approach to content development. It had opportunity through its partnerships to develop content contributed by first source providers. Grant administrators sought out the primary educational resources necessary for development of *NatureShift*-applicable curriculum. North Dakota is a state challenged by sparse population, rurally isolated communities, and a limited economic base (Sanford & Uyehara 97). One key need that drove development of the grant was the lack of resources for the State's North Dakota Studies curriculum framework. *NS* resource partners were selected for their ability to add substantial resources to the project to meet that need. One of the first findings of the grant was that collection of original source material from partners for creating curriculum turned out to be an effective fuel for firing-up interest in learning, even though those resources were delivered through a virtual medium. Because learners could study information that came from their home environment, they became interested in the content under study -- even when that content was delivered via the web. It was, in fact, critical to student interest that that original material was in the virtual presentation. It had the effect of "making it real" (*NatureShift* Progress Report 2000, Solis 97b). Learners no longer simply investigated the application of knowledge to their world in a Real World Adventure, but they now had the "real thing" available on-line for exploring the curriculum they were learning.

Technology

Midway into the *NatureShift* project, it became clear that a robust technology architecture would be needed which could serve a comprehensive web site to learners. It would need to deliver a highly interactive web environment and offer communication and collaboration tools that would ensure appropriate on-line teaching and learning methods. The elements added to the *NatureShift* web site included a model *NS Exploration* for each of the five modules, on-line pre-post evaluations, knowledge checks with feedback, authentic content delivered engagingly, a functional operation that stimulates inquiry and exploration, plus communication and collaboration technologies to encourage learner interactions. The addition of the iMatrix software brought necessary enhancements to these functions and contributed a new layer of user controls.

iMatrix Contributions

Development of the original iMatrix software was the project of SURWEB (State of Utah Resources WEB), a Technology Innovation Challenge Grant formed by a statewide consortium of public and private agencies, led by Southeaster Education Service Center. The project was intended to address educational opportunities for disenfranchised communities, provide authentic, locally-created resources to enhance educational opportunity for all of Utah's elementary and secondary students, provide quality education resources via technology, build connectivity to access information, and develop curriculum applications for the Internet (Bills *et al.* 95). At the conclusion of the project, the software was turned into a consortium of Challenge Grant web sites and renamed iMatrix.

Capabilities of the Software to Deliver *NatureShift* Objectives

The iMatrix software is structured upon searchable digital *Collections* of images, sounds, movies, and PDF documents that are accessible for the creation of HTML-generated *Media Shows*, *Tests*, and *Learning Segments*. This four-part package of tools is easily learned by teachers and students (Nelson 2000). The power of the user tools to create instructional materials over the web in real-time gave to *NatureShift*, as to other consortium members, the ability to generate an archive of instructional resources which users could manipulate for generating new instructional content. What *NatureShift* recognized was that iMatrix provided several answers that could prove effective for the project. It was a database with a web interface that could house all of *NatureShift*'s partner developed resources. It could make those resources available to school partners and Dakota communities. More importantly, the software functionality matched *NatureShift* instructional strategies for putting interpretation of learning into the hands of learners and giving learners the ability to follow their own lines of inquiry. It also offered *NatureShift* users the option to create summative projects on-line for their *NS Explorations*. What development staff discovered, once they began using iMatrix software, was that, given further development to meld the two webwares,* iMatrix could lead to more innovative offerings for both web sites.

Merging Application Powers for Curriculum Development

NatureShift web innovations included the creation of simulation-style learning environments whereby users could enter, watch, interact, listen and explore a specific world of inquiry. iMatrix innovations gave users a web site archive that could be manipulated into instructional products of the user's choice. *NatureShift* staff determined that they could merge the two innovations. By embedding iMatrix tools inside the *NatureShift* world and making them available to *NS Explorers*, it allowed learners to remain in the learning experience and yet have creative power to manipulate it. This tactic offers learners an option for drawing meaning from their *NS Explorations* and a way to prepare an interpretive presentation of what they have learned, without leaving *NatureShift*. iMatrix thereby gains curriculum and/or content focus for its user while NatureShift gains tools for the learner to use with curriculum content. *NatureShift* recreated the design of its web operations to enable iMatrix tools to be used within the *NatureShift* curriculum. This feature meets *NatureShift*'s primary goal of stimulating creative thinking by providing content and giving the learner freedom and power to interpret and formulate meaning from his or her engagement with the content (Pirie & Kieren 92).

NatureShift developers have reviewed the advantages of the merged functions of both web technologies. As a result, curriculum writing teams are now developing coursework for specific curriculum frameworks that can be delivered almost anywhere through this enhanced medium.

Professional Development

Both NatureShift and iMatrix goals include the proven instructional strategy of modeling learning methods when drafting professional development plans. If the merged technologies work well for teaching students, they should work equally well for training educators and professionals. iMatrix is designed for use as a training tool as much as a learning tool. When combined with NatureShift web tools, it functions admirably for demonstrating NatureShift teaching strategies.† iMatrix has been used exceptionally well to demonstrate the twin values of instructional *immediacy* and learner interactivity (Montgomery 2000). With only an Internet connection, iMatrix can be accessed and immediately put to use when giving a presentation. It has obligingly provided its tools for uploading pictures in real time during workshops and demonstrated to participants the power of creating an instructional event in real time to a multitude of learners. A Media Show can be created in less than 10 minutes. iMatrix has the unique capability of providing instruction, demonstration, and training at the same time. It is ubiquitously portable, sending its lessons and media shows anywhere there is an Internet connection to receive it.

Conclusions

iMatrix has proven a powerful tool for putting creative power into the hands of learners. In combination with a curriculum- or content-rich site, it gains power exponentially to help learners interact with the objects of learning. Because the same authoring platform‡ is used by teachers and students, students gain the opportunity to become teachers, thereby demonstrating what they have learned and enhancing their own learning. This ability for users to author instruction matches one of NatureShift's core principles – to give

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* Webware – refers to a package of web programming that delivers a "software-like" application over the web.

† NatureShift teaching strategies include: (1) "Each one teach one" (i.e., teacher creates lesson in iMatrix from which students create their own lessons for other students, or class presentations); (2) Use of technology to deliver instruction; (3) Personalizing learning inquiry (using digital cameras to gather information, uploading it into iMatrix, presenting it).

‡ "Authoring platform" refers to a software tool that allows the user to create (author) new software applications. In this case, iMatrix gives users the ability to generate new HTML-based instructional materials.

learners a way to sum up the knowledge they have gained by constructing their own meaning from it. This functionality, however it might be used, will undoubtedly enhance the NatureShift web site by allowing it to grow openly and through unlimited user contributions.

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The Interactive Classroom

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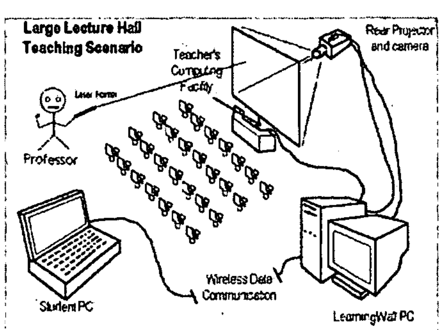
Abstract: Computer programs have been developed that enable students in a classroom to interact with and take control of the computer the instructor is using to present the class material. From their seats students can request to connect their laptop computers over the network to the main computer that is being used to project the course material. Once connected, any student can, at any time, send messages to the instructor and ask to take control of the main computer's mouse and/or keyboard. This enables students to perform actions such as: unobtrusively ask questions, move to another slide in the presentation, make annotations on the main screen to help clarify their questions, participate actively in online simulations, type in answers to questions, and an almost endless number of other tasks that require remote manipulation of the computer the instructor is using. At all times the instructor determines whether a student is permitted to take control of the system and can override that control as needed. The server program running on the main computer also allows the instructor to perform administrative tasks such as maintaining a list of authorized students, their logon IDs and passwords, as well as the IP network addresses to be used.

Introduction

In most universities and colleges large lecture sections have become very common. Unfortunately that kind of environment is not very conducive to meaningful interaction between students and the instructor. Ideally the instructor of a large lecture section should be able to move freely about the room to interact as needed with students as he or she is presenting the material to be learned. In addition it would be beneficial if students could have the possibility of interacting directly with the material being presented without having to leave their seats. We have developed a relatively inexpensive, Windows/PC-based "virtual blackboard" system that can be controlled at a distance by a classroom instructor and/or students in the class. [1] One component of our system is a wireless mouse emulator that is implemented using a software-controlled standard red laser pointer. With this system the instructor is no longer tethered to the computer, but is free instead to roam the classroom and interact with students as needed. The second component is an electronic system of communications between students and instructor. With this system any student can temporarily take control of the mouse and/or keyboard of the instructor's computer. This is a tested, full-featured implementation of the prototype communications system described in the paper "The Classroom of the 21^{st} Century." [2] Figure 1 is a diagram illustrating conceptually how the system is used in a classroom. Figure 2 shows how it can be set up.



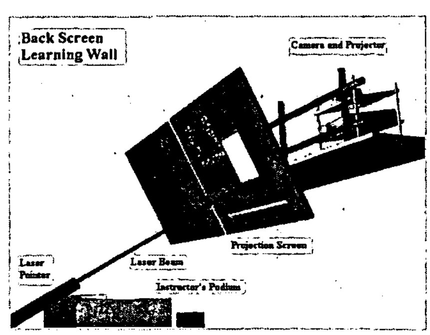


Figure 1. The interactive classroom in action.

Figure 2. Back-screen camera/projector setup

The Electronic Communication System

In this paper an electronic communication system between students and instructor is described. It is assumed that the instructor is using a computer projection system as the main mechanism for presenting the educational material. The instructor may, for example, be delivering a PowerPoint™ presentation, showing material from the World Wide Web, running a simulation that he or she wants students to be able to use, or executing any number of different programs on the main computer. With recent advances in networking technology it is becoming very common to have Internet connections available at every seat in the lecture hall. So quite commonly many students bring their own laptop computers to class. Our system enables any student in the classroom to use his or her laptop computer to send an electronic message to the instructor, and, with the instructor's permission, take control of the mouse and/or keyboard of the instructor's computer. This allows students do perform actions such as: unobtrusively ask questions, move to another slide in the presentation, make annotations on the main screen to help clarify their questions, participate actively in an online simulation, type in answers to questions, and an almost endless number of other tasks that require remote manipulation of the computer the instructor is using.

The keys to the system are two Microsoft Visual C++ programs that we have developed and tested. One of them (ClickServer) runs on the instructor's computer, and the other (ClickClient) runs on each s assumed that all computers are connected to some sort of a TCP/IP-based network. This could be a wired or wireless LAN.

The user of the ClickServer program (the instructor) is presented with a window that has, among others, an "Options" menu item containing "Accept Connections", "User Management", and "Configuration" submenu items. Within "User Management" the instructor, acting as administrator, can add users (user name, password, IP addresses from which the student can connect) and indicate whether or not the user is authorized to request taking control of the mouse and/or keyboard. Within this same dialog the administrator can edit the current list of users or delete users from the list. Figure 3 shows the initial ClickServer screen, Figure 4 the "Options | User Management" Window, and Figure 5 the "Add User Information" dialog box.

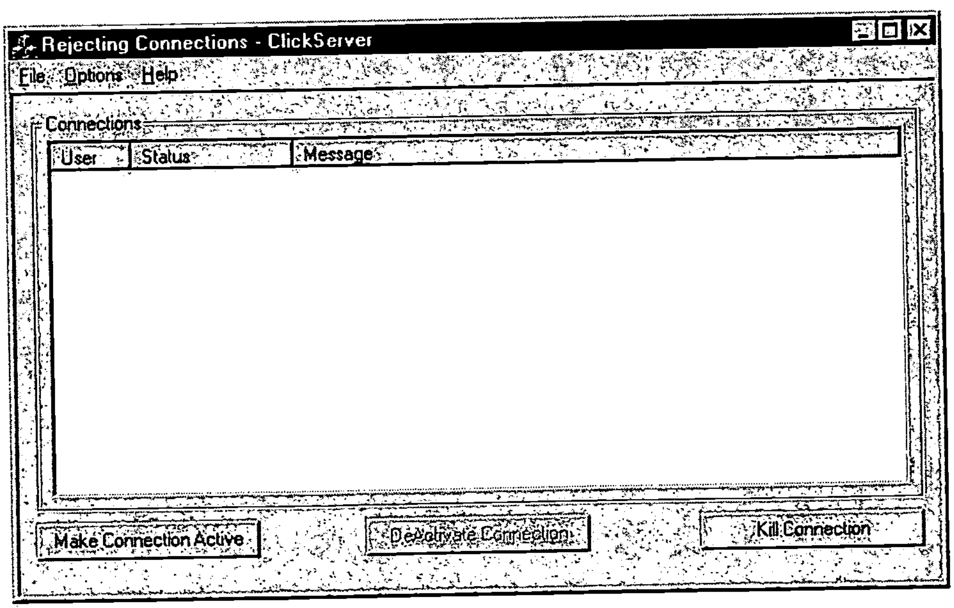
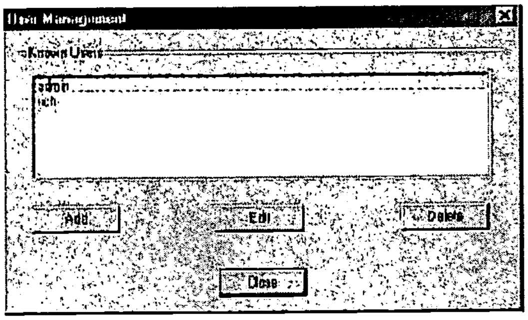


Figure 3. The initial ClickServer window.



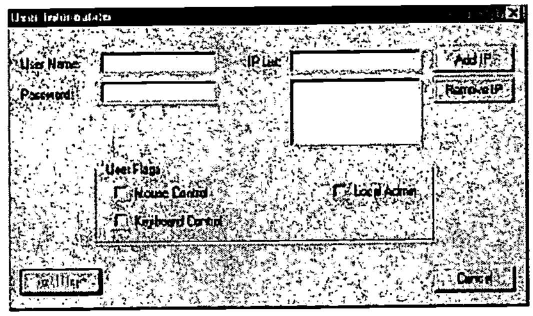


Figure 4. The "User Management Window".

Figure 5. The "Add User Information" dialog box.

ClickServer defaults to rejecting connections when first executed. To allow connections from student clients the instructor selects the "Options | Accept Connections" menu item, which puts the program into "Active Connection" mode. From that point on students can connect to the server program. A list of students who have connected appears within a large "Connections" window. Any messages sent by any student will appear along side that student's name, in addition to a "status" flag that indicates whether or not a given student has taken control of the main computer's keyboard and/or mouse. The instructor can, at any time, click on a button that will "activate" or "deactivate" a student, thereby enabling or disabling that student from taking control. In addition there is a "Kill Connection" button in which a selected student can be disconnected from the server. It should be pointed out that at all times, regardless of whether or not a student is controlling the main computer's mouse and/or keyboard, the instructor also has the capability of local mouse/keyboard control. Furthermore, at any time the instructor can override student control of the system.

ClickServer's "Options | Configuration" menu item allows the instructor (administrator) to set certain system parameters such as the TCP/IP port to be used, to configure "hot key" combinations, and to set or alter other system parameters. In most cases the instructor will not need to invoke this menu item.

When students run the ClickClient program on their laptop computers, they are presented with a window that allows them to enter their user ID, password, and the IP address of the ClickServer. Figure 6 shows the ClickClient screen that appears on a student's laptop when he or she starts the program.

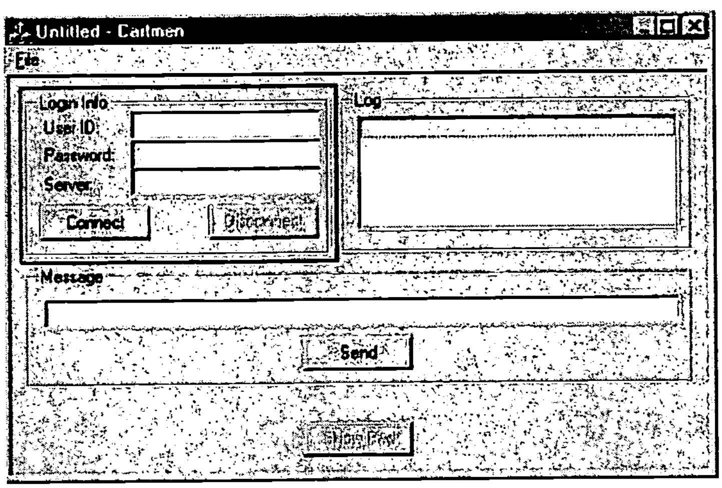


Figure 6. The initial screen that appears on a student's laptop when ClickClient is run.

When students want to connect to the instructor's computer, they can cl
student is an authorized user, has entered the correct server IP address, is plugged into the network, and ClickServer is running in "Active Connection" mode on the instructor's computer, the student will be connected to the server. Messages that specify what is occurring will appear in a "Log" window. Figure 7 shows the typical response that occurs when a student is connecting to the ClickServer.

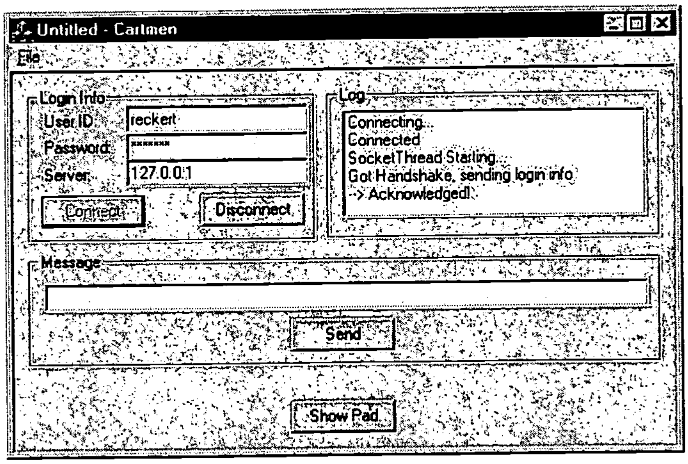


Figure 7. The ClickClient connection dialog.

At any time a student can send a message to the instructor by typing a line of text into the "Message"
utton. Figures 8 and 9 show the student's screen and the instructor's screen immediately after a student has sent a message to the instructor.

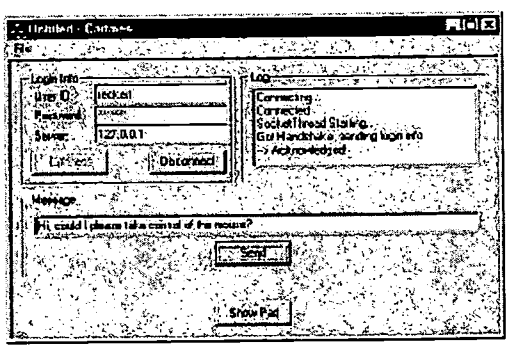


Figure 8. A student sends a message.

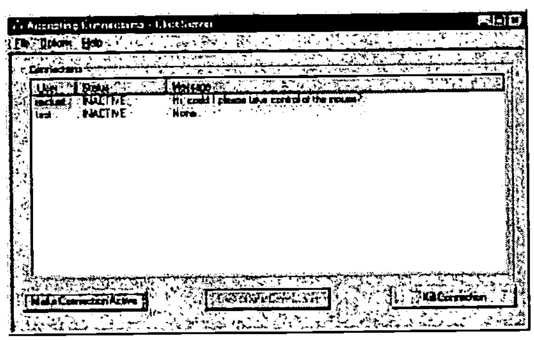


Figure 9. The instructor receives the message.

If a student wants to take control of the main computer's mouse and/or keyboard, he or she can send a message to that effect. If the instructor is willing to grant that control to the student, he or she can do so by clicking on the ClickServer's "Make Connection Active" button. Then, on the instructor's screen, the "Status" of the student who has been given control changes from "INACTIVE" to "ACTIVE". The student's "Log" box will reflect the fact that the student has assumed control by displaying a "Mode set ACTIVE" message. That student can then click on a "Show Pad" button to actually take control. At that point a large rectangular "mouse pad" area will appear on the student's laptop screen, and subsequent mouse movements and clicks while the cursor is over the pad area will cause the corresponding mouse actions to occur on the instructor's computer and be reflected on the projection screen. In addition, any student keyboard actions will also be directed to the main computer. Figure 10 shows the mouse pad that is displayed on the student's screen when he or she has taken control.

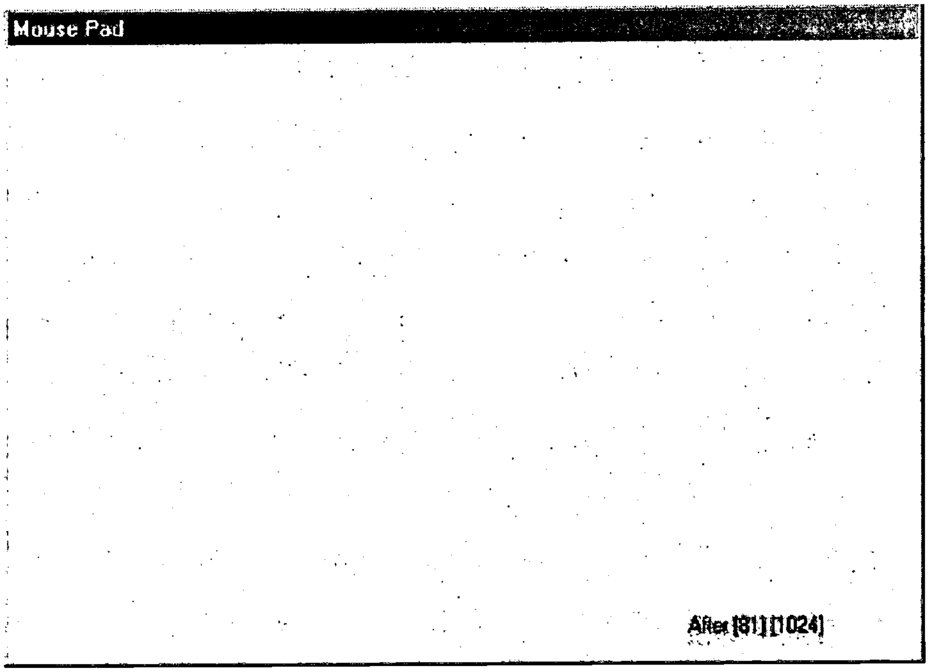


Figure 10. The "mouse pad" that appears on a student's laptop after taking control of the instructor's computer.

If the student tries to use the main computer's mouse and/or keyboard and is not the current active user (i.e., has not been given control by the instructor), messages to the effect that mouse and keyboard control are unauthorized will appear in the log window. At any time, in the program's main window, the student can click on a "Disconnect" button, in which case the server will close the connection of that student's computer to the server.

A demonstration of the ClickServer and ClickClient communication system will now be given.

Conclusions

The ClickClient and ClickServer software has been tested in several university settings. Both students and instructors have commented that the system is relatively easy to use and that it really does enhance interactivity in the classroom. It can be especially useful in those kinds of classes where it is important that students be active participants – for example in situations where the student actually needs to use the instructor's computer to do something. It has been ideal for allowing student manipulation of simulations. One example is a computer graphics ray tracing algorithm animation program that was developed by the author and one of his students. [3] The instructor explains and demonstrates the system at the main computer's projection screen, and then, from their seats, individual students are allowed to work with the ray tracer animator, while the professor guides them and explains what is happening in the animation.

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Implementing a Pre-service Teacher Technology Infusion Model

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Abstract: In June of 2000, the Department of Educational Technology at the University of Northern Colorado (UNC) received a PT^3 grant. One of the most difficult, crucial, and comprehensive aspects for implementing the PT3 grant at this university pivots on how well both the university's and the state's standards have been integrated into the two technology courses pre-service teachers' are required to take before becoming licensed; more importantly, however, is how well these concepts have been integrated into the thoughts and practices of these pre-service teachers once they find jobs and begin creating courses and curricula. To put it another way, the challenge is how well the pre-service teachers have been taught the fundamental concepts of technology and how to apply that technology not only to both the university and the governmentally-mandated standards, but also to the course they will create and teach. This presentation will encompass three elements of the redesign process of the introduction to technology course that all pre-service teachers at UNC are required to take: first, various aspects of the data collection and evaluation will be explored; second, the integration of Colorado Department of Education's (CDE's) Standard 7 into the course's curriculum will be explained; and finally, one aspect of the PT3 grant implementation process will be evaluated. This presentation will illuminate the trials and tribulations of all aspects of the evaluation, course redesign, implementation, and field-testing processes.

Introduction

In June of 2000, the Department of Educational Technology at the University of Northern Colorado (UNC) received a PT^3 grant (Preparing Tomorrow's Teacher to use Technology). This university's grant has three overarching goals: graduates of the UNC teacher education programs will effectively utilize technology for instruction in their classrooms when employed as full-time teachers; two, UNC student teachers will effectively utilize technology for instruction in the partner school classrooms; and three, UNC faculty members will effectively utilize technology for instruction and model appropriate technology use for the preservice teacher education students. This paper will focus on how the PT3 grant team at the UNC will implement and integrate the best practices of technology use (both as a set of teaching tools, and as a model of how to use those teaching tools effectively in classrooms) into the second overarching goal of teaching pre-service teachers to use and to teach the use of technology in the classroom.

In 1996, Persichitte, Tharp, and Caffarella completed a study commissioned by the American Association of Colleges of Teacher Education, which investigated student and faculty use of technology by colleges and departments of education. The authors found that the 744 institutions surveyed generally had extensive infrastructure already in place, but the faculty were either not using it at all, or they were only using it for personal productivity, rather than for instructional activities. The data also showed that students were not being asked or required to utilize technology for class projects beyond basic word processing.

In a year-long research study, Lohr, Javeri, Mahoney, Strongin, and Gall, (2000) utilized a rapid application development (RAD) model to integrate various technologies into curriculum that could be used both as a self-paced instruction (SPI) format, and as an in-class instructional model. Qualitative data gathered and analyzed by Lohr et al., that is significant to this project, found students felt the following about the introductory educational technology class: (a) the self-paced format was not only convenient, but gave freedom and flexibility; (b) the projects and rubrics were not as challenging as they could have been; (c) more examples and non-examples of each project would have been beneficial; and (d) fewer open laboratories would be preferable. The graduate-level teaching assistants (TAs) felt that students who chose to take the course online and thus did not attend many, if any, of the classes turned in less sophisticated projects than those who participated in the weekly class sessions. The TAs further felt that students tended to copy the project example rather than create unique solutions of their own. The project team as a whole was disappointed that the rapid application development (RAD) process did not allow time for learner-based (rather than teacher-based) beta testing—a problem that proved to be a stumbling block during instructional delivery.

As a result of this study, the PT^3 team decided that self-paced instruction should be created using a template that has been originally designed to deliver learner-friendly instruction. This template would allow for continuity and uniformity of language and format. In the process of the Lohr et al., research study, the two educational technology courses it encompassed (a 200-level course for freshmen and sophomores, and a 300-level course for juniors and seniors) were brought current not only in the knowledge and skills they taught and developed, but also in the utilization and implementation of latest in computer hard and software.

In preparing to redesign the courses yet again, not only to incorporate the aims of the PT^3 grant, the improvements in technology, the more demanding standards of the university, and the CDE's governmentally-mandated standards into the curriculum, but also to meet the needs of partner schools as those needs related to the PT^3 grant, UNC's PT^3 team visited 21 partner schools (K-12) to speak with principals, teachers, and technology coordinators as well as observe each school's classroom uses of technology. For each of these visits, two to three team members visited each of the partner schools. Each member of every visitation took notes and wrote up a summary of their findings both from the principal's and technology coordinator's interviews, and from the classroom observations. The initial evaluation of the data collected have highlighted several key issues which need to be addressed in this, latest redesign of the 200- and 300-level courses: (a) all schools visited have a fairly extensive infrastructure, both new and old machinery that is not being used to its fullest potential; (b) networks and file servers are playing a much greater role than could have been imagined; (c) the balance between platforms is shifting away from MAC and toward PC machines running the MS Windows platform and this is true across all grade levels; (d) teachers are not able to generalize how to use software outside of the way they have been originally instructed to either use it, or utilize it; (e) K-12 faculty want and need activities that they can integrate into their curriculum successfully; (f) student information management systems have become a critical component both in the individual schools, and in those schools' districts because state regulatory agencies demand extensive and comprehensive student data every year; and (g) with standards and assessments demanding more and more physical (time and energy) and financial (budgetary resource) support, technology facilitators (technology support personnel) have, as of late, become one of the lowest priorities on the K-12 personnel/time-allocation matrix.

In order to integrate into this university's required technology courses not only the applicable overarching goals of the PT3 grant, but the latest parameters of governmentally-mandated (CDE) standards (Standard 7, see Appendix 2), conclusions gleaned from the Lohr et al. (2000) study, data collected from the PT^3 grant-facilitated school visitations, and information gained from the Persichitte, et al. (1999) study, were woven together to create a tapestry of what the latest redesign of this university's required technology courses. The second goal of this paper and the presentation is to outline the processes involved in revamping the introductory (200-level) technology course. Because the two courses (the 200- and the 300-level courses) are so dependent on each other, the redesign of one cannot be investigated without discussing the other; as a result, during this presentation the redesign of both courses will be discussed even though as this paper is being written, only the 200-level course redesign is nearing completion.

Redesign Process

Each of the PT^3 grant's three overarching goals are interconnected, and the key element the common keystone, if you will—in each of those three arches relies on, depends on, how well the university's pre-service teachers are taught; in other words, how well the fundamental concepts of technology have been integrated into these pre-service teacher's thoughts and practices. The pre-service teachers now enrolled in the university and those to come must be taught the best practices of technology use by their teachers. Preservice teachers must be able to recognize and address the technology-integration needs of schools into which they are ultimately placed, and they must be able to model the various technology's usages to and for the teachers withwhom they will be working. The goal and process of revamping the other courses (as well as the teaching philosophies of those course's professors) in which these pre-service teachers will be taught is ongoing, as is the design of the 200- and 300-level technology courses.

To best achieve the goal of integrating the knowledge, usage, understanding, and dissemination of technology into the consciousness of these pre-service teachers, it was important to create not only comprehensive, effective course material and exercises, but to make the instructions efficient and projects appealing as well. At the same time, the amount of material that needs to be covered to appease the needs and goals of the many interested parties (the PT^3 grant, this university's and the CDE's concerns and mandates, and the needs of the 21 partner schools, as well as addressing the findings from school visitations, Lohr et al. (2000), and Persichitte et al. (1999) was almost overwhelmingly extensive.

The first step in the process was to identify the 'optimals' (the skills necessary in order to meet the -service teacher standard 7, see Appendix 1). This required skills and knowledge base was then matched to the curriculum content of current 24x and 34x courses (the 'actuals' what we were teaching). The difference between the optimals and actuals illuminated for the team the gaps that needed to be addressed in the redesign process. Of the components identified in the optimals list, some were deemed so universally understood that they were dropped completely from consideration for the course material; others were categorized as basic enough to be listed as prerequisite skills for the course; and some were not presently being addressed, so were added to the required instruction for the course. Thetasks, skills, and knowledge-base requirements which remained were either left unchanged, redesigned, or combined with other tasks. Templates were then created for both the self-paced tutorials, and the rubrics used for assessing projects. The templates were designed to ensure that there was uniform wording and formatting both within the instructional content, and in the tools used to assess the students' skills acquisition and knowledge retention. From these templates, the new course's syllabus was created.

The next step, once the course syllabus had been created, was to assign the instructional design/redesign tasks to members of the team (see 24x Schedule Redesign). In the initial step in this redesign process, each instructional designer (ID) identified the critical components of skills and knowledge needed by the learner for the understanding and use of the tool for which the ID would be creating instruction. These components were placed in the rubric that eventually formed the structure from which the creation of the self-paced instruction would come. This process identified the specific tasks required of the learner to show proficiency in the understanding and use of the tools, and from which the learners' grade will be dependent. After each of these rubrics was created, it was presented to the whole PT^3 team for evaluation, feedback, and revision. The ID then implemented the agreed upon revisions and finalized the self-paced instruction module. Once the self-paced instruction was created, the entire team critiqued it for clarity, giving constructive criticism for its improvement. Each module was then beta tested by both the PT^3 grant/design team, and appropriate skill-level learners. Revisions based on feedback from these beta-testing sessions were also implemented into the self-paced instruction modules. This analysis/beta-testing/revision process will be ongoing over the next several months to ensure the most effective, efficient, and appealing courseware possible.

The 200-level course will be piloted during spring term 2001 as part of the formative evaluation process. As unexpected problems arise, they will be addressed by reworking the instructional content. Data will be collected from the learners during and at the end of each piloted class, so their input can be integrated into the final product. The team hopes to have the new courseware in its final form for summer semester of 2001.

At present, the redesign effort of the 300-level courses is in its initial stage, but it will follow the same process as the 200-level courses. The team understands that, due to the constantly changing hardware, software, and market requirements, any course that attempts to teach technology is a work in progress; as a result, this design team's efforts will continually be focusing on an illusive moving target.

Conclusion

At this time, the PT^3 team is in the middle of revamping the two-courses. This phase of the PT^3 grant implementation project will be completed by May 2001 for 24x and August 2001 for 34x. The data collection and evaluation phase turned up some fairly startling facts. First, there was much usable hardware and software already in place in the schools. Second, that while there were a few isolated individuals who were utilizing those tools to good and lasting effect, there still remains a huge gap in the schools' teachers and administrators' desire and ability to integrate those tools. Third, one of the most surprising (and negative) side effects of education's latest push for the integration of intrastate and cross-discipline standards is that the personnel needed to help integrate the technology that can only help expedite the implementation of those well-meaning and well-thought-out standards are being, of necessity, pulled away from what, in the long run, would be advantageous, so that more short-term and short-sighted goals can be met. Finally, even though these courses were extensively redesigned a short time ago, anew redesign is required in order to meet new standards, the changing needs of the market, and the changing complexion of the available hard and software.

Standard 7, the technology standard of CDE's curriculum-wide K-12 listing of standards, has been well-thought-out and is very comprehensive in nature. Integrating all those standards into two one-credit courses created a challenge almost too great to be overcome, especially given the many, varied, and often conflicting requirements of the various entities that warranted influence on this redesign process. Evaluating which of those many and varied demands could be subjugated to the myriad of others that absolutely had to be addressed by the two courses, proved to be a very powerful teaching tool and learning experience for the IDs on the PT^3 team. The result, thus far, has been well worth the efforts, and in the end, all of the crucial goals and requirements have been addressed.

Because of the two studies previously conducted and evaluated for this project, Lohr et al. (2000), and Persichitte, Caffarella, & Tharp (1999), this redesign has gone surprisingly well. There have been very few hitches, problems, or complaints. The redesign process has required an extraordinary amount of work by the PT^3 team, but the results have, thus far, shown that RAD does have a place in academia; however, using a proven template in conjunction with that RAD helps immensely to not only speed up the design process, but to eliminate some of the more frustrating foibles and hurdles the Lohr et al. redesign encountered. Time will tell if the highest of the overarching goals will be met by the efforts of the PT^3 grant team. We will have to wait for four slow-to-take-effect changes to occur before any real success or failure of that goal can be evaluated. Those changes include the revamping of university-wide curricula that affect pre-service teachers; the revisioning of the teaching philosophies of those professors who have applied to the grant for assistance in redesigning the courses they teach; the ability of the course redesigns to reach the students with both new information and with better and more comprehensive tools; and finally, how well those pre-service teachers integrate not only the technology they learned at UNC, but also the technology yet to come. Ultimately, realistically, any valid and reliable assessment of the PT^3 grant team's success or failure may prove unattainable. The success may have to lie in the efforts, aspirations, and desires of the individuals within that team.

