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ABSTRACT

This document contains the following papers focusing on contexts and activities in which teachers can use technology to promote learning with young children: (1) "Read, Write and Click: Using Digital Camera Technology in a Language Arts and Literacy K-5 Classroom" (Judith F. Robbins and Jacqueline Bedell); (2) "Technology for the Tiny: Educational Software and the Young Child" (Sarah E. Irvine and Andrea I. Prejean); (3) "As Commonplace as Learning Centers?" (Joy V. McGehee and Kelly Heckaman); (4) "Creative Computer Contexts: Teachers Building Computer Based Resources for Young Children" (Nicola Yelland and Jennifer Masters); (5) "Joint Ventures: Co-Authored Multimedia Books" (Nancy Yost); (6) "Evaluating Educational Technology: An Invited SITE Panel" (Niki Davis, Mark Hawkes, Walter Heineke, and Wim Veen); (7) "Minorities and Mainstream Culture: Does a Technology Gap Exist?" (Lamar Wilkinson, Walter C. Buboltz, Jr., James Cook, Kathryn Matthew, and Debbie Thomas); and (8) "Technology in College Classrooms: Training Future Teachers" (Carolyn Craig and Mike Omoregie). (Contains 75 references.) (MES)

YOUNG CHILD

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The papers in the young child section this year focused on describing possible contexts and activities in teachers can use technology to promote learning with young children. Without exception the papers draw heavily from principles of practice common in more progressive early childhood education literature.

Judith Robbins and Jacqueline Bedell draw from the new expanded definition of reading to include viewing and representing, to justify the use of digital cameras for use in literacy instruction. Even as representing events in pictures is traditionally done with paper and crayons, Robbins and Bedell suggest the use of a digital cameras. Similarly, whereas viewing activities take place traditionally viewing picture books, television, CD ROM, video and digital cameras provide contexts for critical viewing of information. Children today need to be literate both consuming and producing media.

Also drawing heavily on viewing and representing, Nancy Yost describes a project in which preservice teachers learn to co-author multimedia books with young children. Preservice teachers meet with the professor, review the technological context of the room and finally work with kindergarten students in a series of meetings to write and illustrate their multimedia books.

The next two papers draw on the early childhood literature to describe the teaching and learning of mathematics using technology. Both of the papers on the use of mathematics call into question the blind use of technology strongly encouraging teachers not to sacrifice principles of learning when using technology to teach mathematics. Sarah E. Irvine and Andrea I. Prejean observed computer buddies (preservice teachers) working with different software. They discovered that teachers must consider the aptitude of the children, the difficulty of the program, as well as what the programs allow a teacher to teach. Though adding and subtraction appeared to be common activities in software, Irvine and Prejean found problem solving and reasoning to be less popular activities with software.

Picking right up where Irvine and Prejean left off, Yelland and Masters offer similar criticisms of the existing practice of the use of technology in the teaching of mathematics and provide three specific activities in which teachers make use of problem solving and reasoning. Using web based applications, Powerpoint, and Microworlds, students are forced to be active participants while solving problems in mathematics.

Previous research emphasizes the computer station as a place where young children love to socialize. The final paper describes a study in which children with disabilities demonstrated less sophisticated language and lower levels of play at the computer center than at all other centers. McGehee and Heckaman suggest that perhaps teachers need to be more thoughtful and direct when teaching social strategies when using the computer to learn.

These papers all focus on the importance of considering principles of practice when using technology. Certainly, if these papers are any indication, the importance of teacher thought and subsequent guidance of children when using technology is becoming the major challenge in early childhood education.

Read, Write and Click: Using Digital Camera Technology in a Language Arts and Literacy K-5 Classroom

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Abstract: In today's elementary classrooms literacy education includes teaching about and through various media. In the past, teachers used traditional methods as a means of motivating students to read and write. Students, however, are much more likely to learn through listening and viewing. Consequently, multimedia tools are becoming an integral part of the teaching and learning process. Using the digital camera is one of the simplest ways to accomplish the task of creating and integrating multimedia into the curriculum. This paper will investigate how the digital camera can be used with the young child in the elementary school classroom to promote an understanding of language arts and literacy.

Introduction

The publication of the "Standards for the English Language Arts" (National Council of Teachers of English, 1996) expanded the traditional definition of language arts. In addition to the language modes of reading, writing, speaking and listening, viewing and visual representation has been identified. Further, of the twelve standards, seven incorporate media literacy which broaden the view of literacy to include competence in communication using both traditional print, as well as, non-print media. Specifically, media literacy is "an ability to comprehend, use and control the symbol systems of both print and non-print media, as well as, understand the relationship between them (Cox, 1994, p.13)."

This new focus reflects the complexities of communicating in our continuously evolving technological society. In order to be truly literate, students must learn how to draw meaning from a variety of media sources and understand how electronic and print media interact.

Role of Technology in Language Arts and Literacy

The definition of literacy not only includes the ability to read and write but has been expanded to encompass thinking critically, reasoning logically, and awareness of technology and its impact on a global society (Hunt, 1983). Media literacy is a part of an expanded definition of literacy in general. With the publication of the standards, text has been redefined to include spoken language, graphics, and technological communication (Cox, 1998).

Throughout history concern has been expressed about new technology and the teaching of language arts. At first fear was expressed by orators that writing and print material would relegate speech to the past. While language arts instruction changed with the advent of print, speaking and listening were still considered important basic skills. Today, language arts and literacy professionals voice the same concern about new digital technology. The students of today live in a world where much more information is communicated through listening and viewing. Competent use of media, therefore, becomes essential to effective communication.

While in some classrooms electronic media has been used mainly to motivate students to read and write, in today's classrooms, instruction in both print and non-print texts is vital. Technology, in the form of digital media, is one of the new environments that is capable of focusing ideas for communication though the use of language in formats that include text, visual images, sound and motion. This form of technology provides expanded capabilities for the use of powerful new tools to create, organize and deliver effective communication (Rose & Meyer, 1994).

Cox (1999a) proposes a model for teaching media literacy as part of an effective language and literacy instructional program. She states that experiencing media means students:

1. Use their experiences with media outside the classroom (e.g., print and electronic news, television, advertisements, music, video games, etc.) as a common experiential basis for classroom exploration through talk and writing. Students also gain a more equitable access to language-learning experiences through talking and writing about media events outside the classroom, as well as, print and non-print texts in the classroom.

2. Use their experiences with media in the classroom (e.g., film and videotape, audio recordings, computers, etc.) as a common experiential basis for classroom exploration through talking and writing.

3. Gain a more equitable access to language-learning experiences through talking and writing about media events outside the classroom and both print and non-print texts in the classroom (p. 452).

This model encourages students to analyze various forms of mass media and other symbolic systems to understand and appreciate their structure and effects. It also allows students to create projects using a variety of media, including print, drawings, graphs, diagrams, photographs, and videos (Cox, 1999b).

The Digital Camera

The incorporation of visual images into language and literacy projects in the classroom provides exciting possibilities to enhance creativity and motivate children. Computers, as well as related technologies, give students a wide variety of powers and incentives (Marcus, 1990).

Today, a wide variety of multimedia technologies are available for use in elementary school classrooms. They range from camcorders to computers including digital cameras and scanners. For example, using digital media students can read books on the computer using CD-ROM and Hypercard programs, as well as, write using word processing programs. They can view dramatizations of stories on videotape or laserdisc and create visual representations of stories using Hypercard programs, scan their drawings and add them to books they are writing on the computer. Sound has also been digitized. Students can now add their voices to projects. Interviews, outside resource persons, dramatic productions, and oral histories or other oral reports may be videotaped and added to multimedia productions (Tompkins, 1998).

While digital cameras are one of the newest forms of technology, they have a wide application for classroom use. The majority of these cameras are extremely easy to operate and use the point and shoot method for capturing images. Audio, video and still capabilities are available in these cameras. Several of the newer model digital cameras provide functions that allow the recording of sound and motion. These two media are usually combined in a format that permits the user to verbally describe the action of a particular scene being photographed. The task is accomplished by setting the camera to the movie setting, focusing on the action, and holding down the shutter until the selected action is captured. At the same time, the built in microphone automatically records any and all sound onto the storage device. Still photographs are recorded by simply setting the camera to the still mode, activating the camera and depressing the shutter.

Digital cameras record the still images and motion videos usually in JPEG and MPEG formats respectively on two types of storage media, either flash cards or computer disks, in place of traditional photographic film. Since the formats are basically universal they can be downloaded on any type of computer. Additionally, software to manipulate the image is usually bundled with the camera when it is purchased thus providing a complete package for the user. The cameras range in weight from a few ounces to several pounds. This permits the cameras to be easily handled by young children. Most digital cameras also have a Liquid Crystal Display (LCD) screen that can be used as an indicator for composing a picture. Digital cameras are equipped with an automatic focus feature coupled with a zoom device to permit wide and tight angle focus similar to the controls on a camcorder. These features make the digital camera very easy to use with early elementary school students in a classroom environment.

Because photography is such a commonly used medium and because the digital camera is so easily used by both young and older students, it is easy to incorporate photographic activities across the curriculum. Introducing the concept of photo illustration is easy through the use of children's literature. A list of children's books that use photographs to illustrate text can be viewed at Appendix A.

Benefits of Using the Digital Camera

Use of the digital camera in the classroom provides a number of distinct benefits for students. One of the important benefits is the fostering of the creative process. Through the mechanics of photography students are able to express their creative thoughts and ideas by visual composition. After the photograph is snapped the image can be downloaded and, depending on the application software that is used, the photograph can be manipulated to enhance or change the orientation, color, and size, etc. Along with the creative process, communication is promoted through the use of photographs to illustrate and explain written communication as in an illustrated story. Another benefit relates to correlating visual and writing skills. Students learn to integrate visual images that they have taken and manipulated with writing. Through mastering these skills, photography can be used as an incentive to writing or as an inspiration for stories or other forms of writing. Creatively conceived photographs can also be used to illustrate stories or poems after the writing is completed.

When an activity is designed using a single digital camera, cooperative learning opportunities can be integrated into a collaborative experience where students share ideas, knowledge and skills. In this way the digital camera provides a creative learning experience and promotes the use of socials skills among students.

Teachers can also use digital cameras to document students' projects. Visual, as well as multimedia documentation better represents the information and skills that students have learned. This information easily becomes part of a multimedia portfolio of student work documenting receptive language skills such as listening, reading, viewing and expressive language such as speaking, writing and visual representation.

Conclusion

Multimedia technology is an integral part of teaching and learning in the elementary school classroom. This technology expands the range of language and literacy materials and tools available to teachers and students. The traditional language arts have not been abandoned, but rather expanded through the standards and redefined through technology.

These multimedia tools provide powerful ways through which to learn and therefore, educators must find ways to use this technology in ways that support curricular programs rather than supplanting the programs with technology (Lapp, Flood & Lungren, 1995). Generally children are excited about using multimedia and are enthusiastic about using them in order to creatively express themselves. Through the use of digital cameras, as well as other technologies, media literacy can easily and effectively be incorporated throughout the curriculum as children learn to become competent members of our increasingly complex world community.

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Appendix A

Ancona, G. (1993). Pablo remembers: The Fiesta of the Day of the Dead.. New York: Lothrop, Lee & Shepard.

Ancona, G. (1994). The Pinata maker/ El pinatero. San Diego: Harcourt Brace Jovanovich.

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Hoban, T. (1989). Of colors and things. New York: Greenwillow

Hoban, T. (1990). Exactly the opposite. New York: Greenwillow

Hoban, T. (1993). Black on white. New York: Greenwillow

Hoban, T. (1993). White on black. New York: Greenwillow

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Technology for the Tiny: Educational Software and the Young Child

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Abstract: This paper describes how computer applications (including multimedia software and the Internet) can be used to help young children learn mathematical skills and strategies. The effectiveness of software applications for young children (ages 1-4) were evaluated based on criteria from the National Association for the Education of Young Children (NAEYC) as well as curriculum standards developed by the National Council of Teachers of Mathematics (NCTM). Recommendations for young children who are beginning to explore mathematical concepts are presented.

Introduction

Young children have a wealth of mathematical knowledge acquired through both informal and formal experiences which helps them make sense of their world. They touch, squeeze, and examine everything and these experiences form the beginnings of their mathematics education. Young children construct their own knowledge and learn to think more abstractly with each new rich experience (Kennedy & Tipps, 1994). Developmentally appropriate practice in early childhood education should occur in a rich mathematical environment that includes a variety of mathematical experiences. Parents, teachers, and caregivers should explore mathematical concepts with students so that all will have a foundation for a lifetime of valuing and appreciating mathematics. Kamii (1985) reported that social interaction is important for the construction of logico-mathematical knowledge. Technology can be utilized to provide some rich educational experiences for children. The use of technology has potential advantages, and real disadvantages, and it is the responsibility of teachers, parents, and caregivers to make informed decisions about how they will use children's valuable developmental time. Through the careful selection of software that is matched to the curriculum, early childhood educators and parents alike can enhance children's development of mathematical concepts.

