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ABSTRACT

This paper examines the controversial problem of the availability of and access to computers, training, and technology, and the availability of and access to all types of learners. Technologies must be designed with diverse learners in mind in order to fully realize their capacity and contribution to the field of education. If the need for universal access is ignored, technology will further exclude some learners. The paper suggests four principles of universal design for digital media: (1) allow for multiple representations of information; (2) provide for multiple means of expression and control; (3) provide customizable support and challenge; and (4) allow customizable content. The paper also describes the activities of the Center for Applied Special Technology (CAST) program, which is designed to ensure that computers do not create further barriers for the learners they are intended to assist, and that computer design and implementation address computers' potential for learners with disabilities and others who have been traditionally excluded. The CAST project assumes that adults who become successful learners will model the learning that fosters success in their children, and that use of early and pre-literacy software will support their children's emerging literacy. The project couples training of parents with the training of teachers. (Contains 30 references.) (SD)

Meeting the Needs of 21st Century Literacy by Using Computers in Family Literacy Centers

A paper presented at the National Reading Research Center Conference on Literacy and Technology for the 21st Century

Bob Hughes • Peggy Coyne

October 4, 1996

Identifying the Problem

Computers are powerful tools which help a variety of learners obtain access to information and resources they would not otherwise have. Learners who are unable to turn the pages of a traditional book can have text digitized so they can navigate the text electronically. Learners with visual impairments can have text enlarged or they can have the color changed to meet their needs. Non-readers can have text read aloud to them. In this way, computers offer malleability of media and support for a variety of learning needs. Children who would have been labeled as ineducable in the past can be helped by technologies that provide supports they need to succeed educationally and occupationally.

The new information technologies also expands the skills children need. The demands of an expanding definition of literacy are imbedded within our uses of technology and information processing systems. Traditional reading, writing and numerate literacies of the past will continue to be necessary. However, evidence also suggests that children will need additional literacies to gain access to the skills, information, and resources that will allow them to succeed as adults (Wright and Shade, 1994). The argument for a widening definition of basic literacy has been made so consistently and convincingly that it has become an accepted portion of schools' missions.

With all that in mind, how can schools ensure that all students – regardless of ability or disability and regardless of their gender, race, or income – have an equitable opportunity to use the tools of the new literacy? Assuming that the tools of technology will magically eliminate the problems begs the question of whether technology will have a positive influence on learning and teaching. Putting any resource into schools does not ensure that the schools will know what to do with it, nor does it promise that the uses will affect all learners equitably (Shields and Shaver, 1990).

Imagine a class session on how to use computers. Though all students receive the same lesson, some of the students have computers at home, and others do not. The children whose parents allow them to write reports, draw, or use the Internet maintain advantages over those who only have access at school. Children who perceive that "only 'smart kids' use computers" (or "rich kids" or "techie kids" or any group from which they feel excluded) are less likely to experience the power that computers offer. There are also differences in how schools implement computers. A school with a computer lab that students use periodically creates a different experience of computers than schools where each teacher has a computer and integrates it into lessons. A school's resources, training for teachers, the resources of parents, children's affective reactions to technology all affect how children experience computers.

In addition to these issues of equity are the equally significant problems of curricula and pedagogy that can exclude learners with disabilities. Printed text limits some learners because of its inflexibility. For example, learners whose disabilities make reading difficult or impossible (or those who

cannot read the language of instruction) are limited by these difficulties. It would be wrong to assume that these learners will be magically helped by computers. Students who decode text poorly because of a reading disability will not perform better just because they are sitting in front of a computer screen. If computers and computer training are not equitable and accessible, instead of helping, they can present barriers for some people. On the other hand, when technologies are designed with diverse learners in mind, these tools can provide the support and access that aid all learners. This capacity for universal access is key to the power that electronic technologies bring to learning.