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Appendix 1: Colorado Pre-Service Teacher Standard 7

Knowledge of Technology: The teacher is skilled in technology and is knowledgeable about suing technology to support instruction and enhance student learning.

Standard	*Task*	*24x*	*34x*	*Combine*	*Writer*
7.1	*Apply technology to the delivery of standards-based instruction.*				
7.1.1	Peripherals (camera, scanner, printer)	x			DC
	Computers (Mac, PC)	x			DC
	Web browsers (I.E., Netscape)	x			DC
	Evaluation/Selection of software	x	x		DC
	Preparation for software/version changes	x			DC
	Accessory tools (calculator, character maps)	x			DC
	Folder/File/Directory Management	x			DC
7.3	*Utilize technology to manage and communicate information.*				
7.3.1	Grade books	x		3	CM
	Spreadsheets	x			CS
	Databases (Flat files)	x			MJ
	Test generator		x		EH
	Student information management system	x			DC
7.3.2	Select and apply appropriate tools (See 7.3.1/7.4.1)	x	x		
7.3.3	Web page creation	x			CS
	Web page design/development		x		
	Email/Attachments/Listserv	x	P		CS
	Desktop publishing	x		1	MJ
	Basic Word processing	x		1	MJ
	Advanced Word		P		
	Voice mail	P	P		CM
	Presentation software	x			MJ
	Graphics Design (PhotoShop, Illustrator)	x		2	EH
	Scanning	x		2	EH
	HyperStudio	x			CM
	Video enhancing software & applications		x		
7.4	*Apply technology to data-driven assessments of learning.*				
7.4.1	Grade books		x	3	CM
	Spreadsheets		x		CS
	Databases (Flat files)		x		MJ
	Test generator		x		EH
	Student information management system		x	3	DC
7.5	*Instruct students in basic technology skills.*				
7.5.1	Research tools (CD, Web)	x			EC
	Research applications (CD, Web)		x		EC
7.5.2	NETS student standards	x			DF

Appendix 2: 24x Schedule Redesign

Week	*Instructional Content*	*New/Old/ Adjust*	*Designer*	*Attendance*
1	Syllabus	New	DC	Mandatory
	Email	Old		
	Grade Book	New	DF	
2	Listserv	New	EH	Mandatory
	Web Searching	Old		
	Web Evaluation	Old		
3	Web Theft	Adjust (34x)	DC	Mandatory
	Attachments	Adjust (24x)	DC	
	Copyright	New	DC	
	File/Folder Management	New	DC	
4	***Stretch*** (Data Collection – Graduate Student/Project)			Mandatory
5	Excel I	New	CS	
6	Excel II, Grade Book	New	CS	Mandatory
7	Scanning, PhotoShop	New	EH	
8	PowerPoint I	Adjust	MJ	
9	PowerPoint II,	Adjust (EC)	MJ	
	Publication to Web	New	MJ	
10	Projection, Setup PowerPoint Presentations			Mandatory
11	Presentations II			Mandatory
12	Advanced Word – Page breaks/Setup, Mail merge, Outlining, Columns, Tables, Sorting, Printer settings, Style sheets, Graphics/WordArt/Drawing tools	Adjust	Julie	
13	Advanced Word, Web Creation w/ Word	Adjust	LJ	
14	Front Page	New	CM	Mandatory
15	Front Page	New	CM	Mandatory
16	Finals Week Web Page Presentation			Mandatory

Why Technology is Being Integrated into the Classroom at Such a Slow Rate: A Discussion of Self-Efficacy, Motivation, and Utility.

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Introduction

In the past fifteen years, there has been much attention paid to the issue of integrating computers into the classrooms. The CEO Forum on Education Technology in Washington, D.C., polled nearly 80,000 public schools and found that only about 3 percent of the schools are successfully integrating technology into the curriculum. Why is the technology not being integrated at a faster pace? Researchers have seemingly asked every question but one; "Are teachers motivated to use technology in their classrooms?" I contend that the integration of technology is not an issue of the availability of resources or information. It is an issue of whether or not teachers motivation, and their belief that the integration of the technology into the curriculum will bring about a level of instruction and learning greater then otherwise possible. This is an issue about some teachers' need to avoid negative images. Consequently, too many teachers are struggling everyday, not to master the technology, but instead to invent ways to avoid failing at using the technology.

Perceived Self-Efficacy

Generally defined, self-efficacy is the degree to which one believes that she is able to achieve a given task. A teacher's self-efficacy can be described as the belief that he or she is an effective teacher. More importantly, research supports the idea that a teacher's self-efficacy is significantly positively correlated with student achievement. Teachers' perceptions of how effective they are as teachers is based on how well their students perform the task they have taught. Teachers who do not possess the necessary skills to perceive themselves as proficient with technology will not believe that they can help a student achieve at the task. They will not foresee the students succeeding because of their efforts. The predicted failure of the student leads to the teacher's anticipation of a lower self-efficacy at the task of teaching technology. This anticipation of low self-efficacy presents a special problem for the teacher. Dweck (1988) suggests that self-efficacy at a given task, given certain conditions, can often give rise to negative affect and a significantly lowered perception of self-worth. This is more likely to happen when the individual attributes the failure to forces that are internal, uncontrollable, and stable. These are precisely the attributions that teachers generally make about their "failed" efforts to teach any given subject. The ability to teach the subject is within them. It is not viewed as an environmental or situational force. Where the failure is associated with information that the teacher does not possess, the forces are often viewed as uncontrollable. The final attribution that most teachers make is that the results are stable. They believe that every time they attempt to teach technology with the knowledge that they have, the results will be the same...failure. These factors combine to put the teacher in a position where failure has a negative effect on their perceived self-worth. Consequently, to avoid the negative affect associated with lowered self-worth, teachers develop some mechanism to protect their self-worth. Either they can increase their knowledge of the technology, subsequently raising their self-efficacy about teaching it, or they can avoid the task all together.

Motivation to Achieve

For an explanation as to why so few teachers choose the former of these two options, I consider Atkinson's early theory of achievement motivation. Atkinson (1964) states that "the motive to achieve success (Ms), which the individual carries about with him from one situation to another, combines multiplicatively with the two specific situational influences, the strength of expectancy or probability of success (Ps) and incentive value of success at a particular activity (Is), to produce the tendency to approach success that is overtly expressed in the direction, magnitude, and persistence of achievement-oriented performance." In simple terms, the individuals tendency to approach success is equal to Ms x Ps x Is. The motivation to achieve success is generally accepted as a constant characteristic of the individual. This variable is the same for learning technology, as it would be for learning mathematics, science, etc. The other two variables are where the degree of flux appears from task to task. Atkinson notes that these two variables depend upon the individuals experience in specific situations that are not unlike the one she now confronts. The difficulty of a task as it appears to an individual is represented in terms of the strength of the expectancy of success. Where the task is perceived as very difficult, the Ps is very low. The inverse is true as well. The probability of success (Ps) is, somewhat, subjective for tasks that fall between the impossible and the overtly easy. For most teachers, the Ps in mastering technology is very low. This is because of the perceived difficulty of the task. Atkinson's theory is that this perception is the result of previous experiences with like tasks. In the case of technology, I assert that these past experiences are not all computer specific. Since most of the teachers that are in the classroom do not use personal computers, the difficulty of this task must be generalized from other technology-oriented tasks. It is more likely that these past experiences include such tasks as programming VCRs, bouts with the school copy machine, and setting the clocks on microwaves and televisions. Because of the difficulties with this technology, and the perception that mastering computer technology is even more difficult then these "simple" tasks, the Ps for computer-oriented tasks is perceived as being very low.

The Utility Factor

Now the question becomes, "Why aren't we seeing teachers with high degrees of Ms for technology?" It is easy to see that if the Ms is high then the Ts will be high regardless of the Ps and the Is. This is where Atkinson's model is too simple in its approach. Atkinson fails to account for an individual's utility or value of the task. I propose that Ms is not constant from task to task, but in fact is dependent upon the individual's value of the specific task. An alternate writing of the equation would possibly be Ts = (Ms +/- Vs) X Ps X Is, where Vs represents the individuals value of the specific task. When the task is greatly valued, the individual is inclined to devote more energy toward the task, invoke the use of more volitional strategies to accomplish the task and work toward the task over a longer period. Consequently, the Vs is added to Ms proportionally. When the task is not valued, on the other hand, the Vs is not high, and in fact may even serve to detract from Ms (Ms - Vs). In this case, the individual does not care if failure comes. The failure does not effect the individual's self-efficacy as much as a valued task, and causes little of no negative affect. A further assumption is that if the Ps is small (a very difficult task) and the Vs is small (a relatively unvalued task), then Vs more readily becomes a negative figure. This is the case with many teachers and technology. The Author's personal research has attempted to examine this idea of teachers valuing technology. Middle and Secondary teachers were given a survey that questioned their beliefs about and usage of technology in the classroom. The study found that seventy percent of the teachers surveyed did not believe technology could make them better teachers. Teachers, in general, do not value the usage of computers within their classroom, and so they do not willingly attempt to tackle the task. The effect on their self-efficacy is not rooted in their valuing the task of teaching computers so much as it is in the task of teaching.

Intelligence Types

Dweck's research illustrates why teachers that do not believe that technology can make them better teachers often choose to avoid the task of integrating technology. Dweck suggests that there are two primary types of intelligence, Entity and Incremental. The Entity theory of intelligence is that intelligence is fixed and no matter how much effort you but into developing it, intelligence and performance are generally constant. The other type is an incremental orientation. This theory suggests that intelligence is malleable. These individuals believe that if one works hard and puts a lot of effort into a task, one can improve intelligence and subsequently performance. I assert that teachers that do not believe that technology can make them better teachers are more entity oriented, and those that do believe that their teaching skills can be enhanced with computers are often incremental thinkers. These two types of individuals have specific goal orientations and behavior patterns they display when they perceive their ability as high or low. Individuals that are incremental-oriented are more likely to seek challenges that foster learning. They have a high degree of persistence, and are mastery oriented. These individuals will display this behavior patter despite their perception of their ability to perform a given task. Their goal is to increase competence. This is not the case for entity-oriented individuals. Entity-oriented individuals strive to gain positive judgments and avoid negative judgments of competence. When an entity-oriented individual perceives her ability as being high, that individual will be mastery oriented. They will seek challenge and be very persistent in their pursuit of excellence. This individual does not fair so well, however, when their perceived ability as low. In this condition, the individual avoids the challenge and has a low degree of persistence. This is what happens entity-oriented teachers that have low perceptions of their ability to teach technology. They avoid the task because of their need to avoid negative judgments of competence...even when these judgments are primarily internal.

Discussion

For too long, we have been struggling with this problem. We have sacrificed teacher time and energy, in our efforts to conquer it. What we have not done is, gotten to the root of the problem: some teachers do not believe the technology can make them better, and are not motivated to integrate the technology. They are afraid of failing in front of their students and afraid of failing their students. Consequently, they have not invested themselves into the integration of the technology.

JavaScript for Teachers

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Abstract: Increasingly, teachers at all levels are making use of the Internet—both as a source of instructional information, as well as a medium for instructional delivery. Some instructors develop their own Web pages, which are typically written in HyperText Markup Language (HTML). JavaScript™, a browser scripting language originally developed by Netscape Communications, is a valuable tool that can enhance the functionality of any Web page. This paper examines the nature of JavaScript, and investigates how it can be used to enhance education-oriented Web sites of today's teachers.

Introduction

Increasingly, teachers at all levels are making use of the Internet—both as a source of instructional information, as well as a medium for instructional delivery. According to *Technology Counts '99*, an education technology survey conducted by Education Week magazine and funded by the Milken Exchange on Education Technology, most teachers across the United States currently have access to a computer, either at home or at school. Almost all teachers who have access to a computer use it for some kind of professional activity, and 61 percent use the Web to enhance instruction in their classrooms (Education Week on the Web, 1999).

Taylor (1980) provided a useful model of how computers can be applied to instructional purposes. His "tutor, tutee, and tool" model describes three different approaches to computer use: (1) computer as teacher (i.e., providing information and instruction); (2) computer as learner (i.e., learning tasks via computer scripting and programming); and (3) computer as classroom assistant (i.e., assisting in the completion of classroom projects) (Newby, Stepich, Lehman, & Russell, 2000). Each of these approaches can be applied to the use of the Web in the classroom as well.

JavaScript™, a browser scripting language originally developed by Netscape Communications, is a valuable tool that can enhance the functionality of any Web page. The purpose of this paper is to examine the nature of JavaScript™, and investigate how it can be used to enhance education-oriented Web sites of today's teachers.

What is JavaScript?

JavaScript is an interpreted, cross-platform, object-based scripting language that was designed for the development client- and server-based Internet applications. JavaScript commands can be embedded directly in HTML pages to allow for greater Web page interactivity and intelligence. JavaScript commands can recognize and respond to user actions such as mouse clicks, form input, and page navigation.

For example, a JavaScript-based script can be used to verify that users enter valid information into a online form. And, since a JavaScript script runs on a user's computer without any network transmission required (and the accompanying time delay), an HTML page with embedded JavaScript can immediately interpret the entered text and alert the user via a message window if the input is invalid. A JavaScript can also be used to perform an action (such as playing an audio file or communicating with a plug-in) in response to a user opening or exiting from a Web page.

JavaScript has a rich set of built-in functions and commands and, using JavaScript, even less-experienced developers are able to direct responses to and from a variety of events, objects, and actions. In learning to control and handle events using JavaScript, a teacher can develop Web pages that are dynamic, interactive, and three-dimensional, rather than static and two-dimensional. JavaScript provides anyone who can compose HTML scripts with the ability to change images; play different sounds; and output different information in response to specified events, such as a user's mouse click or screen exit and entry.

As Weiss (1999) pointed out, JavaScript was introduced "to make it easier for Web pages to 'process' information; that is, rather than merely display static information, JavaScript could be used to perform calculations, output results to the page, and so on. Typically, this power is best employed when triggered by the user who is, after all, the primary agent in a Web page."

JavaScript and Java

JavaScript™ is also useful for working in conjunction with, and complementing the many benefits -based applets. Applets are small intelligent programs written in Java™ programming language, that can be used increase a Web page's level of interactivity. JavaScript can be used to execute; modify the settings; and control the appearance and behavior of Java applets. Java applets can be developed for such things as Web page animations and Web page databases. One such example is a Web page database applet called *finditgrid*™ that was developed by DoubleOLogic™ Software Corporation (DoubleOLogic Software Corporation, 2000). This applet will sort information that is provided in a text-delimited format, and then allow a Web page user to search through the information interactively.

Whereas JavaScript is a scripting language that can enhance the functionality of HTML-based Web pages, Java is a general purpose, cross-platform, compiled, application development language that can be used to develop full-blown applications—both for Internet-based or non-Internet-based, standalone information systems. Java was originally developed by Sun Microsystems Inc.

Like JavaScript-based scripts, Java applets execute client-side (i.e., on a user's desktop computer using the browser software), instead of server-side (i.e., on a Web server). As previously mentioned, this feature allows for fewer network transmissions, and much faster processing of information.

Web Page Enhancements Via JavaScript

Below is a list of some of the many features that be added to a Web site and enhance it, through the inclusion of appropriate JavaScript-based scripts. Many of these features can be applied to educational purposes, both by teachers and students. And, for many of these features, there are Web sites that offer free downloadable (shareware) JavaScript-based scripts that will perform these functions. The Web site entitled *The JavaScript Source*™ (http://javascript.internet.com), developed and maintained by internet.com Corporation, is one such site.

Web page features possible through the inclusion of appropriate JavaScript code include:

- Web page input form functions: Field validation, checkbox changer, copy fields, etc.;
- Web page utilities: HTML page builder, print page, e-mail buttons, show link info, list of links, calculator, calendar, clock, etc.;
- Web page search features: Search engine, site search page, etc.;
- Web page dictionary features: Definition of unfamiliar terms, help popup, information box, etc.;
- E-mail: E-mail button, e-mail this page feature;
- Web page menus: Menu bar, pull-down menu, portable menu, midi menu (background music), etc.;
- Web page windows: Popup window, exit message window, etc.;
- Web page navigation: Remote control navigation, thumbnail navigation, page scrollbar, etc.;
- Web page security features: Password protection, text encryption, etc.;
- Web page graphical image display functions: Image slideshow, image previewing, photo/image album, drag-n-drop images, etc.;
- Web page messages: Animated headline messages, banner ads, exit messages, time-based greeting, visitor alert messages, etc.;
- Web page quiz features: User quiz, Math quiz, etc.;
- Web page games: Math Quiz, Maze, Buzzwords, Bridge, Insight Generator, Force Memory, Connect 4, Concentration, Catch a Spy, etc.;

- Miscellaneous features: Quote of the day, daily tip of the day, bookmarks, color picker, name alert, plug-ins alert, random number generator, etc.

Conclusion

The Internet and the World Wide Web, when used appropriately, hold great promise for improving the quality of educational content and delivery; for empowering students and teachers in their educational activities; for providing access to educational resources not previously available; and for making education more readily accessible to learners at a distance who might not otherwise have access. JavaScript is a simple, readily available, low cost technology that can help to support students and teachers in these endeavors.

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Operationalizing a Technology Standard with Proficiency Skill Sets

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Abstract: The presentation of this interactive session will begin with an overview of the existing program which operationalizes the California technology standard for K-12 teachers with the California Technology Assistance Program (CTAP) Region 8 technology proficiencies. Lecture will be supplemented by a PowerPoint presentation and demonstrations of the following web sites: 1) the CTAP Region 8 site (http://www.ctap.org/ctc/) includes a rubric for three levels of certification and digitized video examples of exhibits at Levels 1 and 2; 2) the California technology standard (http://www.csub.edu/~dgeorgi/contents/techstand.htm); 3) the PT3 grant that helped coordinate these efforts (www.projecttnt.com). Next, a description of the process involved in coordinating this certification process with K-12 districts and teacher credential programs. To date, over 500 teachers have been certified including growing a cadre of Level 3 leader/mentors. An interactive discussion on implications for those present will conclude the session.

Introduction

In 1997, the California legislature passed a law mandating the development of a technology standard for K-12 teachers that would be used in the credentialing of new teachers and in the review of teacher credential programs. The Technology Education Advisory Committee (TEAC) was selected from among diverse constituencies to research the topic and develop recommendations for the Commission on Teacher Credentialing (CTC). The TEAC met many times over the next year and engaged the services of the State Librarian to research the efficacy of technology on the teaching and learning process (Umbach Report). A preliminary set of recommendations was sent to all pertinent institutions and individuals for field review. Taking the feedback from the field, the TEAC proceeded to develop language for a technology standard with a number of "factors to consider" that would be used to accredit teacher preparation programs (http://www.csub.edu/~dgeorgi/contents/techstand.htm). The recommendations were presented to the CTC in December, 1998 and were accepted. At first, the new standard was to be made effective in January, 2000, but a number of institutions requested more time and currently the standard will be effective in January 2002. All teacher preparation programs in California have been requested to submit plans for implementation of the standard and a number of methods have been proposed and were accepted.

Meanwhile, the California Technology Assistance Program (CTAP), a consortium of regional offices coordinated by the California Office of Education, was working on developing its own technology standards for teachers. Region 8, consisting of four central California counties, decided to build on the work of the CEAP by taking the technology standard's factors to consider and using them as skill sets for technology proficiencies. The CTAP Region 8 Advisory Committee met several times and developed a rubric for assessing technology skills (http://www.ctap.org/ctc/). The rubric has been used by K-12 districts to organize professional development activities and by teacher preparation programs at CSU Bakersfield. A federal PT3 project included a task force on Technology Proficiencies and helped coordinate the effort (www.projecttnt.com).

The CTC technology standard divided its levels of proficiency to articulate with the system for obtaining a teacher credential in California, which is a two level system. Meeting level 1 is a requirement for a candidate must be recommended for a preliminary credential. Meeting level 2 is required for recommendation for a professional clear credential. Level 1 is primarily personal computer skills with some application to teaching responsibilities; level 2 involves the integration of computer skills into teaching responsibilities.

CTAP Region 8 proficiencies have been organized into a rubric based on the two tiers described above and added a level 3 for advanced certification. All certification is done on the basis of portfolios assembled by the teachers. Teachers can be certified at level 3 as either mentors, whose main responsibility is training other teachers, and leaders, who serve as tech coordinators or administrators. Level 3 teachers can certify level 1 and 2 teachers.

Results

As a result of implementing a coherent approach to certifying teachers at various proficiency levels, a number of positive results have occurred.

First, technology skill training is directed toward meeting the levels of certification. This ensures that teachers attending training sessions are at an appropriate skill level and for specified skill development; avoiding some teachers being lost and others bored. This also allows all training at K-12 schools and university teacher credential programs to be articulated on the factors underlying the technology standard.

Second, teachers are encouraged to attain certification at all levels. Some schools offer a bonus for attaining level 2. Level 3 teachers often receive stipends for the training and administrative tasks they perform.

Third, by having level 3 teachers certify levels 1 and 2, the presence of expertise has been greatly expanded. Most local schools have at least one level 3 teacher and many schools are including the attainment of specified percentages of faculty attaining each level by specified deadlines. A strong cadre of level 3 teachers is being developed and will soon be adequate to provide technical support for local schools.

Fourth, by having a common certification system, unprecedented collaboration is occurring among schools and university teacher credential programs. Level 3 teachers are participating in the writing and implementation of a variety of grants and projects involving technology. One example is the Preparing Tomorrow's Teachers to Use Technology Implementation federal grant, which includes a Technology Proficiencies Task Force. CTAP Region 8, local teachers and university professors have collaborated in developing a web site that includes the technology proficiencies rubric, application for certification, and examples exhibits that meet most proficiencies. In addition, a list of certified teachers is maintained at the CTAP Region 8 office and is posted on its web site. This is a further incentive for teachers to attain certification as it indicates that all teachers are expected to have demonstrated technology skills.

In addition to the positive results of this system, a number of problems have emerged.

First, articulation between CTAP Region 8 and instructors in the university teacher credential programs has had difficulties. University professors have been slow to get certified to level 3. CTAP Region 8 has offered to provide such professors with level 3 teachers so students in university classes can have their portfolios certified officially.

Second, it is difficult to ensure that all candidates will have access to certification. The university credential programs have submitted a plan to the CTC stating that by June, 2001, all credential candidates will be required to attain levels 1 and 2 in order to be recommended for the preliminary and then the professional clear credential. Because of the large number of credential candidates, an independent study course in Technology Portfolio Certification is being developed to meet the needs of out of state teachers and others who fall through the cracks. In addition, the state of California has contracted with National Evaluation Systems to develop a test our procedure for level 1, primarily for out of state teachers.

Third, some universities in the region refuse to participate in the system, citing turf issues. They will be required by the state to meet the technology standard in their own ways.

Fourth, other regions and the state level CTAP are developing their own systems, which may have a future impact on the Region 8 system. Similarly, the ISTE standards are seen by some as a model on which to base training. In response, a correlation chart has been developed, which indicates where specific skills are located in each system.

Conclusion

The implementation of a technology proficiency skill sets certification system based on a state technology standard has had dramatic positive effects on the development of technology skills in local schools. The certification of hundreds of teachers at levels 1 and 2 has encouraged many teachers, including those with life credentials, to develop technology skills that enhance the teaching-learning process. The increasing presence of level 3 teachers is providing that most commonly missing element in technology professional development: adequate and accessible technical support. As an added benefit, the awareness of the importance of technology in schools among level 3 teachers has produced that second most commonly missing element: equipment and training as a result of grant writing activities. As the new technology standard goes into effect, the system described in this paper can be expected to continue to promote the development of technology fluent teachers in local schools.

Educational leadership, community partnerships and 24/7 access to educational technology: Bridging the technology gap in small, rural communities with anytime, anywhere learning.

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Abstract: This paper describes a project providing school children with 24/7 access to laptop computer technology in a small rural school community in western Kansas. Based upon the visionary leadership of school and community figures, this collaborative venture incorporates creative approaches to financing the project, a focus on actively changing approaches to pedagogy and the learning process, and an analysis of the impact of the project upon the school community. Key features of the project incorporate a focus on educational leadership; community partnerships; anytime, anywhere learning; the digital divide in rural communities; 24/7 access to computers; and constructivist learning in a technology dependent learning environment.

Introduction

The tenor of much of the recent literature on the use of educational technology in classrooms is predicated on the belief that the effective introduction of technologies into learning environments creates circumstances and opportunities under which there is a positive effect on student achievement (Honey, McMillan, Culp, & Spielvogel, 1999). Early claims suggested that using technology effectively in classrooms enabled teachers to be more successful and assisted students in learning what they needed to know to be effective citizens (Bialo & Sivin, 1990; Cotton, 1991; Means & Olson, 1993; Sheingold & Hadley, 1990). More recently however, it has been suggested that technology in and of itself, did not directly change teaching or learning. Rather, the critical element was how technology was incorporated into instruction (Office of Technology Assessment, 1995, p. 57).

Longitudinal data from the Apple Classrooms of Tomorrow (ACOT) studies indicated that technology was an engaging medium for student thought and collaboration and that "technology play[ed] a catalytic role in opening the minds of teachers to new ideas about children, about learning and about their own role in the education process" (Dwyer, 1996, p.29). In the words of ACOT teachers: "ACOT has revitalized the teaching process tremendously. It has been a catalyst for a transition from blackboards and textbooks to a method of instruction where students can explore, discover and construct their own knowledge" (p.25).

Others have described similar significant changes to the teaching environment brought on by the presence of computer technology. Sheingold and Hadley (1990) surveyed 608 computer-using teachers. Findings indicated that teachers expected more creative and edited work from their students and that they spent more time with individual students. Further, this research suggested that the presence of computers improved the teacher's ability to present more complex instruction and that the associated amount of time spent lecturing was reduced. Sheingold and Hadley (1990) suggested that data such as these indicate that the presence of information technology had the potential to modify certain practices in classrooms.

Parallel to this focus on technology use in the literature is an equal emphasis upon the incorporation of a constructivist approach to teaching. In stark contrast to the prevailing, traditional, teacher-centered classrooms, constructivist teaching practices do not focus on regurgitating newly presented information, but rather on helping learners to internalize or transform, new information (Brooks & Brooks, 1993). Deep understanding and not imitative behavior appeared to be the goal of these learning environments. According to Perkins (1999), considerable research showed that active engagement in learning often lead to better retention, understanding and use of knowledge. He suggested that "constructivism generally casts learners in an active role" (p.8). Further, Daggett (1999) and Schlechty (1997) have suggested that the skills needed for success today include the ability to access, analyze and apply information to solve predictable and unpredictable real life problems, the ability to manage information and to work in groups to solve problems.

The predominant form of schooling today looks quite different to these images however. For example, despite the fact that Gibson (2000) and Schlechty (1997) have made clear that the way people access, work with, and communicate information is fundamentally different than a decade ago, for the most part, the way learning is structured today appears to be much as it was five or more decades ago. Most teachers use a variation of a teacher-centered model of instruction where the emphasis is upon the presentation of a body of knowledge or a set of skills that students are required to learn (Glenn, 1996; Goodlad, 1984). The focus of power in these classrooms remained with the teacher and students were generally passive listeners. According to Dwyer (1996), in settings such as these, learning was viewed as the transfer of thoughts from one who is knowledgeable to one who is not, and where the work of the teacher was perceived as direct instruction. Common teaching methods include lecture, whole class or small group instruction, drill and practice exercises from workbooks or sheets with a dependence upon facts, rote learning and structured, clearly defined activities.

With the contradictions presented by juxtaposing constructivist and traditional approaches to teaching, and keeping in mind the often recognized potential represented by technology in classrooms, the question of the day then becomes, "How do we engage students in meaningful learning opportunities, and how can schools embrace information age technologies to better prepare students for the world in which they are living?"

The Project

The project described below attempts to address this question by exploring the impact of technology on a small, rural school community in western Kansas. Through creative partnerships and collaboration, educational and business leaders in this community have provided access to laptop learning technologies for students on a 24/7 basis. This working model is attempting to establish the viability of infusing cutting edge technology in all schools, for all students, despite limited school district resources. Conceived as a vehicle for transforming and improving existing pedagogy and curriculum as well as a bridge spanning the digital divide so common in poor rural communities, this project creates an arena for analyzing many of the questions common to school districts nationwide concerned about the impact of increased access to technology on student learning.

Designed to impact the delivery of education and improve access to technology for students, this multi-year project began in the fall semester of 2000, although collaboration, preparation, planning and conceptualizing preceded this beginning by many months. The concept driving the project describes a long term vision that includes a district-wide, wireless network complemented by internet access in students' homes. As the project develops, all 6-12 students in this district, and their teachers, will carry a laptop computer as core equipment for their daily learning activities. In this vision, learning will not be constrained by the arbitrary time divisions of the traditional school day. By redefining the basic building blocks of the traditional conception of 'school' and t expect to see significant positive changes in teaching and learning. These changes are expected to be directly related to expanded access to information and learning technologies and the associated changes in where and when learning actually occurs. In the conception of this project, these significant changes are accompanied by a focus on learning which has individual learners constructing their own knowledge sets, and creating an emphasis upon student-centered learning in the context of authentic and situated activities. Clearly, in these situations, the role of the teacher is expected to undergo significant transformation. Delivery of instruction is expected to give way to a supportive and collaborative role where team work and shared responsibility feature prominently.

Lest the reader be mislead into conceiving of this project as one focusing solely on the school-based learning process in isolation, an understanding of the entire context of this project is necessary. An analysis of the proposed plan of implementation reveals further possibilities of the expected impact on this small, rural community and the business partners supporting the endeavor.

The Implementation Plan

In the first phase of this project a district-wide, wireless network has been installed, capable of supporting the laptop computers provided to all middle school teachers and those leased by all sixth grade students. On-going staff development designed to prepare teachers to teach in this new environment has become a regular feature of school life. A charging station and a spare battery for each computer has been purchased to ensure reduced downtime and strain on the power grid of the school buildings. Internet access has been secured at a reasonable rate for all sixth grade families to guarantee continual access to the internet and district resources. Evening computer training opportunities are being provided for all parents to support the concept of parents as partners in the learning process. Teachers are designing and posting appropriate lessons, units of study, and associated activities for delivery over the internet. Subsequent years of this project will see additional grade levels of students and teachers involved in this rural attempt at anytime, anywhere learning. By the year 2007, the initial phase of the project will be fully implemented and all teachers and students 6-12 of this small, rural district will be involved.

The plan is dependent upon a unique set of partnerships and agreements between school district leaders and teachers, parents, and cooperating business partners. In the first instance, families will lease a computer over a four-year period for $200 per year. Families unable to meet this requirement (i.e. families eligible for free or reduced lunches) will contribute according to their circumstances. Agreements have been reached with community benefactors to cover the cost of these arrangements. At the end of the initial four year leasing period, families will be able to purchase the computer for $50. Arrangements have been made for these students to lease new computers for the remainder of their school careers for $300 per year with a purchase price of $50 at the end of 3 years. Insurance has been arranged by the district to cover damage or needed repairs for a cost of $14 per unit per year and the district will insure against loss or theft at $14 per unit per year. Internet access has been secured for families who cannot afford the monthly rate through the local ISP. This partnership has pledged 10 free Internet accounts for the first year and has potential for an increase in this number as the project grows.

A project of this scope cannot survive without the strong commitment and real involvement of community groups. For example, in this context, the local educational foundation agreed to serve as the fiscal agent for the project, responsible for managing all funds, in addition to conducting appropriate fundraising activities. Further, local benefactors agreed to subsidize a variety of costs during the pilot year. The local bank has established low interest leases for each family, and a local insurance agent has agreed to establish low cost and effective insurance. A further key component of the project is the support of the families involved. While all families will contribute some financial resources to the project, their active involvement was important in other areas preceding project implementation.

Simple in its conception, this project originated with a series of pre-implementation steps designed to create community involvement, buy-in, and increase chances for success over the period of the project. All interested parties were included in conceptualizing and planning: students, parents, teachers, school and district administrators, business partners, members of the board of education, and community members. Productive and active partnerships were established with business organizations and community groups capable of sharing appropriate experience and willing to contribute towards filling each identified project goal. Support from a local, community-based educational foundation was secured and school district personnel were active in revising the district technology curriculum during the previous year in preparation for this new direction. The intent of this curriculum revision was to ensure minimum competencies and the basic technology skills needed for students to function successfully in the new learning environment. In addition, teachers who were involved in the planning process recognized that changing their roles from 'purveyors of all knowledge' to 'facilitators of learning' was a dramatic change that would not happen easily or instantly. Consequently they have created a focus on continual and contextualized staff development as an integral component of the project implementation and maintenance plan.

Such dramatic adjustments to the traditional expectations of schools, teachers, and learners requires careful monitoring to ensure continual success and continual support from the community of contributors and participants of the project. In fact, it has been suggested elsewhere, that education will likely undergo many changes as a result of the incorporation of technology into everyday activities. Jukes (2000) has suggested that education will not be confined to a single place, a specific time, a single person, human teachers, paper-based information, memorization, linear learning, or controlling learners. With such dramatic changes occurring in education, it is part of the responsibility of educational innovators to describe the impact of such innovations on the learning process. The introduction of cutting edge conceptions of education, supported by appropriate technology in this small, rural community demands a serious attempt to gauge the success of this working model of anytime, anywhere learning.

Project Evaluation

To accommodate the need for thoroughly evaluating the impact of this project on the educational community of this small rural school district, and to widely disseminate the results, the project incorporates an evaluation component. The initial evaluation will be conducted by external investigators and will focus on three broad questions.

1. What impact has the introduction of full-time technology access had on the learning process?
2. What impact has the project had on the way teachers teach?
3. What impact has the project had on the school and community?

This activity will be an evaluation in progress. As a result of the longitudinal nature of the study, the possibility of variations in approaches to the research design and to data collection is possible in order to accommodate variations in the project as it evolves through time. During the initial phase of the project, the rationale, design, data collection strategies, and data analysis procedures for this proposed evaluation have been taken from the qualitative paradigm of research and represents a naturalistic approach to educational inquiry (Erlandson, Harris, Skipper, & Allen, 1993; Lincoln & Guba, 1985; Patton, 1990). Naturalistic inquiry was defined by Patton (1990) as a "discovery-oriented approach that minimizes investigator manipulation" (p. 41). As the intent of the evaluation is to determine the reaction of participants to the intent, impact, process and potential of the project, the need to describe their perceptions, expectations and attitudes forms the basis of the data collection process. Erlandson et al. (1993) suggested that although "both qualitative and quantitative methods can be used, qualitative methods are generally preferred, primarily because they allow for thick data to be collected that demonstrate their interrelationship with their context" (p. 16). Further, Babbie (1998) described qualitative analysis as "the non-numerical examination and interpretation of observations, for the purpose of discovering underlying meanings and patterns of relationships" (p. G5).

A variety of qualitative methodologies are proposed for use in this evaluation: interviews, focus groups, observations and document reviews. The evaluators considered that such an array of data collection strategies would provide the richness of data and the variety of perspectives necessary to understand the complexities of the situation under study (Erlandson et. al., 1993). Such a multi-source approach to data collection also provides a further element necessary in building the trustworthiness of the data collected: triangulation (Lincoln & Guba, 1985). Participants in these data collection strategies will include students who have leased a computer; teachers who are involved in teaching in the project, as well as those not involved; parents of students involved in the project; school and district administrators involved in the project, as well as those not involved; and community members who have been actively involved in the project.