The National Council of Teachers of Mathematics (NCTM, 1989) has described five general goals for K-12 students of mathematics. Educators and other adults should provide experiences so students can: (1) learn to value mathematics, (2) become confident in their ability to value mathematics, (3) become mathematical problem solvers, (4) learn to communicate mathematically, and (5) learn to reason mathematically. Keeping these five goals in mind as young children construct mathematical knowledge will provide them with firm foundations for further study of mathematics.

A rich early childhood curriculum for toddlers, preschoolers, and kindergartners should include explorations and experiences such as the above, in which children are allowed to explore all the processes in both structured and unstructured activities. For example, play time should include the opportunity to make and describe patterns with blocks and other concrete materials and opportunities for students to keep their own charts; recording, for instance how they traveled to school, how many days it rained this week, or who is buying lunch on any given day. The National Association for the Education of Young Children (NAEYC) prepared a position statement in 1996 outlining the use of technology with young children, specifically from ages three to eight (NAEYC, 1996). The criteria for the appropriate use of technology includes the following components:

Technology is age appropriate, individually appropriate, and culturally appropriate.
Technology should be used to enhance children's cognitive and social abilities.
Technology should be integrated into the regular learning environment to support children's learning.
Educators should promote equitable access to technology for all children and families.
Technology should not stereotype any group, and should eliminate exposure to violence.
Teachers should advocate for more appropriate technology applications.
Pre-service and in-service teacher training should be provided (NAEYC, 1996).

Even with the advent of technology, it continues to be critical for mathematical development that experiences with concrete objects form an integral part in the education of young children. Perl (1990) advocates the pairing of manipulatives (three-dimensional objects used for mathematical modeling) with complementary software. In this way young children receive the benefit of both mathematical strategies. For example, their exploration should include concrete items as students predict what pattern comes next in the "Wilbur Worm" software application.

Before we use technology with young children, educational software should be examined and evaluated. Specifically, educational software should meet the criteria established by the NAEYC, and be matched to curricular standards. Additionally, Haughland and Shade (1994) developed a checklist for evaluating software that identifies features that teachers should be sure are included in software, from developmental appropriateness to the ability of the software to "make learning fun". Evaluating educational software should be an ongoing task of teachers and parents, and the software should grow with and maintain the child's interest. The key is matching software to the interests and needs of the children who will be using the program (Shade, 1996), as well as finding software that meets the guidelines developed by NAEYC and NCTM.

Finding software that meets the needs of students and that is matched to educational goals can be an exhausting task for the most energetic teacher or involved parent. During long hours shopping for software in technology catalogs, in computer and toyshops, and on the Internet, teachers and parents are likely to encounter technical jargon, pushy salespeople, and more often than not, a very limited idea of how the software actually performs. Teachers and parents need to truly evaluate software in order to illuminate exactly how it will enhance children's learning prior to purchasing. Sometimes, the most telling information is the actual observation of a child engaged in using the program, and what, if any, developmental appropriate practices are encouraged by integrating this software into the curriculum. In an evaluation of software conducted by the magazine Family PC (Bishop 1998), teachers and parents were enlisted to evaluate eight software products on their age appropriateness, ease of use, and use of color and colorful images. Through this process, the observers were able to gain insight into how the children interacted with the software. In this project, software was evaluated not only on these criteria, but also on the connection to providing children opportunities to experiment with mathematical concepts important to their building of logical-mathematical thinking and rational ideas.

Methodology

In order to evaluate the software introduced in this article, two groups of young children ranging in age from one to four years old were observed using different types of mathematics software. The children were enrolled in the campus' Child Development Center, a daycare program for young children of students, faculty, and staff. The children were grouped according to their ages, one group of children ranging in age from one to two and one half and the other group of children ages two and one half to four. According to the childcare providers in the center, most children had had at least some exposure to computers, either at home or in the center.

During this observation, each child was matched with a computer-buddy, a college student who guided the child as they interacted with the software. A total of 35 students were observed using the various software packages described later in this article. During this project, the authors encouraged the computer-buddy to support and facilitate each child's exploration of the software. While watching the children work with the software, the college students identified elements of mathematical concepts, and each piece of software was evaluated using an evaluation form that incorporated all the elements suggested by NAEYC and NCTM.

Themes Uncovered

During the process of evaluating the software with the children, three main themes emerged.

- Children in these groups had a wide range of abilities with regard to computer aptitude as well as understanding of mathematics. Some children were quite able to hold the mouse with their right or left hand and watch the screen, while others of the same age were not able to perform with this level of eye-hand coordination. For example, one child was using the mouse and came to the end of the mousepad. His buddy mentioned that "Sometimes you have to pick up the mouse and move it around", so the child picked up the mouse and moved it in the air.

- Software designed to teach mathematics, both available free on the Internet as well as commercially available in retail stores, varies widely in terms of technical components (such as graphics and animation) as well as in the software's ability to teach mathematics. Many software applications are available to teach children to count, add, and subtract however, software is limited in the areas of data collection, patterning and communicating about mathematics. In addition true problem solving and reasoning experiences were rarely found in the software that was evaluated in this study.

- When evaluating for young children, the degree of difficulty in operating the software needs to be considered. In this project, each child was paired with a buddy, who helped answer questions like "What do I do next?" When teachers select software for their own classrooms of young children, they need to consider the degree to which the child will need help with the basic operation of the application. As most of these children are non-readers, the teacher should look for software with a minimum of text-based instructions. The degree of eye-hand coordination needed to operate the software needs to be considered, as well as the placement and size of button and "clickable" graphics. The software needs to be carefully examined "through the eyes" of the child who will be using it.

Conclusions

Technology has the potential to enhance the education of young children. Several factors must be considered before using technology with students. Chief among these factors is the appropriateness of the content. Mathematics Software must be chosen carefully so that it reflects developmentally appropriate content that is broad in scope and reflects the spirit of the NCTM Curriculum and Evaluation Standards. As stated by NCTM:

> Knowing mathematics means being able to use it in purposeful ways. To learn mathematics, students must be engaged in exploring, conjecturing, and thinking rather than only rote learning of rules and procedures. Mathematics learning is not a spectator sport. When students construct personal knowledge derived from meaningful experiences, they are more likely to retain and use what they have learned. This fact underlies teachers' new role in providing experiences that help students make sense of mathematics, to view it as a tool for reasoning and problem solving. (1989, p.5)

The implications are clear. Teachers, parents, and care givers must choose software that enables children to question and speculate, to discuss and guess, and to supplement other strategies of exploring content with rich ideas. In addition to the content, how the content is presented in the software must be evaluated. The software must be attractive and pleasing to children. Recommendations by the NAEYC should be used to facilitate the evaluation of software used by young children. On occasion technology has been described as the savior of all educational ills. If we wire a school and provide a lab for students, students' achievement will improve. While it is true that technology can help enhance the preschool and kindergarten curriculum, technology can not cure the ills of education. Technology offers a strategy, with the help of an adult's guiding hand, to optimize the instruction that young children receive.

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AS COMMONPLACE as LEARNING CENTERS?

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Abstract: This paper is a report on the findings of an observational study which investigated the social and language skills of preschool children with disabilities while playing at computer centers. Research in the area of computer use by preschoolers primarily has centered upon children who are developing in a typical manner. Although the literature in this area is limited, there are clear indications that young children demonstrate gains in social development, pre-math, and early literacy skills through computer use. Some studies confirm that typically developing preschoolers frequently demonstrate higher levels of cognitive and social skills while playing at a computer than while playing in typical learning centers. Therefore, the young children who might have the most to gain from computer use are children with disabilities. In this observational study, the verbal and play behaviors of 4 preschoolers with disabilities, while playing at a computer center and a typical developmental learning center, were observed and recorded. An analysis of play behaviors and verbal behaviors revealed that these behaviors did not differ between centers. Suggestions for teacher directed instruction for young children with disabilities while playing at computer centers are discussed.

Introduction

The role of computers in the education of preschool-age children is still relatively unfamiliar territory. Inservice training in computer use continues to be a high priority for preschool teachers who, to date, receive little preservice training in computer use unfamiliar with computers and do not believe that computer use in the classroom could have a significant A survey of major academic publishers' early education textbooks will reveal that few authors include discussions relative to the use of computers in preschool classrooms. Inquiries into the nature of preschool computer use show that much of the software developed for young children is not developmentally appropriate. (Haugland, 1997).

Despite these challenges to the use of computers in preschool classrooms, initial studies in computer use by young children yield optimistic data about the effectiveness of computers as learning tools in preschool classrooms. Yost, (1998), in an action-based classroom research project, revealed that preschoolers in her classroom tended to exhibit higher levels of language, pre-reading, and writing skills while working on a computer than they did while working in typical developmentally appropriate learning centers. Earlier studies have confirmed that computer environments with concrete manipulable events teach pre-mathematics skills as well as interactions with traditional concrete objects. (Clements, Natasi, and Swaminathan, 1993). Furthermore, research continues to provide overwhelming evidence that pre-school children prefer to socialize around a computer than play with it alone. (Clements and Nastasi, 1992). Even children who tend to be social isolates tend to socialize more when playing with a computer. (Clements, 1994). Preliminary evidence, therefore, points to several possible benefits of using computers in preschool classrooms.

Unfortunately, research which demonstrates possible benefits of computer use has not been replicated in preschool classrooms which include young children with disabilities. McGehee (1999) pointed out that, relative to the education of young children with disabilities, the topic of computer use tends to take a back seat to such pressing issues as family-centered service delivery, provision of services in least restrictive settings, and developmentally appropriate instruction. Furthermore, most activity and inquiry into the domain of computer use for young children with disabilities has centered around the need for assistive technologies which facilitate computer access for children with motor and sensory impairments. The 1995 "Amendments to IDEA" (Individuals with Disabilities Education Act) mandated that assistive technologies be made available to all school age children (3-21 years of age) who required them for learning to occur. Thus, the emphasis on assistive technologies had a legal push as well as an educational one. There has been almost no research, however, related to children who have mild or moderate learning problems and their interactions with and around computers.

Although there are many questions which need to be answered regarding computer use by young children with disabilities, none can be more pressing than the inquiry into the potential use of computers in helping to develop language and social skills. Seventy five percent of young children with disabilities who receive educational services in preschool classrooms have been labeled as having a "communication disorder." (U.S. Department of Education, 1996). Communication disorders include such problems as speech and language delays. Another area of significant delay for many young children with disabilities is the domain of social skills and play. These children often experience significant problems in establishing positive peer interactions and relationships. (Odom, McConnell, & Chandler, 1993/1994). Since language development is closely associated with social development in young children, and research has shown that young children will tend to socialize more around a computer, we must begin to focus upon the language and social behaviors of young children with disabilities while engaged with a computer. Furthermore, if pre-reading and writing behaviors of young children without disabilities are enhanced by computer use, then we must determine if we can replicate those effects with young children with disabilities.

The Study

The objectives of this study were, relative to preschool age children with disabilities; 1.Describe, quantify and document social and play behaviors while at a computer, 2. Describe, quantify and document verbal behaviors while at a computer, 3. Describe the differences in social and language behaviors of children while in typical developmental learning centers (e.g.: "blocks" center) vs. the computer center, and 4. Ascertain directions for future research.

We must have an idea of what young children with disabilities are doing at computer centers before we can manipulate variables which might have an influence on language and social development. Therefore, this research focused upon observational data. The researchers began their observations with the question "Will we see differences in children's language and play behaviors while playing at computer centers vs. other centers in the classroom?"

The location of the study was an early intervention preschool class for three and four year olds with disabilities. All observations occurred at times and days convenient for the teacher. The researchers observed and recorded behaviors of four preschoolers with disabilities while in typical learning centers and at the computer center. All of the preschoolers in this study displayed delayed language skills. The behaviors under observation included 1. Verbalizations, and 2. Solitary, parallel and/or cooperative play behaviors. Anecdotal evidence relative to such behaviors as attempts at "reading," "writing," and time-on-task also were noted. Using an interval recording form, observers recorded all verbal utterances and coded the occurrence of play behaviors. Play behaviors were coded "S" solitary, "P" parallel and "C" cooperative. "Solitary" play was defined as any play, which was clearly unrelated to what other children were doing. "Parallel" play was defined as two children playing the same thing (or using the same software while at the computer center together) without interacting, and "Cooperative" play was defined as two children playing and interacting together. All observations were conducted while two children were in the same learning center and the observation ceased if a child left the learning center. The observers focused upon one child at a time even though verbalizations of both children were recorded. Approximately 45 minutes of data for each of the four children was obtained and analyzed.

Findings

Since research has shown that typically developing preschoolers tend to demonstrate more sophisticated behaviors while interacting around a computer center, we had hoped to find that these four preschoolers would demonstrate more complex verbal and social behaviors while at computer learning centers. Analysis of the data from this observational study, however, surprised the researchers. Not only were behaviors unchanged from center to center, there was a slight tendency on the part of two children for less sophisticated verbal and play behaviors while engaged at the computer.