Digital media is flexible and adaptable enough to meet a range of learners' needs. The ability to manipulate text, for example, offers opportunities for learners to interact with that text in ways that traditional written text cannot. In writing instruction, that has meant teachers can use word processing to reinforce the value of revision and editing — and the ability to manipulate text provides the supports that many disgraphic writers need to successfully gather, organize and express their ideas. Similarly, reading software can provide readers with auditory and other sensory supports (e.g., changing text size and color) that adapt to their style of learning. That capacity makes digital media a valuable technology because it adjusts to a variety of learning needs.

The typical entrances to school buildings built more than fifteen years ago provide an example of how technology can adapt to the needs of the people it serves. To reach one of these entrances, children would climb a short series of steps that led to the main door. While steps are an effective technology for getting into a building for some people, they represent a barrier for visually impaired or physically challenged people. More recently, schools are now designed with multiple ways to enter. In addition to steps, the schools now built all have ramps and/or elevators that allow every learner to have access. These more recently adopted technologies allow all people to have access, but they do more than just serve disabled people. The ramps and elevators that make schools more accessible for handicapped visitors also benefit all visitors. Ramps and elevators allow multiple methods of access for everyone. In architecture, this concept of designing for special populations in ways that benefit all is called "universal design." The idea of universally designed technologies adapts well to the development and implementation of technologies to learning.

In universally designing and implementing computer applications, it is important to consider the supports that learners need to master the skills and concepts they need. Those supports are based within four principles of universal design which suggest that any technology must address these questions:

It must allow for multiple representations of information

To provide access for all learners, reducing barriers for individuals with sensory and cognitive disabilities, information should be represented in multiple media (e.g., presented in

both printed text and in spoken text), or in a medium which allows for easy transformation from one form of representation to another (e.g., digital text to synthetic speech)

It must provide for multiple means of expression and control

To support communication for all learners, and to reduce barriers for individuals with physical and expressive disabilities, software programs should offer alternative means of expression and control (e.g., recording in oral or written text, control through touch or voice) or be presented in a medium which allows easy transformation from one means of expression to another (e.g., touch to text, voice to text)

It must have customizable support and challenge

To provide appropriate instruction for all learners, the level of support and the nature of the challenge should be individualized by teachers and students

It must allow customizable content

To increase utility and relevance for people from varied social, cultural, ethnic, linguistic, regional communities, instructional materials should be "half-full." That is, materials should provide core content and activities of general applicability, and also be designed so that teachers and students can modify content and activities or add their own (e.g., local images, sounds, text or recorder speech in different languages or dialects)
(CAST, 1996)

These universal design principles offer guidelines that release electronic media's potential to encourage learners to explore and create. A child who uses Kid Pix (a popular drawing program) can learn to use computers to interact with and manipulate the on screen world in ways that will reinforce the explorative and creative capabilities of computers. That child can also learn to express ideas in visual form. In contrast, the child who uses computers only for drill-and-practice sessions, most likely learns that computers are not useful beyond routine tasks. A child who experiences the computer as a tool for exploration and creativity will develop a different relationship with it than the child who has no experience with computers or experiences them as tools of drudgery. A drawing program like Kid Pix can also help a student with limited fine motor skills express ideas visually in ways that would not be otherwise possible. Other programs help children – with various levels of ability and development – through the process of writing and reading. A variety of supports in computers can help learners create and express ideas, but teachers need to be trained in how best to use the power of computers.

Schools which serve low-income students or which have large numbers of disabled students have begun to reduce disparities in the numbers of computers they have available. However, these schools often implement computers in ways that limit students' perceptions of and access to the power of those technologies. As Henry Becker's research shows, though schools with high num-

bers of low-income children have reduced the disparities in numbers of computers available, they have not been as successful in getting their students to experience the high level uses that would allow students to become proficient explorers and creators with computers (Becker, 1994). Much of the gain in numbers of computers used in urban and rural poor schools has come from federal funds which benefit students with learning disabilities. These funds are often used to purchase drill and practice software. This software can be useful in reinforcing skills, and it offers a start. However, it provides little opportunity for creativity or exploration with computers. Thus, students who could benefit the most from computers are excluded from using them in the way that would benefit them most. This gap threatens to exacerbate existing inequities as children from low-income households – and children with disabilities – become increasingly distanced from the technologies they need to succeed as adults.