Data will be analyzed using the constant comparative analysis methodology advocated by Lincoln and Guba (1985). Constant comparative analysis requires data to be unitized. Erlandson et al. (1993) defined unitizing "as disaggregating data into the smallest pieces of information that may stand alone as independent thoughts in the absence of additional information other than a broad understanding of the context" (p. 117). Once data from each data collection strategy are unitized they will be merged into one datafile in a relational database. A process of inductively grouping and regrouping the data will allow categories to naturally emerge from the units of data. In considering the common attributes among the data, common themes will be developed, and will lead to the production of conclusions based on the evaluation findings. The evaluators will use this information to form recommendations related to the guiding questions of the evaluation. The results of these analyses are formative in nature and will be used to modify and re-conceptualize the project as it progresses.

Conclusion

As educational reform is too often equated with "plugging students into anything that happens to plug in." (Stager, 1995, p.78), the goal of this collaborative community effort, unlike many technology initiatives, was not simply to purchase the technology and put it in place. Rather, the intent was to use the technology to positively impact the traditional teaching and learning processes that were prevalent in the district. In addition, this project provided the time teachers needed "to grow in their use of technology"(Miller & Olson, 1995, p. 75). There is no instant solution expected here. As Miller and Olsen suggested, "Educators who believe that technology automatically fosters effective learning styles and instructional patterns need to think seriously about such issues ... the real progress computers can stimulate comes from a healthy debate about what we really care about in classrooms and whether that is happening" (p. 77). This project not only provides a timely analysis of data regarding the merits of teaching and learning using laptop technology, but will also provide a model of community collaboration for public schools to consult when the issue of limited school/community financial resources appears to stifle technological initiatives.

This innovative, community based project also provided an opportunity to evaluate the effectiveness of the partnerships and community collaboration designed to remove the discrimination factor that variable access to technology often generates across subgroups of a population. By making technology accessible to all in this small, rural community, this goal has been partially addressed. Lemke and Coughlin (1998) suggested that emerging trends in research indicate "that under the right conditions, technology accelerates, enriches, and deepens basic skills; motivates and engages students in learning; helps relate academics to the practices of today's work force; increases economic viability of tomorrow's workers; strengthens teaching; contributes to change in schools; and connects schools to the world (p.14-15)." The approach to leveling the technological playing field, described in this project, has the potential to create an environment capable of providing longitudinal data over the next seven years to verify these claims. This project meets the challenge of the digital divide head-on, and provides patrons of this small, rural community with the tools to define their own educational futures and bridge the technology gap with their version of anytime, anywhere learning.

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Acknowledgements

The author wishes to recognize the contribution of Associate Professor Randy Turk, Wichita State University, and Deb Hanake, Educational Services and Staff Development Association of Central Kansas (ESSDACK) to the development of a collaborative grant proposal designed to support the project evaluation described in this paper. Much of the conceptual work included in this description has been the result of collaborative work by this team and the author.

Internet Uses by Senior High School Teachers A Case Study

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Abstract

This research project employs the case study method to investigate the effects of instruction and learning with the Internet at the senior high school level. In the first year of this study, the main focus is to explore the current status of integrating the Internet into school management, teaching and learning. Some teachers were selected in six subjects, Chinese, Geology, English, Mathematics, Biology and Earth sciences, to use the Internet for their professional activities. The data collection instruments included the Teachers' Professional Use questionnaire and The Students' Computer Use questionnaire. The survey data showed that (a) more teachers and students knew how to access the Internet for instructional or learning purposes after the researchers intervened, and that (b) more teachers reported that they needed assistance for designing a web-based database and Instructional strategies for their Internet use.

Keywords: Computer Networks, Internet-aided Instruction, Internet-based Learning

Introduction

Over 90%of schools in America can access to the Internet (Becker, 1999). From statistics (Becker, 1999), 24% of teachers in American access Internet both at home and in their classroom, 35% of them access Internet in classroom only, and 15% of them access Internet at home only. This reveals the Internet begun to be habitual as an information and communications resource in the working and home environment of most teachers. However, most teachers are trained to teach from their textbook. Most teachers devote the majority of class time to presenting information, demonstrating how to solve problems, and assigning tasks to their students who usually have a single, short right answer. Few teachers are skilled integrating the Internet into their teaching. The teacher role is an important issue in the integration of technology into instruction.

Teaching is an active task of inculcating learners with the skills and cognitive processes to "direct" and

on the Internet (Gilliver et. al., 1999). Current teacher education programs have not prepared preservice teachers to integrate the Internet and computers into classroom teaching. The necessary skills, such as computer skills, instructional strategies, and search skills were not taught, so most teachers feel anxious when computers and the Internet technology come into their classroom. Without support from teachers, students cannot learn effectively. Therefore, researchers not only need to evaluate the students' learning in a web-based environment but also investigate the teachers' adoption of technology including the changes in instructional strategies, the changes in learning activity design and changes in assessments (Beaudoin, 1990; Brophy & Good, 1986; Mc Kenzie, Mims, Davidson, Hurt & Clay, 1996; Thatch & Murphy, 1995; Verduin &

Clark, 1991). Other teaching skills also needed in effectively using the Internet for education are, searching for information, web-page design and socially interactive skills on the web. It is important that teachers know how to choose suitable learning activities and instructional strategies when they integrate new technology into teaching and learning in order to promote students' conceptual development and thinking skills (Mc Kenzie, Mims, Davidson, Hurt & Clay, 1996). Therefore, this study conducted questionnaires to investigate teacher Internet uses at a senior high school.

Method

This research project employs the case study method to investigate the effects of instruction and learning with the Internet at the senior high school level. In the first year of this study, the main focus is to explore the current status of integrating the Internet into school management, teaching and learning. Some teachers were selected in six subjects, Chinese, Geology, English, Mathematics, Biology and Earth sciences, to use the Internet for their professional activities.

Participants

The teachers and students at Luodong Senior High School were selected as the participants for this case study. Luodong Senior High School is located in the northern region of Taiwan. The Internet access at Luodong Senior High School was convenient. Most computers were located in three computer labs and some were in the teacher offices. Teachers and students could use the campus Intranet and T1 for Internet access since 1998. There were 59 teachers participating in this study in 1998 and 31 teachers in 2000. Only 23 teachers participated in both 1998 and 2000. The data from these 23 teachers were used for teacher measurement comparisons between 1998 and 2000.

Instrumentation

The instruments used in this study included measurements of teacher computer use and teacher attitudes toward computers. We constructed the Teachers' Professional Use questionnaire to survey teachers' computer use, teachers' access to the Internet, teachers' Internet use for instructional purposes, attitudes toward computers and the Internet, and teachers' anxiety concerning computers. The attitudes toward computers and the Internet consisted of 15 items with five subscales measuring class involvement. The instrument contained selected items from the tests developed by the following authors: Liu & Johnson (1998), Knezek & Christensen (1996) and Moroz & Nash (1997). A panel of experts, including nine professors from National Taiwan Normal University, established the content validity of the questionnaire.

Procedure

This study included three stages: (a) The preparation stage (from June 1998 to July 1998): According to research purposes, we selected a typical case or an available case. Luodong Senior High School was selected because of its available Internet access and full support from the principal. (b)

The baseline-building stage (from August 1998 to July 1999): In the first year, we conducted questionnaires to survey teacher computer use and teacher attitude toward computers. Informal Interviews and observations were also used to gain more information on teacher computer use and Internet access. (c) The intervention stage (from August 1999 to June 2000): Teachers in six subjects, Chinese, Geology, English, Mathematics, Biology and Earth Sciences, integrated the Internet into their class during the second year. At the end of the year, we surveyed teacher computer use and teacher attitude toward computers. Informal Interviews and observations were also used to gain more information on teacher adaptation to computers and the Internet for instructional purposes.

Data Collection and Analysis

The independent variable was the intervention; the dependent variables were teacher professional use and teacher attitude toward computers and the Internet. The survey data was shown as descriptive statistics to illustrate the impact of the Internet on teaching. Additionally, we conducted paired t-tests on one of these dependent variables (teacher attitude toward computers) between pre-intervention measures and post-intervention measures. The collected data was analyzed for teacher Internet use using SPSS (Statistical Package for Social Science, version 7.0).

Results and Discussions

Teachers' Changes Before and After the Intervention

1. Teachers' Computer Use

Most teachers reported making some use of computers in their daily life. Our survey asked about five uses in particular: accessing the Internet, playing games, editing documents, graphing or analyzing data, and using e-mail. A majority of teachers used computers for editing documents: 91% in 1998 and 78% in 2000. Teacher Internet access increased after the intervention from 46% to 78% (see Table 1).

Teachers used computers at home, in the office, in the classroom or the computer lab. The computer was seldom used either at home or in school before the intervention. There were increase uses in the second year (see Table 2). We surveyed teachers' computer-software use including MS word, PowerPoint, Excel, FrontPage and FTP relative software. The most popular software was Word for editing (about 87% of the teachers used it). The next most popular software was Excel for calculating student scores (about 60% of the teachers used it) (see Table 3).

2. Teachers' Access to the Internet

Seventy-four percent of the teachers knew how to access the Internet and 91% did after the intervention (see Table 4). More teachers knew how to access the Internet after the researchers intervened with teacher instruction and student learning with the Internet. A majority of the teachers (60% in 1998 and 74% in 2000) (see Table 5) accessed the Internet below five hours a week and most used it for browsing web pages (65% in 1998 and 87% in 2000) (see Table 6). The percent of teachers using e-mail and FTP through the Internet increased 17% and 9% after the intervention (see Table 6).

Table 1: Teachers' Computer Uses

	Number (Percent) Before invention	Number (Percent) After invention
Access to The Internet	10 (43.5%)	18(78.2%)
Playing games	1 (4.3%)	1 (4.3%)
Editing Documents	21 (91.3%)	18 (78.2%)
Graph or data analysis	9 (39.1%)	5 (21.7%)
e-mail	5 (21.7%)	8 (34.8%)
Others	2 (8.7%)	4 (17.4%)

Table 2: Teachers' computer use at home, in the office, in the computer labs and the classroom

	Number (Percent) Before invention	Number (Percent) After invention
At home	1 (4.3%)	3(13.0)
In their classroom	3 (13.0%)	7(30.4)
In their office	1 (4.3%)	3(13.0)
In the computer labs	1 (4.3%)	5(21.7)
Others	0 (0.0%)	0 (0.0%)

Table 3: Teachers' computer-software use

Software	Number (Percent) Before invention	Number (Percent) After invention
Word	20 (87%)	20(87%)
Power Point	9 (39.1%)	10(43.5%)
Excel	13(56.5%)	14(60.9%)
FrontPage	3 (13.0%)	8 (37.8%)
FTP relative software	2 (8.7%)	2 8.7(%)

Table 4: Teacher Internet access ability

	Number (Percent) (Before intervention)	Number (Percent) (After intervention)
Know how to access to the Internet	17 (73.9%)	22 (91.3%)
Don't know how to access to the Internet	4 (26.1%)	1 (8.7%)

Table 5: Teacher Internet access time per week

	Number (Percent) (Before intervention)	Number (Percent) (After intervention)
Below 2 hours	9 (39.1%)	9 (39.1%)
2~5 hours	5 (21.7%)	8 (34.8%)
5~10 hours	1 (4.3%)	2 (8.7%)
10~20 hours	1 (4.3%)	1 (4.3%)
Above 20 hours	0 (0.0%)	1 (4.3%)

Table 6: Teacher Internet Use

	Number (Percent) (Before intervention)	Number (Percent) (After intervention)
BBS	3 (13.0%)	2 (8.7%)
E-Mail	6 (26.1%)	10 (43.5%)
Browse web pages	15 (65.2%)	20 (87%)
FTP	6 (26.1%)	8 (34.8%)
Gopher	1 (4.3%)	0 (0%)
Games	0 (0%)	1 (4.3%)
IRC/ICQ	16 (69.6%)	0 (0%)
Others	2 (8.7%)	3 (13.0%)

3. Teachers' Internet Use for Instructional Purposes

Overall, few teachers made use of the Internet for instructional purposes before this study. Our survey asked about four professional uses in particular: student work on the World Wide Web, demonstrating web-based materials in the classroom, developing instructional materials using Internet resources, and requiring students to find information on the Internet. After the researchers intervened with teacher instruction and student learning on the Internet, more teachers used the Internet for instructional purposes; especially, for student work on the World Wide Web (from 9% to 17%), developing instructional materials using Internet resources (from 13% to 26%), and requiring students to find information on the Internet (from 13% to 30%) (see Table 7).

Table 7: Teacher Internet Use for Instructional Purposes

	Number (Percent) (Before intervention)	Number (Percent) (After interventio n)
Student work on the World Wide Web	2 (8.7%)	4 (17.4%)
Demonstrating web-based materials in the classroom	1 (4.3%)	2 (8.7%)
Using Internet resources to develop instructional materials	3 (13%)	6 (26.1%)
Assigning homework requiring students to access the Internet	3 (13%)	7 (30.4%)
Others	1 (4.3%)	2 (8.7%)

4. Teacher Needs for integrating the Internet into instruction

Since relatively few teachers reported using the Internet for instructional purposes, what capabilities do teachers need for using the Internet in the classroom? Our survey asked about six skills needed by teachers in particular: computer skills, skills for Internet access, skills for the use of editing software, skills for the use of graphic or image-processing software, skills for designing web-based database and Instructional strategies. Most teachers reported that teachers need training in computer and instructional skills. More teachers perceived that they lacked enough skills after the researchers intervened in their teaching with the Internet (see Table 8). Skills for the use of graphic or image-processing software (61%) and the skills for designing web-based database (73%) were needed most by teachers before the intervention. After the intervention, teachers reported that skills for designing a web-based database (70%) and Instructional strategies (65%) were needed most when they made use of the Internet for instructional purposes (see Table 8). With experience to use the Internet in the classroom, teachers perceived Instructional strategies were as important as the necessary computer skills.

Table 8: Teachers' Needs

	Number (Percent) (Before intervention)	Number (Percent) (After intervention)
Computer skills	11(47.8%)	17 (73.9%)
Skills for Internet access	15 (65.2%)	20 (87.0%)
Skills for using editing software	11 (47.8%)	15 (65.2%)
Skills for using graphic or image-processing software	14 (60.9%)	10 (43.4%)
Skills for designing a web-based database	17 (73.9%)	16 (69.6%)
Instructional strategies for integrating the Internet into the classroom	11 (47.8%)	15 (65.2%)
Others	0 (0%)	3 (13.0%)

5. Attitudes Toward Computers and the Internet

There was no statistically significant difference in teachers' attitudes toward computers and the Internet before and after the intervention. The pretest mean was 52.95 with a standard deviation of 5.30. In contrast, the posttest mean was 51.77 with a standard deviation of 8.44. The paired t-test results show that there was no significant difference between the teacher pretest and posttest on computer attitude ($t = 0.68$, $p > .05$; The data was shown in Table 9). This means that teacher computer attitudes did not show a significant change before and after the intervention.

Table 9: Summary Table for Paired t-test: Teacher Attitudes toward the Computer and the Internet

	Mean	S.D.	Paired t value	P
Before intervention	52.95	5.30	0.68	0.50
After intervention	51.77	8.44		

Conclusions

The findings in this study demonstrated that more teachers knew how to access the Internet and use the Internet for instructional or learning purposes after the researchers intervened. However, more teachers also reported that they needed assistance in developing skills for designing a web-based database and instructional strategies when they used the Internet for professional purposes.

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Creating Technology Mentors for Rural School Districts: An Examination of the T.I.M.E. Mentor Program

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Abstract: This study examines the strengths and difficulties of the Technology Integration Mentors in Education (T.I.M.E.) program through accounts given by participants. The T.I.M.E. program, at its peak in 97-98, included approximately 400 inservice teachers from 55 school districts in eastern Idaho. Several inservice teachers who have successfully completed two years of the program were asked to participate in an extensive online interview and survey format (via WebCt) designed to pinpoint major characteristics of the program as well as attitudes. This research explores three areas of the T.I.M.E. participants' experiences: Workshop training experience, implementation of technology into their own curriculum, and peer mentoring activities. The detailed perspectives of these participants are critical to understanding the successes and difficulties of the program. The results of this current research will inform improvements in the implementation of the T.I.M.E. program.

Introduction

This study examines the strengths and difficulties of the Technology Integration Mentors in Education (T.I.M.E.) program through accounts given by participants. Several inservice teachers who had successfully completed two years of the program were asked to participate in an online interview and survey format (via WebCt) designed to pinpoint major characteristics of the program as well as attitudes. This is a pilot study for more comprehensive research into the T.I.M.E. Mentor program. Also, the results will inform proximal instructional decisions for the program.

About the T.I.M.E. Mentor Program

In 1996, the College of Education's Support for Integration of Technology in Education (SITE) team developed the T.I.M.E. inservice program. The T.I.M.E. program serves a mostly rural area that includes 55 school districts that cover about 40,000 square miles of eastern Idaho. At its peak in 1997-98, there were about 400 participants. This teacher-mentor program trains teachers to utilize tool and multimedia software in real-time classroom instruction. Then the teachers are required to perform peer-to-peer mentoring and formal training of teachers in their building/s. The program can be expressed in the following flow model: Technology Trainer → Mentor → Peer Teachers. This mentor model is tiered, in that there are three years of incremental instruction and mentoring requirements. Upon completion of the program, each mentor has had opportunity to become proficient at using computer technology in the classroom and at training peers to do the same.

Formal mentor programs are common in the business world, but recent examples can also be found in educational institutions. Knight and Albaugh (1997) report success in the "Teaching Software

Institute" (TSI) mentoring program, a one year model similar to the T.I.M.E. program. Teachers were trained in specific software applications and then required to train groups of teachers. The T.I.M.E. program is distinctive from the TSI program in that it is tiered in content and time. In other words, the teacher-mentors learn a progression of softwares (e.g., tool software basics to multimedia software) over a period of three years, and are expected to "ramp up" their mentoring opportunities from peer-to-peer contacts to also include the formal training of groups within their schools.

Research Design

This research explores three areas (constructs) of the T.I.M.E. participants' experiences: Workshop training experience, implementation of technology into their own curriculum, and peer mentoring activities. Participants, through survey (online), semi-structured interview (online) and submitted journals of mentoring activities, offer a participant perspective critical to understanding the successes and difficulties of the program.

The survey and interview are given in a WebCt environment. The participants are given an orientation to the WebCt site, and then allowed to take the survey and the interview when they wish. An important characteristic of both survey and interview instruments is their asynchronous design. Though the survey can be completed in as little as 10 minutes and the interview in about 20 minutes of continuous work, participants do not have to complete either in a single sitting. Within the basic time limits of this research, they can complete all instruments at their convenience.

During the orientation to the site, participants are also introduced to an open bulletin board forum with participant anonymity. The forum is seeded with two leading questions designed to grow a conversation among the participants. The bulletin board will always remain unstructured; the three constructs that guide every survey and interview stem will be absent. Potential dialogue may bring out aspects of the T.I.M.E. Mentor Program that have not been asked about in either the survey or interview instruments.

Results

At the time of acceptance of this research paper, the survey and interview processes were still underway. Completion by all participants and the analysis of the data is expected to be complete in early January. The full results will be presented at the time appointed for this paper.

Preliminary results show that this small selection of participants has had a qualified good experience as T.I.M.E. Mentors. Attitudes toward the program and its effectiveness appear to be related to attitudes toward the technology instructors and toward the handling of workshop and mentoring assignments by the technology instructors. More definitive results are forthcoming.

Summary and Conclusion

The current research examines the implementation of the T.I.M.E. Mentor program from the perspective of successful participants. The program is tiered in that there are three years of incremental instruction and mentoring requirements. The participants in this current research have successfully completed the second year of the program and are asked their views on the workshop training, their own implementation of technology into their curriculum, and their own peer mentoring activities. By examining the responses of the participants, the strengths and difficulties of the program will be clearer and will help elucidate the effectiveness of the program.

Reference

Knight, P. J., & Albaugh, P. R. (1997, February-March). *Training technology mentors: A model for professional development.* Paper presented at the Annual Meeting of the American Association of Colleges for Teacher Education, Phoenix, AZ.

The Florida Center for Instructional Technology

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Abstract: The Florida Center for Instructional Technology (FCIT) is located in the College of Education, University of South Florida, at Tampa, Florida. The Florida Department of Education funds FCIT, Office of Educational Technology and the Florida Information Resource Network, to provide leadership and support services to educational institutions with regard to the integration of technology in education. A primary focus of FCIT is the development of instructional materials and databases for telecommunications. The faculty members and graduate students in the USF Instructional Technology program contribute to many of the products created by FCIT.

Purpose

Established in 1982, the Florida Center for Instructional Technology (FCIT) has been a leader in working with educators to integrate technology into the curriculum. With its location in the College of Education at the University of South Florida, Tampa, FCIT is available to assist over 1,200 pre-service teachers who graduate from USF each year as well as thousands of in-service teachers in Florida. With funding from the Florida Department of Education, Bureau of Educational Technology, and the Florida Information Resource Network, FCIT provides many resources for Florida teachers, including training materials for telecommunications, interactive instruction on technology, and maintenance of online database resources. FCIT offers a wide variety of services and materials for Florida's educators.

VITAL

FCIT offers extensive support for the University of South Florida faculty through its membership in VITAL (Virtual Instructional Team for the Advancement of Learning). VITAL (USF's Virtual Instructional Team for the Advancement of Learning) was established in 1997 to assist faculty at the University of South Florida in the use of technology for the enhancement of teaching, learning and research. When VITAL began on campus, the instructional technology expertise of FCIT was tapped as a resource for USF faculty as well. Hence, a new "division" of FCIT was created to offer services to faculty in the College of Education and the University.

At the University of South Florida, several collaborative initiatives are addressing the challenge of integrating technology into the teaching and learning model. VITAL is not an entity with a physical location on our campus, rather it is a consortium of units housed in separate pre-existing areas, working together as a team to provide the best support for the most faculty possible. It is a virtual one-stop-shopping support unit. The majority of organizations that belong to VITAL have been providing these services and support to faculty as part of their overall mission for many years. VITAL combines the expertise and resources of these seven existing units to better support the development of technology enhanced education. Members include Academic Computing, the Center for Teaching Enhancement, Educational Outreach, the Florida Center for Instructional Technology, the Health Sciences Center for Information Services, the Tampa Campus Library, and WUSF-TV.

Faculty are encouraged to seek individual mentoring and assistance as well as attend workshops designed for small groups. Faculty who want individual assistance with technology issues can call upon a specific VITAL member, or they can reach a "generic" VITAL contact through multiple means. The many services that are offered by each VITAL member can be viewed on the VITAL Web site http://www.usf.edu/vital (see Figure 1). In addition, VITAL has an email list (vital@usf.edu) that reaches all members, any of which are able to answer support questions. Support is also offered to the "Learn from a Distance" program in the College of Education for those faculty teaching via distance.

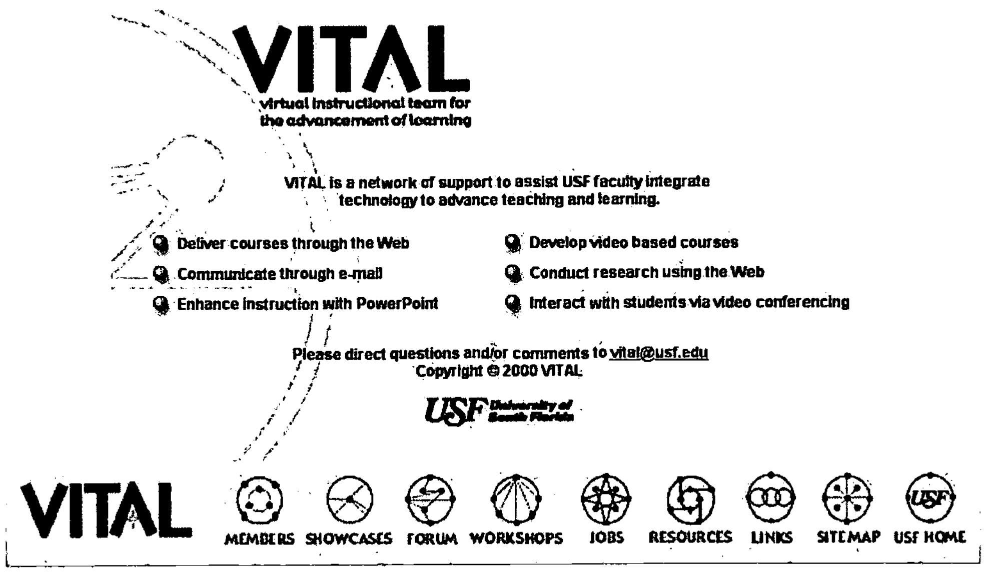

Figure 1: VITAL Web site.

VITAL provides many skill building and informative workshops on the uses of technology for teaching and learning. This past semester, VITAL facilitated 23 skill-building workshops in which faculty and graduate teaching assistants were able to improve their level of comfort and skills with technology. The workshops cover a wide range of technology topics, but many are related to enhancing teaching using the Internet. Some examples include; "Making the Right Choice: A Comparison of WebCT and CourseInfo", ing and Learning with Online Communication Tools", "Creating Web Pages: A One Day Workshop", "Improving Teaching and Learning with WebCT Version 3.0: A Two-Day Intensive Workshop" and Discovering Options: Using Streaming Media to Enhance Online Teaching and Learning".

Recently, VITAL began providing additional support personnel in a lab environment for use by the College of Education faculty and staff. The College of Education and Technical Services and Resources provide the lab to all employees of the College of Education yet was being underutilized. This lab is now staffed for 30 hours to assist those who need to use technology but may feel uncomfortable doing it alone or do not have the resources necessary in their offices. This has increased the number of faculty who take advantage of the technologies provided in the media lab as well as technology usage in general.

FCIT

FCIT provides leadership and support services to educational institutions, such as local schools, districts, museums and other educational agencies. Through these partnerships, FCIT has designed distance education tools, conducted research, provided technology assistance and staff development, assisted in grant writing, and produced multimedia instructional programs. FCIT booklets, brochures, and electronic media are distributed free-of-charge to Florida educators. Printed publications may be duplicated for educational purposes and online materials may be downloaded from the Center's Web site.

The FCIT Preview Center provides educators with an effective source of integrative technology for the classroom. The Preview Center maintains a library of over 3,000 educational software and multimedia titles to provide k-12 educators, faculty, and staff with the opportunity to preview the latest in educational software. The Preview Center also provides valuable services for preservice teachers at USF. The students are given the opportunity to use the software and to learn methods for integrating technology into the classroom. The Preview Center is equipped with a lab of 40 networked Macintosh and Windows computers so those educators can preview the software on the platform of their choice. Other featured technologies include telecommunications, Smart Boards, digital cameras, video conferencing, flatbed and film scanners, assistive/adaptive devices, digital video cameras, and MIDI keyboards.

Throughout the year, FCIT offers one and two-day hands-on workshops for K-12 educators. Many workshops focus on technology integration in a specific teaching such as reading, science, math, music, art, or foreign language. Other workshops cover topics such as Web page publishing, networking for Windows and Macintosh, digital video, digital imaging, computer graphics, the one-computer classroom, desktop publishing, internet for education, digital photography, basics of MIDI sequencing and mini-grants for technology. It is during these workshops, that the diverse software and hardware is featured, allowing teachers to experience what is available for integration of technology into their classroom.

FCIT has been given the opportunity to collaborate with the school district of Pinallas County on a variety of projects. One project is the Pinellas County Schools' Student Expectations Database, an educator's resource and reference tool to identify what students should know and be able to do at the pre-K through grade 12 level in ten subject areas. This guide relates the Pinellas County Student Expectations to the Sunshine State Standards, benchmarks, competencies, lesson plans, assessments, and resources. The Student Expectations Database was developed in partnership with Pinellas County Schools through the Goals 2000 Student Achievement Grant.

Another project is a television show called Digital Learning, is broadcast on a local cable channel. Digital Learning is a cooperative venture covering a wide variety of topics relating to the use of computer programs and networking facilities. The television shows provide teachers with the opportunity to have training at home or at school. Topics have included QuickTime, Inspiration, HyperStudio, MovieWorks, and how to scan.

Other projects included assistance to fellow departments at USF to realize some of the benefits of instructional technology. The first project was to develop a Web site for the International School Connection. This project underwent some change in scope as the project developed, but throughout had a focus on better enabling educators to have a global perspective on student learning and achievement. FCIT was responsible for creating the Web site for this program. This project also illustrated nicely the collaboration between the K-12 and the higher education components of FCIT. While the K-12 side was building the Web site, the higher education component was working on creating the Web-CT side of the program.

A second project that FCIT has worked on is "Thinking Like a Marketer". This was a grant from the National Training Collaborative for Social Marketing, funded thought the Center for Disease Control. The grant focused on taking the center's existing in-person training modules and provides them on both the World Wide Web and CD-ROM based format. This project was exciting in that in incorporated a number of different technologies. Transcriptions were created of the different sessions and recorded using a professional narrator. Those recordings were then compressed using and saved as QuickTime movie files. The sound files were then used allowing each session to have the real time feel that it does. Finally, Macromedia Coursebuilder was used to create the engagement questions that participants would be asked about content as they listened to the presentation. Combined, these different components came together extremely well and produced a viable way for health professional to easily receive training on marketing strategies.

Teaching N' Technology is a database of technology-related lesson plans developed by Florida educators. Search 400 lesson plans to easily find activities to enhance your curriculum. Each TNT lesson plan contains technological and subject information, as well as its correlation to Sunshine State Standards. Each lesson provides detailed instructions on how to implement the activity in your classroom. TNT enables you to search by subject area, by grade level, and by keyword. Select lesson plans from the TNT database were distributed to Florida schools on the "FCIT Teaching Tools 2000" CD-ROM, fall 2000.

Currently, FCIT is working with the Childhood/Language Arts/Reading Education department on a project called InterLnk. This project is being funded from a grant with the Corporation for National Service. The project will include working with one school in Miami, Florida, two schools in Tampa, Florida and one school in Memphis, Tennessee to develop model literacy classrooms with technology integration.

The print publications cover a variety of topics for educators. *An Educator's Guide to School Networks* provides an overview of computer networks and their integration into the school setting; *The Internet: Ideas, Activities, and Resources* provides an overview of the Internet and includes curriculum integration ideas for Florida educators. *A Teacher's Guide to Distance Learning* provides an introduction to distance learning technologies and applications in K-12 education. *Getting Started With Telecommunications* offers information on obtaining and using a Florida Information Resource Network (FIRN) account. *Language of the Internet* is a convenient guide to Internet terms and acronyms. *Searching the Web* is a beginner's guide to using Web search tools; and *HTML Quick Reference Guide* is a summary chart of basic HTML code.

In addition to all of the booklets and brochures available on the FCIT Web site, there are simulations. *Cruising the Information Super-Highway Simulation* provides information on the various features and components of the Internet and World Wide Web including Internet connections, Telnet, FTP, Gopher, WWW browsers and more. It also provides hands-on practice with Web page creation and video and audio conferencing. *Interactive HTML Tutorial* is a student project by David Tai. Learn basic HTML commands by typing text directly into boxes on the tutorial and see the results immediately. *Interactive HTML Tables* Tutorial is a student project by Lara Labastie. Practice constructing HTML tables and sees the results in pop-up windows.

CD-ROM products are distributed to Florida schools as a part of a Technology Literacy Challenge Grant. *The Teacher's Guide to the Holocaust* version two and the *Fourth Grade Reading FCAT Staff Development Tool* were distributed in late fall of 1999. Public school copies were shipped to the district Superintendent's office for distribution. Private school copies were mailed directly to the school address.

FCAT Reading 4 Staff Development Tool (See Figure 2) is designed to help teachers prepare students for the fourth grade reading Florida Comprehensive Assessment Test. Sections include teaching strategies, rubric scoring, practice tests, and references. This CD-ROM was distributed to Florida schools in the fall 1999.

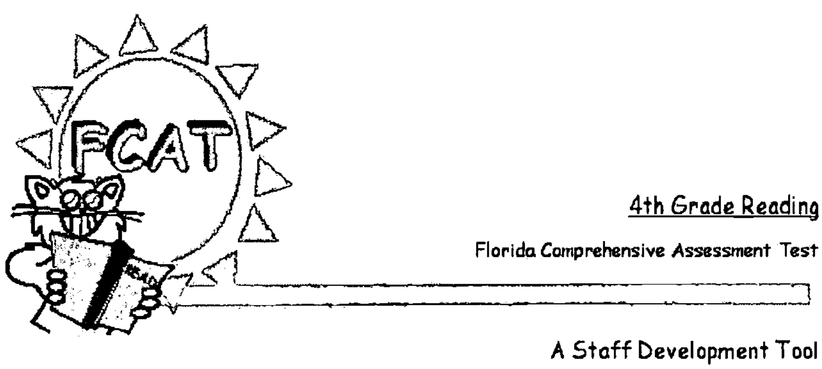

Figure 2: FCAT Reading 4

FCAT Reading 8 Staff Development Tool (Figure 3) is designed to help teachers prepare students for the eighth grade reading Florida Comprehensive Assessment Test. Sections include short and extended response rubrics, a self-test using scoring rubrics, two FCAT practice tests, teaching strategies, and related Web sites. Distributed to Florida schools on the "FCIT Teaching Tools 2000" CD-ROM, fall 2000.

Figure 3: FCAT Reading 8

A Teacher's Guide to the Holocaust (Figure 4) is an overview of the people and events of the Holocaust through photographs, documents, art, music, movies, and literature. Version 3.0 adds thousands of new files to the Teacher's Guide including 600 new photographs, 25 virtual reality movies, 75 movie clips of survivor testimony, and a complete site index.

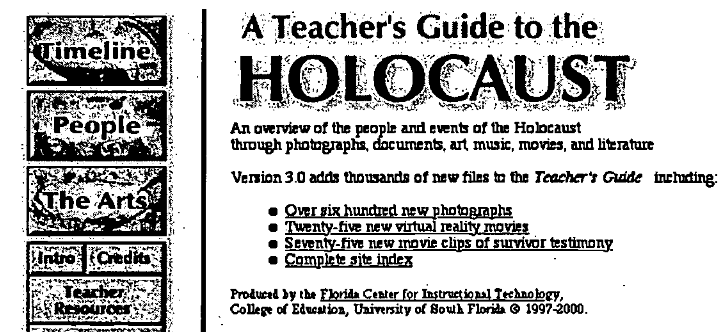

Figure 4: Teacher's Guide

Currently, FCIT is working on projects to be distributed in the fall of 2001. *A Teacher's Guide to Florida History* will include both a fourth grade unit and a set of resources suitable for use at any grade level. *FCAT Reading 10 Staff Development Tool* is being designed to help teachers prepare students for the tenth grade reading Florida Comprehensive Assessment Test. *FCAT Math 5 Staff Development Tool* is being designed to help teachers prepare students for the fifth grade math Florida Comprehensive Assessment Test.

FCIT has collaborated with the Research and Measurement department at USF to conduct a variety of research studies. The first research study was A Holocaust Web Site: Effects on Preservice Teachers' Factual Knowledge and Attitudes Toward Traditionally Marginalized Groups This study reported is an initial investigation of the impact of the *Teacher's Guide to the Holocaust* Web site on preservice teachers' knowledge of the Holocaust and attitudes towards traditionally marginalized groups. In addition, this research provides evidence of the extent of pre-service teachers' knowledge related to the Holocaust. Ultimately, this research should lead to further development and improvement of Holocaust instructional materials, as well as improvement of Holocaust education in Florida.