Of the four children who were observed, (J, W, M, and E), two, J and W, demonstrated less sophisticated verbal behaviors while at the computer center than at other centers. J, for instance, demonstrated a "Mean Length of Utterance" (MLU) of 1.5 while at the computer center and an MLU of 2.5 while in other developmental centers. His most sophisticated utterances at the computer center were "My turn" and "Turn page." While in the "housekeeping" center, J's utterances sometimes included three words and included "You hurt me" (to M while she was combing his hair), and "Help me, please." W also demonstrated less sophisticated verbal behaviors while at the computer. His MLU was 2.0 while at the computer center and 3.0 at the art center. His verbalizations while at the computer center primarily consisted of "My turn," and "Faster." On the other hand, when W was playing at the art center, his verbalizations were more sophisticated with regard to both semantic and pragmatic functions, in addition to length of utterance. He volunteered beads with "Here, M… bead," and information, "I do blue, red and yellow." The two other children in the study did not demonstrate differences in verbal sophistication from center to center.

Of the four children in the study, three demonstrated higher levels of parallel and cooperative play while at typical developmental learning centers than at the computer center. While at the computer center, J, for instance, engaged in solitary play 66% of the time, in parallel play 34% of the time, and did not engage in cooperative play. When he was in the housekeeping center, J engaged in solitary play 5 % of the time, in parallel play 50 % of the time, and in cooperative play 45% of the time. W engaged in parallel play for 70% of the time and in cooperative play for 30% of the time while at the computer center. Those figures were exactly reversed in other centers. M engaged in parallel play 10% of the time and in solitary play 90% of the time while at the computer center (most likely because J wouldn't give her the mouse) and in cooperative play 75% of the time while she was in the housekeeping center. E demonstrated higher levels of parallel and cooperative play than the other children at all learning centers.

Discussion

Definitive statements regarding verbal and social behaviors of young children while at computer centers, vs. the same behaviors while in other centers, cannot be made when four children in the same classroom have been the only participants in the observations. Many such observations would have to occur in order to draw any conclusions regarding children's behaviors at computer centers. In addition, there are many factors, for which controls must occur, which might have influenced the outcomes of these observations. Such factors might include familiarity with the items at the computer center (software and/or peripherals) vs. familiarity with the items in other centers (housekeeping utensils, toy refrigerators, etc.), relationships among specific children, or the inclusion of typically developing peers into the scenario. The results of these preliminary observations with regard to computer use by young children with disabilities, however, point to several possibilities. The first possibility is that computers could prove to be a very valuable tool in the acquisition of verbal and social skills in young children with disabilities. The second is that specific language and social skills will not automatically generalize across situations unless certain conditions are present, and the third is that early intervention preschool teachers will need to acquire many more skills themselves in using computer centers as instructional arenas.

Although the children in these observations did not demonstrate the more sophisticated behaviors while at computer centers that the researchers were expecting to observe, it was clear that all of the children were highly motivated to play with the computers. Perhaps the lowered level of utterances and play behaviors at the computer, with most of the children demanding turns and fighting over the mouse, had to do with increased excitement and novelty. These preschool children clearly were excited to be able to use a computer and were motivated to attend, for the most part, to the images on the screen. In fact, there was some indication that "time on task" might have been improved at the computer center for one child. (This would concur with data that suggests that children with autism might have improved attention while at computer centers.) There was nothing to suggest, in these observations, that computer use might be inappropriate for preschool children with disabilities. In fact, it seemed clear that, given appropriate teacher guidance, the computer could be a valuable tool for the instruction of verbal and social behaviors.

It was clear from these observations that the highest levels of social and verbal behaviors possible for children will not necessarily generalize from one setting to another. Special educators have, for many years, insisted that instruction in any skill for children with disabilities must include techniques which facilitate generalization. A discussion of instructional techniques which facilitate generalization in early intervention settings may be found in McCormick and Noonan's Early Intervention in Natural Environments (1993). Early intervention teachers must begin to focus upon instructional strategies which facilitate the generalization of important verbal and social skills for young children.

The third possibility suggested by these observations is that preschool teachers will need to receive more than a new computer with early education software packages if they are to use computers as teaching tools. They will need direct instruction in the use of computers for facilitating the acquisition, maintenance, and generalization of verbal and social skills in young children. As previously mentioned in this paper, there has been very little research which could provide data based strategies for teachers in this area. It is clear that young children with disabilities will need direct instruction in the use of computers and in the necessary social skills to interact with other children while at a computer. Furthermore, teachers will need a clear picture of the cognitive prerequisites required in order to benefit from computer use for children with disabilities. For instance, one little boy in these observations had not made the connection that he could "click" on a picture to make something happen (cause and effect). His strategy for using a mouse was to move it all around the table. It was clear that he did not have an understanding of the causal relationship between the mouse and progress within the software program. Researchers have suggested that one of the prerequisite skills for children's use of computers should be knowledge of cause and effect relationships. (McGehee, 1998).

The approach of the teacher in this study was to command "Share" when the children would fight over the mouse. Generally speaking, this was an ineffectual strategy because the children's interpretation of her command would be to relinquish control of the mouse for about 10 seconds and then grab it back! Teachers need to be clear that children who are not in a cooperative stage of play will not automatically acquire the skills necessary to interact with other children at the computer center. As with all developmentally delayed skill areas in young children, specific skills related to using computers with other children must be targeted and taught via direct instruction.

As we understand more and more about the importance of early intervention in the lives of young children with disabilities, we must begin to develop a clear picture of instructional techniques which enhance early learning and remediate early deficits. If there is, indeed, a possibility that playing with a computer could enhance the language and social skills of children with disabilities, then the implications for preschool teachers and for early intervention research are obvious. Researchers should begin to investigate the pedagogical challenges presented by the special learning needs of young children with disabilities who could potentially benefit from computer use. Early education teacher training programs must begin to include computer competencies for preschool teacher education majors, and school systems should begin to equip all early intervention classrooms with computers and appropriate software. The most important component in this equation, however, is the necessity for teacher training in the unique requirements of young children with special needs for effective learning at computer centers. If and when these issues are addressed, computer centers in early education classrooms should become as commonplace as block centers.

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Creative Computer Contexts: Teachers Building Computer Based Resources for Young Children.

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Abstract: The purpose of this paper is to explore ways in which teachers can use technology to create learning environments for their students. Such contexts are characterised by knowledge building and information exploration, which enable learners to use processes and develop skills fundamental to discovery based learning principles. We have developed a number of courses at the University level which, while the students enrolled in them attend classes on campus, contain resources that the students may need on line and also provide a context in which students can share their work, based in technological environments, with others – both at the production stage for constructive feedback and when completed in order to share their ideas with other professionals

Introduction

A number of government initiatives have been implemented in order to get computers in schools and to coax teachers into using them. It would seem that education for the information age is recognized as important to governments across the world. The United Kingdom has established a National Grid for Learning (NGfL) which will connect education facilities to homes and services such as libraries and museums and all Local Education Authorities are required to develop plans for Information and Communications Technology (ICT) in order to receive funding. The stated priorities of the NGfL are connecting schools with minimum access charges, the development of curricula which will be available on the Grid and supporting the development of ICT in all schools. In Queensland, the Primary computer program ($20 million, 1993 to 1996) provided funds so that year 6 and 7 classes throughout the state could have one computer for 10 students and more recently this has extended "down" to the lower grades so that they may enjoy the same children to computer ratios. In the plan, money was to be set aside for both software purchase and professional development, but in reality many schools spent their allocation on hardware and had to rely on other funds to support the purchases of essential software and professional development opportunities were rare for staff. Since this time numerous other official documents such as the Schooling 2001 Project have reaffirmed government commitment to the use of technology in schools. Yet one only has to walk into a classroom today to see that while technological advances in society have been stunning over the past two decades, the developments in school have been somewhat lagging.

Papert (1996) was scathing in his condemnation of policy and practice in terms of computers in schools:

> The cyberostriches who make school policy are determined to use computers but can only imagine using them in the framework of the school system, as they know it: children following a predetermined curriculum mapped out year by year and lesson by lesson. This is quite perverse: new technology being used to strengthen a poor method of education that was invented only because there were no computers when school was designed. (p.25)

In a similar vein Hawkins (1993) suggested that the discussions about the promise of technologies to improve the quality of teaching and learning in schools has been too narrowly focussed on isolated learning with machines. Hawkins recommended that a new approach characterised by a deliberate emphasis on designing and using technology to improve the organization of schooling and learning opportunities in them, was needed. It was evident that early courses related to the use of technology in classrooms tended to focus on the machines rather than how to use them to support teaching and learning. This was often achieved under the banner of 'computer literacy' when, what teachers really needed was support and ideas of the best ways to incorporate technology into their curriculum and activities that might promote new ways of thinking as well as to enhance existing tasks via technological applications.

Contemporary research (e.g. Resnick, 1987; Scardamalia & Berieter, 1992) has revealed that effective education is characterised by providing contexts in which children can engage with materials and ideas in collaborative and individual learning activities in which they are afforded the opportunity to use artefacts of the culture in an atmosphere of challenge, inquiry, decision making and experimentation. In essence two basic conditions have been extrapolated from the large body of work. These include knowledge about when students learn most effectively, that is:

- when they are motivated and can actively explore materials and ideas, in open ended tasks using a variety of problem solving techniques, and
- when they feel confident that their contribution is valued and they are personally known by their teacher(s) who is sensitive to their individual needs and interests.

Preparing Teachers for the 21st. Century

It has been noted that teachers lack confidence in using technology and identify experience with computers as a high priority in their professional development (Hargraves, Comer and Galton, 1996). Many teachers can use a small range of applications (Murray & Collison, 1995) but are reluctant to go beyond that phase of development. In the United Kingdom the inspectorate have confirmed that teachers lack confidence and knowledge about the variety of applications that are available (Goldstein, 1997). They did however recognize that there were many incidences of valuable and innovative work being carried out by some teachers. These were often related to effective use of graphics packages, yet they were viewed as occurring in isolation. At the present time there are many demands on a teacher's time and the use of the various manifestations of technology rates poorly alongside basic proficiency in literacy and numeracy and the development of skill and knowledge in the core areas of the curriculum. A basic problem remains that technology, and computers in particular, are regarded more as just another thing to cover, than as a device that can enhance exploration and learning. A change of mindset is needed to address this problem.

Teachers have identified both benefits and disadvantages regarding the use of computers in schools (Bliss. Chandra and Cox, 1986). In considering the advantages, those that were mentioned most frequently included the computer being:

- A motivational tool that could promote individual learning
- A statistical tool which afforded opportunities to represent data in new ways
- Able to reform learning as a visual medium

Disadvantages included:

- The limited range of quality applications available which could be incorporated into programs
- Problems associated with access and infrequency of use
- The monopoly of the machines by particular groups of students, such as boys, the most able, and those who also had computers at home.

At the Queensland University of Technology, the undergraduate program that prepares elementary and early childhood teachers is the four-year Bachelor of Education Program. Students attend classes on campus on a full time basis and enroll in a large number of core courses. To some extent electives and choice of majors are limited and defined by demand.

In all of the core units that may be offered to these students, such as MDB385: Information Technology in Educational Contexts, MDB383: Using Information Technologies in the Curriculum and EAB 347: Early mathematical explorations and a number of curriculum and discipline electives, the use of technology is integrated into the content. These courses have on line resource pages that contain lecture content and notes, information about assessment, additional information related to readings and activities associated with them. The web sites also have e-mail discussion lists and are able to be linked to resources that assist in the preparation of assignments.

Examples from Practice

Elementary school teachers are known for their creative production of resources that engage young children's imagination and provide a context for exploration of ideas in new and dynamic ways. While the most common use of computers with young children involves commercially produced software, basically in a limited way to reinforce traditional curricula, the potential of computers to provide exciting and relevant learning environments, that are local in nature, and easily developed by teachers, is largely ignored.

In the Elective unit EAB 422: Technology and the Young Child, which we team teach, we promote the practice of teachers building resources for learning, using technology, that are relevant to their own context but can be used on a wider scale. Subsequently, a major assessment item is the development of a multi media resource for learning that will be used by children in the elementary years of schooling

Our purpose was to use utility software, such as HTML, Powerpoint and the Multimedia application, Microworlds. The resources that were developed were cognizant of key learning areas and were designed to help children work collaboratively on meaningful tasks that were based in a problem solving approach. In doing this, we considered the following issues:

- Educational software is often incompatible with a problem solving approach characterised by active learning and inquiry
- Further commercial software developed primarily in America, is often not appropriate for Australian children. For example those that use US currency, present seasons, flora and fauna that are typical to the Northern Hemisphere and have narrators with an American accent, do not afford the opportunity for Australian children to contextualise their learning.
- Teachers need to be able to adapt their applications as they observe children interacting and engaging with the materials. Such customized learning environments mean that teachers can target needs and interests of individual students.
- The need for children to be viewed as active participants in their own learning processes.
- The use of peripherals such as digital cameras and/or scanners.

The most recent implementation of this unit produced some excellent resources. The students, who were from the third and fourth year of the early childhood teacher education program, used this opportunity to develop effective curriculum teaching and learning stimuli using computer based experiences.