A separate study was Preparing 4th Grade Students for the FCAT Reading Test. The purposes of this study were (a) to determine how 4th grade teachers in a large Florida school district prepare themselves and their students for the FCAT reading test, (b) to investigate relationships between preparation practices and school characteristics, and (c) to estimate correlation between preparation methods and subsequent student performance on the test.

The final study is Computers in the Classroom: Teachers' Attitudes and Uses targeting their attitudes toward and use of computers in instruction. A special emphasis was placed on classroom uses consistent with the proposed NETS for teachers and students. The data for this study were obtained from a survey administered to all teachers in a large Florida school district. Surveys were distributed to each school site with instructions that all classroom teachers were to be provided the opportunity to participate.

Using Intelligent Agent Tutors

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Abstract

Intelligent agents are, in simplest terms, software programs built to perform certain specific tasks for the user. They are "autonomous" in the sense that they operate without specific user intervention. One form of intelligent agents, "chatterbots", is beginning to provide the capability to have intelligent tutors available to students at all times.

Many of these chatterbot software packages can be customized to provide content appropriate for individual lessons and can perform other tasks **automatically**, such as opening web pages, reading text, running other programs, answering questions and providing instruction. Further, they can even solicit information and distribute information. Several low-cost, easy-to-use packages have emerged, with useful features, such as anthropomorphic features and speech recognition. Soon, chatterbot agents will be providing useful information in many classrooms and over the web via distance education.

This demonstration will showcase several of these packages, including examples of how they are being used and can be created. One agent, Sylvie, will assist in the presentation of material.

Introduction and Background

One of the most interesting, and potentially important, aspects of the information technology revolution might be the rapid integration of intelligent agent tutors into the classroom environment. "Intelligent software agents", also known as "knowbots" or just "bots" have recently become more than just a better way to search or to find bargains on the internet[1]. Moreover, these second and third generation agents are taking on aspects of human intelligence, allowing them to assist educators with classroom functions. Interactive anthropomorphic agents are beginning to actually provide instruction, explain answers, grade exams, answer questions, give references, provide underlying theoretical logic, link to websites, and, in general, guide and instruct students---all functions heretofore were done by humans. The list of tasks that intelligent agents are already performing and might someday perform is rather extensive.

Intelligent agents (a.k.a. software agents and/or knowbots) are, in simplest terms, software programs built to autonomously perform certain specific tasks for the user. Intelligent Agents combine elements of Artificial Intelligence from other subsets (e.g., expert systems, object-oriented technology, neural networks, genetic algorithms, case-based reasoning, speech recognition, natural language processing, etc.) into an interface that has great applicability and appeal. Behind the agent front end is more often than not some simple rule-based programming which triggers actions when certain conditions are met. Some of the agents even have a crude capability to adjust their "reasoning" and "learn" from the user.

Current incarnations of intelligent agents can perform such useful tasks as retrieving information from the web, assisting in shopping for items by automatically finding the best price, monitoring auctions for specific items, gathering stock quotations and building customized newspapers. The latest generation of software agents moves closer to the ideal—an agent which can function autonomously to assist the user or the learner by providing help in dealing with what has become an information hyperabundance.

Today

Today, an important use of intelligent agents is providing features that can guide, advise, teach, critique and explain in an intelligent tutor or classroom instructor role. Although these early applications are often just prototypes, more importantly for educators is that the rapid development of intelligent agent tutors is becoming both a practicality and a necessity.
Being able to provide students with just-in-time learning, customized for what they need at the moment they need it is not possible with human instructors. Agents can also assist instructors in finding, filtering, and fusing the vast amounts of information now available. Due to the massive data explosion and the limited time and availability of human instructors, more often than not instruction is provided at a level which accommodates the majority in mostly a same time, same place environment. Now, however, the potential exists to tailor lessons specifically for each individual.

Soon it will be possible to have a personal tutor for each student. This intelligent agent tutor will be customized to not only provide the instruction that the student seeks at the time he or she seeks it, but the tutor will do so in a very effective manner. Several low cost, easy-to-use packages have begun to emerge, with useful features, such as impressive anthropomorphic features and speech recognition. Indeed, they could soon even become mentors for faculty as well as tutors for students. An interesting example in development is the agent Virtual Steve that can provide tailored instruction for training. [2] Virtual Steve has a virtual reality front end and an intelligent agent engine combined with speech recognition and speech synthesis. Unattended Steve is able to guide students, react to their actions, correct them if they make a mistake and admonish them if they ignore procedures. Although only a research effort at the moment, Virtual Steve is an example of the type of customized personalized instruction that is possible with intelligent agent tutors.

Many of these new software packages can be customized to provide content appropriate for individual lessons and can perform other tasks **automatically**, such as opening web pages, reading text, running other programs and answering questions. Further, they can even solicit and distribute information. Already they can provide answers to questions, instruct on how to perform actions and provide feedback to queries. Soon, agents will be providing useful information in many classrooms and over the web via distance education. Providing these services in a 24/7 environment makes them an attractive method for the delivery of customized instruction.

Agents can also provide great assistance to teachers and students by automatically finding and organizing data available over the world wide web. Using such agents leverages the valuable time and energy of teachers and students. Autonomous agents can function as assistants (someday even colleagues) and look for information relevant to the lesson at hand. Some agents can even assist in the knowledge management function, so necessary as the amount of information becomes overwhelming.

Future

The future is even brighter for the use of intelligent agents, both as software tutors and as Learner Relationship Management (LRM) assistants. Indeed, the use of intelligent agents for these purposes will soon be seen in several venues. So far, several articles have profiled the development of intelligent agent tutors, but few academics and faculty have begun to use them. In a recent issue of Educause Review an article by Alfred Bork gives a vision of providing instruction via intelligent computer tutors to everyone at an affordable cost.[3] The inexpensive use of software expert tutors means that superb instruction can be available at any time for anyone. Further, the instruction can be tailored to be different for every student. Just now beginning, the rise of intelligent agent tutors will become a flood as the technology matures. Their potential to provide valuable assistance not only in the traditional classroom but also over the web (e.g., distance education) is tremendous.

As the technology rapidly matures, the limiting factor will no longer be the technology itself, but the development of a new paradigm for teaching. Instead of "one size fits all" lectures, for example, lectures will be customized for each student and provide information at a pace appropriate for each student. This mass customization feature has been taking place in other areas, but, so far, has been limited in education. Intelligent Agents will provide the means to have a personal tutor or instructor tailored for each student. Instead of having to rely on one instructor, students will have the ability to tap the information reservoir through their intelligent agents who can link to virtually all information. Instead of having to wait for feedback on an exam or private counseling session, students will instantly know what they have done right and wrong. Instead of having to meet at a particular time and place, students will be able to meet anywhere, anytime with their personal agent tutor and still enjoy the richness of a face-to-face session.

Additionally, there will be an increased growth in the ability of the agents to learn for themselves rather than being constantly reprogrammed with new information. Increasing ability to "learn" from experiences, increased improvements in anthropomorphic features, increased friendliness, increased ability to collaborate and increased ease-of-use will no doubt boost the use of intelligent classroom agents. Already, some collaborative agents which can meet and share information are beginning to emerge. Gossip, for example is one such collaborative agent which can meet with other agents with similar interests, exchange web links (gossip) and ideas and return more knowledgeable about a subject[4]. It is not much of a stretch to envision these agents acquiring additional knowledge on a particular subject of interest, incorporating this new knowledge into the subject matter database, and updating their material for lectures or presentation automatically!

Likewise, the use of intelligent agents in the area of LRM appears to be likely. Imagine having an online assistant to aid students in answering their administrative questions. Unlike the tutoring use of agents, the LRM involvement of agents might take on a slightly different tenor. These LRM agents will, perhaps, have to examine the student data base to answer queries about courses to take; they might have to calculate grade point averages and suggest remedies or future studies; they will have to be more conversational in nature to be able to interact with students on a more equal basis versus providing instruction. The growth in LRM agents, however, seems likely as already such agents are providing similar assistance in the business world (see: www.extempo.com, for examples).

Summary

The development of intelligent agent tutors and LRM assistants has begun and will continue at a rapid pace, greatly expanding the ability to provide excellent instruction, tailored specifically for individuals at any place and time. Continued technology improvements will make the use of such "intelligent tutors" and LRM agents not only possible, but probable. Educational institutions will need to become involved with these developments since they will alter the way in which educational instruction is provided for many future students.

[1] References and links to the intelligent agents mentioned in this paper and others can be found at http://www.botknowledge.com.

[2] Virtual Steve can be found at: http://www.isi.edu/isd/VET/vet.html

[3] Alfred Bork, "Learning Technology," in *Educause Review*, January/February, 2000, pp. 74-79, http://www.educause.edu/pub/er/erm00/erm001.html

[4] GOSSIP collaborative agent can be found at: http://www.tryllian.com/.

A Framework for Integrating Technologies in Teaching & Learning

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Abstract: Convergence of IT & communication technologies brings about greater potentials & possibilities in using technologies as a powerful medium of delivery, instruction & communication. Changes in student demographics generate a strong demand for international higher education which can provide life-long, flexible learning programmes. Compelling change of skills needed at workplace drives education communities in all over the world to re-think about education requirements & processes. Combination of these factors set a scene of transformation in education causing a paradigm shift in teaching & learning, which poses new challenges to educators in acquiring skills & competencies not only in technology literacy but also in pedagogy. This paper aims at presenting a practical framework for integrating technologies in teaching and learning. The collective findings based on the author's experience and that of other institutions of higher education can serve as a general roadmap for an educational institution in adopting innovative educational practice supported by technologies.

Introduction

Integrating technologies in teaching & learning goes beyond setting up system infrastructure. The emphasis of integration is on curriculum re-design for using technologies to support student-centred, process-oriented curriculum & building learning communities in cyberspace. This paper seeks to offer insights into a range of issues confronting educators on deployment of technologies in teaching and learning. As with the case of any innovation, effective & successful integration of technologies in teaching and learning is best described within a framework. The framework comprises six components namely, institutional support, training & development, designing for integration, approach to integration of technologies, paradigm shifts in education & technological development, cultural change among educators.

Institutional Support

Research has shown that institutional support can exert both direct and indirect influence on the outcomes of staff in adopting innovations, therefore it plays a critical role influencing the success of integrating technologies in teaching and learning (Hart et al. 2000; Bottomley,1999; Collis,1997; Mogey,1997). Some form of top-down management decision and support is necessary in providing the initial 'push' and in maintaining the momentum of any innovation adoption. Hence, an institutional needs to establish a suitable climate or environment for change before any significant change can take place. The support includes a combination of the following :

- Establishing relevant institution-wide policy on the use of technologies
- Commitment of resource in terms of
    - Building a stable and robust IT infrastructure
    - Providing human resource in technical support at all levels
- Providing adequate computing access and facilities for both staff and students
- Providing recognition and reward to staff on teaching excellence and effective use of technologies in teaching and learning
- Providing time release for teaching staff who are involved in developing interactive technology-

based instruction

- Establishing academic support centers or units for providing on-going staff training as well as for assisting staff in developing technology-based courseware
- Inculcating sharing culture corporately so that experience, skills and knowledge on any innovation and the adoption of innovation will be shared among the staff. This practice provides a mechanism for enhancing knowledge of the staff via peer-teaching as well as prevents duplication and 're-inventing of wheels' of known innovations within the institution

Training and Development

A good classroom teacher is not necessary a good online teacher. Training plays the most critical role in the successful integration of technologies in teaching and learning (Hart et al. 2000; McCarton et al. 2000; Roger,2000; Lim,1999a; Littlejohn & Stefani,1999; Collis,1998; Canole & Oliver,1998; Mogey,1997).

Staff training and development is essential, both in terms of learning and handling the technologies and in terms of how to use technologies in a learning environment. Therefore, successful training goes beyond software skills training. It is important to develop cohesive training programmes with emphasis on learning which encompass an understanding of how people learn, course design and teaching strategies (Rogers, 2000; Verneil & Berge,2000; Littlejohn et. al, 1999).

While staff training provides the initial familialisation of various teaching methods and selected software, the actual learning is effected during implementation of integrating technologies in teaching and learning. It is during the implementation phase that the staff can experience the synergy of pedagogy and technology.

A one-off training event such as a workshop, a demonstration, or a seminar, will achieve little without proper follow-up in staff development. It is therefore, apparent that during staff development, which constitutes the post-training phase, the staff require a continuation of technical support and "hands-hold" sessions before they can gain confidence and competence in deploying innovative teaching which are supported by technologies.

Adoption of innovation with technology entails a learning curve for both staff and students. Therefore, students also need to be trained in technology literacy before they can use technologies effectively in their learning (Lim, 1999a; Mogey,1997).

Designing for integration

It is very common for staff to have a conception that going online equates to no more than presenting lecture material, in traditional print format, onto a Website so that students can access them easily, without due thinking through the process for student learning (Littlejohn et.al,1999). The consequence of poorly designed technology-based courseware is that students find the materials unclear, confusing, difficult to navigate, boring and non-engaging.

Another common practice among staff is to treat technology-based instruction as a separate entity from traditional teaching without proper integration with the rest of the curriculum. Consequently, students cannot relate the technology-based learning materials with the rest of the curriculum in terms of lectures, tutorials, lab session and assessment. Therefore, technologies in teaching and learning will not be effectively used unless it is properly and thoughtfully integrated into the existing curriculum (Lim,1998b, 1999a, 2000a).

Approach to integration of technologies

Traditionally emphasis has been placed on technologies without regard to teaching and learning aspects. It is important to avoid this pitfall by ensuring that the adoption of innovative teaching is educationally sound (Littlejohn et. al,1999; Mogey,1997; Lim,1999a,2000a).

Technologies alone cannot provide solutions to teaching and learning problems and needs. Neither can technologies themselves transform teaching, learning and assessment. Transformation comes from re-structuring or re-designing of existing teaching and learning practice with incorporation of technologies. Various findings from the research strongly indicate that deployment of technologies in teaching and learning goes beyond acquisition and set-up of technical infrastructure. Hence, the integration of technologies should not be technically-driven.

Pedagogical-driven approach begins with considering teaching and learning problems, needs and learning styles. Technology will be relied on when there is a need to accomplish desired learning outcomes (Lim, 2000a; Bottomley et.al,1999; Littlejohn & Stefani, 1999; Collis,1998; Mogey,1997).

With this approach, adopting innovative instruction requires raising awareness of alternative teaching methods (e.g, active learning, problem-based learning) necessary in addressing paradigm shifts in education, developing new skills with the methods, and know when to apply those methods to optimize student learning.

Paradigm shifts in education and technological development

How do the two diverse disciplines : education and technology synergize in the deployment of technologies in teaching and learning ?

This section of the paper examines contributing factors of paradigm shifts in education in the light of globalisation, contemporary learning theory and technology-supported instruction and learning.

Globalisation via flexible learning programmes

Benefits brought about by using Internet as a medium of delivery are well-documented. Internet-based education has been providing means of delivering education in ways not possible by traditional delivery methods. It is able to reach out to diverse groups of students in diverse geographical locations. Learning becomes borderless, stretching beyond the physical boundaries of "real" colleges and universities thereby greatly extending and enhancing learning experience beyond traditional classroom-based instruction can provide.

Shifting from teacher-centred instruction to student-centred learning

Traditional mode of instruction treating students as passive recipients of information is deemed as ineffective and inadequate in preparing students for the workplace of the new millennium.

A wealth of literature suggests the shift of teacher-centred instruction to student-centred learning in which active involvement of students in their learning is seemed as critical for effective learning (Felder et.al,2000; Lim,2000a, 2000d, 1999a; Rogers,2000; Ritter & Lemke,2000). The role of the teacher or instructor is shifted from being a sole information-provider to that of a facilitator for guiding students with different learning styles in attaining desired learning goals.

By capitalizing on interactivity, bringing together resources of different media (text, graphics, audio and video), and converging of IT and communication technologies, technology-supported flexible learning environment is capable of providing various pedagogical interventions necessary for active learning. These include provision of learner-control over pace, time, place of accessing materials as well as selecting or skipping of materials as required, student engagement in carrying out various online learning tasks and activities, self-reflection, and self-evaluation with the archived transcript of online conferencing (Lim,2000d; Ritter & Lemke,2000; Verneil & Berge,2000).

Shifting from content-based to more process-oriented curriculum

A truly content-based approach to instruction and learning can no longer cope with the proliferation of information and with the rate of change in technologies. Hence, students preparing for the workplace of tomorrow need to acquire a range of process skills besides having a firm grasp of discipline fundamentals. As defined by Wood et.al (2000), process skills are 'soft' skills used in application of knowledge. These include skills in construction of new knowledge, multidisciplinary problem solving, communication, writing, learning to learn, self-assessment, change-management skills. Well-designed Internet-based instructions are capable of supporting active construction of knowledge via information retrieval, evaluating, analyzing and synthesizing of information.

Shifting from individualistic learning to more collaborative learning

Group work plays an important role in promoting team-working skills which are greatly valued by employers (Rugarcia et.al,2000; Felder et.al,2000; Wood et.al,2000; Rena et al,1999; Kear & Heap,1999). Underpinning team-building skills is the notion that learning is a social process characterized by the exchange and sharing of ideas, thoughts, opinions among people, resulting in new ways of understanding the materials via multiple perspectives. Through team–building, members are able to appreciate diversity in views and respect views of others enabling them to work interdependently during problem solving. By working on real-world problems in problem-based learning helps students work collaboratively. Technologies can be deployed to facilitate problem-based learning (Lim,2000c). Computer-mediated communication (CMC) has been shown capable of supporting and promoting collaborative learning (Verneil & Berge,2000; Lim,1998a,1999a,1999b,2000a; Ritter & Lemke,2000; Salmon,2000) via group communication and work. The online collaborative tools used include e-mails, bulletin-board systems, newsgroups, chat, audio conferencing and desktop video conferencing.

Cultural change among educators

Cultural change among educators encompasses "buy-in", preparedness, commitment and engagement in adopting innovative teaching. Research has shown that educators are often unconvinced about effectiveness of technology-based instruction. Hence, one of the challenges for implementing an institution-wide deployment of technologies in teaching and learning is to determine the motivating factors which drive the educators to "buy-in".

Adoption of new teaching practice supported with technologies will call for major curriculum and course structure reviews, re-design, development and delivery as well as implementing of alternative teaching methods and assessment. The initiative and the effort of change will greatly rely on willingness and commitment on the part of educators to adopt innovative teaching practice and to expect and endure initial implementation hiccups. They also need time for adaptation and adjustment of their instruction in response to the changes in the practice (McCarton et al. 2000; Hart et al. 2000; Lim,1999a; Bottomley et.al,1999).

As integration of technologies cannot function based on the initiative of an isolated educator, the commitment and engagement of all educators for any particular course are recommended for an effective adoption of technologies in teaching and learning. This will ensure a coherent use of technologies across a course and not in isolated topics and subjects.

Conclusion

While institutional support provides the climate for adopting innovations in teaching and learning, true culture change will only materialize from the widespread adoption by many individual educators (Littlejohn & Stefani,1999, Collis,1999; Mogey,1997). Therefore, a successful integration of teaching and learning requires a mixture of initiative i.e, firstly from a top-down component via management support and decision and secondly, a bottom-up component via commitment and willingness of educators to change in adopting innovative teaching practice.

While there are sufficient and mature technologies capable of supporting student-centred, process-oriented curriculum and collaborative learning, the driving motivator of a successful institution-wide deployment of technologies in teaching and learning should be pedagogy rather than technology. Technologies are tools for complementing and facilitating teaching and learning. The initiative requires educators to re-structure their instruction to take advantage of the interactive capabilities of technologies. For an effective deployment, technology-based instruction should form part of the mainstream teaching and learning (Lim, 1998b,1999a,2000a).

Findings at Temasek Polytechnic and other institutions of higher education suggest that successful integration of technologies requires close attention be paid to pedagogical, institutional, cultural and technical issues (Rogers,2000; Verneil & Berge,2000; Lim, 1999a,2000a; Bottomley,1999; Littlejohn & Stefani,1999; Littlejohn et.al.,1999; Mogey,1997). The collective findings can serve as a general road-map for an educational institution in adopting innovative educational practice supported by technologies.

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Zones of comfort, proximal development and technology skills diffusion: A critical reflection on a curriculum-based approach to inservice teacher training.

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Abstract: This paper explores the current practice of inservice teacher technology training through the lens of two theoretical constructs; Roger's Diffusion of Innovations theory as it relates to technology diffusion among select groups and Vygotsky's constructivist concept of Zones of Proximal Development as applied to practicing teacher's exposure to new tools in their working environment. The approach to training teachers in the context of their own workspace is directed at exploring situated experiences with new technological tools. The relationship between these tools and their patterns and habits of pedagogical practice are described through ethnographic and quantitative data collected during an inservice technology training for K-8 teachers.

Introduction:

An acknowledged problem with the infusion of technology into the classroom environment is the relative lack of skills-training current and new teachers receive both as part of their initial preparation for certification and during inservice training provided for professional development (OTA, 1995; NCATE, 1997). Information and communication technology (ICT) is positioned in close proximity to the working environment of teachers but these practitioners may not have the necessary skills (Cuban, 2000) nor the theoretical orientation to fully utilize it. A situation exists where investments in technology (hardware and software) are not providing the benefit sought by educational policy makers and planners, either as a lever for massive, systemic transformation of learning environments or simply as a means to raising achievement scores (Becker, 1994).

While government and private sector efforts currently emphasize preservice technology training as a way of insuring that new teachers are proficient users of technology, inservice training for practicing teachers is also encouraged and local school districts invest many resources towards this effort. Various models are used in this latter area of activity. Common among these is a model where teachers are invited or encouraged to attend summer, inservice workshops which typically concentrate on a few selected skills, often focused on specific software applications. The transfer of relatively complex skills into classroom practice using this model has proven to be inefficient and problematic. Teachers may, for example, demonstrate competence in using the new skills in the workshop itself but fail to implement the new skills with technology in their classrooms. Moursund and Bielefeldt (1999) also describe the problems associated with isolated technology courses for pre-service teachers advocating an integrative approach where skills are transparently meshed with the teaching of content or pedagogical methods. Technology training programs which utilize traditional instructional design methods (broad overview followed by component skills introduction and practice) in hopes of seeding the "revolutionary" change towards socially constructive, problem-based pedagogy, would seem illogical. It is the author's view that much of this type of training is conducted in the absence of any (intentionally) applied theory. This paper describes a theory and practice based approach to teacher inservice technology training which, following Byrom's (1998) suggestions, builds on known advantages to considering curriculum practices first, communicating technology transfer through peer or practitioner relationships, and through considering the levels of complexity of the target technology. In this latter regard, proponents of technology integration into preservice and inservice education have consistently overestimated time and resources (Conte, 1997), and professional "space" needed to develop the desired levels of technology infusion. There is no unifying theory guiding the practice of using technology in education. Traditional instructional systems models are often placed alongside sociocultural practices with each proposed as an effective means for achieving the same outcome; Technology integration. Multiple theories are used in rationalizing the cost and purpose of linking certain pedagogical practices with specific information and communications technologies.

In hopes of illuminating conditions which will offer alternative considerations, this paper will explore two disassociated yet related and well known theories, applied here to a single instance of teacher inservice technology training: Vygotsky's Zone of Proximal Development and Roger's Diffusion of Innovations in technology transfer. Several characteristics of these two theories, both related to how individuals construct new perceptions and skills related to tools and practices in their immediate environment, are explored under the rubric of a "curriculum-based approach". This approach situates the skills acquisition and development within a physical and socio-cognitive proximity to the practitioners.

Even though the zone of proximal development generally refers to an early developmental and sociocognitive concept, this paper posits that it has value in exploring socially constructed knowledge among adult learners as well and is generally compatible with works by Dewey and Kolb in relation to adult learning theory. In this sense, teacher/practitioners, as adult learners, have specific learning needs related to their highly individualized and established behavior patterns and constructed knowledge. The Curriculum-Based Inservice training model used in this case first sought to capture a "snapshot" of each participant's integrated technology skills as foreground and their approach to curriculum (as practiced in their classroom) as background. This was done through the application of a self-survey instrument and individual interviews prior to the training program.

In this paper, each of these perspectives are used as a way of understanding the emerging processes of the teacher's exploration of technology skills. In particular, the concepts of "zone of comfort and proximal development" are applied to the issue of complexity (diffusion theory) in learning new technology skills in relation to existing practice. The focus of this combined theory analysis is an inservice training in central New Jersey of 18, K-8 classroom teachers, one administrator and the school's technology coordinator.

The Training Design:

The general design of the training called for a three-phase modular approach. First, teacher/participants conducted (guided by the facilitator) a pre-assessment of their own teaching with technology skills including an inventory of existing technology skills. The inventory is a detailed, incremental list of skill categories and listed sub-skills with a 5 level, self-scoring rubric[1]. Many skills assessment tools are usually directed at identifying frequency of use in basic categories of technology such as word processing, spreadsheet software or presentation software. The use of a detailed, self-scoring rubric allowed for a higher level of analysis of each participant's zone of comfort with specific sub-routines such as "manipulating an email filter to sort and organize email messages". The self scoring rubric used is represented by the following table.

Table 1.
Self-scoring Rubric for Technology Skills Self-Assessment Tool.

Level 1	Level 2	Level 3	Level 4	Level 5
I am a complete novice in this area. I do not really understand the terminology or what this function/software is about.	I have heard of this function/software or I have seen it used and know something of its potential, but I have not actually used it or learned it myself.	I understand what this is and I have used the function/software occasionally with limited success. I feel I could learn much more about this.	I understand what this function/software is and what it can be used for. I use the basic features on a regular basis in my work but I am uncomfortable explaining it to others.	I am fully familiar with this function/software and I am able to explain it to others so they may use it also. I know and use many of the more advanced features associated with this.

This was followed by a simple questionnaire which elicited information for participant profiles. An additional part of the first phase of the training was an in-depth interview between the skills trainer (the author) and the participant. In this interview, a general sense of the participant's level of comfort and prior use of technology was elicited along with anecdotal information on successful curriculum design and implementation experiences. These latter examples did not need to contain any relationship to applied technology in the classroom and were generated for purposes of establishing the participant's own orientation towards creative and constructive curriculum practices.

As a second stage to this process, teacher/participants engaged in an intensive one-week exploration of skills related to their own individualized (and shared) curriculum goals. This workshop was designed to first introduce a variety of optional uses of technology in the classroom, including modeled examples of WebQuests, PowerPoint presentation software and uses of spreadsheet software for classroom organization and assessment.

The introduction of any one of numerous "kiddie software" (as the technology coordinator called them) programs was eliminated as the teachers already had numerous opportunities in the school to review the plethora of various "learning software" packages available. The initial list of available technologies were drawn then from the office productivity package used at the school and web-based classroom activities (WebQuests). As each of the identified technologies were introduced, their component skills were demonstrated and participants were "allowed" to interrupt the presentation and seek more detailed explanation. This process led to an emerging set of skills which became the focus of small dyads and triads of teachers, working collaboratively to explore a targeted technology tool. The movement of participants from the computer lab to their own classrooms in the week prior to the beginning of the new teaching year also proved to be an essential part of exploring new skills and knowledge within these zones. This allowed for the trainer to visit with and observe the transfer of newly acquired skills in the laboratory setting into the classroom where the teacher would likely employ.

In the third and final part of the training, (which as of this writing is in the planning stage) the teachers will re-convene during the school year for a half-day consolidation workshop. Finally, follow-up assessment activities for evaluating the effectiveness of the model will include a presentation mini-conference where teachers share their progress and experiences with parents, colleagues and community members.

Applied Theory in Technology Inservice Training

Two features dominate our thinking about technology as an integrated part of the teaching process. First, current forms of ICT being promoted in classroom use are relatively new, and not generally widespread as commonly observable and accepted routines of practice, and are therefore defined as an innovation in practice. This fact should not be minimized in the overall discussion. Whatever theories are used to dissect and study the process of how innovations interact with current states of practice, one common feature holds that all innovations, as changes in patterns of behavior and culture, are difficult to instigate and direct as an intentional outcome. Secondly, teachers need to be both comfortable with and "convinced" of the adaptability of the skills being introduced to current practice as a starting point for eventual transformation of the culture of teaching and learning in their own workspace. Technology training, therefore, carries the dual burden of presenting a highly complex array of new behaviors with challenges to the basic assumptions and underlying approaches to classroom practice conducted by the teacher. Given this, it is a wonder that teachers learn any new skills at all.

Technology transfer theory has informed us that new skills and practices are best utilized when a natural process of adaptation occurs. Adaptation is described here as a process of first receiving new information, transforming the modeled practice and information to form the best "fit" between existing patterns of behavior and those previously described which then results in new forms. This process of adaptation is crucial to teachers being able to use new skills in their teaching. It requires a maximum flexibility in defining the expectations for skills development as pre-defined learning outcomes may not match the resulting experiences. Rogers, in *Diffusion of Innovations* (1995) supplied 5 essential characteristics of successful innovation adoption, based on numerous studies of how various technology innovations have been introduced, accepted and become widely used among select population groups. In regards to technology in the classroom, these 5 characteristics can be used as a framework to discuss how teachers view technology in the applied inservice training example:

Relative advantage over what it replaces:
The new technology and associated skills, at the very least, must provide some clear advantage, such as saving time, minimizing redundancy, providing a better defined product, than performing the same task without the technology. This is an often overlooked characteristic in technology inservice training. The introduction of spreadsheet applications in organizing assessment records and class lists provides a useful example. These teacher tasks are common practice which traditionally involve pencil, paper and inexpensive and readily available materials. The advantage of using grade book software (specifically designed for this function) or spreadsheets (which require teacher input into basic formatting) must be demonstrated as easily "doable" and providing an advantage over traditional methods. Several teacher/participants who, once shown how a simple spreadsheet could be used to merge information with a form letter, quickly identified this as the most relevant and desired technology skill to focus on in the first part of the intensive workshop. The reflexive process allowed them to pursue this as a small group while others worked on different skills. The teachers looking at the

spreadsheet example saw an immediate advantage to more laborious methods in communicating letters to parents which typically need to be individualized for the learner yet containing much redundant information.

Compatibility
In a similar way, the technology needs to exhibit some degree of compatibility with the existing tasks facing teachers in the classroom (in their own work) or with the perceived structure of the individual teacher's classroom practice. This is a particularly difficult area for technology proponents and educators since in the most fundamental sense, the "new technology" being promoted is actually a demand for profound changes in the most personal and basic activity of the teacher's professional performance. It follows that new technology practices which are furthest from the existing practice of the teacher are the least likely to be seen as compatible.

Complexity
This perhaps is the most important of these considerations. Rogers (and other "diffusionists") identified many instances where even though a new technology had many demonstrable advantages over existing practices, the acquisition of skills needed to manipulate and work the new technology were too complex and required a higher level of effort which made continuing with existing practice more desirable. Complexity, however, is also directly related to Vygotsky's theory in that distant actions, currently out of the reach of one's proximal development zone, appear too complex and unattainable. The gradual scaffolding of new skill acquisition can reduce the perception of complexity.

Trialability
In a linear diffusion model, trialability has to do with a prospective adopter (of new technology) being able to test or to "try out" new skills in a safe and comfortable environment. This also has interesting connotations in the present discussion for understanding a teacher's own "zone of comfort" in encountering new skills. The training model employed here allowed for a safe and non-judgmental approach to testing out new skills in an un-pressured, loosely structured training environment. The extension of the training experience from the laboratory to the classroom and further, to the demonstration of use in practice after some period of time, allows for the much needed practice, modify and reapplication cycle promoted.

Observability (of results)
Related to the perceived advantages of using a new technology is the ability to see changes and positive outcomes to adopting the new skills and technology. If the positive results of the training process were not visible, little impact would be expected.

The short training program offered teachers a technology skills training tailored to their own classroom practice. The actual training itself was first preceded by defining the participant's existing comfort level, skills and classroom practice approach and then followed by activities planned to further build on the new skills. The acquisition of new, advanced technology skills is therefore fully integrated with their teaching styles, goals, learner outcomes and curriculum standards. The expectation is that as these new skills are acquired, the teacher's own practice will undergo a transformation both to accommodate the technology and to reflect the types of instructional activities the new technology can make possible. It is further possible that the transformation of teaching will occur through the development of technology skills which lead to a more constructivist-based approach to curriculum in the classroom.

Discussion and Conclusion:

Emergent preferences for personal productivity skills which resulted from the workshop activity could reflect a desire to gain control over the technology and associated skills prior to, rather than as part of, the integration of technology use in pedagogical activity. In this way, teacher's desire to be comfortable around their computers, in the face of colleague interaction and observation by the school administration, parents and the students themselves, would be a motivational factor in the acquisition of the newly introduced skills. Teachers' own level of comfort and self-assessment allowed for clear definition of individual zones of proximal development. From this, skills training could be targeted for high levels of efficiency, with the trainer serving to help identify the closest proximal relationship between the teacher's existing patterns of classroom activity and extended uses of technology with new associated behaviors.

Even though the described training model provided for an expanded and flexible orientation to individualized training needs, the continual support and monitoring to enhance a scaffold approach developing the teacher's use of the technology is difficult to sustain. The on-site technology coordinator, who participated in the training, provides additional assistance to the teachers but must also attend to maintaining the network system, software installation, equipment maintenance and provide services to other faculty at the school. While the training design allowed for individual exploration of specific technologies, workshop participants expressed in the workshop evaluation a desire for more directed, "step by step" training. This was an unexpected outcome, where teachers who are used to traditional models of direct instruction need to be provided with a highly-structured training targeted to very specific sets of skills and technology use. Identifying key technology skills related to personal goals would seem to be verified as an effective strategy for determining training needs but then should be followed by a highly individualized module which matches a specific technology use to the teacher's self-defined training goal. Such just-in-time training can be delivered through a variety of methods but must be established in the routine of teacher's expected professional development.

Finally, by designing a workshop training is such a way as to reflect both a diffusion of innovation and constructivist approach, the success and likelihood of technology skill transfer from the training experience to the classroom in the form of adaptable, sustained practices would seem more likely. Additional study of this particular group will yield further information related to the design.

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The Identification of Opinion Leaders in the Elementary School

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Abstract This study focused on the identification of opinion leaders by administrators and teachers in the elementary school. The intent was to determine the extent to which opinion leaders exist in the elementary school. Three methods were utilized to identify opinion leaders within the school social network; self-designation, key-informant and sociometric. Three areas of opinion leadership: (a) school policy issues, (b) curriculum issues and, (c) technology related issues, were analyzed. Results of these methods were combined to identify teachers viewed as opinion leaders by their teacher peers. The findings reveal that teacher opinion leaders exist in the elementary schools included in this study. Fifteen of the 117 teachers included in this study were identified as opinion leaders.

Introduction

Effective school systems make adjustments to meet the changing demands of society. Changes are continually necessary in both curriculum and pedagogy. A variety of forces are responsible for driving these changes. One such force is advancement in the area of technology. Microcomputers and networking capability affect the way we communicate, store and retrieve information, and the way we learn. Consequently, many educators recognize this time of rapid technological introduction and change as pivotal in public education (Poole, 1997).