The following extract from the course outline indicates what the students were required to achieve.

> Create a multimedia teaching resource suitable for use with children in the age range three to 8 years. This should be submitted on a 3.5 floppy disk. Provide one page of implementation notes that indicates to a teacher audience:
>
> - the title of your application
> - the age/year level for which it is intended
> - the objectives of the application
> - how the application will be introduced and developed with young children
>
> It is anticipated that your resource will act as one or more of the following:
>
> a stimulus for learning and the development of language
> a problem-solving agent
> a vehicle for introducing writing
> a mathematical environment
> a means of creating pictures and other graphics.
>
> This task addresses objectives 3, 5, 6 of the course.

The format of the task was deliberately left open for individual interpretation by the students so that they could respond in a variety of different ways. Some chose to focus on a theme and then integrate a number of curriculum activities into the resource. Others focused on a stimulus item, such as a book, and then provided information and extension tasks that would engage the learner in specific knowledge and skill building activities. Another approach was to consider a generic activity, such as journal writing, and then create a context for the children to participate in activities in the genre related to a stimulus or theme.

Creating web based applications

Felix Around the World

"Letters from Felix" is a children's book by Annette Langen that tells of the adventures of a lost rabbit who sends home letters to his owner from locations around the world. Two students, Amanda and Melina, built their resource, a web page, around the theme of the book using Netscape composer. They not only developed their own activity pages but also set up links to museums in the locations that were identified and mentioned in the letters that formed part of the story. Their focus was both to encourage children to develop the genre of letter writing, participate in activities related to their program in mathematics and social studies, and also to engage in collaborative problem solving using technology. Additionally, they could also use research centers, that is museums around the world, in virtual contexts to compliment local visits and investigations. (http://www.fed.qut.edu.au/students/n2188031/webpage/felix_p1.html)

Powerpoint

Pirate Stew

Colleen and Gaynor used Powerpoint (Figure 1) to record a visit by Colleen's (practicum) pre-school to a drama production of *Pirate Stew*. The resource provided a context in which the children could record and recall their visit to the production. While on the excursion the students took photographs and later scanned them and created graphics files. These were then integrated into the Powerpoint presentation in order to re-tell the story. The text used in the slides was the "Queensland Cursive Font", an electronic version of the hand-writing taught in schools in the State. Additionally, Colleen retold the sequence of events and used the recording as an audio file attached to each slide and she even sang the accompanying songs. The Powerpoint presentation was then loaded on to the pre-school computer, so that the children could revisit the event during class times.

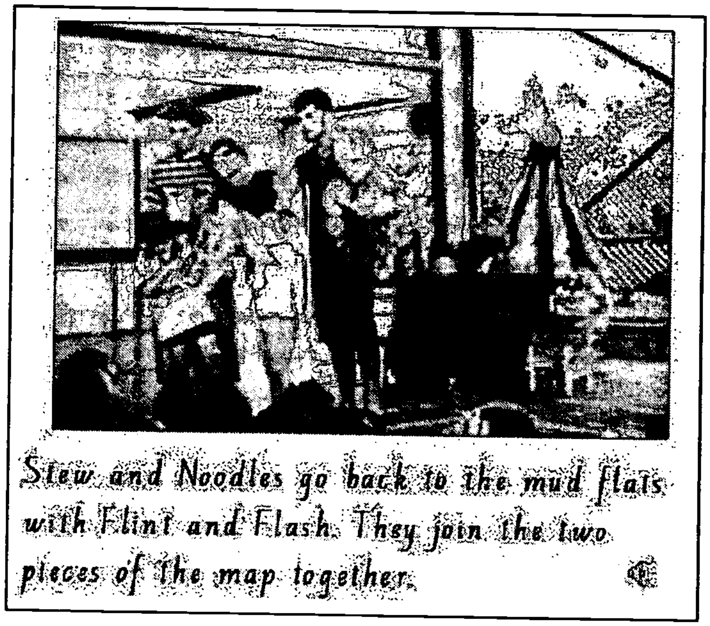

Figure 1: A slide from the "Pirate Stew" Powerpoint presentation

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Microworlds

Happy Birthday, Jane

This resource was an interactive multi-media presentation developed in the "Microworlds" application. Catriona took the popular theme of birthdays and developed a number of mathematical activities which included sorting, counting and patterning as well as those associated with number and spatial concepts. Microworlds has a Logo programming interface, a drawing center, writing capability and the option to incorporate both graphics and sound into the resource. Catriona utilized these functions effectively to produce an appropriate resource. The scope of this project is revealed in the curriculum web reproduced in Figure 2.

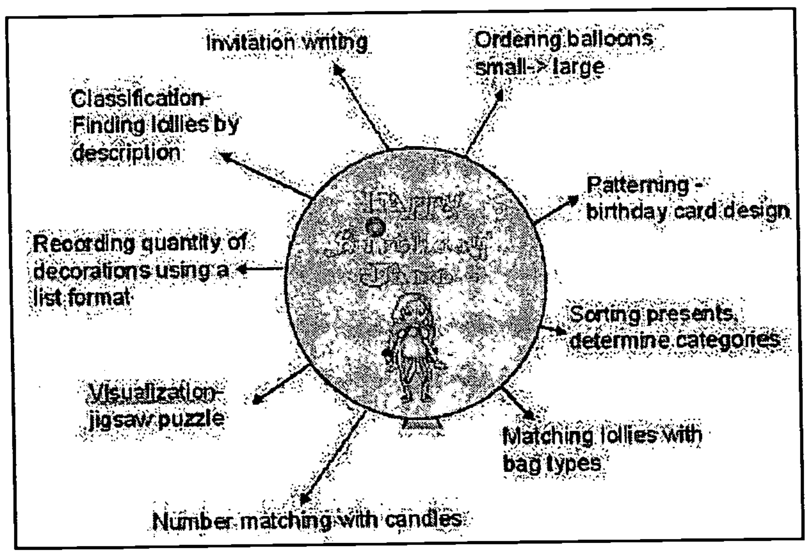

Figure 2: Birthday activities in the "Happy Birthday Jane" resource

Silkworms

Sarah and Tammie used Microworlds in the context of a Science theme to present the life cycle of the silkworm. In accordance with the aims of the University assignment, they made their resource interactive so children could use the environment to record and present information about their own silkworm projects. The multimedia functions of Microworlds were particularly useful in this instance. Buttons were use to navigate through the pages of the resource and by attaching custom designed shapes to the "turtles" on the page, the students could provide objects on the page that the children could move around according to the requirements of the various tasks. For example they could be sequenced to create the life cycle or form the basis of a classification task.

Figure 4 The Silkworms Microworld

Conclusions

Teachers have to be particularly discriminating in their choice, and use of, computer applications and ensure that the primary goal of using the resource is engagement and learning, via active exploration and the deployment of problem-solving processes. Selecting software to incorporate and use in educational contexts is not an easy task. There are a bewildering array of titles that make wild promises about being able to engage children to learn a multitude of concepts and skills. We have attempted to show how this can be achieved with reference to a few specific examples, that have incorporated the use of utility software. We have highlighted applications that are conducive to meaningful engagement with ideas, via the use of technology, and suggested some ways in which educational contexts can be organized in order to achieve mastery over the machine, while motivated by the task and the magic of the moment. In the immediate future the challenge will be to provide opportunities for children to extend exploration in technological environments in more dynamic ways.

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Joint Ventures: Co-Authored Multimedia Books

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Abstract: This paper presents information on how to carry out an assignment that provides pre-service teacher with the opportunity to increase their understanding of how technology can be appropriately integrated into an early childhood curriculum. The multimedia projects utilize PowerPoint, a program the pre-service teachers learn as a part of their studies. The students work collaboratively with other pre-service teachers in the university laboratory school creating multimedia storybooks with kindergarten children. The result is not only better understanding of how to use technology with young children, but an increase in their technology skills and classroom management skills as they work with a small group of children. This opportunity becomes an valuable unscheduled practicum experience.

Introduction

The last several years I have had the unique experience of working with three distinct populations at my university: faculty, undergraduate education majors, and kindergarten children. My primary teaching responsibility is to a classroom of kindergarten children at a university laboratory school. However, for several years a quarter of my workload has been to assist the education faculty with integrating instructional technology into their courses. During one of these collaborations, I suggested that two of the instructors offer a "choice" assignment to the pre-service teachers, one of producing a multimedia storybook with my kindergartners. Drawing upon the work by Nancy Scali (1993) I thought we could create storybooks with PowerPoint similar to those Scali created using Hyper Studio. This has turned out to be a fantastic experience for all involved. This paper will look at the following aspects of how I assist with the coordinate and carry out the projects with the pre-service teachers.

Getting Started

The students begin their project initially when they sign up for the option of creating multimedia storybooks with the instructor making the optional assignments. They might are students in either a children's literature or an educational technology course. The instructors for both of these courses allow lots of latitude in the expectations for the final projects, basically assigning only a due date. Likewise, I have attached no requirements to the assignments. As instructors the three of us have agreed that the intent of the assignment is for the students to learn how technology can be integrated into an early childhood program and that the students will gain additional technology skills.

The next step for the project is to make an appointment with me to visit about the project. I show the students books that have been created in my room, as well in other classrooms. I point out the amount of time people have put in on the different versions of the books. A single student created a book with perhaps 5 hours of work, while others might have 40 hours of work by each of two team members. This project can be a major time commitment for the students and I want them to be aware of this up front. The students can come with little experience beyond turning on the computer up to experienced computer users; this affects the amount of time involved in the project. I explain that I will assist them as they learn to use technology and programs, so they don't have to be familiar with the equipment or programs to do the project. In addition to the time involved increasing their technology skills, the type of book they decide to create and the intricacies involved with it affect the amount of time required.

We then discuss the different ways that books might be extended. We look at re-writing a story, creating a new meaning. Examples of how to build upon predictable stories are examined. I point out how this type of story supports the emergent reader and writer. We look at poems that lend themselves to illustrations. Songs the children know become another option for creating books. Writing original stories are explored also. As we talk, the students begin to see that there are many options, and usually begin throwing out their own ideas. As I present these options, I usually illustrate the type of book being discussed with examples of other multimedia books or books created with traditional materials.

The second part of this initial meeting looks at the type of technology available the students when they create their books. In my room, the students have access to:

- multimedia computers
- a scanner
- a Sony digital camera
- a Kodak video-conferencing camera
- microphones
- KidPix and other drawing programs
- drawing tablets

We now look at the technology skills the student has, and what skills they wish to gain. They are free to use any of the equipment. However, we do examine the project they have decided to do and what might be appropriate options for their particular project. Some book styles lend themselves toward certain combinations of technology use. The students are encouraged to work in pairs. By doing this the student are able to help each other, as well as coming to my student teacher or myself.

The final decision at this meeting is when these pre-service teachers will come into the kindergarten to work with the children. There are certain times in the kindergarten schedule that lend themselves to having small group projects occurring. If these times do not work into the college student's schedule, we look for other options when I can make a group of kindergartners available to work on the book. The students working in pairs may, or may not be actually working with children at the same time. They do come together at other times to pull the pieces together into the final form.

The Project

The students come to the classroom and present their concept to the children. Because of the child-choice nature of my program, the children are invited to participate if they choose. The college students usually end up with a group of four or five students. This makes a nice size group for them to interact with and generally makes a very manageable book. This initial meeting involves reading the book with their group of children and discussing what the activities around the book will be. The children may have input into the type of activities that will happen too. I have prepared the college student for this, and encourage them to attempt to the kindergartners' suggestions. The feeling of ownership is important for the children, just as it is important for the college student.

On a series of visits, the pre-service teachers work with the children creating the illustrations for their individual pages in the book. These illustrations might be created with a drawing program, like KidPix, or they might be done with traditional drawing materials on paper, or a third option is a digital photograph taken by the child for their illustration. When the pictures are completed, I suggest the student visit the room in the afternoon so I can explain how to use the scanner, or how to crop the pictures if necessary. I make sure the student is familiar with using PowerPoint features to create a show, to insert new slides, to save a file, and to insert pictures from files. Since I function in a networked environment, I also explain the network server space. The students save their files to the server so that they can be accessed from any of the three computers in the room or my laptop computer.

The next step for the book is usually to insert text. My kindergarten program is based upon the emergent literacy philosophy. I want that philosophy reflected in the work the children produce with the students. To do this I briefly share Clay's (1975) concepts and principles of print with the students. I have a one-page information sheet that explains the stages of writing development that I share with the pre-service teachers. The students work individually with the kindergartners, supporting their writing at a level that is appropriate and comfortable for the individual child. The kindergartners are encouraged to do their own typing in the text box. However, if the child is not comfortable with writing the student may support in ways suggested by Don Holdaway in Foundations of Literacy (1979). Children might copy from a written text supplied by the college student; or the child might ask the college student what the letters are that go with sounds they don't know; or the child might take turns typing with the college student; finally the child might ask the college student to type for them as they dictate the text. This might be the final step for some of the projects.