Recent school reform efforts have a rich history from the introduction of programmed readers to the implementation of 'new' math. And, although schools would seemingly appear to have vast experience in adapting to and promoting change, attempts at change have often been unsuccessful (Futrell, 1994; Zaltman, Florio, & Sikorski, 1977). Many factors contribute to this inability of our school systems to effectively make changes. Some analysts believe that a portion of the difficulty lies in the fact that key teachers within the school system have been found to stop the change process (Webster, 1994). Webster's,

(1994) study in a secondary school found that a group of senior staff members prevented the adoption of a new curriculum because they did not 'buy into' the product.

Some researchers believe that the leadership model based on a top-down approach has impeded the change process (Hofstede, 1994; Lieberman & McLaughlin, 1992). Teachers who are not consulted when planning a change often have difficulty adopting the change (Lieberman & McLaughlin, 1992). Research suggests that the organization of our educational system can be more effective when the structure permits information to flow from the bottom-up (Mehlinger, 1996; Fessler & Ungaretti, 1994; Yarger & Lee, 1994; Kelly, 1994). This allows for teacher involvement when formulating school policies and procedure. Some teachers are influential in the school system and ultimately can either promote change or prevent it (Webster, 1994).

Diffusion of innovations research examines the manner in which a change, whether a product, procedure or a way of thinking is adopted. Rogers (1995), defines diffusion as 'the process by which an innovation is communicated through certain channels over time among the members of a social system.' Communication, and particularly two-way communication of ideas is necessary for the adoption of innovation or change initiatives. When planning for change in the elementary school, it is important to understand the school social structure and the school environment (Lieberman & Miller, 1992; Hall & Hord, 1987). These two factors significantly impact the communication that occurs. Social network analysis methods allow us to examine relationships or 'ties' connecting members of a society (Scott, 1991). By examining these social structures, we can better understand the processes affected by the communication of ideas (Rogers, 1995). This understanding can then be applied to efforts for planned change in the elementary school (Harzing & Hofstede, 1996; Han, 1996; Lieberman & Miller, 1992).

One area of diffusion research analyzes the impact that certain individuals have on the adoption of a change initiative. This research indicates that some actors within a social system have a greater influence than others to promote or halt the adoption process (Rogers, 1995). Individuals who are able to influence others' behaviors on a consistent basis are identified as 'opinion leaders'. Top down, bureaucratic leadership models assume the opinion leaders to be school administrators. However, opinion leaders may be either school administrators or classroom teachers. The entity promoting a change may solicit support from these opinion leaders to facilitate the change process and aid in the improvement of our schools.

This study focused on the identification of opinion leaders by administrators and teachers in the elementary school. A comparison of the formal leadership structure (principals, vice-principals, department heads) to the informal leadership structure, that includes opinion leaders was analyzed. The study also examined relationships between opinion leadership and the specific areas of: 1) technology, 2) curriculum, and 3) school policy.

Results

It is beyond the scope of this paper to include all of the data and findings generated from this study, therefore, general information and data related to technology will be reported. For more detailed information, refer to O'Rourke (1999).

The networks (i.e., elementary school) ranged in size from 16 to 29 teachers. The average size of the networks contained 23.6 teachers. These networks included regular classroom teachers, ancillary teachers and special education teachers. The schools in this study maintained computers in the classrooms or in the library and did not have computer labs. Therefore computer resource room teachers were not part of these elementary school networks. Grades kindergarten through fifth were represented in each school. One hundred and seventeen teachers in the five schools were invited to participate in this study. Ninety-five teachers (81%) returned the questionnaire.

The results of the three different techniques used to identify opinion leadership; (1) self-designating, (2) key informant, and (3) sociometric were combined to identify teacher opinion leaders in each of the five elementary schools included in this study. Table 1. Provides an example of the data utilized to determine opinion leadership. Teachers identified by all three techniques were considered to be opinion leaders. In addition those teachers identified by two of the three techniques and to a lesser degree the third were considered to be opinion leaders.

code	self-designating	key-informant	sociometric	identified opinion leader
A101		C-P		
A231		C-T		
A001		C		
A241		C		
A002	NR			
A251	X			
A232	X	T-P		
A121	X	C-P-S	X	X
A242		P		
A122		T		
A111				
A112		T-P		
A252	X	C-T-P-S	X	X
A071				
A072	NR			
A073				

Note. NR=no response, C=curriculum, T=technology, P=school policy, S=most frequently sought out, and X=identified by that measure as an opinion leader.

Table 1. School A: Opinion leader identification

The findings revealed that teacher opinion leaders exist in the elementary schools included in this study. Two of the fifteen teacher opinion leaders were part of the school's formal structure (department heads, head teachers). Conversely, thirteen of the fifteen teacher opinion leaders did not carry formal designation as a leader in the school system. These teachers seem to constitute an informal leadership structure within the elementary schools studied. The study revealed that only one teacher identified as an opinion leader was viewed as an expert in the area of technology, in the elementary schools in this study.

Implications

An opinion leader becomes valuable to any individual promoting change within a specific environment (Krassa, 1988; Hall & Hord, 1987; Harzing & Hofstede, 1996; Rogers, 1995). Studies have found that their influence is related to the success of the adoption of a new product, a new methodology or a new technology (Beal & Rogers, 1957; Coleman, 1957). Their influence on the members of a social system can assist or hinder the efforts of a change agent (Rogers, 1995).

The integration of technology into a school's curriculum involves the adoption of such technologies by teachers. Schools choosing to incorporate instructional technologies by utilizing a top-down approach may be impeding the change process. Research suggests that the organization of our educational system can be more effective when the structure permits the information to flow from the bottom, up (Mehlinger, 1996; Fessler & Ungaretti, 1994; Yarger & Lee, 1994; Kelly, 1994). This allows teacher involvement in instructional technology decision making. Some teachers are influential in the school system and ultimately can either promote change or prevent it (Webster, 1994).

Surry and Farquhar, (1997) suggest that analysis of social factors be incorporated into the instructional development process in order to increase an innovation's use. They believe that, "instructional developers should consider the potential adoption and implementation of their products as carefully as they consider the instructional outcomes." Other researchers have also included consideration of social factors in the adoption of educational innovation process. An Environmental Analysis (Tessmer, 1991), where factors within the school setting are analyzed and considered by the instructional designer, provides information that may increase the adoption rate. When teachers and other members of a school social network involve themselves in the adoption process, the integration of the innovation is more successful (Hall and Hord, 1987; Mehlinger, 1995).

Summary

The intent of this study was to generate information concerning opinion leadership within the elementary school. The opinion leaders in this study were influential in the area of curriculum and to a lesser degree school policy issues. Leadership within the area of technology seems to be quite different from those teachers whose opinion is sought out in regard to curriculum. The administrative educational technologist was cited as most frequently sought out regarding technological issues. Some teachers were also identified as opinion leaders in this area. However, only one teacher identified as a leader in technology was identified as an opinion leader in this study. Additional research in this area could provide further explanation for the cited difficulties in educational technology integration. An examination of communication patterns and influence as they relate to the diffusion of technological innovations in schools may yield information towards an explanation of the seeming failure of many teachers to fully utilize the potential of computer technology in the classroom.

These findings suggest that the diffusion of innovation process or teachers' willingness to adopt new technologies may be promoted or impeded by the school's social structure. An individual attempting to drive change in such a school system could benefit from understanding this structure and developing a formal plan for the adoption of innovations into the classroom by teachers. They may consider seeking out the teacher opinion leaders and soliciting their support. In addition, schools may want to offer additional training to teacher opinion leaders in the area of technology. If other teachers observe these respected teachers utilizing the technology and integrating it into the curriculum, they may recognize its value.

In summary, a school's social network should be analyzed and this information applied to a plan for the diffusion of technologies into the classroom curriculum. This may help to enable individuals responsible for promoting change in schools to facilitate the adoption process.

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Acknowledgements

I would like to thank the members of my dissertation committee, Dr. Louis Berry, Dr. John Bolvin, Dr. Patrick Doreian together with my advisor, Dr. Barbara Seels from the University of Pittsburgh and the teachers, administrators and especially Dr. Deborah Kolonay from the school district included in this study for their generous contributions to this research.

The Use of Two-Way Audio Video at the University of North Texas As a Tool for Practicum Supervision

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Abstract: One of the challenges of course delivery at a distance is determining an effective method to conduct practicum supervision. In the past, educators have used a variety of strategies to observe practicum students completing their field work. On-site supervision often required extensive travel for faculty or hiring adjuncts to conduct supervision. The University of North Texas Educational Diagnostician Program is involved in a research study using EnVision, desktop conferencing software developed by Sorenson, Inc., to supervise graduate students enrolled in an advanced practicum. This paper assesses the effectiveness of the EnVison System as a tool for monitoring practicum students in the Educational Diagnostician Program.

Using Technology to Enhance Practicum Supervision

Supervision of students during a practicum is often a major challenge in distance education. On-site supervision may required extensive travel for faculty or hiring adjuncts to conduct supervision. Earlier attempts at using technology to reduce faculty travel time included video taping practicum experiences and reviewing the video tapes to provide educators with feedback. Although this practice can reduce faculty travel time, very often it is difficult to provide timely feedback to students. The technology is now available to use desktop conferencing software as a tool for practicum supervision.

The University of North Texas Educational Diagnostician Program is involved in a research study to supervise graduate students enrolled in an advanced practicum using EnVision, a desktop conferencing software developed by Sorenson, Inc. We are interested in determining the accuracy of using the two-way audio video technology for supervision purposes. Students need to pass a check out procedure for using standardized assessments. This check out involves the university student administering the standardized test using correct procedures with the instructor scoring the assessment procedure and providing feedback. Travel and time are issues for both students and faculty. Therefore, using the EnVision software, we proposed the following research questions: Does the EnVision two-way conferencing technology provide the opportunity to observe students at a distance with the accuracy required for supervision? What are the perceived benefits and limitations to using two-way conferencing technology for supervision of a practicum at a distance?

Research Project

This study involved observing thirty students enrolled in three graduate level assessment classes using EnVision software. All students participating in this study were observed administering a standardized test (Woodcock Johnson R, PIAT, or WISC III). Protocols for check out on the tests was developed by two instructors in the Educational Diagnostician Program and checked for reliability prior to beginning the study. Each student participant was observed while administering an assessment instrument by two evaluators communicating through EnVision. One evaluator was on-site with the university student administering the assessment and one evaluator was observing at a distance. Reliability was determined by comparing scores with the on-site rater and the distance rater. In addition, a questionnaire was given to all participating students prior to and following the observation to determine perceived strengths and limitations of using two-way conferencing technology.

Desktop Videoconferencing Practicum Supervision

In order to maintain the same high quality supervision during the practicum component of the assessment course through distance education, affordable technology that provides audio and video connections point-to-point is required. The EnVision software uses compressed voice and video and runs via the Internet or ordinary phone lines. For this study one computer is located at the main campus in a faculty office and one computer is located at the student's practicum site. The system includes an audio video connection and a chat function with a save and print function. While supervision is taking place, the two observers type observation notes for each other's viewing without interrupting the student's performance in the practicum experience. Using application share software the two observers are able to complete the observation simultaneously.

The pre/post questionnaire given to students helped to assess the following advantages: ease of use of the system for supervision at a distance, accuracy of observation notes, and frequency and ease of use of the EnVision System. Possible disadvantages to be assessed of the use of this technology included: cost, ease of installation and subsequent use of the Envision Software, student confidentiality, and the effect that the Envision System may have on the reliability and validity of the practicum observation.

Program Assessment Procedures

A major part of field experiences for the educational diagnostician program centers on assessment procedures. Assessment is the process of collecting data for the purpose of decision making (Salvia & Ysseldyke, 1998). Aligning the assessment procedures to provide continuous monitoring of individual progress is required for teachers to meet the definition for special education as *specialized instruction* (Dyck, Pemberton, Woods, & Sundbye, 1999). In order to provide students with disabilities an appropriate education, teachers need information about student progress in a timely, systematic fashion that can be used to make instructional decisions on a per student basis. Educational diagnosticians provide expertise in the area of assessment to individuals working with students.

Students in the program master the competencies for norm-referenced assessments, which can provide information on an individual's performance compared with the performance of many peers (Taylor, 2000). These assessments provide information ranging from academic achievement to intelligence scores, depending upon the test selected. There is a need for students to master the correct procedures required for various norm-reference assessments. The EnVision software is one way for the instructor to observe the testing situation at a distance. The chat and document share functions on the EnVision software are both available as a vehicle to provide feedback that is not interruptive of the assessment process.

Parents, teachers, medical staff and students in a day treatment center are interviewed over the EnVision system as a part of the process for conducting a Functional Behavior Assessment. The goal of the functional assessment is to provide information to use in the redesign of environments and selection of new skills to be taught. A Functional Behavior Assessment to develop a positive behavior plan is now required by the Individuals with Disabilities Education Act of 1997. Part of this assessment is gathering information from interviews, questionnaires, and direct observation.

Advantages and Challenges of the Remote Supervision Technology

There are many advantages of using technology for supervision at a distance. First, it makes it possible to observe and supervise students in remote locations. Second, because travel time is eliminated, more frequent observations and more extensive feedback can be provided. Third, the potential for interaction between the student at a distance and the faculty member is unlimited. Faculty members can see and hear the students, understand the directions, and directly view the assessment procedures and provide feedback. Fourth, this technology provides an opportunity for students and faculty to observe quality assessments. Fifth, number of opportunities to interact through interviews with others during the assessment process has increased.

Challenges to the use of remote supervision technology include amount of technical support to set up, debug, and maintain equipment. The cost to equip each site limits the number of sites available. Issues of confidentiality and protocol used during conferences must be addressed for each use of the technology.

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Effective Use of Technology in a Distance Education Program For Educational Diagnosticians

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Abstract: The University of North Texas Educational Diagnostician Program has implemented effective uses of technology to help address the critical need for diagnosticians in the Dallas/Ft. Worth Metroplex and surrounding rural areas. Students in the Metroplex often deal with traffic back up, while students in rural areas may need to drive long distances. Technology can assist in meeting the needs of these two distinct student populations. The challenge for instructors in the program became how to use technology to support student learning without compromising the requirements of a certification program that includes a rigorous state exit examination and a high level of expertise on the job.

Program Overview

The College of Education at the University of North Texas (UNT) offers a Master's in Special Education and/or certification as an Educational Diagnostician. This degree program is designed for students who want to be employed as an Education Diagnostician or for teachers who are interested in assessment issues in the classroom. A focus of this program is directed towards Curriculum Based Assessment and the implications it holds for teachers in making curricular decisions. In addition, students will be certified to administer standardized tests including the WISC-III. The curriculum is divided between didactic courses that provide knowledge in critical areas of special education and field-based practica that address assessment skills. Upon completion of the program, students must successfully pass an ExCET examination for certification in the state of Texas. Graduates are expected to demonstrate a high level of expertise in the area of special education and assessment for employment. UNT currently has a pass rate of 98% on the ExCET examination and 100% placement of graduates of the program.

Importance of Technology for Course Delivery

There is a critical shortage of educational diagnosticians in the Dallas/Ft. Worth Metroplex and surrounding rural areas. Students in the Metroplex often deal with traffic back-ups that require a huge investment of time. Accidents or road construction on key highways can significantly impact travel. Students in rural areas often must drive long distances to access university classes. Technology can assist in meeting the needs of these diverse student populations. The challenge for instructors in the program became two-fold: Use technology to provide easy access of content for students and support student learning without compromising the requirements of a certification program. In addition, the need to supervise students during assessment procedures to ensure accuracy was critical. The entire program is now structured for course delivery in a distant education format through the use of technology. Thus, the content becomes accessible to our diverse population of students.

Program Features

The goal of the program is to develop distance education technology that enhances and supports the delivery of a quality educational diagnostician program. The main features of the distance education program are:

1. Didactic classes are delivered through an electronic, microwave-based, interactive, closed circuit two-way television system. Our program is currently using five sites, with the option of adding more as the program expands. The program time slot is from 5:30 PM to 8:30 PM on two evenings a week. Broadcasts typically originate from the UNT System Center, but most professors broadcast from each site at least once during the semester. There is a support person at each site to address technology needs. During broadcasts, the instructors may lecture, conduct a class discussion, show a video, or present information on an overhead. Faculty present lectures using PowerPoint slides. Students give presentations, discuss and ask questions, and work in small groups. There are two large television screens at each site. The instructor and students are viewed live on television screens and that image is transmitted to all sites. The camera is voice activated and projects the image of the person speaking at the time. Students and instructors interact in much the same way as they do in on-site classes.

2. A program Web site provides general information about the program, application forms, and faculty to contact for additional information. In addition, each faculty member maintains his/her own web page for courses offered. Extended syllabus, assignments, class notes, announcements, and tests are transmitted through the Web site. In addition, students' work/projects may be posted in certain classes for other students' viewing and learning. Potential students can open the Web site and view information about the program prior to enrolling.

3. Email is used to communicate with students on advising issues, assignments and updates. Assignments are often sent in as attachments. Students are encouraged to email and share information with each other as they move through the program.

4. Practicum courses are supported through EnVision, a two-way audio/video desktop conferencing software developed by Sorenson, Inc. EnVision is available on the main campus and in one of the centers of the university. Students in their final year of study can check out an EnVision software system to use on their school computer. Faculty can observe students during assessment with standardized tests through EnVision and provide immediate feedback to the student. The chat function on EnVision is used to coach the student during the assessment process, if needed. The protocol currently used for assessment supervision provides information directly to the student through the document share function. Students can also discuss data collected on Curriculum Based Assessment projects with their university faculty member in a timely manner.

Students use EnVision in a connection with a day treatment school located away from the main campus. The day treatment school is for students with emotional/behavioral disorders or other health impairments. Part of the assessment process is gathering information from interviews, questionnaires, and direct observations. Students' assignments include interviewing teachers, parents and grandparents raising students with disabilities.

Advising students, and often students' peers that are interested in university work, can also take place over the EnVision system. This face-to-face contact and the demonstration of technology are both exciting and available to current and potential students.

5. Software programs to support diagnostic report writing assignments are located in two of the main computer labs for the university: one on the main campus and one in a university center located ninety minutes away. Students also can purchase a copy of the software for home or school use. This software provides students with an opportunity to learn best practices in completing reports following diagnostic evaluations. A partnership with Ewing Solutions has provided ReportWriter software to assist students with preparing appropriate psycho-educational reports in a time efficient manner. Additional software has been purchased to score various tests and rating scales. The use of scoring software greatly reduces scorer error. With the use of technology, scoring tests and writing effective psycho-educational reports can be accomplished in a time efficient, accurate manner.

Technology is an important component of the Educational Diagnostician Program. Needs of the students, instructors, and overall program dictate the technology used. Technology serves as a tool to make a highly successful program convenient for commuter students while enhancing the learning opportunities.

Open Source and the Diffusion of Teacher Education Software

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Abstract: Three recent reports, one from the U.S. government and two from European Union related groups, indicate that the open-source software development model is gaining worldwide acceptance. This model provides a means for teacher educators to create software that is sustainable, continuously improving, and sharable. As a result, it can reduce duplicated efforts among PT3 grant recipients and reduce the risk that a project's work efforts will go unutilized when a grant's funding ends. The paper gives a brief overview of what the open-source model is, explains how it can be used to benefit the different stakeholders in a grant funded project, and discusses how it can support the diffusion of technology innovations. The paper concludes with the recommendation that the U.S. Department of Education should encourage the use of the open-source model in all department-funded projects that have a software development component.

Introduction

"The PITAC believes the open source development model represents a viable strategy for producing high quality software through a mixture of public, private, and academic partnerships. This open source approach permits new software to be openly shared, possibly under certain conditions determined by a licensing agreement, and allows users to modify, study, or augment the software's functionality, and then redistribute the modified software under similar licensing restrictions. By its very nature, this approach offers government the additional promise of leveraging its software research investments with expertise in academia and the private sector" (President's Information Technology Advisory, 2000).

These opening comments were part of the transmittal letter for a report by the President's Information Technology Advisory Committee titled "Recommendations of the Panel on Open Source Software For High End Computing." Although the Committee chose to focus its efforts on high-performance computing, the report provided some general observations about the open-source software development model that are applicable to all types of software, including educational software. In a similar report about the open source development model, the Working Group on Libre Software, created at the initiative of the Information Society Directorate General of the European Commission, reported that:

"The impact of open source technology is expected to be quite noticeable in the software industry, and in society as a whole. It allows for novel development models, which have already been demonstrated to be especially well suited to efficiently take advantage of the work of developers spread across all corners of the planet" (Working group on Libre Software, 2000).

Another European initiative, the Information Society Technologies theme in the 5th Framework Programme of EU RTD (IST), a division of the European Commission with a budget of 3.6 billion Euro, has specified two objectives in a draft version of it 2001 Workprogramme that support free and open-source software. The first objective is "to foster in Europe a critical mass of development of free software released under GPL [General Public License] - compatible licenses." The second objective is "to make available European based support services for free software projects" (Information Society Technologies, 2000). These objectives are not likely to change before they are adopted and will be used to guide the selection of projects that the IST will fund. One can read more about GPL compatible licenses at http://www.gnu.org/.

These three reports are clear indicators that the open-source software development model is gaining worldwide acceptance. This model provides a means for teacher educators, and educational software developers in general, to create software that is sustainable, continuously improving, and sharable. An immediate benefit is that this model can reduce duplicated efforts among PT3 grant recipients and reduce the risk that a project's work efforts will be under or unutilized when a grant's funding ends. The paper gives a brief overview of what the open-source model is, explains how it can benefit the different stakeholders in a grant funded project, and discusses how it can support the diffusion of technology innovations. The paper concludes with the recommendation that the U.S. Department of Education actively encourage the development of open-source software in future requests for proposals.

Open Source

There are two forms that every computer program is stored in. The first and most commonly experienced form is as a binary executable file made up of 1s and 0s that only the computer can read and cannot be modified by anyone. The second form is as human readable computer code, source code, which can be modified at any time and used to create a binary version of the program. The open-source model facilitates the sharing of source code and the binary files. Currently, the field of teacher education, and instructional technology in general, does not have a method to facilitate sharing and building on the building blocks/source code that other community members' used to create an intervention/computer program. Software development is the only area in these fields that is confronting this limitation. Unlike academic research reports, there are no established protocols and outlets for creators of educational software to share their work with others in a way that allows for it to be critiqued and built upon. Imagine a system where professors conducted research but no one could critique their research design, data collection, or data analysis methods and statistical procedures. Researchers would not have the option of selecting which parts of the study they found useful and reusing those parts. A researcher's choices would be to use the resulting intervention as is, or start from scratch. They would also be completely dependent on someone else to update and modify the procedure used as the environment changed. There is little doubt that researchers would recognize that each environment is unique and that they needed to be in control of the tools that they use and would choose to redevelop the intervention for their target environment. This scenario is very analogous to the one that teacher educators and instructional technologists who develop software applications currently face. Researchers working in these fields lose all of the advantages of the scholarly journal system that most other fields take for granted. The benefits of the scholarly journal system are what an open-source software development model brings to the field of software development for teacher education and instructional technology in general.

The open-source model is not a set model or procedure for developing software. It is closer to a philosophy than a process. However, the development process used by most open source projects is very similar to the rapid-prototype methodologies. The biggest difference between the rapid prototype model and the model used by most open source projects is that when the first prototype is released the source code is also released for other developers and potential user to examine and offer feedback on. Opensource.org (www.opensource.org/osd.html), a leading Web site in the open source community, provides a definition of what types of software should be considered open source. According to this definition, software should be considered open source if its associated license provides for (1) free distribution, (2) a means to easily access the program's source code, (3) the ability to distribute derivative works, (4) non discrimination against any person, group, or field, (5) distribution outside of the original product, (6) a means for not contaminating the licenses of other software that work with it, and (7) equal treatment for everyone who wishes to license the software. A more complete description of these criteria and a list of associated software licenses can be found on the site.

Open Source and Stakeholders

Some of the principles embedded in the definition of what qualifies as an open-source license are probably foreign to the stakeholders involved in a grant funded software development effort. This section will briefly explain the benefits to each major stakeholder of using this model. These are some of the arguments used when members of the Shadow netWorkspace (TM) project (**http://sns.internetschools.org**) successfully convinced the University of Missouri-Columbia to allow them to distribute software using an open-source license.

Funding agencies

Funding agencies often have the goal of each project have as large an impact on the targeted audience as possible (e.g. getting the most bang for their buck). Because software developed using the open-source model has all of its source code freely available, any organization that might have a use for the program can acquire a copy of it at little or no cost to them. Established online communities such as the one at **www.sourceforge.net** provide a means to publicize and distribute an open source program to a worldwide audience at no cost to the author.

In addition to knowing that the resulting software will be free, the process of publishing the source code ensures that other researchers can build on and modify the original product. This in effect embeds the ability for the program to be sustainable and continuously improving as versions of operating system or Web browsers change. In effect, this open approach to software development allows a funding agency to lower their exposure to risk. Even if the project can't support itself when the funding discontinues and the researcher moves onto another project, the open-source model allows anyone who finds value in any piece of the work to continue building on it. The result is that the risk of a funding agencies' investment going underutilized is greatly reduced.

Universities

Most universities have a goal of increasing their name recognition to support recruiting and fundraising efforts. Because the open-source model facilitates the widest possible distribution of a software program, an organization that sponsors the development of an open-source project, vs. a closed source project, receives the widest possible exposure. A university does not give up the copyright when they license the software under an open source license. This ensures that their name will be associated will all of the project's work.

The goal of generating revenue from the work efforts of its researchers has recently gained increased attention from universities. Giving away software that a researcher produces may seem contradictory to this goal. However, this simplistic view ignores the trend in the software industry to view the industry less as a manufacturing industry and more as a service industry. Universities that promote open-source projects are in the best position to capitalize on revenue generated from the services associated with these programs. Who is someone more like to turn to for service with a product, a name that has been associated with the product from its inception or a third party? There are multiple business models that are based on selling services associated with open-source software. The most notable of these is Red Hat, a company that supplies a version of the GNU/Linux operating system and associated services.

Developers/Researchers

From a developer's perspective, the open-source model offers a means to bring the time-tested model of sharing via journals and conferences presentations to educational software development. Just as is the case with traditional publishing, mistakes (bugs) in the work are easier to identify when more people review the methods used. Solutions, modifications, and workarounds to the limitation/bugs can be openly discussed so that others can confidently build on the work effort. This allows each researcher to evaluate, select, and reuse the pieces of a work effort that are appropriate for his/her context. None of these activities are adequately facilitated by the current system of close source programs. The result is unnecessary duplicated effort among developers because they can't

As described above, by appealing to a funding agency's desire to maximize results while at the same time reducing their exposure to risk, a researcher can gain a competitive advantage when applying for funding. Proposals that commit to using an open source approach embed the concept that the project maximize the number of users while allowing others to build on the resulting work. Researchers can use these points to their advantage when competing against others who propose to develop closed source program. There is a great difference between a researcher who simply promises to make a program freely available and one who proposes to provides a means to allows others to build on every aspect of what is produced. Researchers can highlight this in their funding proposals.

By using an open-source model, developers can also take advantage of online community sites such as www.slashdot.org and www.sourceforge.net to raise awareness of their project, recruit developers, and in effect multiply their development and user testing teams. Also, because using an open-source license and taking advantage of the existing online communities will likely result in a wider distribution of a software program, researchers will likely have a larger group of users and as a result have a larger pool of potential research subjects to draw from.

Supporting Diffusion

The nature of the open-source software development model encourages and, because of the associated licenses, almost requires users to form communities to support the use of the software. Because of this, encouraging the development of the open-source software would help form communities of educational software developers filled with educators communicating and sharing reusable software programs. Communities such as this have already developed around other open-source projects such as the GNU/Linux operating system, the Apache Web server, and the Perl programming language.

Everett Rogers has identified a set of attributes, as perceived by potential users, that affect an innovation's adoption rate. The five most important attributes that Rogers identified are relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1995). A short comparison between the attributes of open-source software and these attributes reveal that the open-source model holds several advantages over the currently employed closed-source model of software development. Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. Because the open-source model invites comments and developer contributions throughout the process, it is reasonable to expect that a more attractive product (e.g. less bugs, more desirable features, etc.) will result. "Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 1995). By opening up the development process and gaining increased input and possibly increased work effort, the open-source model is more likely to be compatible with the needs of a larger number of users than if it was designed and developed by only a few individuals. "Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 1995). Because potential users are exposed to more options for using and participating in the development of an open-source project than a closed-source project, projects using an open-source model do run the risk of seeming more complex than closed-source projects. Developers who are aware of this can take precautions to not overwhelm potential novice users with too many options. However, because of the increased opportunity for user and developer input, a project developed using an open-source model should be able to identify any potential perceptions of complexity early on. "Trialability is the degree to which an innovation may be experimented with on a limited basis" (Rogers, 1995). Because, using the opensource.org definition described above, all open-source projects are free, they hold a clear advantage over closed-source projects in the amount of trialability they offer the user. Anyone can download an open-source project, try it out and continue to use it for as long as they like without any limitations. Although this easy trialability can be true for a closed-source program, open-source licenses allow third parties to make copies of a program and distribute it. Unlike closed source programs, it is perfectly legal for teacher "A" to make a copy of a program for teacher "B" to try out. The last major attribute that affects an innovation's rate of adoption is observability. "Observability is the degree to which the results of an innovation are visible to others" (Rogers, 1995). Rogers states, "The observability of an innovation, as perceived by members of a social system, is positively related to it rate of adoption" (Rogers, 1995). Observability is one variable that both closed and open-source projects struggle with. Because software programs in general are relatively hard to observe being used, neither open nor closed-source projects have a clear advantage in observability. However, as this paper mentioned earlier, because users of open-source software are encouraged to join a community of users, open-source software could be seen as having an advantage in observability. Although this is a very short review of the attributes that Rogers identified as affecting an innovation's rate of adoption, it is intended to raise overall awareness of the attributes of the open-source model and hopefully initiate a discussion within the research community about the merits of this approach.

Conclusion

This paper briefly reviews reports by the President's Information Technology Advisory Committee, the Working Group on Libre Software, and the Information Society Technologies theme in the 5th Framework Programme of EU

RTD all supporting the open-source model of software development. It then gives a brief overview of what the open-source model is, explains how it can benefit the stakeholders in a grant-funded project, and how it can support the diffusion of technology innovations. In light of these reports and the arguments presented in this paper, we argue that the U.S. Department of Education should encourage the development of open-source software in all department-funded projects that have a software development component.

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Integrating Videos Into a Business Calculus Class

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Abstract: The authors have been using Excel and Maple in their Business Calculus courses, and they have also been using WebCT for managing the class and the students. This paper discusses WebCT and the idea of producing compressed videos of class work that are made available to the students through the Internet. The videos show the students how to use the technology (for example Excel and/or Maple) within the course. The students can view the videos as often as needed and then practice the concepts while watching the video. The advantages to students, course content, and time management are obvious.

Introduction

How does one integrate technology into the classroom without neglecting the subject matter of the course? This is an area of concern when trying to include Excel and Maple into a Business Calculus class. Using Excel and Maple would afford the opportunity to discuss more "real world" type examples without getting bogged down in mountains of algebra. This would also allow students to focus on what answers and calculus concepts mean instead of focusing on algebra and rote memorization of formulas. The challenge is that students must be taught how to use Excel and Maple, as well as the class concepts, in a very finite amount of time. Students may miss class or fail to immediately understand the "how to's" of the technology. Thus the authors have introduced compressed video into their Business Calculus classroom in order to help alleviate this problem.

The authors are currently using WebCT to manage the class and the students. This allows the students to have unlimited access to grades and class announcements. The authors have also recently started the production of compressed videos of class work that are made available to the students through the Internet. This affords the opportunity of unlimited access to class work as well as class announcements. The videos must show the students how to use the technology (for example Excel and/or Maple) within the course. The students can view the videos as often as they wish and then practice the concepts on their own. The advantages to students, course content, and time management are obvious.

WebCT

WebCT is a web tool that allows the instructor to create an intricate web-based course without having to design everything "from the ground up." It allows the instructor to create, with relative ease, learning and communication tools for students within the web-site, as well as providing class management options for the instructor. The authors use it for Business Calculus and a discussion of how they use it follows; however, it is not just a web tool for mathematics classes, and one may visit the WebCT web-site at http://www.webct.com/ to obtain more general information.

The homepage can be created quite easily and the instructor controls its organization. The following is a sample of icons on the homepage:

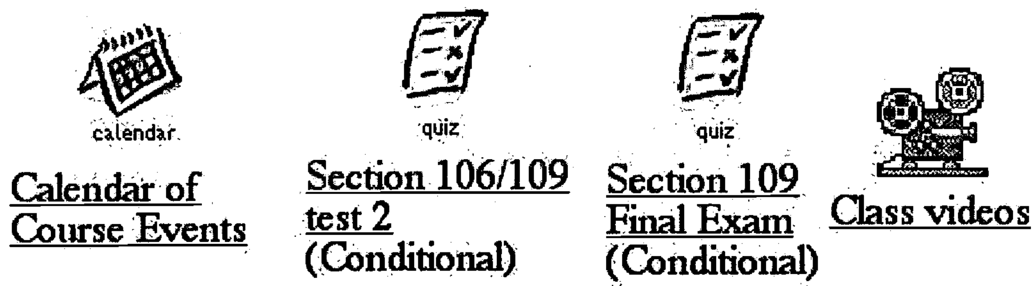

Figure 1: Icons available on the homepage.

The icons labeled "conditional" are not generally seen by the students. The instructor can program settings that specify when and how long the icon is available and also specify which students or sections are allowed to see the icon. The programming can be done through a point and click fashion within WebCT.

The calendar of course events is always available to the students. The instructor can provide messages, downloadable files, and homework assignments to the students and also include his or her own private schedule within the calendar. To view the day's assignments, the students need only to log into their WebCT account, click on the calendar icon, and then click the day of interest. The day's messages for the students are then displayed. Html code can be embedded within the calendar messages, permitting the instructor to provide downloadable files. The following is a sample of what can be seen by a student:

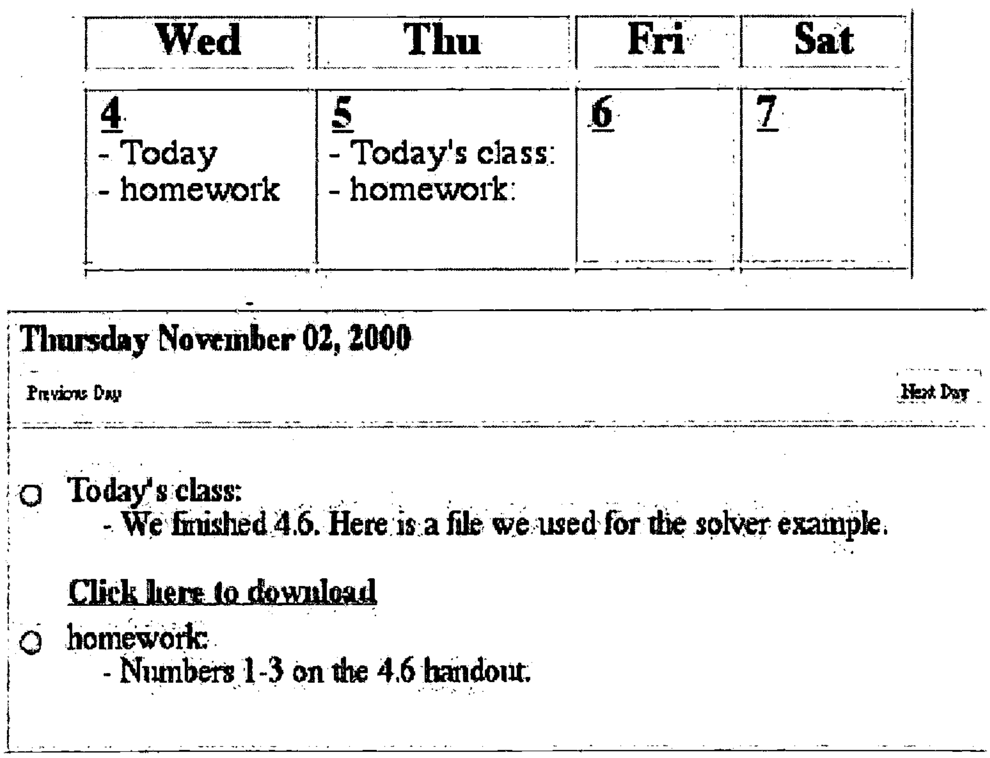

Figure 2: A sample of the Calendar of Course Events.