Other books might include an audio file of the children reading their individual pages. A brief demonstration is usually necessary on how to use the sound recorder feature of the computers in my room. It then becomes the responsibility of the college student to record the necessary files for their book. Some of the books even include group reading of the title and/or introductory pages. The video camera is frequently used to provide a video clip of the children reading their pages. The pre-service teachers may insert the audio, or video clips, immediately allowing the children to see their page finished. The delight of the children as they hear or see themselves reading their page becomes rewarding for the students.

Final work on the book is often done when the children are not in the room. This allows the student, and me, the time to focus, uninterrupted, on the details of finishing the book. The final details might include a cover page, a project description page, or adding any transitions, timings, or animations.

The pre-service teachers make one last visit to the classroom; this is a celebration of the finished project. There is a group viewing of the finished work, often resulting in a shortcut being added to the desktop so that the children can view the book on their own. Final projects are presented to the college classes where the assignments originate, also.

Conclusions

The multimedia storybooks become meaningful and authentic technology projects for all involved, just as the National Association for the Education of Young Children suggests in their position statement on integrating technology into early childhood programs (NAEYC, 1996). The university faculty members then have a technology integration model to share with their classes with copies staying on the college server in shared folders for future use. The undergraduate students have new technology skills, a portfolio item, and an additional teaching experience with children. The kindergarten children gain new technology skills and lots of one-on-one time with an adult in a literacy project. I get extra hands in the classroom and the joy of mentoring students through an integrated technology experience. It appears to be a win–win situation for all involved.

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Evaluating Educational Technology: An invited SITE Panel

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Abstract
The recent upsurge in the application of educational technology in education, especially teacher education, makes the evaluation of the applications of new technology even more important than before. Billions are being spent on resources for major innovations and even more value is being invested in time and other commitments. A higher quality of teacher education with and for new technologies is sought around the globe, but how do we evaluate it? This panel will discuss a number of issues, approaches and methods. Two members will draw upon experiences in the USA and two on European perspectives. The participants will be encouraged to add perspectives from schoolteachers and policy makers from around the globe.

Questions for the panel

Who should be involved in evaluation of technology in teacher education?
What are the purposes of evaluation?
To whom should evaluations be disseminated and how?
What are appropriate approaches and methods?
Who can and will fund evaluation and its dissemination?

The need for evaluation in teacher education

Recently the U.S. Secretary of Education held a conference on Evaluating the Effectiveness of Technology in Education. The conference was held to explore ways in which educators can better answer calls for accountability by policymakers and to better understand ways of providing feedback to practitioners attempting to integrate technology into teaching and learning. The U.S. Department of Education, Division of Post-secondary Education is currently sponsoring the Preparing Tomorrow's Teachers to Use Technology program through which they are funding attempts to foster innovation in technology and teacher education. This program will be evaluated for overall effectiveness and grantees are being asked to rigorously evaluate their programs for effectiveness.

In Europe there is also and increasing emphasis on evaluation, both to inform future policies and also to justify the apparently large sums of money being spent on information and communications technologies. The European Commission, national and local government are commissioning much more evaluation and looking for reports from many sources. Organizations including commercial concerns and schools are also keen to have the results and some are also prepared to commination evaluation studies, and possibly to influence their design and the messages that they disseminate. Those who pay for research, including evaluation, have a major influence in what, how and when the research takes place and the ways in which it is disseminated. The Keynote talk by Peter Scrimshaw to the UK Association for IT in Teacher Education Research conference in 1999 brought into focus the UK government's literacy and numeracy strategies against colleagues' research in progress. Peter helped us to see the links between funding for research and Government imperatives and the ways in which the two were managed. He noted that agencies that were given the role of implementing government strategies and could also be called into account for not fulfilling the political imperatives. As a result these agencies may tend to be more extreme in their demands to control research and development. And they may also continue to change the aims and objectives of evaluation as their masters (the government) changes its stance in response to popular opinion. There were several murmurs of agreement from those present, many of whom had been involved in national and international projects managed in this way. Peter urged colleagues to take the long view, while responding to opportunities arising from political initiatives, which have within them immediate and interim imperatives.

The Asia Pacific Chapter of AACE at its recent conference in Japan, ICCE'99, showed less concern for evaluation. However, this is probably due at least in part to the relatively recent introduction of technology into schools and teacher education in Asia. However there were some significant studies evaluating teachers needs. For example, in Japan where IT has been introduced only recently Toshiki Matsuda and Natsuko Ishii trialled a teacher training program for teachers new to IT in Japan and found that teachers were unable to apply the criterion in selecting what to teach with technology (Ishii & Matsuda, 1999). And in Hong Kong, where IT is more common although not widespread as yet, Nancy Law and her team's evaluation of the development and delivery of an intensive 120 hour course has led them towards a model of IT training for inservice teachers (Law, Wan, Lau, Lee & Yen, 1999).

Many countries and organizations are looking for is a transition from "isolated skills practice" toward integrating technologies as tools throughout the disciplines. Jan Hawkins argued that in order to realize high standards, education needs to move beyond traditional strategies of whole group instruction and passive absorption of facts by students. New more effective methods are based on engaging student in complex and meaningful problem-solving tasks. Technologies need to be used to bring vast information resources into the classrooms. We need a transition from inadequate support and training of teachers to support for all teachers to learn how to use technologies effectively in everyday teaching (Hawkins, 1996).

Another key evaluation issue follows from the above and centers on the definition of effective technology training in preservice education. For instance, a college of education may be operating under the assumption that the best way to prepare future teachers to use technology is to expose them to and train them in basic computer hardware and software skills. While another teacher education program might believe that a course in the basics does not address the content specific nature of technology applications in teaching in different content areas. Teachers mastering software such as Excel or ClarisWorks does not mean they have mastered the ability to integrated these tools into their instructions. So, evaluators will have to ask: "What is the basic philosophy and underlying theory of technology integration held by program participants?"

This leads to requirements for additional evaluation criteria: What are best practices of technology integration by preservice faculty and, in any program evaluated, to what extent are faculty modeling effective practices of technology integration in their teaching? What are the conditions of these best practices? And finally, what should a preservice teacher be able to do with technology in teaching at the end of her preparation program and in the first years of induction? What would an effective preservice social studies student be able to do with technology? What would an effective preservice math student be able to do with technology? Do the practices learned in preservice training carry over into the induction years?

Policymakers, evaluators and practitioners may have different answers to fundamental questions about the effectiveness of educational technology. Everyone is asking for results of the investment of technology in education. Perhaps the primary difficulty in coming up with new ways of evaluating or assessing the impact of education technology is that there is little consensus about its purpose (Trotter, 1998). Policy makers often work from a cost-benefit model with increases in norm referenced and criterion referenced test scores viewed as the primary benefits. This appears to be at odds with the view held by teachers or by the public that educational technology benefits include: preparing students for jobs, increasing student interest in learning, increasing student access to information and making learning an active experience. These were all rated above technology's impact on basic skills by parents in a 1998 public opinion survey sponsored by the Milken Exchange.

It is therefore important to understand who is paying for the evaluation and for what purpose(s) and to remember that the evaluators and the participants may be 'paying indirectly' in addition to the formal funding agencies. This understanding is important for those involved in the evaluation and to those who 'use' its findings. Readers will be familiar with the need for such a critical reading in other fields, such as when purchasing a new brand of soap powder. Perhaps there has been less readiness to understand the need for such a critical view in education, especially when it is applied to new innovations with technology.

Putting a value on the costs and benefits of educational technology

There are few reports of failures in the research literature, but they can be instructive. Attempts to put a value on the costs and benefits of technology for professional development of teachers and more widely in higher education fall into this category. Niki Davis' early attempts to show the value (positive or negative) are one example.

The strategy adopted was that of an accountant's balance sheet. On one side went the costs of the traditional way of doing the educational activity. One the other side was the cost of the new approach using IT. The resulting balance could show a profit or loss for educational technology. Niki's first attempt for email in 1987 was a dismal failure. Even the committed network of educational email users could not come to an agreement of costs in either column! The second attempt to evaluate the use of ISDN for the professional development of teachers was more successful. The narrowing of the focus, which also drew on case studies, permitted the drawing up of list figures from actual practice. The balance sheet showed a slightly positive monetary value to the use of ISDN digital lines through which professional development was delivered by desktop conferencing (Davis, 1993), but the reliability of the figures and their range could not be expressed well. The supporting commercial companies, British Telecom and ICL, were pleased with the approach, which was coherent with their commercial culture. Educational staff, including managers, were also comfortable with the method and findings and, as I had worked in commerce as well as academia, I too was happy with the relatively simple approach at that time. Working with some staff in business studies we also developed a business plan for a Multimedia Brokerage service for education (Davis & Wright, 1995).

Some years later Niki was awarded better resources for the evaluation of Information Technology to assist in the process of teaching and learning in a research project. The English universities' funding council (HEFCE) chose Niki to lead the project to inform their work and Sir Ron Dearing's review of higher education. The ITATL project had a scant six months for its multidisciplinary and multinational team to gather and model the evidence. The project proposal was from both an educational and an economic standpoint and drew to a limited extent on the USA Flashlight project. In the event the economic view was emphasized by HEFCE (Boucher et al, 1997), although we continued to push for a more educational and qualitative balance to ensure an adequate view of the range and complexity of the use of IT in higher education (Dillon, 1998). The methodology drew upon:

- Literature reviews, educational and economic
- Seminars and focus groups
- Case studies
- Surveys
- Economic modeling in STELLA software

The most important lessons for evaluation of educational technology are that, although we were unable to gather the appropriate data for economic modeling, we were able to explore the changes in who pays for what. The economists wanted to know how much time the various participants spent at various stages and the cost of that opportunity. For example, the university teachers told us that development took a lot of time. What were academics being distracted from? Research perhaps, or was their collaboration enhancing research and other aspects of the work in high education? The question of the amount of time and opportunity could not be answered: staff and students had, without accounting, spent time and other resources. Similarly the educational researchers were unable to put a figure on the improvement(s) in the quality of learning or wider educational benefits, such as transferable skills. Like the earlier attempt at a balance sheet for valuing education technology, the topic was too broad. However we did come up with key recommendations and an early model to develop with higher education staff, which Adrian Boucher continues to work on in the University of Warwick. We concluded that gains in efficiency and/or effectiveness of ITATL could only be identified in a limited number of instances (Boucher et al, 1997):

1. Where a large group of academics agree on course content
2. Where the course content tends to evolve slowly
3. Where IT can produce significant support for the learning process, such as in simulation of an inaccessible process

This is not to say that ITATL is not valuable beyond these pointers, only that it was not shown using the methodology chosen by the economists. To gain the figures for modeling the process requires additional research at the time of ITATL development and deployment. However, it also became clear that the choice to omit IT in teaching and learning was not an option for educational organizations: IT has already become one of the indicators of a high quality institution. The evaluation of educational technology is therefore vital to inform the process, so that cost effective high quality education MAY result. There is a clear need for a range of supporting approaches and methodology that will be accepted by a wide range of disciplines and users, including those in academia and commerce.

You may also note the undercurrents in this description. There were many influences on the processes and outcomes of evaluation:

- the funding agents' influence on the time, approach and dissemination
- the expertise and beliefs of those undertaking the evaluation

- the need for full involvement of the participants, at the very least to assist in capturing the costs of their actions

Formative evaluation with a pedagogical emphasis across Europe

Wim Veen led the evaluation of the European project Telematics for Teacher Training (T3): both formative and summative. Such a project can provide a valuable insight to projects across the world that aim to update and develop technology in teacher training across institutions and across countries in a way which sued the communications technology to facilitate the process of the pedagogy and processes within those institutions.

The T3 evaluation plan was designed for a project that can be compared to a discovery journey towards new worlds in education. We are aware of the rapidly changing technological learning environments, but no one can tell at this stage how this is going to alter educational practice. The T3 project was perceived as similar a journey across new oceans that have never been sailed before, and we were like the sailors who have to adapt their navigational skills to new environments. However, we had substantial experience from journeys in the past: we knew which direction we want to go and we were well prepared for the hazards we had to deal with. There was heavy weather to face, and we did meet some monsters from some faceless bodies. But we were convinced that there must be ways to discover our new educational horizons and we wanted to be among those who model them.

A discovery journey could not be set out in advance in full detail. One of the characteristics of good planning is flexibility. Therefore, our evaluation plan provided us with a clear itinerary, but at the same time we had built-in flexibility, so that changes and amendments could be taken aboard whenever it was appropriate. Although calculations had been made on staffing requirements to match our planned activities, new situations or changing requirements of partners led to matching changes or amendments to the evaluation plan.

The T3 Project

The T3 project (Telematics for Teacher Training) was a three year project which aimed to build an ongoing partnership among a group of university teacher training institutions, each of which was committed to experimenting with the uses of Telematics (communications technologies) as part of their curricular and organizational development strategies. The partner universities were the University of Exeter in the UK (leading partner), Utrecht University in Holland, University of Oulu in Finland; University of Minho, in Portugal; Dublin City University in Ireland; IUFM Grenoble in France; ITD in Genova, Italy, and Ghent University in Belgium. http://telemtatics.ex.ac.uk/T3

The T3 project wanted to raise awareness of the uses of ICT in teacher education and teaching across Europe by providing courses developed at different sites. By means of these courses a common understanding will be fostered of what is valuable and cost-effective enough for teacher education through Telematics. Hence, the core of the project consists of the implementation of innovative teaching practices within the partner universities. These innovative teaching practices included staff development and organizational development of the partners involved. There was an emphasis on action research with the various participating institutions providing case studies from which common themes and issues were defined.

The T3 project took place in an environment in which teacher education itself was subject to significant change. New educational policies were being introduced in many countries, resulting in new roles and partnerships for teacher education institutions and schools. This means that the evaluation of the T3 project itself had to be flexible enough to cope with changing contexts of organizations and curricula.

The T3 approach

The T3 evaluation activities focused on 'case based reasoning' and included data collection through various instruments from the stakeholders involved. A 'multi-perspective illumination' approach (Parlett & Dearden, 1977; Melton & Zimmer, 1987) was adopted focusing on the emerging new teaching practices within the participating teacher education institutions. As the T3 project was an educational innovation project, the process of implementation of the new teaching practices will be described using as a theoretical framework the 'CBAM' Model, the Concerns-Based Adoption Model (Hall, Louckes & Rutherford, 1977).

The foci of the evaluation effort, then, was on:

- formative evaluation of the development and implementation of the new teaching practices using Telematics within the partner universities involved, and
- summative evaluation of outcomes and impact of the project as a whole and of the development of pedagogical approaches for Telematics learning environments.

Identifying the Main Purposes of Evaluation

Prior to the development of the evaluation plan, the T3 evaluation team identified the general principles that guide decisions in spending manpower on specific evaluation activities. In order to involve all T3 partners in this identification of principles and purposes, the evaluation team undertook three initial activities:

- the work package descriptions as presented in the T3 project plan were analyzed.
- preliminary interviews were conducted among the T3 partners. Such interviews are advisable for projects aiming at the implementation of ICT in education.
- a first draft of the Operational Evaluation Plan was presented to all T3 partners and comments received from several of the partners.

Those activities have helped to identify the main objectives of evaluation for the T3 project.

1. To improve performance by helping project partners develop mutual understanding of useful applications of Telematics at specific teacher education institutions and identify generic uses of Telematics in teacher education across Europe.
2. To help project partners to implement the results of their efforts both within their institutions and among the T3 partners. Here, evaluation activities will focus on strategies and experiences of implementation. Dissemination of results outside the project partners will also be a focus of evaluation.
3. To contribute to the overall learning process within the T3 project as a whole that will be useful for future projects and programs.

These general purposes were made operational through various activities such as:

- support processes of information-sharing through videoconferencing, stimulating discussion forums and provision of information on the T3 web site http://telematics.ex.ac.uk/T3
- assisting in progress reviews
- providing support for the overall functioning of the project, in particular the management of the project, through regular virtual meetings with the project coordinator and through data collection using various instruments
- focused studies of the processes of development and implementation within the partner institutions, using a case study approach.
- providing evidence on the development of pedagogical approaches and their usability across Europe.

Stakeholders

A variety of stakeholders had to be considered for the T3 evaluation. These include the people whose involvement and co-operation is necessary for the project to succeed, as well as the people who are expected to use or to act on the evaluation results. Different stakeholders had different questions relevant to the interest they take in the objectives of the T3 project. They also had different views about what was useful and feasible, and how success is to be defined.

The main stakeholders in the T3 project were, in the first place, the teacher trainers involved. It was concluded that evaluation activities should focus on three domains of interest. They are:

- the pedagogy of tele-learning and tele-teaching
- the identification of usability and added value of Telematics in teacher education
- the implementation and dissemination of the uses of Telematics within the teacher education institutions involved.

The second group of stakeholders was the student teachers who will be involved in the tele-teaching activities of the teacher trainers. From case studies performed in different T3 partner institutions, student teachers appear to be critical users, having high expectations of the effects of Telematics on their performance as student teachers. They were mostly interested in immediate results and tend to define the uses of Telematics in terms of supplementary support from teacher educators, ignoring possibilities of self-help and peer-help. It was critical to include this group of stakeholders in the evaluation activities in order to get feedback on questions that are of interest to them and that can improve the range of Telematics used in the teacher training curriculum.

The third group of stakeholders are the T3 sponsoring partners that do not belong to the above mentioned groups. They were the private and public organizations interested in the opportunities of Telematics in learning environments from their specific different point of view. The most important of these was the European Commission, whose call for research had instigated the T3 project and to whom the major reports were submitted for evaluation and acceptance. It was compulsory for the evaluation to include them for identifying their interests and to include their input into an evolving definition and the subsequent evaluation activities.

A Demand Driven Model of Teacher Development

Mark Hawkes feels that there are many reasons to believe that the value of educational technology lies in helping teachers meet the increasingly numerous and complex tasks required of them in the classroom. Were it to purposefully serve teacher needs, technology's infusion into professional development would match teachers' real-life concerns, be available just at the time they need it most, build on the paths that other educators have forged, align with teachers varying skills levels and be ongoing. The use of technology for facilitating teacher learning contrasts with current situations where teachers toil all day with very little intellectual stimulation to learn. Technology opens new avenues for thinking together.

Based on discourse of researchers and other expert groups, coupled with the observation and evaluation results of several professional development products and processes currently being tested, a demand-driven model to teacher development is emerging. This model, though not fully functional in any one site, has features with unique potential to address teacher preparation through and for technology application (Hawkes & Wilber, 1999). The features of this emerging development model relegate technology to a support role, emphasizing the process of improving instructional practice. It is designed to meet teachers' information needs right as they materialize in the classroom. Such a demand-driven system would gather, organize and present a suite of cutting-edge information access and manipulation tools teachers require in their own and their students' learning environment.

A demand-driven/just-in-time approach to professional development engages teachers in reflective understanding of what they do in their classrooms, how they do it, and how they could do it better. It would help teachers narrow in on the topic of their interest and define their research or curriculum questions. In this way, the demand-driven system would help users personalize their own professional development. It would be guided inquiry, available at the fingertips. The system also would mark trails teachers have previously forged so new inquirers can capitalize on that work or even take it in unprecedented directions.

The model is interactive, allowing users to pose challenges, questions or scenarios into a common database. In this way, the system would draw on the intellectual base of experienced teachers. It would recognize these teachers' skill in identifying key instruction process and content issues, and in presenting them in ways that make sense to their peers. This broad-level connectivity is critical to just-in-time technology capacity building. The design would accomplish two essential outcomes:

- It would model collaboration in a way that illustrates how students might be engaged in the learning process, and
- It connects teachers with peers who have vastly differing levels of expertise and divergent teaching beliefs.

For example, teachers who are at different places on the continuum of adoption/application of technology could collaborate on real curriculum issues they face. This could generate opportunities for practitioners to be mentored (via peer coaching or even student-led guidance) during the school day. Similarly, since teachers' approaches to technology use often stem from pre-existing pedagogical beliefs, just-in-time collaborative technology development can address or complement those beliefs at a level familiar to the teacher. As it is developed, the model could expand to meet the needs of policymakers from the school board level to the state house, as well as legislators, parents and others. Providing support to all stakeholders in school reform would enhance mutual understanding of the issues pertinent to each group, thereby facilitating progress.

Broadly stated, the objective of a demand-driven model to teacher professional development is based on intentionality (Jonassen, 2000). This model's ***intention*** lies in knowledge-building. Being so, the emphasis is in linking technology-based solutions to content learning. Because the majority of current discussion around developing teachers' professional capacity centers on the technology—we perpetuate the assumption that technology is something separate from the learning experience. When learning is the object of discussion, however, technology is embedded in the development of knowledge. The demand-driven model of teacher development considers technology to be the means of mediating a form of activity that teachers have not engaged in before. Instead of talking about where and how technology fits into teacher professional development, the dialogue is about what it is teachers want to accomplish in terms of student learning outcomes. The design of teacher development suggested here centers on awareness of the power and application of technology in the classroom, not just a "technology" curriculum. The model implies that professional development should take place every day, all the time. It encourages teachers to work together to collaborate on real curriculum issues facing them and their students.

Implications for Evaluation

Though only a glimpse of the not yet completely articulated demand-driven approach to teacher development is provided here, it is enough to consider how we might go about evaluating such an approach to teacher development. These criteria evolve from the model itself with a specific attempt to avoid becoming a list of fixed knowledge competencies. The rapidly evolving nature of educational and telecommunications technology suggests that fixed competencies are relevant only for the acquisition of general foundational skills (keyboarding, point and click, systems operation, navigating). The criteria presented here attempts to keep teacher and learning foremost.

The criteria listed below are framed as evaluation questions. They are overlapping with an attempt to build some internal consistency between the dimensions. These questions, however, can take a variety of forms and should net be limited by what is asked here. Each criterion is accompanied by brief elaboration.

[redacted]	[redacted]
Provide ubiquitous access to telecommunication tools?	Access to the hardware and software that support change is critical. Interaction in the form of coaching, mentoring, and critical friendship encourage teacher professionalization.
Encourage teacher understanding of the research process?	Much of technology focused and infused professional development is solution oriented. The focus on the research process puts knowledge into teachers' hands through the process of inquiry.
Involve teachers in collaborative, knowledge-building communities?	Leveraged in the right way, the powerful connectivity of network resources can bring teachers together to share collective knowledge on educational policy, subject area, and professional community.
Model authentic, inquiry-based, engaged learning?	New technology tools can help us create the kind of situations where teachers are taught exactly the same way we hope they teach their students. That is, to model the process along with the content.

Offer just-in-time support?	Information is often most useful when it is just enough, just in time. Demand-driven development gets teachers quickly to the point where their students are doing interesting work that is clearly facilitated by the technology. And, it builds skills en-route to the instructional outcomes.
Honor the K-12 teachers' knowledge base?	A quality professional development approach finds ways to reflect back the wisdom of the most talented teachers. Structures are needed (mentor/communication) that pass that knowledge to new generations of educators.
Encourage teachers to integrate and share the documentation of their practice?	There is increasing teacher awareness that documenting practice in the place where they work is an important and powerful tool to help teachers understand how to improve their teaching. Development that not only helps teachers document their practice, but finds ways to make it interchangeable helps leverage relevant knowledge—which is a repeated theme throughout this approach. Evaluators can be of special help here by helping build a common pattern language among practitioners and between practitioners and evaluators for identifying learning outcomes.
Respond to issues unique to the context in which the technology is embedded?	Learning itself contains so many interacting variables that without unique learning goals and benchmarks that measure them, the penetrating effects of the technology may not be fully noticeable.
Show how technology is and isn't capable of facilitating learning outcomes?	Technologies adaptations are limited and knowing those limitations are key to helping teachers manipulate the technology to serve their own and their students learning needs.

Address teachers' personal assumptions about teaching, learning, and schooling?	Most development programs link technology integration to external factors such as administrator support or time to practice. An understanding of how teachers' perceptions about schooling are affected by technology integration is a basis for productive development activity.
Clearly show how other teachers address problems, situations, and opportunities on common occasions and in common areas of interest?	This question inquires after the presence of a dynamic intelligent data base that gathers, organizes, and displays teacher experiences in addressing common issues. A registry of collective, evolving wisdom.

These criteria are not unique to many past and present evaluations. And a few of these criteria have found their way into evaluations of technology programs on a somewhat consistent basis. But taken together, as a set of guiding evaluation questions that target learning experiences as opposed to hours of training on certain types of applications, these criteria are rather distinct.

Summary

The frequent change in evaluation questions addressing the outcomes of technology on teacher development are partly due to the rapid cycles of innovation that technology tools have undergone. This iteration of evaluation questions could likely be the next stage of that cycle. Educators, evaluators, and developers of measurement instruments struggle to keep current with the rush of information needs having to do with technology's effectiveness. By casting key evaluation questions from the vantage of learner and teacher development rather than technology capacity, we may be able to avoid that process that often makes our evaluation questions obsolete. However, the complexity of the task should encourages us to focus and to understand the many layers that make up our complex educational environments. Perhaps one of the most important roles of the evaluation of technology in education is to focus all the actors back into re-evaluating what education could do for whom and whom each may assist during the process of lifelong education across communities and countries as well as within them.

Finally, the last year or two has marked a recent shift in schools' focus on technology, in the western world. Where once the emphasis was on building and implementing a technology infrastructure, today it is on evaluating the effectiveness of its use in school and classrooms. Parents and teachers, school boards and administrators, governors and state legislatures, and world governments all want to know if their nation's investment in technology is providing a return in student achievement and teacher development. The pressure is on to show that technology has a positive impact on what students learn and how teachers teach.