The instructor also has many options in managing a course or students within WebCT. Student names and grades can be stored in column format. Each column can be programmed to be viewable or hidden from student view. Each student can view, if the instructor allows it, his or her grades only and not the grades of other students. The order of student information and what is available to students is completely at the instructor's discretion. All settings can be programmed with ease. The following two figures show the point and click options for programming column settings:

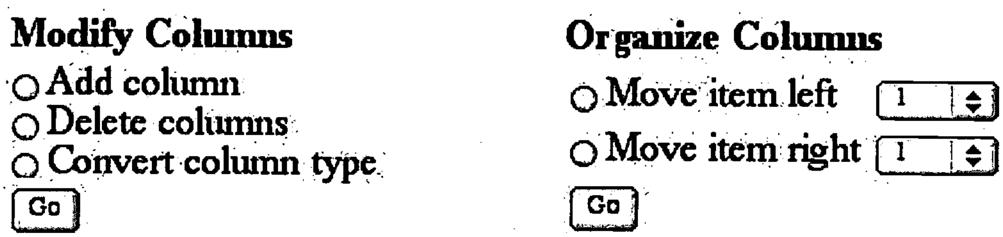

Figure 3: Column modification options.

Update

Select:	☐	☐	☐
Label:	Last Name	First Name	Final Grad
Type:	A	A	C
Alignment:	Center	Center	Right
Hidden:	No	No	Yes
Released:	Yes	Yes	No
Statistics:	---	---	None
Decimals:	---	---	All
Account Creation:	Not Shown	Not Shown	---

Figure 4: Column layout options

Tests can also be created within WebCT and graded by the instructor or by WebCT. Test questions can be categorized according to the instructor's desires. The test questions can be formatted as multiple choice, paragraph, short answer, matching, or calculated. Once a test bank has been established, an instructor can create a test within minutes, and grading can be done in seconds. In fact, it is possible to have final averages computed and available to the students within one second after the last student submits his or her exam.

Calculated questions allow the instructor to ask the same type of question, but WebCT randomly assigns different inputs, numbers for a math class, according to the instructor's specifications. All other question formats deliver the same question to each student. The following two figures show the students view of a calculated question and the instructor's editable version of the question:

Suppose you take out a loan of $53174 at an annual rate of 8.7% and decide to pay it back monthly over a period of n years. If the payments are $353.16 per month, what will the balance on the loan be after the third payment is made?

Answer

[ ]

Figure 5: The student view of a calculated question

Question

Suppose you take out a loan of ${p} at an annual rate of {r}% and decide to pay it back monthly over a period of n years. If the payments are ${d} per month, what will the balance on the loan be after the third payment is made?

Format ● HTML ○ Text

Image [ ] [Browse...]

Formula (((p}*(1+({r}/100)/12)-{d})*(1+({r}/100) [Analyze variables]

Figure 6: Part of the instructor's view of a calculated question

Once the question and formula are entered, the instructor clicks on "Analyze variables" and then enters upper and lower bounds on the variables. One then need only click on a button labeled " Generate random answer set" and the question is complete.

Variables

p Min 50000 Max 60000 Decimal places 0

r Min 6 Max 9 Decimal places 1

d Min 300 Max 400 Decimal places 2

Calculate answer sets to 2 Decimal place(s)

Answer set

[Generate random answer set] Number/set 10 [Edit answer set]

Number	p	r	d	Answer
1	58448	7.6	381.26	58414.52
2	59903	8.1	327.44	60135.28
3	53174	8.7	353.16	53271.76
4	50735	6.3	370.75	50420.18
5	53149	7.7	368.58	53065.85

Figure 7: Variable set for a calculated question

Videos

The authors' Business Calculus course required extensive use of Excel, Maple, and WebCT. This afforded the opportunity of discussing more interesting "real world" problems; however, some class time had to be used to teach the use of the technology. Of course, at least one student would inevitably be absent, and others would not grasp the instructions immediately. The goal would be to maximize class time for the discussion of Business Calculus concepts while providing enough instruction on technology use for every student. With this goal in mind, the authors considered producing videos that explained class concepts and technology use.

Some problems do immediately arise. Production medium, availability, and file size are some of the major considerations. The production medium could be simply videocassettes of the class presentation; however, this seems impractical. The point is to make the movies accessible over the Internet. One could use a digital camera to create a video, but this creates a rather large file that would hamper accessibility. The video must be quickly viewable, downloadable, and contain all pertinent information for the concept.

The authors decided to use Snapz Pro, which can capture from 1 to 30 frames per second and can capture audio as it records the computer screen. Most of the videos were made on a Macintosh PowerBook G3 with color settings of 256 and a resolution setting of 640x480. Snapz Pro was set to record microphone input and record five frames per second. This produced videos of computer screen activity with audio and achieved a file size of approximately 500K per minute. Better color and resolution settings could be used to view the videos, and most of the videos required less than eight minutes. The videos were then hinted and made available on WebCT through either streaming video, or the student could download the video to his or her home computer and view it. In either case QuickTime Player was used to view the videos.

As long as students viewed the streaming video on computers with high speed Internet connections, the hinted videos worked well, unless students wanted to rewind the video. If one tried to view it with a 56K-modem connection, the results were troublesome. However, the video could be downloaded and viewed without any troubles. At present, only downloadable versions are made available so that all students can access them through any computer with an Internet connection.

The advantages of this approach are clear. The file size is not huge, so students can download and view the videos in a reasonable amount of time. Students can play, pause, rewind, fast forward, progress one frame at a time, and view the video as much as necessary.

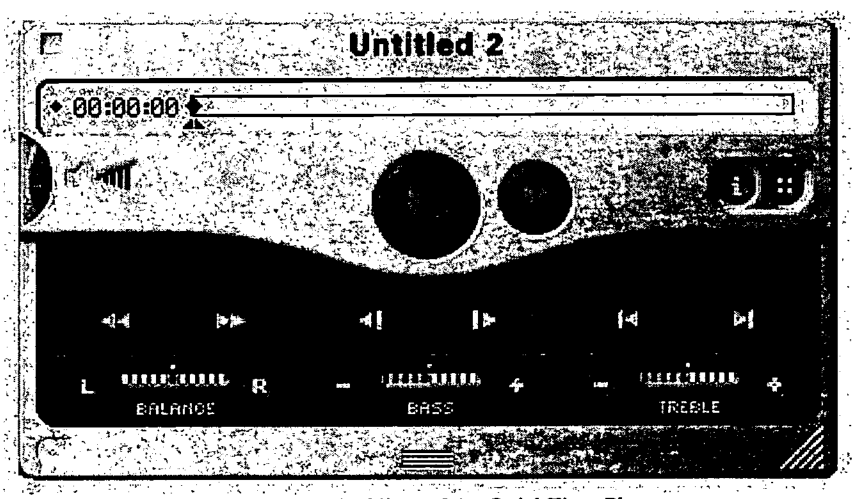

Figure 8: View of the QuickTime Player

From Figure 7 above one can see that the student has a great deal of control over the video. The students immediately see the cause and effect relationship of Excel and Maple commands and can practice them. In fact, students can work along with the video as it plays. Finally, if a student must miss class, then he or she can access the videos and keep up to date with the rest of the class.

Conclusion

By using Excel and Maple in Business Calculus, more useful examples and problems can be discussed. However, students can often have problems understanding the concepts or understanding how to use the technology. The goal is to provide plenty of instruction on how to use the technology in order to analyze the problems in the class.

WebCT is useful in helping to accomplish this goal. It is a wonderful tool for managing the students' grades as well as course content. The students can log into their accounts at any time and receive class updates. Any students that must miss class can still keep up to date with the class schedule. However, the student that misses class also misses valuable instructions that may not be communicated as well with the written word.

The present generation of students is well acquainted with computers and video of many types. Producing these class videos provide a useful tool to students in a medium to which they are accustomed. The student that must miss class can now keep up to date much better than before. The authors' students have been watching the videos, and student feedback thus far has been positive.

Implementing a Web-based Middle School Science Curriculum: An Evaluatiuon Report

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The Internet and its associated World Wide Web (WWW) have been marked by phenomenal growth and use in seemingly every aspect of life. The WWW has emerged as an area ripe for development of products that can support educational efforts at all levels. As a case in point, Active Ink Incorporated--a Texas-based firm specializing in development of web-based learning materials--has developed the eeZone Project. This project is a Science/Technology/Society (STS) on-line, web-based interdisciplinary curriculum. The intended audience is middle-school students.

Our primary purpose here is to report findings and related recommendations resulting from a year-long evaluation study of the eeZone Project. We sought to determine how teachers and students at a single South Texas middle school used the eeZone materials; what factors supported teachers' use of eeZone; and finally, what skills, knowledge, or attitudes students and teachers may have acquired along the way.

In this report, we include a review of literature, description of our method and findings, discussion, conclusions, and recommendations for the future.

Review of Literature

Criticality of Planning

Many educators agree that instructional technologies hold high potential for improving learning in the schools. However, like any major social innovation, adoption of IT by teachers is a complex, multifaceted, and lengthy evolutionary process.

One is also cautioned to remember that technology is a means--a tool which must be used thoughtfully and in planned ways. Providing hardware or using technology are not end results in and of themselves:

> Technology alone cannot improve teaching and learning... Technology use must be grounded firmly in curriculum goals, incorporated in sound instructional process, and deeply integrated with subject-matter content. Absent this grounding, which too often is neglected in the rush to glittery application, changes in student performance are unlikely (Baker, E.L., Herman, J.L., & Gearhart, M., 1996, p. 200).

Clearly, planning how to integrate uses of technology such as the eeZone Project into the school curriculum has emerged as one of the most critical issues facing educators and instructional technologists today. Growth of the Internet and the World Wide Web, advances in digital video technology, and the introduction of alternative, affordable storage media such as "write-able" CD-ROMs all add to the challenge of successfully integrating technology in today's school curricula.

Technology Standards for Texas Students

The Texas Education Agency (TEA) has developed a set of technology standards which closely parallel established national standards. These standards--placed as elements within the Texas Essential Knowledge and Skills (TEKS) standards--are known as TEKS for Technology Applications.

The TEKS address the acquisition of technology application skills as a continuum, progressing from the elementary to the grade twelve level. The technology TEKS are organized by benchmarks, not by grade level, so as to provide schools with flexibility in how to achieve them. Students are expected to demonstrate targeted proficiency levels before exiting second, fifth and eighth grades, respectively. Embedded within the grade clusters are four strands, or levels, with appropriate student expectations in skills and knowledge for each strand.

The first strand is the Foundation Level. Students are expected to demonstrate knowledge of hardware components. Specific skills at this level include using the correct and appropriate input and output devices, demonstrating keyboarding skills, navigating successfully within the desktop, saving files, and using peripherals.

The second strand--the Information Acquisition Level--requires that students gather varieties of information from electronic sources. This involves performing keyboard searches and navigating successfully to access information in text, audio, video, graphical, or combined modes. Students are expected to both gather the information and to evaluate the relative success of the search along with the credibility and usefulness of the acquired information.

The third area targets problem solving. Here, students are expected to create and modify problem solutions, using software to incorporate audio, video or graphic components. At this level, students also conduct research using electronic tools in order to be able to justify the recommended solution. The student should generally be able to use word processing and multimedia software to explain ideas and to solve problems.

The fourth strand is the Communication Level. Students should be able to present audiovisual information, selecting appropriate fonts, graphics, and color, all of which are geared to enhance communication. Other communication skills and knowledge include suitable printed output, consideration of monitor displays, video presentations, and use of electronic mail. The expectation is that the student should select appropriate applications in order to facilitate and evaluate communication.

The technology TEKS are useful. They provide direction to school districts, focus attention on the teaching and learning of technology skills, and encourage student and teacher use electronic communication and technology tools. The intention is a worthy one--to promote students' lifelong learning as citizens in a technological age. The goals of the eeZone Project are consistent with this orientation. By completing on-line activities within and related to eeZone, students focus on problem solving and communication--the third and fourth strands of the technology TEKS.

Constructivism and Technology Use

Constructivist conceptions about human learning have also emerged in the literature and at professional conferences as a central theme associated with technology use in the schools. The constructivist view holds that learning and knowledge construction are grounded in meaningful experience and individual meaning making. Again, we see that the design of the eeZone on-line curriculum is consistent with such a view. Jonassen (2000) asserts that students do not learn anything, per se, from computers. Rather, he argues that teachers should use computers to engage students in thinking meaningfully and representing their knowledge. Under this view, "... the most effective uses of computers in classrooms are for accessing information and interpreting, organizing, and representing personal knowledge" (p.4) rather than for studying traditional instructional software. The learning activities included in the eeZone curriculum are structured in a manner that is consistent with this view.

While the constructivist view holds appeal for many, most educators recognize that constructivist approaches must be used in balance with more traditional instructional strategies, including direct instruction.

A brief review of some of the tenets of constructivism is in order, as they serve to remind us of the need to engage students in meaningful uses of technology which foster knowledge construction. Jonassen, Peck, and Wilson (1999) provide an excellent summary of key, related views. Their views and related commentary follow:

1. **Knowledge is constructed rather than transmitted**: that is, knowledge cannot simply be handed off or passed from the teacher to the student. Rather, learners construct meaning and knowledge from experience. Technological assists here insofar as it is used to broaden students' base of experience. For instance, computer-based simulations allow students to experience a modified version of some reality such as planning a city that may not otherwise be possible. E-mail can increase students' experience in communicating with others across the country and world.
2. **Knowledge is acquired through activity**: accordingly, learners acquire knowledge by actively interacting with elements of the world around them. Instructional technologies are also consistent with this view insofar as they foster active engagement on the part of the student. It should be noted, however, that instructional software titles vary in the degree to which they require active learning.
3. **Knowledge is grounded in the learning context**: when a student interacts with phenomena in the world, acquired knowledge includes information about the context where the interaction occurred. This view suggests that teachers should be careful to help students see the linkages between computer-based learning experiences and the real world. Further, as students use technology for traditional curricular purposes, they are likely to gain separate skills and knowledge related to use of technology tools--specifically, computing skills.
4. **Meaning is subjective in tbe mind of the individual**: there is no absolute external meaning; people can hold common views or share meaning through the process known as social negotiation. The end result is that multiple perspectives of phenomena exist across individuals. Computers can foster shared meaning and social negotiation by bring individuals together to work on technology-based products such as multimedia presentations or web pages. Of course, e-mail and on-line chatting or discussion groups directly facilitate communication among individuals, which is at the heart of the matter.
5. **A student's interest in solving a problem or resolving some type of perceived dissonance will prompt that student's ownership of the learning task and increase relevance and meaningfulness.** Many students find the very use of computers or other types of technology such as video equipment inherently interesting. Many teachers report that this increased interest increases students' ownership of the learning task. For instance, a student might have greater ownership of producing a computer-based presentation than of producing a traditional essay.
6. **To truly learn and generate knowledge, the learner must articulate and reflect upon relevant learning experiences.** When used as a communication tool--whether for word processing or developing a multimedia presentation--the computer supports articulation of experience.
7. **Meaning may be shared with others**: learning is often a social process, and conversation can prompt meaning making. So called knowledge-building and conversation communities are natural extensions of this view. Technology supports the sharing of meaning when students use the computer to communicate with others. Engaging students in group projects also fosters conversation.
8. **Meaning is distributed within communities.** Our interaction with other members of a community influence our beliefs and knowledge. Again, technology can bring students together and further communication, thereby supporting interaction with others.
9. **Not all meanings are equally valid.** The viability of knowledge is determined by its acceptance and the degree to which it is acted upon. Technology can assist teachers and students in determining the validity of given meaning because it allows for the amplification and sharing of ideas.

Constructivist views remind us to place the learner at the heart of the schooling enterprise and to plan for learning experiences that will be meaningful and engaging to students. However, the views should be kept in balance. Fisher, Dwyer, and Yocam (1996), in discussing the Apple Classroom of Tomorrow (ACOT) project, offer related commentary: "Mature ACOT sites tend to balance use of direct instruction with a collaborative and inquiry-driven knowledge-construction approach to teaching and learning" (p. 8).

Educators should thus keep in mind that using computers to deliver test preparation software or other inflexible, commercially produced instructional software is insufficient. Rather, these uses should be balanced with more constructive activities involving analysis and display of data, communication between people, and development of multimedia and web-based products. It seems clear that the design of the eeZone Project is consistent with the conceptions about constructivism just described.

Purpose of the Study

Although leaders in the field of instructional technology have urged educators to include multimedia and instructional software as integral components of teaching and learning in schools, many teachers still struggle to meet the challenge.

The purpose of this study was to examine the implementation of a Science/Technology/Society (STS) on-line, web-based interdisciplinary curriculum to learn how its use affected teaching and learning at one South Texas middle school. The following research questions guided this investigation.

1. How do teachers use the eeZone materials to support student learning?
2. What conditions or factors support teachers' use of the eeZone online curriculum?
3. What knowledge, skills, and/or attitudes have students and teachers acquired through their participation in the eeZone online project?

Method

Participants

Participant informants in this qualitative case study included all of the eighth-grade teachers at one suburban South Texas middle school campus, their students, and the media specialist who also acted as a mentor for the project. The fifteen eighth-grade teachers were arranged in three teaching teams. Each team consisted of five teachers: two language arts teachers, one science, one math, and one social studies teacher. The teachers represented a variety of experience levels ranging from two to 38 years with the average years of teaching experience being 13. There were 12 female and three male teachers. Although one team had piloted the eeZone materials the previous year, the other two teams had never used the on-line eeZone curriculum prior to the 1999-2000 school year.

Data Collection

Data were collected through interviews, conversations, observations, and analysis of program documents and products. The use of multiple data sources allowed us to compare and cross check the consistency and validity of the data collected. Triangulation of data was also utilized to limit the effects of researcher bias.

Interviews

Interviews were conducted with both teachers and students regarding their use of the eeZone curriculum. While formal interviews were scheduled with individual teachers, we also met with teams of teachers in focus groups. Interviews with students were never scheduled, but were conducted randomly during site visits. A generalized interview guide approach (Patton, 1990) was utilized. Prior to conducting interviews, we identified a few key questions we wanted to explore with each respondent, but allowed the conversations with teachers and students to unfold based on their comments and interests. This allowed us to elicit certain information from every participant without rigidly structuring the conversation. Such an approach was found to be more responsive to individual participants expectations and concerns. The open-ended nature of the questions allowed respondents to share their unique perspectives without being limited by boundaries imposed by a rigid interview protocol. All of the interviews were conducted at the middle school. Formal interviews were audiotaped and transcribed.

Observations

In addition to interviews, we observed teachers and students engaged in eeZone activities. In September of 1999, we joined the eighth grade teachers for the initial training on the implementation of the eeZone curriculum. Throughout the year, we observed classes working on eeZone projects in the computer lab and in their classrooms. Field notes were recorded during site visits.

Documents and Products

Document and product analysis also contributed to our understanding of how the eeZone curriculum affected teaching and learning. We first reviewed the eeZone on line curriculum and even registered as users so that we were able to monitor the ActiveInk web site. We also monitored teachers entries to the Working Circles, an on-line reflective journal allowing teachers to log comments or responses to key learning questions. Some of the questions posed included:

1. How do technical problems affect student learning?
2. Does eeZone address our curriculum?
3. How does the technology of eeZone help students gain real-world skills?

Student products reviewed included maps, graphs, charts, and Power Point presentations. We also reviewed teacher products such as lesson plans and teacher-generated teaching materials.

Data Analysis

In order to bring structure and meaning to the mass of collected data, inductive processes of data analysis were employed. The use of inductive analysis allowed patterns, themes, and categories to emerge from the data. After each site visit, audiotaped interviews were transcribed and field notes reviewed. Interpretations and emerging patterns and themes related to the data were noted and recorded in quarterly reports.

Findings

Three major themes emerged from the data.

THEME 1: Implementation of the eeZone Online curriculum was inconsistent and hampered by unavailability of computing equipment, experience levels of team members, and other internal and external factors.

Calallen teachers and students got a late start on eeZone projects due to external factors such as lack of computers and the lateness of some projects coming on-line. Although teachers participated in the initial eeZone training in September 1999, implementation of the curriculum began in January 2000. The late start was due primarily to unavailability of classroom computers for some of the participating teachers. Although some teachers had classroom computers, teams delayed implementation until all team members were equipped with the necessary computer hardware. Unfortunately the computers were not received until late in the fall semester. In addition, some of the eeZone projects were not posted on-line until January. Many teachers reported that the lack of equipment and slow posting of some eeZone projects on-line significantly delayed their efforts to implement eeZone projects earlier in the school year.

Internal factors such as lack of time and experience and stress due to TAAS testing also contributed to the late start. Many teachers reported that even after the computers were delivered and all of the eezZone projects were on-line, they delayed implementation of projects so that they could prepare their students for the February administration of the Texas Assessment of Academic Skills. Even though math, science, and social studies teachers were not directly involved in the February testing, teams delayed projects while language arts teachers were focused on TAAS testing. As a result, all three of the eighth grade teams got late starts on eeZone projects. Once projects were initiated, many teachers temporarily abandoned their projects to prepare for the April administration of the TAAS. Overall, it seemed that the emphasis on high-stakes testing drew teachers' and students' attention away from eeZone.

Teachers' level of experience also affected their implementation of eeZone projects. The value of related prior experience was evident. For example, the Eagles team, composed almost entirely of teachers who worked with the eeZone Project last year, completed more eeZone project activities and exhibited a higher level of confidence. Teachers also reported that it took a great deal of preparation to integrate eeZone into their existing curriculum and identify related TEKS. Most teachers suggested that it would save them a great deal of time if ActiveInk would clearly identify TEKS related to eeZone project activities. However, by the end of the school year, all teams had initiated a project related to their discipline and aligned with state mandated TEKS.

Overall, teachers' comfort levels with eeZone projects varied based upon their prior experiences. However, teachers viewed the 1999-2000 academic year as a learning experience and felt that they would be more proficient in using the eeZone Online curriculum next year. One teacher summed it up this way:

> I don't feel like we've accomplished our objectives this year because of the late start. Next year I'd like to see better coordination between the teachers on my team. But next year we will be ready because we have developed more skills. I think we did pretty good this year. You know, the first year, you get your feet wet. The second year you do better, but the third year, we will have great coordination and it should be terrific (Lowe, 5-11-00).

THEME 2: Critical support for teachers implementing the eeZone Online curriculum came from other teachers on their campus.

As is common with any instructional innovation, the teachers often felt uncomfortable and incompetent during initial attempts at implementation. Most of the teachers were unfamiliar with the use of eeZones web-based software and initially weren't sure that the eeZone curriculum would help them meet the instructional standards mandated by the Texas Essential Knowledge and Skills (TEKS). In addition, some teachers expressed difficulty understanding how the inquiry-based environmental eeZone projects fit into their existing curriculum. Several teachers described themselves as technology illiterate. Although they used computers for word processing, they had little experience with utilizing technology and multimedia in their instructional practices. As a result, they initially expressed anxiety and frustration about their abilities to utilize the eeZone program.

The technology specialist on the campus who also served as the eeZone project mentor provided critical support for the teachers. The project mentor acted as the liaison between ActiveInk and the pilot teachers. She reported concerns and difficulties to the software designers and provided trouble-shooting expertise when teachers experienced problems with hardware or software. She also assisted teachers in the computer lab and made classroom visits. The specialist also provided training for the teachers in the use of digital cameras and software programs such as Excel and Power Point.

The technology specialist also assisted teachers in their efforts to relate the online projects to local environmental concerns. For example, when the teachers chose the eeZone graffiti and landfill projects for their classes, she copied related articles from the newspaper and regularly distributed them to the teachers. She even participated in a field trip to the local landfill with one of the teams.

On the whole, the teachers expressed much appreciation for the support that the technology specialist provided. Teachers indicated that her support was instrumental in their successful implementation of the eeZone projects.

Teachers also reported that their peers provided valuable support. Since teachers planned as teams, they had opportunities to share successful strategies or materials with other team members. This was particularly evident on the team that piloted the eeZone materials the previous school year. One of the language arts teachers on the team was new to the campus. She was very positive about her participation in the eeZone project. We found this surprising since many of the other teachers who had never previously used eeZone seemed much more uncomfortable than she did. When we questioned her more closely, she credited the other members of her team with giving her the support and encouragement she needed to feel successful. She reported:

> We started with the waste project because we felt we would have an advantage going in that direction since the other teachers on my team used it last year. They know where they had problems and they have new ideas about what they want to do this year. So I am

> really leaning on the experience of the other team members because they have done it before and they share ideas during team meetings. (Brown, 2-28-00)

Overall, teachers shared materials and ideas with one another and tried to provide assistance to team member who were experiencing difficulty. They indicated that teaming provided a support mechanism that was readily available and trustworthy.

THEME 3: Teachers enhanced their technology skills as a result of their participation in the eeZone projects.

Both teachers and students perceived that their personal technology skills improved as a result of their participation in the eeZone project. While improving students technology skills was clearly an anticipated outcome of the schools participation in the program, improving teachers technology skills was an added benefit. During interviews, teachers often reported increased competence and confidence with regard to the use of computers and multimedia in planning and delivering instruction. Their new found competence and confidence went beyond the use of eeZone software, extending into other computer uses and applications.

The teachers reported that one factor significantly contributing to their enhanced technology skills was increased access to computers. Many of the teachers had never had a computer available in their classrooms prior to receiving one through the eeZone pilot program. Teachers noted that once they had a computer in their classrooms, they began to experiment with new software, to review web sites that could be used to enhance instructional units, and to generally increase the use of technology in classroom instruction.

At the end of the 1999-2000 school year, one of the participating math teachers decided to leave the school district to pursue a Masters degree in educational technology. He credited his experiences with the eeZone project as the catalyst that sparked his decision. He reported:

> Before the computer was put in my room, before I was made to do eeZone, I had been through some computer workshops. But I didn't feel confident. Now I feel confident that I can do computer work, that I can do research. I can do downloading; I can converse with others through e-mail. I can get on the computer, go to sites, answer questions. I feel a lot more confident. On a scale of one to ten (10 being the highest level of competence), I was about a three at the beginning of the school year, now I'm about a six. Yeah, I'm much better, more confident. That's why I applied for the technology/math program in San Antonio (Villarreal, 5-11-00).

Even teachers who described themselves as technology illiterate or anxious at the beginning of the year, perceived that their computer skills had improved. The social studies teacher on the Patriots team provided one such example:

> At first, I wasn't real sure what to do with it [eeZone Online materials]. I was pretty technology illiterate. I began to play around with itÉlearning how to do new things. As a result, I've improved my computer skills. It has made my planning much easier. I've started using a computer grade book and, boy, that has really been great. I'm doing projects I haven't been capable of before, but there's a lot more Id like to learn. On a scale of one to ten, I was about a two in using computers, now I think I'm about a six. I like it. I've always been a book, pencil, and paper kind of teacher. I don't like to play games. I don't think kids benefit from that when they go to high school. But computers are different. That will be something that will help kids when they go to high school (Lowe, 5-11-00).

On the whole, teachers credited their enhanced computer knowledge and skills to the increased availability of computers. They also perceived that their classroom instruction improved as a result of their enhanced technology skills.

Discussion and Conclusions

Our evaluation produced some positive findings while also revealing some pitfalls associated with implementation of an on-line curriculum project such as eeZone.

On the positive side, our study revealed that the project empowered some teachers in the use of the computer for instruction. Many teachers reported a gain in skills and confidence in computer use. Teachers also expressed how much a skilled technology mentor can contribute to successful project implementation by providing moral and technical support and general encouragement. These findings suggest that use of a project such as eeZone can have positive effects on development of teachers' computing skills. They also support the view that a strong on-campus technology leader and mentor can have a powerful influence on teacher behavior relative to implementing a project such as eeZone.

Students also expressed positive views concerning use of the eeZone curriculum. They were generally enthusiastic about their on-line learning experiences, seeing them as a favorable, more active alternative to traditional classroom instruction. Some students who worked on the waste project indicated that their awareness of how much trash they generate increased. Others stated that they had learned how to use electronic mail in conjunction with their eeZone work in order to receive directions from a teacher. Some developed multimedia presentations on their eeZone research. Clearly, the majority of students enjoyed using the materials and found the experience to be fun. This suggests that students are likely to find future interactive web-based science curricula such as the eeZone project both appealing and motivating.

While positive outcomes resulted from use of eeZone in the school, certain problems related to implementation also emerged. Foremost among these was uneven implementation. In some cases, teachers waited until the last two months of the school year to begin using eeZone with their students. Such a delay in using the on-line materials certainly undermines the likelihood of providing students with a rich, deep, and meaningful learning experience. Problems obtaining computing-equipment for the project no doubt hampered things at the start; however, as time wore on, lack of motivation on the part of some teachers to "get to it" seems another major cause of the weak implementation. Teams which lacked a member with eeZone experience or strong technology skills were also hindered when it came to implementing.

Teachers also delayed use of eeZone due to concern about preparing students for the Texas Assessment of Academic Skills (TAAS). Others expressed uncertainty as to possible linkages between eeZone and the Texas Essential Knowledge and Skills (TEKS). Addressing teachers' concerns in these areas would do much to foster more timely, sustained implementation of the project.

Recommendations for the Future

Based upon the findings of our study, we offer the following recommendations:

1. **Establish time-certain milestones for project implementation**: rather than providing teachers with free reign as to when they will complete project activities, establish a timeline for achieving milestones and try to monitor and hold them accountable.
2. **Ensure that each eeZone team includes an experienced user whenever possible**: encourage formation of teams to include an experienced eeZone or technology user as a support mechanism for the less experienced teachers. In this regard, a general strategy would be to build on teachers' previous successes using eeZone.
3. **Provide additional, accessible teacher support materials to foster stronger implementation**: in many cases, teachers failed to see how eeZone might contribute to students preparation for TAAS or how it correlated with the TEKS. Support materials--possibly in print format--providing explicit guidance in these two areas might do much to encourage greater and more timely implementation.

Closing Thoughts

The development and implementation of the eeZone Project represented a massive undertaking. As with most human endeavors, the effort at the school we focused upon produced positive results along with ideas for "how to do it better" in the future. For some involved teachers, lack of follow-though emerged as a prime cause of poor and less than timely implementation of the project. On the positive side, students expressed appreciation for eeZone as an interesting and fun alternative to more typical learning activities. Teachers too indicated that their technology skills improved due to their involvement with the project.

In sum, the evolution of projects such as eeZone holds great promise for engaging students in powerful on-line learning activities that relate to the real world.

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WEB-LIBRARY

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Abstract: This paper presents an effective use of the World Wide Web by schools. This is a multidisciplinary proposal intended to integrate disciplines from the school curriculum in a common project. A description of the steps to develop this virtual school library for its use as a tool in the everyday process of teaching and learning is provided. School teachers have tested this Web-library and their comments greatly contributed to the paper.

Introduction

It is difficult and challenging to find new ways of teaching and organizing information. Any learning experience today involves not only the mastering of the fundamental concepts in the field but also, the use of technologies (Bruce, & Levin, 1997). Nowadays, the improvements in educational technology help educators to deal with completely different methods of teaching and organizing knowledge (Nicaise, 1998). Computers and the Internet open the door to thousands of possibilities, hence a lot of ways of exploiting those possibilities.

The Benefits of the Internet

A recent study of uses and impacts of the Internet, WWW, and related technologies in community colleges found that library and learning resources are seen as the application with the most potential positive impact on students' outcomes and institutional effectiveness (Layton, 1997). The Internet has become the least expensive method for communicating and distributing information (Friedman, McGrath, & Barron, 1997).

Projects that include technology help in improving people's fluency with information technology. This fluency is defined as the key to survive in the current and future world by the Committee on Information Literacy (1999).

The Purpose and Advantages of the Web-library

Our proposal is to build a library according to the school needs and not just to explore somebody else's creation. It differs from others in the sense that it points to the creation of the site by those who will be the potential users.

This library source will cover the areas required in the curriculum, because the teachers of those areas will be involved in the organization and design of the site.

The material will be considered as *owned* because teachers will feel they are not adopting something imposed, as software. The difference is marked by the relationship of what teachers and students are doing in the process of exploring learning: Either following somebody else's agenda, or following their own (Papert, 1993).

The material will be customizable since the users will be able to edit or add things as they use it, so it will be *framed to their needs*; it will answer to the needs of that school and for the time it is created, but with the potentiality of updating and customizing.

Our purpose is to encourage schoolteachers, staff, students, and parents to create a space on the WWW that will function as a source of information, a non-linear library made by hyperlink connections, for their use as a tool in the everyday process of teaching and learning.

This cyberspace would be unique to each school, though it will contain documents, which are shared with all the Internet community. The sense of uniqueness is given by the way this documents are selected and organized from a huge amount of possibilities.

The implementation of this virtual library will save the time spent in exploring sites at random, and will allow teachers and students to make immediate use of the information already evaluated, selected and appropriately listed in the web library.

This project can equip educators with a new dynamic teaching tool and addresses the national science education standards since the students can apply the information that they gather with the Internet to solve real-world problems. The data that students can collect can be obtained for real sources of scientific research, then making the learning experience an absolutely real scientific work.

Project Development

The actions proposed to carry on this project can be synthesized in these terms: engaging, building, using, maintaining, and the cycle will be constantly looping.

Now that the advantages of this approach have been considered, the stages to develop the project will be described. First the basic requirements to start the project will be mentioned, and next detailed steps to carry it on.

Assuming that schools will be provided with Internet connections, the ideal situation for carrying on this project would be several computers in the classroom where the users can access and retrieve the data on demand.

This project will need the involvement of member of the school personnel (or PTA) with Internet skills, that is with the ability to communicate using e-mail, browse the Internet, develop a web site, and be able to solve the basic problems encountered in the process from browsing to publishing. A person aware not only of the advantages that the information super highway can bring to the class, but also the danger of the misuse or irresponsible use of it, if necessary and agreement on the possibility of a previous training should be considered. This is a very important point that shouldn't be disregarded. Eastwood et al. (1998) affirm that unless staff development is properly addressed, infrastructure per se will do little to improve teaching and learning.

Then it is necessary to group those that will be in charge of starting to develop the project, taking into consideration computer skills, areas of study, and position in the school.

The number of individuals that have to compose the team should be determined by the scope that the school want to bring to the project, a minimum of one teacher and student per area of study should be involved, though more people in the same area make more sense because in the process of selection of the information various criteria would help a better result.

Once the school is engaged in this project, the starting point will be developing a productive and time-efficient search approach. The process that goes from collecting data to using that data as knowledge base resource will follow these steps:

1- *Determining the Needs*: The first step will be to decide what are the most important topics that will be included in this bank of information. To decide about the topics the team will have to consider items that are shared by various disciplines, are taught in various grades at different levels, and are still subject of study in many areas so they are constantly updated

2-*Collection of Data*: There are several factors to consider in data collection to make it more efficient and organized: a- Who will look for the information? b- How long will be devoted to the collection of data within the whole duration of the project? c-What amount and what type of information shall be considered?, d- How will the information be stored?