Changes in Evaluation Practices

Walter Heineke notes that evaluation means many things to many people. According to Glass and Ellett (1980) "evaluation- more than any science- is what people say it is, and people currently are saying it is many different things" (cited in Shadish, Cook and Leviton, 1991, p. 30). Experts on program evaluation (House, 1993; Schorr, 1997; Shadish, Cook and Leviton, 1991) all indicate that program evaluation have undergone a major transformation in the last three decades, at least in the USA. It has changed from "monolithic to pluralist conceptions, to multiple methods, multiple measures, multiple criteria, multiple perspectives, multiple audiences, and even multiple interests. Methodologically, evaluation moved from primary emphasis on quantitative methods, in which the standardized achievement test employed in a randomized experimental control group design was mostly highly regarded, to a more permissive atmosphere in which qualitative research methods were acceptable (House, 1993, p. 3). The most fundamental shift has been away from a blind faith in the science of evaluation and experimental research methods based on standardized test scores. These changes in the practice of evaluation have significant implications for questions about the future of the evaluation of technology in teacher education.

It is clear that teaching and learning processes are complex systems. The challenge is to develop evaluation models that reflect this complexity. Just as technology has caused us to reevaluate the nature of knowledge and instruction, it prompts us to reevaluate the forms of evaluation that are brought to bear when examining educational technology. According to Schorr (1997) we need a new approach to the evaluation of complex social programs, one that is theory-based, aiming to investigate the project participant's theory of the program; one that emphasizes shared rather than adversarial interests between evaluators and program participants. This new approach should employ multiple methods designs and aim to produce knowledge that is both rigorous and relevant to decision-makers. In order to accomplish these tasks it will be necessary to design evaluations of technology based on the experiences of evaluators, the experiences of program developers, "state of the art" in the field of technology, and learning and the various program descriptions.

Many argue what are needed more than anything else are a new set of learning outcomes for our students. New learning outcomes must clearly focus on the demands of the New World environment. We need students who can think critically, solve real world problems using technology, take charge of their life-long learning process, work collaboratively and participate as citizens in a democracy. Experts in the area of technology and education such as Jan Hawkins and Henry Becker have developed ideas that could be developed into criteria for new ways of thinking about technology, teaching, and learning. These new learning outcomes could be translated into learning benchmarks and new types of assessment and methods for measuring outcomes could be developed to measure these benchmarks.

Key questions for the evaluation of technology in teacher education center on the extent to which preservice faculty model best practices of technology integration and the competencies of preservice teachers to use technology to effectively tie content to teaching methods at the end of their preservice experience and in the first years of induction. Are teacher educators and other faculty modeling best practices and are preservice teachers learning them and using them? Evaluation must also measure the impact of these practices on the learning of elementary and secondary students.

Implementation analysis becomes important under these conditions. With all of these complexities, the effects of technology on student outcomes may not be measured in the short-term evaluations because they are not yet evident. Evaluation must take into account that different institutions and faculty are in different phases of integration of technology, including:

- Purchasing and installing hardware and software
- Training faculty
- Integrating technology into the curriculum and instruction, especially content methods courses
- Evolution of the institution and the program within and beyond its traditional boundaries

Recommendations

We need to take a formative approach to the evaluation of technology in education, because of the rate of change in technologies. Technology changes quickly while faculty and teachers are often asked to keep up and integrate new ideas at the same pace. The definition of the innovation within education is thus constantly at issue. We must spend time documenting the program that may be changing over time.

In order to get at the complexities of these processes multiple measures (quantitative and qualitative) should be used. These should include traditional experimental and quasi-experimental designs and include such methods as paper surveys, email/Web-based surveys, informal and in-depth interviews, focus group interviews, classroom observations and document analysis. Evaluation design should incorporate longitudinal studies of cohorts of students over several years. In addition evaluation designs should rely less of participants self-reported attitudes and more on observations of participants actions within learning contexts. Research and evaluation needs to demonstrate the potential of educational technology but in a way that attends to the layers of complexity that surround the processes. We need to include a wide variety of experts and stakeholders in the process of evaluation of technology in teacher education.

Dissemination of research including evaluation

One final point is that we can evolve new ways to disseminate our research to practitioners and involve them in the process. In the USA Hans Becker has created a web site and disseminated his research through conferences of researchers and practitioners.

He asks his audience for additional evaluation questions to further analyze his evidence gathered for a large study of teaching with technology in the USA is collaboration with Margaret Riel.

A new example currently from Europe is the ICT Educational Research Forum created by a team led by Niki Davis with the educational research community and practitioners in Europe (so far) at http://telematics3.ex.ac.uk/erf
This web site supports leading researchers to make presentations of their research to users, with practitioners as a high priority audience. Users are also encouraged to become involved in the discussion and process of research (Davis and Tearle, in press).

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Minorities and Mainstream Culture: Does a Technology Gap Exist?

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Abstract: The current technological revolution occurring in society is making vast amounts of information and opportunities available, but only for those who have the ability to obtain and make use of it. With the tremendous technological changes occurring the question remains: Will all individuals have the opportunity and abilities to take advantage of this new developing phenomena? Current research indicates that not all individuals will have the opportunity and/or abilities to take advantage of this technological revolution. Due to the current and potential future impact that technology will have, the technology gap that currently exists should be of utmost concern for educators, policy makers and the general public. Based on the current evidence of the existence of a technology gap the primary purpose of this paper is to examine the current state of affairs and provide some basic interventions that can be employed to help eliminate the technology gap.

Introduction

The use of and access to technology and it associated components continues to grow in today's society. America appears to be in the midst of another revolution, namely a technological revolution that is transforming all segments of society to some degree (Kennard, 1998). Most researchers and lay people alike would agree that advances in technology and computers are altering people's lives in many different ways. These technological changes are altering how individuals work, learn and play, as well as, increasing productivity and making available new ways of communicating and accomplishing daily tasks of life. Individuals who have access and have acquired the skills and knowledge necessary for high technological competency will have a distinct advantage in this new technological society compared to those who do not possess the skills and knowledge (Carver, 1994). The current technological revolution is making available vast amounts of information, but only for individuals who have the ability to attain and make use of this information. With the tremendous technological changes occurring in society the question remains: Will all individuals have the opportunity, demographic and personal characteristics to learn and take advantage of this new developing phenomena? Current research indicates "No" and that there is a digital divide occurring between segments of society. Malveaux (1998) posits that there exists a technology gap between young people who have access to technology in their education and those who do not. Additionally, she notes that there is a technology gap between ethnic minorities that may have serious implications for their potential education and work. Due to the tremendous impact that technology is currently having and will have in the future, this technology gap should be of utmost concern for educators, government policy makers and the general public. Based on this disheartening information and evidence, the primary purpose of this paper is to examine the current state of affairs of minority (African American) technology use. As well as provide some basic interventions that can be employed to help eliminate the gap that appears to be growing in the use of technology and technological competency.

Current Findings

The National Assessment of Educational Process (NAEP) in 1983 indicated that there are ethnic differences in terms of computer and technology use in favor of Caucasian Americans. Martinez and Mead (1988) examining the results of this survey noted that the differences concerned access to computers in schools and at home, as well as, ethnic differences in computer competencies that favored Caucasians. In 1984, 27% of Caucasian students had a computer at home as compared to 11% of African American students. However, overall African Americans were not statistically different in their level of access to technology and use of computers. The authors note that African Americans may be accessing technology outside of the home. However, it should be noted that this finding has not been replicated in other surveys examining computer use and access by different groups. When economics were taken into account, it was found that African Americans in economically disadvantaged schools did not receive or have access to computers and technology comparable to Caucasians at affluent schools (Webb, 1986). Furthermore, African American students were exposed to computers for remedial purposes, while Caucasian student's were exposed to computers to emphasize and enhance computer literacy. Kominski (1991) found that in general Caucasian students experienced significantly higher levels of school computer use than African American students. A 1993 survey of 55,000 American households found that 25% of African Americans were using computers and interacting with technology compared to 38% of Caucasian Americans (Evans, 1995). Other national surveys show that a large proportion of individuals (20% of Caucasian Americans and 40% of African Americans) do not use a computer or interact with technology at all. Additionally, a 1994 Commerce Department report showed that only 19% of African American households had a computer compared to over 40% of Caucasian households.

Student Use

Focusing specifically on students interacting with, learning and use of technology the numbers become even more discouraging. Resta (1992) found that African American elementary students were more than three times as likely as Caucasian students to attend schools that did not have computers or access to computers and technology. Hoffman and Novak (1998) found that over 70% of Caucasian students owned a computer while only a little over 32% of African American students owned a computer. Furthermore, adjusting for household income the difference remained. Other data has shown that in general African Americans have less access to computers and technology than Caucasian students (Wenglingsky, 1998). When we examine the state of affairs for college students the picture is somewhat more complex. Several studies (e.g. Kahn, 1997; Hoffman & Novak; Resta) have indicated that African American college students have less access to technology and thus interact and use technology less. However, it should be noted that for students who had been exposed to computers and owned a computer, interaction with and use of technology was similar between Caucasian and African American students. A finding of interest is that for individuals who did not own a computer Caucasians were more likely to seek out and use technology compared to African Americans. A possible explanation posited in the literature for this finding is that African Americans have a general distrust of technology and perceive a connection with computers, Internet use, and technology with an invasion of privacy (especially tracking of ethnicity) more than Caucasians (Ervin & Gilmore, 1999). Research results indicate that there may be a difference in the use of technology and computers between ethnic groups. Resta asserted that minority students were more likely today to use the computer in rote drill and practice learning fashions; and, that these methods stemmed from efforts to improve performance on standardized tests. Additionally, Wenglinsky found that African American students were not exposed to higher-order uses of computers, as were Caucasian students, and, in fact he found that African American students were more likely to be exposed to lower-order computer uses than were Caucasians. Finally, research appears to be indicating that ethnic groups differ in how they use computers, technology and their level of technological competency. Hawkins and Paris (1997) found that African American students tend to use computers when required, while Caucasian students tend to use computers and technology for various tasks. Also they found that Caucasians tend to be multi-platform users, while African Americans were not. Along these lines assessment conducted by the Educational Testing Service (ETS) found that African American high school students had much lower levels of computer competence than Caucasian students in general. In fact, results showed that Caucasian students had an advantage over African Americans at the third, seventh, and eleventh grades. Roach (1998) posited that there is evidence that African American students come to college with not as much active computer use and competency in the use of technology as Caucasian students.

The U.S. Department of Commerce (1998) report on Telecommunication and Information Technology Gap in America shows significant and dramatic gains in American's accepting technology. Overall, the report found that the number of Americans connected to the nation's information infrastructure is soaring. However, this report also noted that "digital divide" still exists, and, in many cases, has widened over time. Minorities, low-income individuals, the less educated, and children of single-parent households (particularly rural and central cities) are among the groups that lack access to information resources and opportunities to develop technological skills. As can clearly be seen the opportunity for African Americans and other groups to interact with and learn the basic skills of technology (computer use) is limited at this time compared to Caucasian Americans. At the current time the literature is unclear as to the cause(s) of this difference. However, it is important to realize that African American and other groups are less likely to use technology and be prepared for competition in the new educational and informational age (Malveaux, 1998). The impact of this less preparedness has not been totally felt at this point and future research will need to more closely examine the impact of being technological unprepared. In 1995, a report by the United States Department of Education showed that African American students were 30% less likely than Caucasian students to have computer Internet access in the classroom and to be exposed to the new information superhighway. Malveaux noted that computer access was a key to developing technological competency and proficiency, but also basic skills and literacy are equally important. Although, we need to change our focus to some extent in education to focus on technology to make individuals competitive for the future work world, at the same time we can not forget the basic of education. The best possible solution at this time would appear to be for educators to use technology to teach and have students learn basic skills and knowledge. By using technology to teach basic skills educators would not only be educating the youth of America, but also would be exposing and helping students develop basic technological competencies that would allow them to thrive in the new information age. Based on the current research and implications for the future, America is in error if it does not address the ethnic technological gap that exists and appears to be widening. Hoffman and Novak (1998) posited that if any sector of American society is denied equal access to technology and Internet use, the businesses of the United States will lose their competitive edge in response to the lack of technological skills and competency in the work force. They have emphasized the critical need of improving educational opportunities for African Americans and other minority groups to provide for their participation in the information revolution.

Interventions

The U.S. Department of Commerce (1998) report believes that schools and libraries might prove to be the great equalizers in the quest for technology literacy. This nation needs to continue to increase its outreach efforts, especially directed at the information disadvantaged. Clearly, we are standing at the doorway of a segmented society, those that have the knowledge and skills to make use and benefit from technology and those that do not possess the knowledge and skills to take advantage of this new technological revolution.