3- *Search Strategies* : Learning about the Internet search tools and some of their strengths and weaknesses should be included in an outline to follow a search plan.

4- *Assessing the quality of information*: Because the web is available to almost anyone with access to a computer, teachers must assess the quality and trustworthiness of the information they have accessed. This task can be accomplished having in mind the following aspects: The scope of the information, the audience form whom it is intended, the author, the publishing body, the currency and treatment of the information, and the ease of use (Fenton & Repass, 1999).

5- *Documenting the search:* The final outcome of the preceding work is a list or database that will document the search. This list will be the one that the school will use as a knowledge base resource. This will not differ much from an ordinary library card or a catalog.

6-*Development of the web-library site*: The team will design and create a website which will host the selected information resulting from the search process. This will be the visible outcome of the project.

7- *Maintenance*: The group must be in charge of keeping the library web pages updated.

Online Test Version of the Web Library

The web site developed as a result of this project can be found on the Internet at http://www.students.uiuc.edu/~scagnoli/weblibrary/. This is a version that we developed for the schools that we invited to test and explore its usability. The site consists of

- *A Front Page*: This introduces the idea of the project and explains how to use it.
- *A Search Page*: That will allow users to type in the topic and search by category, topic, name of the site or keywords
- *Results for their search*: The results will be displayed in order of relevance with the topic.
- *List by Categories*: Users can select any of the categories displayed on the menu and a complete list of all sites in that category is showed on the screen. They can access to the site by clicking on the URL (Fig. 1).
- *Add a Site page*: A form that allows users to add new sites to the library (Fig. 2).
- *Edit a Site page*: With the same procedure that the sites are added they can be updated or deleted.
- *Add/Edit a Category page*: The sites are indexed according to disciplines or categories. In this case the categories correspond to the main areas in the school curriculum. They can be added/edited or deleted from the web library when necessary.
- *Add/Edit a Sub-Category page*: Categories can be divided into sub-topics.

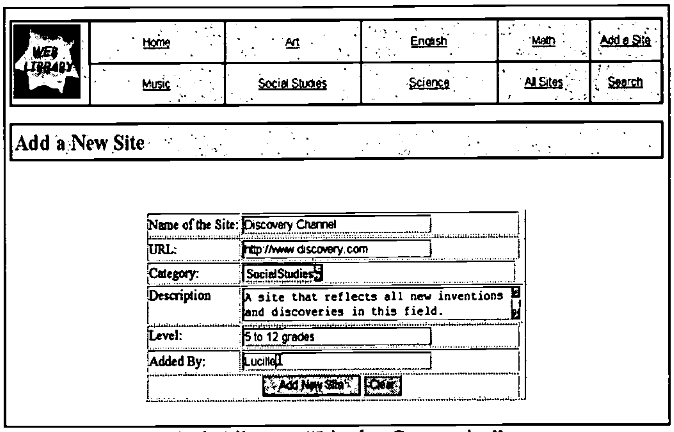

Fig 1- Web Library: "List by Categories" screen

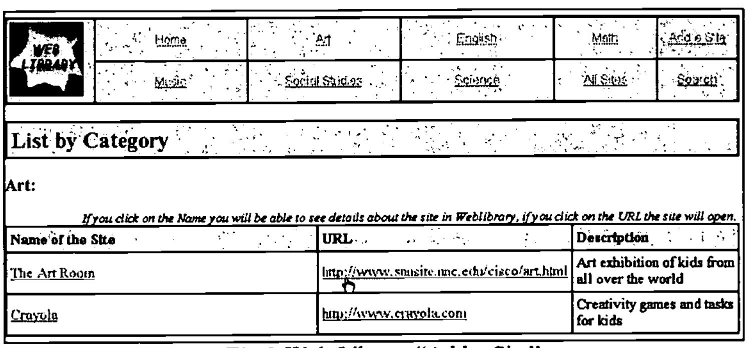

Fig 2-Web Library "Add a Site" screen

Conclusions

Most schools are in the technology game. This web library proposes a customized guide achieved by the collaborative work of the school people, which will ensure saving time, sharing expertise and encouraging involvement. This project has been presented in schools in Urbana Illinois, USA (Urbana Middle School and Martin Luther King Elementary School) and their feedback has been used to improve the project. Since we believe in the usability of the project we plan to expand its scope making it available to larger audiences and other school settings.

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Planning Makes "Perfect?" - A Comprehensive Look at Successful Implementation of Technology and Teaching at a Major University

Abstract: Temple University has demonstrated success at infusing technology and at implementing innovative approaches to teacher education. This presentation is comprised in five segments that address successful strategies and programs at different university levels: university, college, department, course, and community/school district collaboration. Each segment will address specific topics such as Preservice Teacher Education, technology diffusion, faculty development, and diversity. One of the primary goals of this presentation is to connect strategic planning at the university and college levels with successful implementation of innovative programming at the program, course, and community/school district levels. Presenters include faculty, professional staff, and graduate students.

University Level: Temple University Instructional Technology Planning

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Major comprehensive changes in technology planning began in 1994 in conjunction with the establishment of a "Teaching-Learning Technology Roundtable" (TLTR) at Temple University -- (the first developed in accordance with American Association for Higher Education (AAHE) guidelines). This resulted in University-wide emphasis on the theme that "curriculum and instruction should drive technology" (instead of having technology drive curriculum and instruction).

This paper is written from one faculty member's perspective, based on TLTR and TLTR Academic Planning Committee (TLTR-APC) membership since 1995. Much information reported previously was presented in TLTR-APC or TLTR documents. Many people collaborated in developing ideas and procedures that serve as the foundation for Temple University's planning processes and results. Though certainly not "perfect," it is this author's view that Temple's approach to technology planning has stimulated much more thought and discussion about programmatic planning than existed previously at Temple. Comments in this paper about TLTR activities at Temple mainly focus on University and College annual IT planning processes; however, it should be acknowledged that other TLTR committees have made similar positive contributions. For example, one committee was closely involved in the design of a new high technology classroom building, and other committees have explored prospects for cross-university collaboration on various IT ventures.

As examples of how some "outsiders" (i.e., professionals not participating in Temple University TLTR activities) view TLTR planning, here are quotations from the Middle States Commission on Higher Education Report as a result of Temple University's review during Spring 2000:

> "The TLTR has been a catalyst for infusing academic technology into teaching and learning at Temple. A broad-based and inclusive faculty membership with a commitment to process and communication provide responsiveness and flexibility to re-engineering curriculum with technology enhancements in a collaborative framework. The TLTR operates through a structure of working committees drawn from faculty representing a cross section of all programs. It is fair to say that Temple is noticeably ahead of other universities of similar size and mission."

> "The TLTR created technology-planning guidelines that are used to examine the curricular and pedagogical requirements at the college level and to create the college's plan for the use of technology to meet these requirements. The TLTR faculty review the college's plans and from them develop a set of recommendations for funding technology investments and initiatives within the college for the University administration."

During early discussions about TLTR, many questions were raised as to (a) whether such a venture could be successful, (b) why and how people might be willing to be involved with TLTR in the long term, and (c) what ways TLTR and its respective committees might be a constructive influence for students, faculty, staff, individual colleges, and the University. Some illustrative questions, issues and concerns include the following: What is to be accomplished via "TLTR activities"? Why should TLTR and its committees be xisting assemblies, committees and other groups? Why "bother" identifying curricular goals and potential career impact of IT resources, instead of simply "listing" the computers, software and other resources that "we" (in whatever college) really feel we
funds or other favorable results? Won't such discussions produce "turf wars" regarding distribution of limited funds and other resources? If college IT plans are required annually to receive funds for IT resources, what kinds of guidelines should be provided for development of college IT plans? Once planning processes (and IT plans) "mature," how might "supplemental plans" be developed annually rather than preparing an almost completely new plan each year? What might happen if "reasonable" rates of funding do not regularly result from regular programmatic planning?

The importance of technology planning is illustrated by the following statement contained in University feedback to annual college IT plans: "The technology planning process is expected to be continuous and active, and can help the University focus its attention on using technology to improve teaching and learning. This process brings accountability to all parties involved, assists in establishing priorities for technology investment, and provides the Provost and Vice President with solid information to make their case for increased technology investment to the Board of Trustees."

College Level: College of Education Technology Planning

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Temple University

The Instructional Technology Committee of the College of Education at Temple University is an advisory committee to the Dean and works in close collaboration with the provost and vice president of Computer and Information Services. This committee, chaired by Dr. Slesaransky-Poe, is faculty-led and includes multiple college and university stakeholders (i.e., faculty members from the four departments; students; staff; administration; and K-12 school personnel, including technology specialists).

The Instructional Technology Committee interacts with other college and university committees. Several committee members also participate in the university-wide Teaching, Learning, Technology Roundtable (TLTR), mostly through the academic planning process, and are members of the TLTR Executive Committee.

The overall goal of the Instructional Technology Committee is to promote and develop improved methods of teaching and learning through the effective use of technology. To achieve this overall goal, the committee creates a very comprehensive annual Technology Plan. The planning process includes: 1) setting priorities based on curricular goals for our students' needs and national and state standards; 2) designing, implementing, and evaluating a multi-modal faculty development process; 3) developing a needs assessment of human, physical, and fiscal resources; and 4) assessing outcomes based on the technology plan.

Several significant outcomes resulted from the solid planning process. They include physical and curricular changes. For instance, all classrooms are connected to the Internet with "smart carts" available to faculty; the College Educational Computer Center is equipped with state of the art hardware and educational software commonly used in K-12; all courses in the new undergraduate teacher education program are required to document how they will integrate effective uses of technology.

These examples resulting from the successful planning and careful implementation of instructional technology contributed to place the College of Education at Temple University at the forefront of the field of technology to improve teaching and learning.

Department Level: Two Approaches to Program Development

On-Line Masters Degree in Education

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One aspect of Temple's *strategic plan* is to address the ongoing professional developments educational requirements stipulated for K-12 inservice teachers by legislative mandate. For too many K-12 teachers, the professional responsibilities along with family obligations coupled with geographic distance makes compliance with legislation, such as PA Act 48, onerous if not wholly unfeasible. A second component of the *strategic plan* is to maintain the University's commitment to meeting student and pedagogical diversity concerns. These issues were the driving force for developing the Online Master's In Education 2001 program. Identifying and developing new courses for the program was obtained from face-to-face feedback given by K-12 teachers in surrounding communities who attended information sessions designed to develop locally delivered Master's programs. Temple's locally delivered face-to-face Master's programs vary from site to site because of the expressed professional development needs in each district. However, many of the requests for specific courses from the different districts are quite similar, if not almost exactly the same. The Online Master's program has targeted ten of these "frequently requested" courses as the basic core for the online program.
Not all participants will want to complete a full Master's degree. Hence, successful completion of the first three courses in the sequence will earn each participant a Certificate Of Advanced Professional Development In Education. This allows participants the opportunity to meet legislative mandates and to forgo formal matriculation into the University's Graduate School of Education.

Several of the courses proposed for the Online Master's program have been taught as web-enhanced courses with inservice teachers where some of the classes have been held online and others held face-to-face. This process has afforded faculty time to experiment with the various aspects of online learning. Not all faculty will use the same online platform to deliver courses but many of the pedagogical approaches are highly similar and reflect the use of best practices for online learning. Feedback from K-12 inservice teachers is extremely diverse. While many K-12 teachers value the online learning process, there is a smaller but significant number of teachers who clearly do not value online learning - despite the active online participation among full classes and smaller group breakout online meetings. We have discovered that one aspect of the digital divide, as it relates to current inservice teachers, is that many of today's learners have barriers, such as limited learning styles, that will keep them from cyber learning as much as the lack of equipment and a paucity of computer related skills define the digital divide for other segments of society.

Some K-12 teachers are preparing to deliver online teaching to their students for a variety of reasons such as illness, special needs and lack of access. These inservice teachers comprise the strongest body of interested online learners. They should be identified early on and used as used as models, where appropriate, in a graduate level online course. Somehow these teachers tend to self-select into smaller groups and the cross-fertilizations of their ideas and instructional approaches often stimulate others to become more proficient online learners and users of more experimental pedagogical approaches to teaching.

Instructional Learning and Technology Specialization in Educational Psychology

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Educational Psychology Program

Temple University

The Instructional and Learning Technology (ILT) specialization in the Educational Psychology program is the result of a long-held vision endorsed by educational psychology faculty and championed by individuals throughout the University. This vision gained college and university-wide support in 1999 when an Instructional Technology program was included in the College of Education's Instructional Technology Plan and endorsed by the University's Teaching, Learning, Technology Roundtable. Faculty and professional staff from the College of Education as well as from throughout the university wrote the initial proposal for a Masters degree in Instructional Technology. Of note is that this strategic planning was mirrored by activity at the Pennsylvania's Department of Education where development of new requirements for Instructional Technology Specialist Certification was underway.

The goal of the planning team was to develop a multidisciplinary program that would serve graduate students from a range of professional and academic backgrounds. The multidisciplinary foundation of the program is supported by two kinds of relationships with other academic units. First, courses in other programs, departments, schools, or colleges would serve as cognate areas of study for students enrolled in the ILT specialization. Second, Instructional and Learning Technology courses would serve as a cognate area of study for other programs.

The decision to create a specialization in the Educational Psychology program is consistent with current trends in educational psychology as well as within the field of instructional technology. The mission of the specialization is not just to stress the practical "how" of using learning technologies, but also the "why." This distinction is important in the employment arena, where it is advantageous for an applicant to have a knowledge base in instructional design theories as well as application and technical skills.

Historically, programs in instructional technology have evolved from the confluence of educational psychology and educational media programs. The rationale for the intersection of instructional/learning technology and educational psychology is a logical one. Since its inception as a discipline, the field of educational psychology has been concerned with the "aims," "materials" and "methods" of education (Thorndike, 1901). This attention has taken many forms and the field of educational psychology is widely viewed as a multi-faceted discipline that includes learning, development, cognition and measurement as core areas. In more recent years, this focus has included application of instructional and learning technology. For example, in his review of articles published in the Journal of Educational Psychology, Ball (1984) categorized 14 topic areas. One of these (admittedly a small percent of articles) he identified as relating to "educational technology, media and computers." Similarly, in a review of educational psychology graduate programs, Klausmeier (1988) identified one of 10 content areas as "artificial intelligence and information processing technology" including "computer and other technologies."

In summary, the strength of the new program specialization is that is grounded in this intersection of educational psychology and the technologies of learning and teaching. In addition, it was developed as part of a larger strategic technology plan from an interdisciplinary perspective.

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Course Level: Two Approaches to Preparing Preservice Teachers to Infuse Technology in Teaching

The Effective Use of Instructional Technology in the Classroom

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Appropriate incorporation of technology into classrooms is essential for any teacher in the 21st Century. The College of Education at Temple University recently implemented a new core curriculum that included a course specifically addressing effective use of instructional technology in the classroom, not merely computing skills. This course was the product of a committee of faculty who worked together, using the standards established by ISTE and the Commonwealth of Pennsylvania, to redesign the original computer-based instruction course from a basic skills course to one that infuses multimedia, web-based instruction, distance education and other emerging concepts in Pre-K12 education. This process continues through bi-weekly meetings to discuss pedagogical issues related to the course, share materials, and to discuss how computer resources are used with other core courses and the subject-specific teaching methods courses. One goal of the continued discussions is to gain insight into how a course on instructional technology can support other pre-service education courses, and vice-versa.

Project LITT – Literacy Improvement Through Technology

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Project LITT (Literacy Improvement Through Technology) infused technology into classroom academic standards-based instruction in Language Arts portions of our Teacher Preparation Programs from March 1999 to June 2000. In seven cooperating schools (3 elementary and 4 high schools), 160 elementary and 60 secondary preservice teachers (for approximately 7,280 K-12 students) were trained to deliver technology-based classroom instruction. Preservice teachers paired with in-service teachers developed and implemented standards-based instruction heavily steeped with technology resources, and collaborated in two Summer Institutes demonstrating and teaching technology-supported standards-based instruction received classroom instruction influenced by Project LITT.

Results showed that faculty will adapt to using new technologies in classrooms when appropriate equipment, software, training assistance, and technical help are available. Additionally, technology activities started by Project LITT have been extended within the College of Education. Cultural changes have occurred within the language arts teacher preparation program; faculty, students and staff now recognize and accept a role for technology resources along with other teacher preparation resources in preparing our future teachers.

Project LITT staff developed a hardcopy and web-based manual offering college faculty and classroom teachers information and ideas to consider when integrating technology into the classroom. The Project LITT website is www.temple.edu/LITT-L2L.

LITT was supported by Link-to-Learn, PA Dept. of Education, a Microsoft Software Award, and Temple University.

Community and School District Collaboration: Project RAINBOW

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Project RAINBOW (Restructured Academic INclusion BOnded with the World) was designed to integrate computer and Internet resources in K-12 classroom curriculum and instruction. This Project, originally scheduled for five years, is currently in its sixth year. Project RAINBOW goals are to help teachers, librarians, and other educators to: (1) increase student intellectual skill development, especially higher order thinking, (2) reduce student isolation, and (3) provide other teacher training and curriculum development. Project RAINBOW's vision is that technology resources are valuable in K-12 schools to the extent that they are integrated with more traditional curriculum and instruction resources to facilitate students' academic achievement and motivation to gain a good education. Activities are designed within a two-level framework – (a) for classroom use and teacher-student interactions, and (b) for teacher-teacher networking via Internet communication – in support of off-line as well as on-line educational application of Internet resources. Project RAINBOW is a collaborative project by Temple University with the Audenried Cluster of the School District of Philadelphia, started as a "Technology Challenge Project" funded by the U.S. Department of Education.

Guidelines for faculty development in effective use of IT resources were developed using a test bed approach, instructional psychology ideas were tested, revised, and implemented to facilitate K-12 teachers' use of Internet resources in their work. Barriers to achievement of IT training objectives are identified, (lack of/unequal access to instructional technology resources, individual differences in teachers' prior experience with instructional technology resources and some negative attitudes towards the use of instructional technology resources), and training modifications implemented to address these barriers are described.

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Use of FrontPage 2000 to Develop and Manage a Teacher's Educational Web Site

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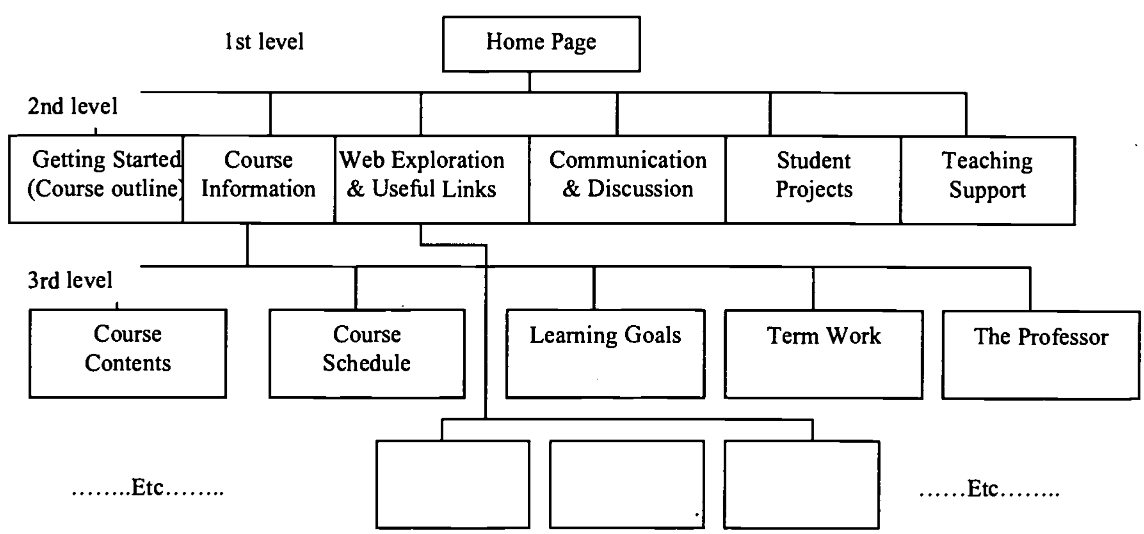
In this paper, I will describe briefly the necessary steps to build a simple Web site to support the teaching process and promote learning outcomes. Here are the main steps that I will show throughout this session:

Draw a structure of the Web site on paper

You can use the drawing tool of Word to prepare a mock copy of the Web site you like to develop. This approach helps you to think about the elements (course info, student projects, etc.) before building the Web site using FrontPage.



Creation of a quick Home Web page

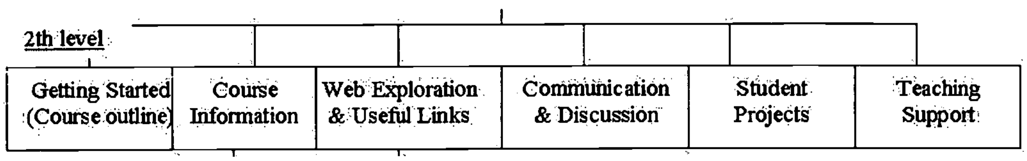
I will demonstrate how to create a Home Web page for the educational Web site. The Web page may be different for each teacher according to his/her needs. The Home Web page has to be simple and appealing to encourage the learners to surf the Web site. Make it simple ...use simple vocabulary and simple images if necessary. The menu Insert presents objects that you can add to the Web page.

A quick preview in the Browser

As you create a Web page, I encourage you to view it in the browser (Internet explorer or Netscape Communicator). Then, you can bring changes now before you upload to it to the Internet.

Linking the Home Web Page to the other Web pages

Now that you home Page is created, create quickly simple Web pages (2nd level of your Web site) and links them to the Home page. Later on, you can edit them to improve their contents:

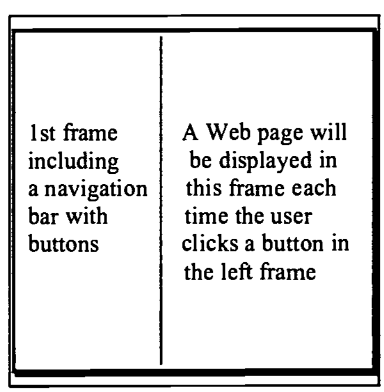


Improving the appearance of the Web Page

The menu **Format** presents commands that can help you to improve the appearance of the Web page. You can add a theme, a background, or a style to a page. Some of the features will be demonstrated during this session.

Use frames to facilitate the navigation of the Web site

Why use frames? Frames are useful to organize the display of pages in a Web site into regions in a Web browser's window. FrontPage makes the creation of web pages including frames easy. You can create frame or resize the current ones by clicking and dragging. You can control displaying a page in a frame by creating a hyperlink to the page and specifying the frame as a target of the hyperlink:



Images and Image Maps

FrontPage presents a set of tools to create, edit, and manipulate images. Image Composer, part of FrontPage, can be installed to create images and change their appearance. You can import images or use images from the Microsoft Clip Gallery. A nice way to facilitate the navigation of the Web site is to create hyperlinks from image maps.

Quick creation of a Web site

FrontPage presents a functionality to build quickly a Web site with specific features such as discussion lists, registration form, and calendars. Let us experiment with this functionality (**New** command from **File** Menu).

Integration of Web pages created by Word and Excel

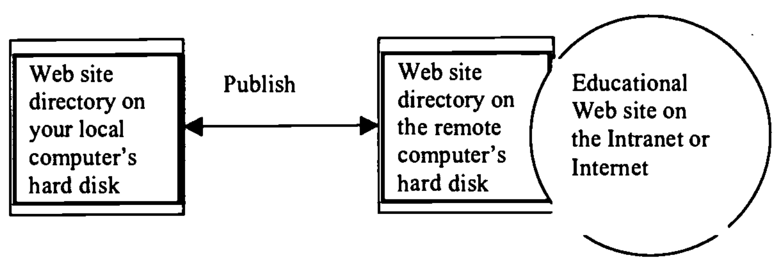
Word or Excel can convert a basic document to a Web page (command **Save as a HTML page** in **File** Menu) that you can save in the Web site directory on your hard disk. Then, you can import or open this file in FrontPage to improve its contents and features.

Organization of the Web site

As you add more Web pages to the Web site, you may have to organize the Web site that includes several Web pages. The buttons **Folders**, **Navigation**, and **Hyperlinks**, displayed in the FrontPage Views bar, provide different ways to look at Web pages in different directories and reorganize them. I will demonstrate some of the features.

Publication of the Web site

You are ready to show your Web site to your learners on the Web. How do your accomplish this task? You may post the contents of the Web site on an Intranet (inside the organization) or the Internet as shown in this figure (**Publish FrontPage Web** command under the **File** menu):

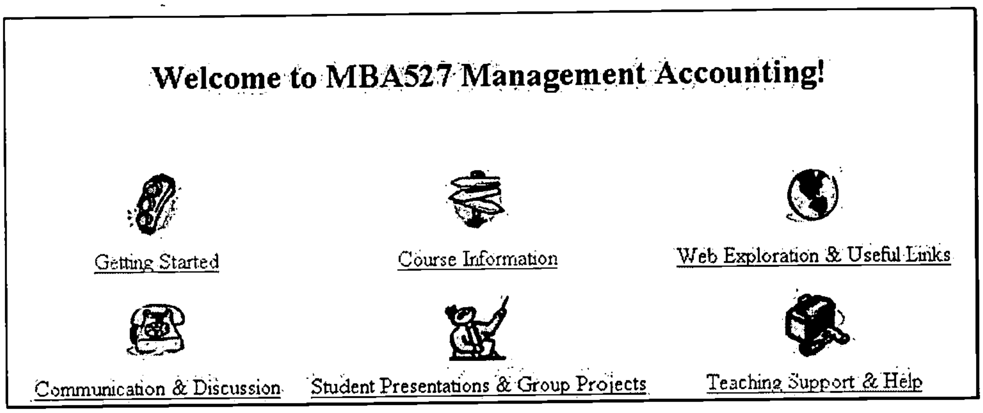


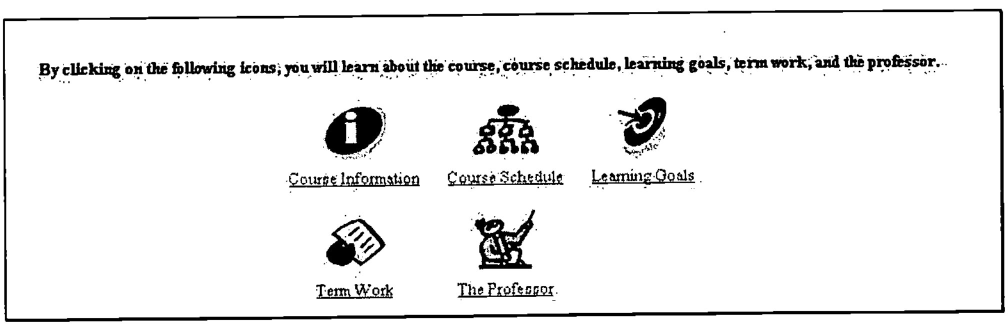
Maintenance of a Web site

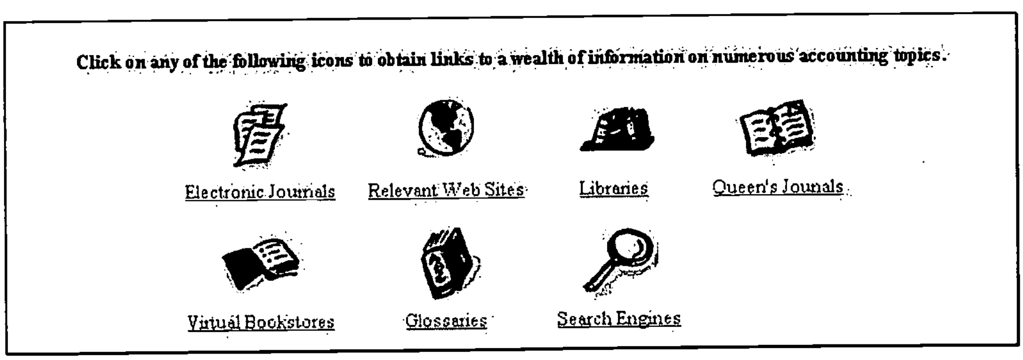
After your posted the Web site on the Internet, you have to maintain the Web site on your local disk such as the contents. For example, you may have to change the student project for the course, modify the course outline, add a new homework, etc. FrontPage presents some tools to help you verifying broken hyperlinks (**hyperlinks** button), check the spelling of all selected pages, add new tasks to be done or complete the ones already started (**Tasks** button), or include sophisticated features such as animated images, sound clips, and others using (JavaScript or VBScript).

An Educational's Web site sample

The following images present an example of the components of a Web site to promote teaching outcomes.







Conclusion

The field of instructional technology is evolving, especially due to the change in Web technology. We are living in a communication age and open learning systems will dominate traditional classrooms. The Web teaching tools and services now available such as Bulletin Boards, chat rooms, Web pages, e-mail, etc., are present in this society and will be more effective than the old methods for many aspects of teaching. Web-based teaching prototypes with sound instructional technology will be multiplying every day, thus the learner will study anywhere at any time. Distance and time will no longer be constraints to the learning process.

In summary, the goal of this session was to demonstrate the creation of an educational Web site prototype using a tool such as FrontPage.

Collaborative University-Public School Partnerships: Development of an Online Network for School of Education Faculty and Public Schools

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Abstract: This paper details the development of a collaborative network that supports a university-school partnership. The intention of this proposed network is to help School of Education faculty develop and maintain collaborative relationships with their public school counterparts. We describe the various stages of development of this network, as well as an analysis of features available in existing online teacher networks. We expected that the testing of this network will yield several issues related to developing effective university-school partnerships.

Proposed Collaborative Network

Increasingly, higher education institutions are expected to develop partnerships with public schools, particularly Schools of Education and Arts and Sciences faculty. *Partnerships of Excellence* is an example of this type of partnership and is an initiative of East Carolina University's School of Education (SOE). The expectation is to develop a reflective practitioner relationship (Schon, 1984) between SOE faculty and practicing teacher professionals within the East Carolina region. The impact of this initiative is two-fold: (a) enhance teaching and learning in public schools; and (b) augment existing research and theories about teacher education. While these goals are admirable, the issue is how to develop increased and effective collaboration amongst SOE faculty and their partnership school counterparts. How can the SOE initiate, implement and provide online support to maintain existing and form potential collaborative relationships? Though there have been several successful individual collaborative projects amongst SOE faculty and public schools, our question is how can the SOE collaborate with all of its schools in the entire region?

We looked at the existing literature on collaborative teacher networks. Fortunately, there have been considerable collaboration amongst public school teachers. Teachers collaborate with their colleagues in several national and regional computer networks devoted to promote collaborative public school sites (e.g., LearnNC, EdGate) . However, we could not duplicate these networks and expect SOE faculty to effectively work with public school teachers. There are distinct differences between higher education faculty and public school faculty. SOE faculty have different motivations and incentives than public school teachers. For example, SOE faculty not only teach pre-service teachers, but they conduct research that could impact future classrooms and thus, actively pursue external grant monies. We propose that exact duplication of existing teacher networks would not achieve effective collaboration between higher education and public school faculty.

Description of Initial Project

This proposal describes a project that created a collaborative online network that linked School of Education faculty at East Carolina University with their Partnership schools, named East Carolina Clinical Schools Network. There are approximately 800 schools in this network. Initially, we had questions on how to develop such a network. Some of these questions included:

- How will faculty assess the importance of collaborating with public school teachers?
- How can we design a network that will maximize the collaboration between SOE faculty and their public school counterparts?

Namely, the intention of this project was to achieve two goals:

- Build and initiate collaborative relationships between Partnership members with School of Education faculty, and also,
- Build and initiate collaborative relationships amongst SOE faculty members.

Some of the features of this proposed network included:

- *"Knowledge bases"*: These resources inform School of Education faculty and their school partners about current educational trends.
- *Mentoring advice*: This support system offers professional development opportunities for its clients. SOE faculty and school partners participate in peer mentoring activities. For instance, a fifth-grade teacher can offer his/her insights to an Instructional Technology faculty member about the social development of ten- and eleven-year olds.
- *Online review section*: Faculty members or school partners can edit and collaborate on publications and/or grant proposals.
- *Online bulletin board*: Faculty members and school partners can "advertise" about their teaching and research interests. The School of Education thus communicates information about important events or recent information (e.g., clinical teaching intern placements) sponsored by SOE and various partner schools.

Development Process

With these goals and proposed features, we sought to evaluate the effectiveness of our proposed network. We adopted the rapid prototyping approach (e.g., Tripp & Bichelmeyer, 1990) and evaluated the network in three iterative phases. Successive feedback from each iterative influenced the next phase of our project. Below is a description of these three iterations.

Iterative phase #1

First, there was a needs assessment of three major stakeholder groups related to this project. The three stakeholder groups included: School of Education administration, School of Education faculty, and public school teachers. With this information, a prototype was developed. School of Education faculty and teachers evaluated the strengths and weaknesses of the first prototype. The features of this prototype included:

- Partnership-Faculty alliance
- Directory
- Current events
- Workshops
- Discussion roundtable
- Research
- Advice
- Information resources

Overall, each participant approved of each of these sections. There was some confusion about the similarities between these sections. For instance, participants were unclear about the differences between the Partnership-Faculty alliance section and the Research. In our next iteration, we sought to eliminate this overlap and consolidate these sections.

Iterative phase #2

Six public school teachers and two School of Education faculty members participated in usability sessions. These individuals evaluated each section illustrated in the current prototype (see Figure 1). There were three goals of these sessions, namely: 1) effectiveness of prototype's interface; 2) effectiveness of specific features found in prototype; and 3) overall satisfaction of proposed collaborative network between School of Education faculty and public school teachers. These usability sessions yielded the following information:

- Overwhelmingly, participants expressed satisfaction with proposed features found in the prototype.

- Next, the prototype should provide a pathway to specifically find particular items within the collaborative network. Participants did not want to search for specific items. They wanted to readily access features in which they were interested.

- The collaborative network should not be a typical web site, but present some enticement to potential users to visit web site. Next, the prototype should use a newspaper/magazine metaphor.

- When visualizing how they would use network, participants expressed primarily information-related activities.

Iterative phase #3

Prior to the development of the revised prototype, an assessment of current teacher online networks was made. This evaluation yielded additional features that were "borrowed" from existing teacher online networks and incorporated in our current prototype. The intention of this iterative phase was to evaluate the effectiveness of the newspaper/magazine interface. It also examined how School of Education faculty and public school teachers anticipated how they would use this proposed network. With the results of these usability sessions, the development of a "final" offline beta prototype took place. The initial screen of this prototype is found in Figure 2.

Final outcomes and impact

It is expected that the outcome of this project will yield potential answers to several questions related to university-public school partnerships. Some of these questions include:

- Would School of Education faculty collaborate online with public school teachers? If so, for what purposes? How successful would these interactions be?
- How do School of Education facultyperceive the use of a collaborative network? How do public school teachers perceive the use of a collaborative network? Are there any similarities or differences between these two perceptions?
- What kinds of impact does this collaborative network haveupon School of Education and public school students?

Conclusion

It is assumed that higher education faculty can benefit from forming collaborative relationships with their public school counterparts. Can a networked environment help develop this relationship? Will higher education faculty express the need for such an environment? More importantly, will faculty actually use this proposed networked environment effectively? Our study and presentation will address these questions and related issues.