The question now turns to how as a society are we to rectify this problem. Several suggestions have been posited for improving African Americans and other minority groups use of computers and technology. Minority students need more points of access and encouragement to use them in all phases of their lives. One possible help in this endeavor is the development and implementation of Community Access Centers (CACs). A CAC is a locally operated computer and technology center that provides basic training and access to technology (e.g. Internet access). Currently, many CACs are within schools, libraries and other public facilities with preliminary results show that CACs are well used by those groups that lack access to technology at home or work. Providing public access to the Internet and technology will help individuals and groups advance economically, as well as provide them with the technological skills to compete in today's digital educational and economic environment. Although, technology education and its use can occur anywhere it appears to be essential that computer and technology education take place in schools and be applied to all learning experiences, especially as the world outside of education is becoming technology heavy. To ensure the participation of all Americans, but especially minorities in the information revolution, it is critical to improve educational opportunities for African Americans since African Americans appear to have a disadvantage in accessing technology and personal computers. In conjunction with this mentoring services for disadvantaged individuals may be beneficial in improving the technological skills and technological usage of disadvantaged individuals and groups. At the same time it is essential to encourage and support all students, especially minorities to seek computer literacy and technology based skills, in addition to reading and writing, as an indispensable tool of education and empowerment (Hawkins & Paris, 1997).

In education, exposing African Americans to meaningful computer technology experiences, not just drill and practice will enhance computer literacy (Carver, 1994). To provide meaningful technological experiences, the school must ensure that school computers and technological resources are available and that they change with technological developments. Additionally, schools must provide access to technology and revise curriculum and teaching methods using technology to meet the needs of students. Teachers who promote meaningful engaged learning through authentic uses of technology provide students with vast opportunities to interact with a wealth of resources and technological materials. When educational technologies such as the Internet and distance education are used at the classroom level to help achieve challenging educational standards, they provide powerful alternatives for creating more effective learning environments and more productive learning opportunities. As schools, districts, and other organizations develop and implement technology plans they clearly need to emphasize equity. To ensure that all individuals have equal access and opportunity there are three strategies that can be employed to ensure that all students have access to technology that supports meaningful learning of material and development of technological competency. First, equipment and wiring needs must be determined, such as hardware, software, and a networking infrastructure that supports a technology integrated curriculum. Second, appropriate funding must be secured not only to cover initial costs, but also for the ongoing costs of maintenance and technological assistance. Finally, there must be professional development for educators, so that technology is implemented in the classroom in meaningful ways and contributes to the attainment of high standards by all students.

Additionally, several suggestions to remedy the lack of computer competence of minority students have also been proposed by Resta (1992). Resta states that access to computers and technology with training in the appropriate use, should be a major effort of public schools. States must fund and develop plans for acquisition and distribution of technological and computer resources in an equitable manner. The federal government should integrate computer education and technological needs into existing programs. At the college level, technological competence can be enhanced by providing special programs and summer camps for minority students, sponsoring after school sessions, tutoring, and increasing the school and college counselors' awareness of computer competence for the minority student. In working with students as they prepared for making decisions about the world of work, counselors can enlighten students to the importance of gaining technological competency to be competitive in the world of work in the future. Also, training and technical assistance to minority students entering college should be provided. Along these lines, funding programs should be established to assist individuals in purchasing computers and gaining access to the new technologies that are available. Inservice training for teachers (with focus on under prepared populations) may be beneficial as a way to help teachers be comfortable and effective in using the new technological tools for learning. It also may be the time that teacher education programs devise curriculum for teachers that not only incorporate technology into the learning process and how to use technology to teach, but also provide preservice teachers with the skills and knowledge to teach technological competency to students. Teachers need to be comfortable with technology and have the prerequisite skills to be able to teach technological competency to others. This point can not be stressed enough as we move full steam ahead into a digital world. Additionally, the recruitment of minorities into teacher training programs, outreach programs, support for research and development in technology may lead to more opportunities for minorities to gain valuable experience with technology and its many components.

Summary

Computer access can democratize educational and economic opportunity for all Americans and it must be recognized and developed (Hawkins & Paris, 1997). It is of utmost importance that educators, policy makers and the general public ensure that equal access to technology and computers is made available. It is possible the without equalization of technology between groups the technology gap may continue to widen and lead to a segmented society with it many inherent problems. With, initiation of educational programs, moving technology into classroom's and other programs focused on technology integration into individuals lives may lead to a closing of this technological fissure and allow all individuals the opportunity to be competitive in the educational and work realms.

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Technology in College Classrooms: Training Future Teachers

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"Abstract"

In order to "make it happen," pre-service teachers and their professors need to know the who, what, when, where, and how and then have the courage and motivation to "just do it!" as it relates to using technology in the classroom. This capacity building project was funded by the US Department of Education to help college professors to do more than just "talk the talk" and move to "walking the walk" by modeling effective use of technology since we tend to teach the way we were taught. This model for implementation reports the research-based development of the project and documents where-we-are-now in the process via a video presentation.

Introduction and Background

"Two million new teachers will be hired over the next decade. Will these new teachers be comfortable and skilled in using technology? What will it take to transform schools of education so that faculty feel comfortable emailing students, using listservs for projects and instruction, and introducing candidates to soft-ware that enhances instruction? As technology moves from the periphery to the center in P-12 schools, so must it move from the periphery to the center in teacher preparation," states Arthur Wise, President of the National Council for Accreditation of Teacher Education (NCATE), in a report on the needs for technology in teacher preparation programs (1997, p.v).

In efforts to support this stance, NCATE has adopted special performance criteria developed by the International Society for Technology in Education (ISTE) and is developing expanded standards of their own, due out in 2000. The ISTE criteria state the foundation standards for all teacher education students to include the following core principles:

A. Basic Computer/Technology Operations and Concepts. Candidates will use computer systems to run software; to access, generate and manipulate data; and to publish results. They will also evaluate performance of hardware and software components of computer systems and apply basic troubleshooting strategies as needed.
B. Personal and Profession Use of Technology. Candidates will apply tools for enhancing their own professional growth and productivity. They will use technology in communicating, collaborating, conducting research, and solving problems. In addition, they will plan and participate in activities that encourage lifelong learning and will promote equitable, ethical, and legal use of computer/technology resources.
C. Application of Technology in Instruction. Candidates will apply computers and related technologies to support instruction in their grade level and subject areas. They must plan and deliver instructional units that integrate a variety of software,

applications and learning tools. Lessons developed must reflect effective grouping and assessment strategies for diverse populations.

Sincere we tend to teach the way we were taught, the philosophical basis for this project is for college faculty to model the use of technology. This is supported by many including Parker (1997) when he states that, "Faculty must engage in active collaboration in planning for the systematic, ongoing integration of technology. They need to model a multi-faceted approach including critical thinking and reflection."

However, higher education faculty members are slow to embrace the use of technology. In a report by SEIR*TEC (1998) the research of several authors is reported on this topic. "Many are ill-prepared, use it inconsistently, and thus do not provide a positive model for technology integration (Northrup & Little, 1996). Another reason is that university faculty report that they have to concentrate on more traditional forms of productivity rather than on technology-based projects (Seminoff & Wepner 1994). Other reasons for lack of infusion identified are limited equipment, lack of training, no clear expectations, lack of funds, lack of time, doubt about pedagogical validity, lack of technical support, lack of appropriate materials, and absence of clear goals (Topp, Mortensenm, and Grandgenett, 1995: Baron & Goldman, 1995)."

The SIER*TEC (1998) report continues, "Other studies have found that when some of these barriers are broken, faculty still do not use technology. For example, King, Harvey, and Moller (1997) found that making an innovation available does not guarantee its use. They found the one-on-one help appears to be the most effective strategy. This is in keeping with the diffusion theory, which holds that face-to-face communication is the most effective way to persuade someone to adopt an innovation. This study also underscored the findings of other research studies with conclusions that if faculty members are going to use technology, they must feel confident that it will work properly. When something goes wrong, faculty should be assured that they can find help."

Finally, it is important to incorporate into any effort the lessons learned from past efforts. A second SEIR*TEC document, (1999) itemizes these based on their research:

1. Leadership is the key ingredient
2. If you don't know where you're going, you'll end up someplace else
3. Technology integration is a s-l-o-w process
4. No matter how many computers are available or how much training teachers have had, there are still substantial numbers of educators who are "talking the talk," but not "walking the walk"
5. Effective use of technology requires changes in teaching; in turn, the adoption of a new teaching strategy can be a catalyst for technology integration
6. Each school needs easy access to professionals with expertise in technology and pedagogy
7. While many of the barriers to using technology to support learning are the same for all poor communities, some populations have additional issues
8. In some schools, infrastructure remains a serious barrier to technology adoption

9. Educators can benefit from tools that help them gauge the progress of technology integration over time

Methodology and Results

There were three components of the research effort to develop the grant proposal:

First, a questionnaire was given to 146 junior and senior students in an assessment course required of all education majors. Three questions were posed:

1. Rate yourself on a scale of 1 to 5 for being able to use technology as a tool of instruction in the classroom
2. Rate your college professors in the School of Education on a scale of 1 to 5 on their use of technology as a tool of instruction in the classroom
3. List the ways you have seen technology used in your coursework in the School of Education.

The results on questions 1 and 2 were mostly one's (the lowest) and some two's. Question three yielded such responses as VCR's, word processing, software demonstrations, Internet searches outside the classroom, and a few power point presentations.

Second, interviews were conducted with faculty members about their use of technology in the classroom. (The faculty members involved in teaching the instructional technology courses were purposely omitted.) The resulting comments were rich in content—all really wanted to do more and learn more but obstacles kept getting in the way. Obstacles cited were: No equipment in the classroom (labs but none in the classroom), no time to learn and prepare, nobody to help if something goes wrong, and no real "push" from administration. They also reported that although many of their students are required to make presentations and do projects that require the use of technology, that they themselves are not "into" it much.

A third component of the research involved talking to current teachers in nearby school districts and to technology staff at the State Department of Education. This was done in an effort to find out what training had been offered to current in-service teachers, how much technology was being used in K-12 classrooms, and what would new teachers be expected to know when they entered the workforce. We found a tremendous gap in knowledge and training between university personnel and current in-service K-12 teachers. School district administrators interviewed said that they expected new teachers to be ahead of their "older" teachers in the area of using technology in the classroom, but were disappointed more often than not.

Project TiCC—Technology in College Classrooms

Thus the development of the proposal set out to really "make it happen" in four targeted courses each of five universities/colleges. 8 objectives were developed to eliminate the obstacles that stand in the way of infusing technology and build the support necessary to promote the efforts of faculty to become more proficient in using technology as a tool of instruction. Activities were developed to foster the implementation of the objectives. Those objectives and activities are discussed below:

(1) develop collaborations—by establishing an on-going communication effort using a variety of strategies and providing a contact person (to receive stipend) at each institution to coordinate and foster collaboration efforts. Methods of communication include a videoconference, a newsletter, a listserve, and the development of a web page designated to the project. (Misery really does love company, and with proper care and feeding can learn and travel better together.)

(2) build knowledge base—by hosting a technology infrastructure summit and developing a resource center at each university. The purpose of the summit is to provide education faculty with knowledge of what already exists in the state as it relates to infrastructure resources. So often this information simply does not filter down to the faculties in schools of education. The resource center will provide documents, books, curriculum suggestions on the use of technology in the college classrooms. (Got to know how to get there from here.)

(3) furnish access—by reviewing and updating technology plans and purchasing equipment needed in the classroom. At the participating universities, there was not a well designed technology plan for the schools or divisions of education. Each of the universities had an overall technology plan for the whole university but needed the time and motivation to develop a plan more specific to the needs of the faculties of education. Expertise in writing such plans is a necessary prerequisite. (A roadmap and car filled with gas are necessary components of the trip).

(4) redesign curriculum—by using the expertise of consultants to incorporate specific strategies that align directly to course objectives. Very often the faculties reported that they just did not have the time to find out what to do or when they did know what to do, they didn't have the time to make it specific to the objectives of the course they were teaching. In addition, this project will develop a new course for students that focus less on mechanics and more on application in the classroom. Plans include designing this course around ISTE and NCATE standards that are part of the discussions about setting technology standards for future teachers that will be required for certification. (The roadmap needs to one printed rather recently if it is going to contain all the possible routes--hasn't somebody made this trip before?)

(5) train faculty—by building on and adding to the successful training currently supplied to K-12 teachers. We found a tremendous gap between training that was supplied to K-12 teachers in our state (by the State Department of Education) and the training provided to college faculty. Past efforts to include college faculty in these training sessions were turned down because of space , time, and money. By providing the training to college faculty they will be more knowledgeable of what current teachers are expected to know, thereby they can better prepare the future teachers they are training. (Got to know what I don't know, if I'm going to get what I need to get.)

(6) provide sustained support—by providing on-site technical assistants. This directly relates to the often heard comment, "What will I do if something doesn't work?" (We all get by with a little help from our friends.)
(7) make it happen—by providing stipends for attending the training and rewards for implementing the training. Time if valuable and limited for busy faculty and recognition of this fact provides one of the many necessary motivations to be involved. (Just do it!)
(8) insure quality administration and evaluation—by providing staff, evaluation consultants, the development of effective evaluation instruments to gauge progress and chart the course, and management consultants from the community. Having people "tell the story" of their efforts to learn and grow in the field of technology can be very motivating to both the participants and others. The management consultant is a member of the community and fosters the collaboration at that level. (Read those road signs -- Publish or Perish, Grants are Grand, Report/Reported/Reporting, Exit here. . .)

Where Are We Now

Video presentation highlighting implementation process.

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