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East Carolina schools network

Members and Institutions
Find out who we are...

Inservice Workshops
Learning opportunities...

Current Events
East Carolina school events...

Discussion Roundtable
Talk about your ideas...

Resource Library
Professional links and
related projects...

Figure 1: Initial screen (Iterative phase #2)

Smoothing the Transition to the Instructional Technology Age: A Change Model Based on Professional Development and Innovation

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"THE SIGNIFICANT PROBLEMS WE FACE CANNOT BE SOLVED AT THE SAME LEVEL OF THINKING WE WERE AT WHEN WE CREATED THEM."

Albert Einstein

Abstract: Transition to the information and communications age will be chaotic and disconcerting for many, including educators. While the bumps are inevitable, there are steps which can be taken to minimize the trauma. Successful transition requires us to rethink the process. More specifically, the past failures of instructional technology to gain widespread use or to provide transformative effects on education can be understood in the light of successful and unsuccessful diffusion of innovation. The TIES was developed to specifically address what we have learned about innovation diffusion over the years. This paper will report on the philosophy, foundation, structure and operation of TIES in a university setting. Extensions to technical schools and public schools will be made.

The Problem of Change

Humanity has passed through several major eras, based on technological advances, which have changed society dramatically. Sometimes the change was for the better, sometimes for the worse. Examples include changing from 1) hunter to agrarian, 2) quill pen to printing, 3) agrarian to industrial, 4) manual to electrical, and 5) bits to digits (the digital revolution). The latter is also called the information technology communications (ICT) revolution and we are currently engaged and embroiled in its infancy.

After each of these major social revolutions became fully diffused into society, periods of relative calm, peace and stability ensued, interrupted by the occasional war. During each of these periods of transition to the new order of things, however, there was major chaos, upheaval, and uncertainty. For example, the transition to the age of electricity witnessed the major dislocation of slaves in the United States as the spread of rural electrification made them too expensive to maintain. The industrial revolution witnessed one of the greatest mass migrations in history as people left rural areas to form burgeoning urban areas which led to the growth of social support systems.

We are currently embroiled in the next major revolution, stimulated by the microcomputer and attendant digitization. This has been referred to as the Information Communications Technology (ICT) revolution. This revolution is resulting in significant changes in the way people and organizations communicate and function. It is radically changing, in both qualitative and quantitative ways, how we carry out our day to day activities.

A subset of this revolution involves the application of ICT to the process of teaching and learning. Known as the Instructional Technology revolution (IT), it is beginning to be evidenced in the way instructors and education and training institutions carry out their day to day activities. However, there are also disturbing signs of implicit and explicit chaos from a variety of sources and viewpoints. If history is any indicator, education will experience significant chaos during the transition process. This chaos may be long lasting and will certainly be highly disruptive. Are we to batten down the hatches and try to survive the bumps and bruises, or is there some way we can minimize the disruptions and smooth out some of the larger bumps along the way? The thesis of this paper is to describe a strategy which may be helpful toward meeting this goal.

Overview

The purpose of this paper is to describe a change system that was developed specifically to increase educators' use of instructional technology (IT) in the process of bringing about major and systemic change in education. The basic assumption is the major reason that IT has failed to reform education is not in the technology, but in the tendency of individuals and institutions to resist change. While many would agree with this statement, very few systems have been put into practice to deal head on with the issue of change. The strategy of the change system is professional development and the system is called the Training, Infrastructure and Empowerment System (TIES). The roots for TIES stretch back to the middle 1970s but the current implementation was developed over beginning in 1996 and implemented in a large educational institution with funding from the Government and University of Alberta.

This paper will examine some of the things learned about instructional technology (IT) and educational reform during the past 4 decades and compare the ideal, potential state of affairs with reality. The TIES, which is based on characteristics of innovation will be described, with emphasis on the main components of vision building and empowerment through professional development of leadership teams.

What have we learned from four decades experience with digital IT?

IT has been extensively researched over the years (Szabo, 1998a) and it is clear that instruction which makes substantial use of IT, when compared with conventional forms of instruction, results in

- equal or higher achievement,
- equal or better attitude toward learning and the subject,
- significantly reduced learning time, of the order of 10 to 50 percent savings,
- significantly greater access to education through distance or alternative delivery,
- significantly reduced delivery costs (Harapnuik, et al ,1998),
- easily scalable, and
- revolutionary changes which have increased the capacity and ease of use of IT.

While it is difficult to pinpoint the exact role of IT, these findings are impressive and lead us to believe that IT holds great potential to improve and reform the way we conceive of and deliver education. However, examination of the practice in the field reveals a very different picture.

The reality is that while there have been sweeping changes in hardware, software, courseware, tele-ware and skinware (people) during the past four decades;

- very few educators make use of IT; most use is confined to low level,
- education has been left unchanged or unreformed (the self-contained classroom dominates),
- vast sums of money have been spent with little to show for the expenditures, and
- many remain uneducated or under-educated, in poverty, unable to share the riches of an expanding global economy where the vast majority resources and money are controlled by a small number of individuals

Why has IT failed to live up to its potential?

First, individuals and institutions have a natural and rational reaction to anything as different and innovative as IT; they resist it in order to preserve the systems they worked so long and hard to build and are so comfortable with. Secondly conventional approaches to professional development are either unaware of this important aspect of human behaviour or unable to deal with it, resulting in less than optimal results. For example, most professional development efforts are built on the theme "Build it and they will come." History shows this to be a myth. Finally, there have been many over zealous proponents of IT who made grandiose predictions about the revolutionary nature of IT. As these predictions fell, one by one, disappointment and disenchantment with the field grew.

In spite of this, professional development efforts grew and flourished. By and large they are characterised as having:

- good and honourable intentions and goals
- high quantity and quality of training
- recognition of the challenge of learning to use IT
- the lack of urgency to provide increased access
- expended significant amounts of money

The poor results are more surprising in light of these positive elements.

What is the solution?

The solution is to create a complete system of professional development around IT which successfully addresses several major topics. First, it acknowledges and works with key elements (hindrances to) change and reform in education. Second, it provides training in the use of how, why and when to use IT to improve education or reach out to new opportunities. Another important element is the use of IT to provide a model which can be emulated and enhanced by instructors. Finally, the system must be delivered in accordance with recognised principles of adult learning and development. But just what are these topics and what do they look like? While all have been addressed in TIES, this paper will focus on the elements of reform and developing willingness to change.

Three guiding principles came out of the study leading up to TIES. First, we must assume that IT is a major and significant innovation in the way instruction is delivered. This leads to the second point that to understand IT means we need to understand the characteristics of successful and unsuccessful innovation. To this end, a study of innovation in society, politics, technology, religion and administration was undertaken. The overwhelming conclusion is that while we verbally accept innovation as an abstract concept, we have a poor understanding of its characteristics. These characteristics are described in the following section. The third principle is to synthesise our knowledge about innovation and develop a comprehensive system for reform around that knowledge.

Lessons learned from Innovation

- Most innovations fail—there is considerable risk involved. Thus, while innovation is warmly embraced, at least verbally, the recipe for disaster may be in the making.
- Successful innovations evolve into something different and more useful than originally envisioned—people need a vision for the future and the ability to tailor the innovation for their own environment and ownership. When there is no clear path, one must have a vision to rely, and be able to adapt in moving toward the vision.
- Widespread adoption is a sign of successful innovation—this presents enormous logistical problems of training, distribution, etc. Every educator, regardless of grade level or subject taught, is a potential user of IT. To train and support all educators, using conventional approaches to training and support is logistically an impossibility. IT itself must play a role if the job is to get done.
- There are three stages to successful adoption of innovation—success or failure needs to be judged based on the current stage.
- Creating an innovation requires a different type of person and organisation than does leading an innovation to successful adoption. The former calls for a person with missionary-like zeal who will face all obstacles head-on to achieve his or her dream. Often this is a person who works alone and because of the fervour has been called the 'keeper of the dream'. The latter needs to inspire change through leadership (Kotter, 1996) rather than micromanagement or decree, because the former inspires the creativity needed to innovate while the latter stifle it. The leader must also be capable of garnering a team to bring about change.
- Successful adoption of an innovation takes significantly longer than we would like, significantly longer than the tenure of politicians and administrators. It took 250 years from the discovery that citrus fruits prevent scurvy to the requirement that ocean vessels carry citrus fruits; it took 200 years for the industrial revolution to flower; and it took 20 years for

the computer mouse to migrate from the laboratory to everyones' computer. We often do not have the patience to let innovation flower and either abandon, ignore, or put it out of its misery.

Other sources of change and reform were consulted in the area of education (Fullan, 1991), society (Rogers, 1995), business (Senge, 1991; Kotter 1996) and IT (Szabo, 1996).

Training, Infrastructure and Empowerment System (TIES)

The characteristics of change and innovation have been crafted into a system to promote change and reform of education through professional development using the area of IT. The premise of TIES is rather straightforward. It states that reform of education through IT must be guided by a powerful vision of what an educational institution will look like in the future and that vision must be implemented by those who are driving the teaching program of the institution. Furthermore, the vision will be unique to each institution and the implementation will vary within the institution according to the needs and goals of the different units.

An analogy is useful here. Suppose there is an individual, who has neither the time nor expertise of a painter, who wishes to have a particular painting commissioned. The commissioner specifies the fee and describes the vision of the picture as having a large sailboat, sailing into the sunset on a light breeze, and there can't be any pink colours in the painting. The artist is then free to interpret this vision using the skills and resources he or she has developed over the years, within the constraints specified by the commissioner. This example is analogous the operation of TIES.

Development of Vision

In first part of TIES, chief academic officers create, nurture and commit to a vision of what the institution will look like in some specified period of time, say 10 years. This is accomplished in a retreat and workshop setting, away from the pressures of the institution. The retreat is ideally conducted over 3 to 4 days and achieves four goals. The first goal is to expose the administrators to the world of IT in general and more specifically to individual exemplary applications at the local, national and international level. In part the purpose is to establish a sense of urgency to stimulate action (Kotter, 1996).

The second component of the workshop is designed to produce a vision of the future of the institution with emphasis on IT as a new form of instructional delivery. The vision is stimulated by the following exercise. Imagine it is 10 years into the future and the vision you developed at the workshop became wildly successful. If you were to walk through the institution, city, province, country and abroad, what evidence would you see of its success? This exercise helps develop a vision which is concrete, visualizable and realistic. Some time is then taken to refine and polish the vision.

The third component of the workshop is the identification of barriers to that vision. One common barrier is finding a way to convincingly communicate the vision to the rest of the institution. Another is to find a way to demonstrate verbal and tangible commitment to the vision. Faculty quickly recognise that a verbal commitment without tangibles is no commitment at all.

A third barrier comes in the form of providing the infrastructure necessary to meet the vision. Infrastructure needs to be analysed carefully, as there are two kinds: hard and soft infrastructure.

The list of hard infrastructure varies with what particular brand or flavour of ET is being used, but usually includes the following.

- Hardware—computers, VCRs, projectors, videoconference/audioconference facilities, digital capture and editing facilities.
- Software—application programs for video, audio, computer assisted and managed instruction, web browsers, e-mail.
- Telecommunications—high speed access to the internet and WWW via modems

Soft infrastructure refers to more than people. It includes a strongly positive environment with corresponding attitude from all concerned. It includes experts to conduct the training and support for instructors. It is guided by the vision of the future. It is enhanced by a positive, supportive, and risk-aversive environment at the department, faculty, and senior administrative levels. This environment must be demonstrated in overt commitment. An administrator who offers some resources, however modest, to help instructors use ET is demonstrating commitment, while one who applauds the idea and suggests the instructor apply for a grant to do the work is exhibiting virtually no commitment, regardless of the words.

A final barrier is the development and support of a culture which promotes reform through IT after sufficient learning has taken place, not before.

In the fourth and final stage of vision-building, the participants begin to prioritise the barriers and identify how they may be overcome. Throughout the whole process, the emphasis is placed upon brainstorming rather than criticising the work to date.

Develop the Leadership Task Forces to Carry out the Vision

Once the vision has been completed and communicated, the artist takes over and carries it out. Unlike the painting analogy, however, the administration cannot hire completely new personnel to do the job. They must engage in extensive professional development with the extant staff.

TLTF terms of reference: TIES uses teams who will function in a leadership capacity. These TIES Leadership Task Forces (TLTFs) are trained to implement the vision in their unit. Specifically, they are asked to accomplish four tasks (and provided with the training and infrastructure to do so). First, they model the use of IT in their own classes, thereby demonstrating that IT is not so complex that the typical instructor cannot use it. Second, they identify the training needs within their own unit and arrange to meet those needs. Third, the TLTF identify the on-going support needed and arrange to provide that and support. These are to be just-in-time, effective and credible for colleagues. Finally, armed with experience and a good feeling for the size of the task, the TLTFs develop a multi-year, rolling plan to move their unite from the current culture to the new IT culture.

TLTF selection criteria: The selection of TLTF members is critical to the success of the system. While a team effort is necessary in order to distribute the work load and involve diverse opinions, most education is not done by teams but by individuals in self-contained classrooms. It is hard to break this mold. The impact of TLTFs must be leveraged, that is they must function at a point of power, where decisions are made or broken. In a university, that is often the department head, while in public schools the head of the school often holds the power to make or break innovations.

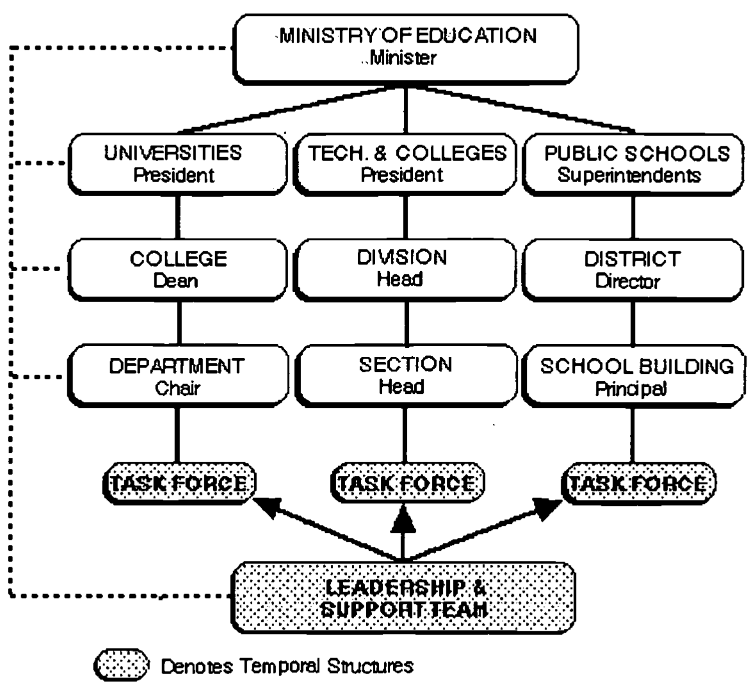

Figure 1. Organizational structure of the TIES

TLTF members are selected and invited to participate by the departmental administration using criteria supplied by the Central Leadership Team. TLTFs must include key opinion leaders in the department, as well as at least one departmental administrator. Along with the department administrator comes a commitment to support the Task Force for at least one year following their initial training. A curriculum and technology specialist is also an important person to have on the TLTF. The number of TLTF members should be 10-20 percent of the department, with a minimum of three.

TLTF training approach: Training TLTF members must be done (1) to insure the members are qualified and (2) as part of professional development leading to empowerment. As is common in education, the skills and knowledge possessed by the TLTF members varies greatly. In addition, they must be trained using adult learning principles (andragogy).

The training of TLTFs from several department takes place during a one week intensive workshop and one of the goals is to build cohesive departmental teams. Individuals complete an exercise to assist them to identify their skills and knowledge strength and weaknesses and to select which modules to complete. To facilitate a mixture of team based and individual independent study both during and following the workshop, the instructional materials have been assembled in modular format suitable for small group or individual, self-paced learning and delivered via the Internet.

TLTF training content: TLTFs need to be well versed in (1) how to use IT, (2) how to integrate it with the curriculum and evaluation structure, (3) how to provide leadership in their environment, and (4) miscellaneous topics, such as copyright protection. There several dozen modules which cover these topics in a self-paced learning format and delivered through the Internet (Szabo, 1998b).

TLTF support: A key element in the success of a complex venture such as this is the availability of support during the year following training. A Central Leadership Team, which developed and operated TIES, provides support as needed by the TLTFs. The support provided models the support the TLTFs are asked to provide during their work and should be effective, current and believable. The CLT advises departments, facilitates workshop training, and facilitates communication within and between different TLTFs and administration.

Progress to date

TIES was pilot tested in a major research university in Canada in 1998. A visioning retreat was conducted with the participation of chief academic officers of the institution. Five departments or faculties committed to training and support of TLTFs. The CLTs provided support to the TLTFs during the subsequent year. The findings and conclusions from this work have been documented by Szabo, Anderson & Fuchs (1998).

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Successful Multidisciplinary, Thematic Curriculum Activities: Development, Implementation, and Impact

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Abstract: This paper will focus on a multidisciplined, integrated, and thematic curriculum unit developed and taught by teachers from two Nebraska school districts involved in a U.S. Department of Education Challenge grant. The teachers from these schools designed the units using an online form and database developed by the grant project's staff. The project teachers received staff development training on several aspects of effective teaching/learning, such as multi-intelligences, brain research, multi-disciplinary strategies, efficient assessment, and the importance of connecting learning to community and real world situations. This paper explains the process of curriculum development, online availability of the units, training for teachers, local school support, lessons learned, and the impact of this type of activity on student learning, teacher growth and attitudes, school climate, and community connection to student learning and the school. In addition, the benefits to undergraduate and graduate education in a college of education will be discussed.

Introduction

"The Connections Project; Strengthening Learning Through Technology-Based Integrated Curriculum and Professional Development" has been successful in helping teachers to use technology effectively and to integrate it into their class curriculum. This project is a United States Department of Education Technology Innovation Challenge Grant, of which the lead sites are four Nebraska school districts and two adjudicated youth centers. In addition 16 school districts are partner sites participating in teacher training and in several interdisciplinary curricular projects that include effective teaching/learning techniques such as multi-intelligences, brain research, multi-disciplinary strategies, efficient assessment, and connection to community and real world situations. The project is designed to improve student learning through effective teaching that includes technology-integrated curricula reflecting state curriculum standards/frameworks and national standards. In addition, special focus is given to high-risk students, as well as developing partnerships among educators, business, agriculture, industry, and parents. The grant evaluation team is from the University of Nebraska at Omaha College of Education Office of Internet Studies. The process of change used in this grant is important to teacher education, as all learn from the successes of P-12 schools and teachers. The university professors on the evaluation team use the ideas and examples in their own lesson plans for both undergraduate and graduate teacher education classes.

Designing curriculum that engages students, has connections to their community, and has real-life activities has been found to be a successful way to revitalize the learning environment of students. An example of this type of effort is the *World Hunger* curriculum unit at two Nebraska high schools participating in the Connections Project Challenge Grant.

School Settings

One of the Connections Project's lead schools is Morrill High School, a small rural high school in the northwestern part of Nebraska. Mitchell High School is a Connection's Project partner school to Morrill and is within 30 miles. These two schools work together in many ways. Each month, teachers from both schools meet. Activities include introduction of teachers, discussion of units that they have written, and challenges to write new units. In addition to major units, they also were challenged to work with one other teacher to develop a "mini-unit." The *World Hunger* unit, the first unit completed and undertaken by teachers from these two schools, was one that would be unique to teachers across the state

Example of an Integrated Curriculum Unit

Unit Design

This interdisciplinary curriculum unit, designed by teachers from the two partner schools, was titled *World Hunger is Local TOO*. The goals of the unit were as follows: a) make students aware of world hunger and how it affects their own communities, b) inform students as to what they can do to help alleviate world hunger, c) promote teachers working together to encourage learning, and d) design a unit that could be presented at a conference. The uniqueness of this project was that not only were connections made between curriculum areas but also between two schools and two communities. Curriculum ideas for each discipline were outlined. These included:

1. Geography/Social Studies--research countries and world hunger
2. Home Economics/Foods--compare calorie intake of the countries researched by the geography/social studies class
3. Business/Computers--make charts using the facts found by the home economics and geography classes, make posters to advertise food drive
4. English--write analogies from the information collected
5. Journalism--write an article for both school newspapers and the local town paper, design an advertisement about the food drive
6. Reading--character analysis and story plans on books about hunger.
7. Art--design an advertisement about the food drive, decorate food collection boxes

The unit would be introduced by a PowerPoint presentation, designed by the Connections Project Site Coordinator. This presentation would be shown at both schools, challenging both students and teachers alike to participate in the project.

The timeframe for the unit was between Thanksgiving and Christmas. Classwork began right after Thanksgiving vacation and the actual collection of food was limited to the last five days before Christmas vacation. Some parts of the unit were completed in both schools and some were done in only one school, according to how best each part of the unit fit the situation at the respective schools. It was found that in order to encourage more communication between the schools, it was necessary to have some parts completed at one site and then sent to the other site for follow-up work.

Additions to the project during the implementation included: a) the writing of a script for a skit incorporating the challenge theme, with presentation at each school by the opposite school's students; b) hosting a guest speaker on the subject of world hunger; c) student volunteer work at the local soup kitchens; and d) more teachers being encouraged to become involved.

Introduction

An introduction to world hunger, via a PowerPoint presentation, was presented to the social studies, home economics/foods, reading, business/computer, and English classes as well as to the Student Councils of both schools. Students were asked to bring cans of food for the charity and teachers were asked to use the world hunger theme in their courses. Also each school challenged the other to see which school could collect more cans of food. Numerous facts about world hunger were presented along with ideas of why hunger exists. The presentation encouraged all students to become involved in the project. The "9 Steps to Third World Living" was included in the slide show. This captivating part of the presentation really helped students relate to people in need. Students were also given many examples of Internet resources containing the information needed to complete their specific class assignments. The PowerPoint presentation ended with a challenge to students: "What can you do to help stop world hunger?"

Gathering Facts

The social studies (Morrill) and geography (Mitchell) classes had group discussions on identifying *indicating factors* relating to their specific curriculum area that might cause world hunger. They gathered data on hunger in several countries on each continent, focusing on such facts as population, life expectancy, literacy rate, arable land, and per capita income. The geography students defined what *developed*, *third world*, *G-7* and other terms meant while categorizing nations. After categorizing nations, they sent the list of countries to the other classes. Students also looked for facts about hunger in their own county and state. Students searched for data in class textbooks, almanacs, encyclopedias, atlases, and on the Internet. Students started their Internet search with the site <http://www.thehungersite.com/> which has a map of world hunger in which the countries dim when someone dies of starvation. Other Internet sites used in the social studies and geography classes were <http://www.overpopulation.com/index.html> and <http://www.worldhunger.org>

Students in the home economics/foods class (Morrill) discussed indicating factors that would help determine the cause of world hunger. They learned about nutrition and the food pyramid and studied the food web from their textbook chapter on nutrition. After learning about nutrition, they created a menu for different areas around the world. Next the foods class searched for data on nutrition, malnutrition, and calorie intake for the list of countries that was sent from the geography class (Mitchell). Students searched for information in textbooks and on the Internet using the site http://www.overpopulation.com/child_malnutrition.html. Each student chose an area of the world and made a list of foods eaten and the number of calories in the diet for that group of people. After all research was finished students designed a *Menu for the Hungry*. Students in home economics/foods class also determined the information to be on the *tags* for world food intake for later use in assemblies. The *tags* represented world hunger figures: 70% are hungry; 20% are adequately fed; and 10% are well fed. The final project for the home economics/foods class was to prepare the food for the soup kitchen.

Graphs/Menus/Tags/Flyers/Posters

The information found by the classes doing the research was sent to the business class (Mitchell) where students formulated the data, using the software Microsoft Publisher. They created posters with charts and graphs and made flyers advertising and promoting the project. The business class also made the *tags* for the assemblies from information sent by the home economics/foods class.

The menus from home economics/foods class was given to the computer class (Morrill) where the students made printed menus similar to those found in restaurants. In the computer class (Mitchell) students were grouped in pairs and given research data relating to a country. They used the data to create a worksheet and graph. They then used the worksheets and graphs to make a poster about how their topic related to world hunger.

Paragraphs/Character Analysis/Story Plans

After hearing a poem by Sandra Alesiani, the students in the junior high reading class (Morrill) described to a partner what it might be like to be a victim of hunger. Following the descriptions, students were given a list of books about hunger and the homeless. Each student read one book, completed the character analysis and story plans worksheets, and then wrote a paragraph summary of their book to share with the class.

Analogies

The senior English class (Morrill) received a folder containing all the above materials. Students read and analyzed the materials on world hunger, both in graph and written form. Students then created an analogy and were given a choice of presenting it in either written, narrative, or artistic format. Students then determined what elements were necessary to write a script to challenge the student body at Mitchell High School to participate in the food collection project. They were asked to use things such as humor, facts, cordial challenge, and loaded words. Students used the scripts for skits presented at assemblies, half time at basketball games, and the final presentation to the food pantry.

Presentations and Advertising

Pep rallies were held in both Mitchell and Morrill. Two to six Student Council members from each school went to the other school's site and challenged each other's school to beat theirs in a food drive. They used the skits prepared by the English class students.

Students in journalism/yearbook business and art classes were asked to design an advertisement for the local paper to promote the food drive. The advertisement was to meet the following guidelines:

1. Have a headline or illustration (or both) that seizes the reader's attention.
2. Have a block of copy that does some or all of the following: a) recognizes the problem/desire of the client, b) recommends a solution to the problem, c) promises benefits, d) personalizes those benefits for the reader; has a call for action; and includes a logo and information on how to purchase or participate.

The journalism class (Morrill) also reported on one phase of the Hunger Project for the school newspaper.

The Yearbook class (Mitchell) took pictures of the project to be used for a display at the final assembly, a page for the yearbook, and a class presentation. They put together a PowerPoint presentation of 5 slides, an avid cinema presentation of 2 minutes, and an 18x24 poster. The business class (Mitchell) made posters (as previously explained) to advertise the food drive in the schools and local businesses. The art class (Morrill) decorated boxes to collect cans for the food drive.

At the Mitchell versus Morrill basketball game students passed out the *tags* (which indicated the level of hunger) to spectators as they came into the game. The project was explained by students in a skit using the script prepared in the English class with help from Student Council members. World hunger was demonstrated by a representative sample of the spectators: 70% received a pizza crust, 20% received crust with sauce, and 10% received a pizza with all the toppings. Then students encouraged spectators to donate food to help alleviate hunger.

Outcomes of the Project

The Scottsbluff Star Herald published an editorial, saying: "A fun way to give, Morrill and Mitchell students devise a friendly contest to help others at Christmas time." Also, several teachers involved with the unit were excited about its impact. Nancy Sakurada, teacher at Morrill said, "Being able to use computer technology allowed us to see a bigger picture of our world....especially the developing countries where poverty and adversity is the norm. We were able to see that the majority of our world does not live as we do in the United States. I feel that this project and the way we applied the curriculum changed our way of thinking about standards of living around the world." Teacher Ellen Ramig from Mitchell added, "During the *World Hunger is Local TOO* project, my students entered the data into spread sheets and charts. This project was very beneficial to my students. They also were able to participate in a project that required them to take raw data and make conclusions using a variety of learning styles."

After completing *World Hunger is Local TOO*, the group decided to do more of these types of integrated units. The next unit dealt with an important local industry, sugar beets. The new project is titled *How Sweet? Sugar Beet Sweet!*

Summary

The efforts of these two schools, in developing a unit that infused technology, centered around a theme, and included two different school districts is an excellent example of a vibrant, exciting curriculum activity. Not only did students become more engaged and excited about learning, but also teachers and the community both benefited from participation in the project. Because of this unit, the teachers at the two schools have continued to develop new curricular units and activities. The community gained heightened awareness about world hunger. These types of activities are important to teacher educators, as they provide examples to research and to share with future teachers.

"Adopt-a-School" – a Program of Hope in a South African Community

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Abstract: With the aim to play an active role in the community and in support of the National Education Department's Tirisano Project 2000-2004, the Technikon Free State (TFS) in Bloemfontein launched its Adopt-a-School program in September 2000. The program, in which the Lereko Senior Secondary School will be assisted in various ways, is a collaborative action between the TFS and a disadvantaged secondary school in the Free State province. In the first phase of the program, the emphasis is on the professional and personal growth of Lereko's teachers, with computer literacy as one of the main objectives. The TFS equipped a computer laboratory with Internet facilities at the school and started with the training of teachers. The discussion of the progress of the project presents a preview of what can be achieved when the more advantaged reach out to the less advantaged in this country with its unhappy past.

Introduction

The Technikon Free State (TFS) in Bloemfontein, South Africa, launched its Adopt-a-School program early in September 2000. The program, in which the school will be assisted in various ways, is a collaborative action between the TFS and a disadvantaged secondary school in the Free State province (Lereko Senior Secondary School), with the possible support of a business partner. The aim is to play an active role in the community in support of the National Education Department's Tirisano Project 2000-2004. The program is aimed not only at empowering teachers to teach effectively, but also at exposing teachers as well as learners to real technological education in addition to fostering an entrepreneurial climate in the development of school education in disadvantaged communities.

The Partners

Technikons – as they are known only in South Africa – offer higher career-oriented education – and should be distinguished from technical colleges that offer more basic career training. The TFS offers programs in four faculties: engineering, applied sciences, human sciences and management. The programs include degrees, diplomas and certificates in various information technology fields as well as technical teacher education and paramedic sciences. In 1999 the student population totaled 7105, with roughly 60% of the students from formerly disadvantaged communities. The TFS has reached a relatively high level of academic excellence and is one of the institutions that has advanced to the point where the possibility of converting it to the status of a technological university is being investigated.

Lereko Secondary School is situated in the Mangaung township in Bloemfontein, the capital of the Free State province. The school enrolment is roughly 1500 learners, with 45 teachers and a number of administrative staff members. The community is extremely poor and, although the double-storey school building is relatively new, the signs of vandalism and neglect are very obvious. Previous interviews with teachers revealed serious problems such as a shortage of school textbooks; almost no teaching aids (except one overhead projector in a working condition and a television set); only one laboratory for the whole school; a lack of science apparatus; no duplication facilities; and, of course, no computers - even for administrative purposes. Teaching methods are restricted to the chalk-and-talk and textbook methods. In summary, the Lereko of the past reflected a lack of commitment from teachers and learners and, undoubtedly, a lack of a culture of teaching and learning.

Tirisano is a corporate plan of the National Department of Education (DoE) that was announced in 1999 (Department of Education 2000). The vision of Tirisano is of a South Africa in which all inhabitants have access to lifelong education and training opportunities, which will, in turn, contribute towards improving the quality of life and building a peaceful, prosperous and democratic society. Organizational values such as Team Work ("Co-operating with one another and our partners in education in an open and supportive way to achieve shared goals") and Learning ("Creating a learning organization in which staff members seek and share knowledge and information, and are committed to personal growth") are highly rated.

The TFS Adopt-a-School program clearly falls within the priority range of Tirisano. In the first phase of the program, the emphasis is on the professional and personal growth of Lereko's teachers, with computer literacy as one of the main objectives.

Implementation and Progress

The TFS equipped a computer laboratory with 30 computers and Internet facilities at the school. The training of teachers started in late September. The Department of Information Technology at the TFS handles the IT component of the program. It will carefully monitor the progress of the teachers over the next twelve months and will adapt its training to the teachers' needs. In the first phase attention was paid to keyboard and other basic skills, as about one-third of the teachers have not used a computer before. After doing basic word-processing, they proceeded with Excel, as knowledge of spreadsheets proved to be a handy tool for teachers handling very large classes. From the beginning of 2001, staff members will be trained in using computers for administrative purposes that will greatly enhance the effectiveness of this relatively large school. The provincial administrative program, FREESAD, will be used for this purpose.

As several of these teachers are enrolled at institutions of higher education for postgraduate degrees and diplomas, the utilization of information communication technologies in supporting them in their studies will be investigated. It is hoped that on-line facilities will improve the communication with the provincial department of education and also serve as a tool to keep teachers informed about implementation strategies in Curriculum 2005, the new outcomes-based education model adopted for the country. A logical outflow will be the implementation of IT in classroom teaching and the establishment of computer laboratories as well as literacy programs for learners.

Teachers are considered as full partners in the Project. They are free to air their views and make suggestions to improve the program. They also complete questionnaires on a regular basis. Those who had not worked on a computer before, reported problems with their keyboard skills and with using the mouse and doing the "clicking". They also found the saving and retrieving of information difficult in the beginning. But they are all very enthusiastic. When asked how they were going to use their newly-found skills at Lereko, most said they intended to type their examination papers and undertake the processing of marks. Several expressed the wish to teach computer skills to their learners. They also asked for more advanced skills, such as doing the school's administrative work, preparing timetables and work schedules, typing mathematics papers and drawing geometrical figures.

Conclusion

The TFS has now officially taken Lereko under its wing. Although implementation problems can be expected, the program offers a valuable opportunity to educators at the TFS to serve their local community and, at the same time, gain valuable insight into the problems of implementing information technology programs in a school in a developing community.

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Collaborative Technology Exploration: Bridges Between University and K-12 Education

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Saginaw Valley State University teacher education and content faculty are engaged in a research and development initiative through the United States Department of Education Title II Grant (Teacher Quality Enhancement). One strand, identified for study and implementation by the Title II Grant, is technology. Content Development Teams (CDT's), comprised of participants from the following areas; university content faculty, two per team; university teacher education faculty, one per team; and K-12 master teachers, two per team, are expected to use technology in some manner as a pedagogical tool. Content and teacher education professors and master teachers are engaged in learning about and implementing various technological methods. Syllabi are being redesigned to be placed on a web site created especially for each course. Course web sites will include an interactive component, search engines and other online resources important to the course. CDT members will also be trained to use Blackboard technology and will integrate it into redesigned courses. Our group is curious about the effectiveness of technology as a pedagogical tool in university content and teacher education classrooms and elementary and secondary classrooms. In this process, we intend to re-examine our ideas about student participation, instructor roles, and expectations with technology use.

Our project perspective, therefore, is one of collaborative examination and learning about technology as a pedagogical tool in each of our disciplines. Our aim is to work together, examining various technology options and software, Blackboard, GroupWise, PowerPoint, and Daedalous, in in-service development. We are collaboratively and individually investigating the effectiveness of infusing our various practices with technology. Our data consists of recorded formal conversations from weekly meetings and in-service development meetings. Meetings and collaborative work on multiple strands, delineated by the Title II Grant, take place during fall semester 2000, and winter semester 2001. E-mail communications about Grant technology implementation between our CDT members will also comprise data. Student evaluations of technology initiatives, piloted in winter semester courses, will add a student perspective to our thinking. Individual manuals developed through this process including our collaborative work will add substantively to the data as well.

Preparation of classroom teachers requires teacher educators to construct curriculum that uses technology as a pedagogical tool to teach content and methods (NCATE, 1996; Holmes Group, 1988; Michigan Curriculum Framework, 1997). Collaborative examination of technology incorporation into existing curricula by university content and teacher education faculty and k-12 master teachers will facilitate: rethinking student participation, instructor roles, and expectations in the teaching learning process. Additionally, participants will evaluate the effectiveness and pitfalls of technology as a pedagogical tool while piloting a redesigned course. Lessons experienced and analyzed will benefit other teacher education and content faculty members and master k-12 practitioners.

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