There are, then, two problems which must be addressed to ensure that computers do not create further barriers for the learners they are intended to assist: The first is the issue of equity. If equity is defined as fair access to technology, then computers must be equitably available to all learners. Additionally, there must be, in computers' design and implementation, consideration of how best to use computers' potential for learners with disabilities and others who have been traditionally excluded.

A Solution

For the past three years, CAST (Center for Applied Special Technology), a not-for-profit educational research and development organization, has piloted a project to address these issues. This project provides computer training and access for low-income parents who — because they do not have resources and/or education that would expose them to computers — would not have this opportunity. This training and access allows parents to use computers in ways that support their children's learning while increasing their own learning. The project is based in the belief that parents who model computer use provide the strongest incentive for children to learn to use computers. By creating a supportive environment for parents to learn about computers, the project also assists parents develop the confidence they need to address their own deficiencies in both traditional and electronic literacy. Additionally, CAST has developed software and training that bring the power of computers into the learning process. This software and training emphasizes the ways in which computers and other technologies can help learners to master skills. In addition to training parents, the project trains primary grade and pre-school teachers training. By training parents and teachers together, the project creates opportunities for collaboration between parents and teachers.

Over its twelve year history of applied research and design, CAST has developed and adapted technologies to provide equitable educational opportunities for people with disabilities. CAST has learned that technology applications which meet the needs of disabled learners benefit all learners. This project is an extension of that work. In this project CAST is using the principles developed while working with disabled learners to meet a broader range of needs — for both disabled learners

and other traditionally excluded populations. An example is Wiggleworks™, an early literacy software program which CAST developed with Scholastic, Inc. Wiggleworks™ has one function which reads text aloud to visually impaired students. That function also assists any students who need auditory supports for learning. It additionally reinforces all students' word recognition and pronunciation. Using this same perspective of developing applications that are universally designed to meet a broad range of learners' needs, CAST designed and implemented the Family and Community Literacy Project.

How it Works

The project began as a collaboration between CAST and North Shore Head Start in Beverly, MA. In the current project, 80% of the parents have not completed high school, and most have limited literacy which impacts their ability to nurture their children's emerging literacy. The director of North Shore Head Start estimates, based on her 23 years of experience working with Head Start parents, that 50% of the parents served by the agency struggled with undiagnosed learning disabilities in their own education. By improving parents' learning, the project addresses the intergenerational cycles of failure that create poor achievement and high drop out rates among these parents' children.

Parents and teachers attend training sessions together. They begin by learning to use pre-literacy and early literacy software, and then they progress to learning word processing. Starting parents with children's software has three important effects: Since this software is more easily mastered than most other programs, it provides an accessible entrance into learning about computers. Secondly, both parents and teachers find a value in this software since they can use it with children. The third benefit to beginning with literacy software is that it helps parents with low reading skills begin to address those deficiencies. In these ways, parents and teachers collaboratively learn to support children's reading literacy and computer skills, a combination that helps prepare children for the complex literacies of the 21st Century. Also, parents who have not been successful in their own learning have found success through the gradual increase in skills that they have gained. The project has additionally helped parents and teachers forge the school-to-home links that make parents and teachers partners in children's learning.

A recent participant in the project illustrates how this has worked. Alma has a five year old daughter, Beatrice, who attends an elementary school which has been active in the project. Though Alma reads well in Spanish, she has difficulty understanding oral and written English. Before the school year began, she visited the town library with Beatrice so they could find children's books and study them together at home in anticipation of the school year ahead. At the library, Alma was directed to the computer catalogue where she could find books. She walked to the machine, realized that she was unable to use it to find what she needed, and quietly left. She was too embarrassed to ask for assistance.

At mid-year, Beatrice's kindergarten teacher enrolled in the Family and Community Literacy Project training class to learn how she could use the Macintosh computer the school had purchased for her. The teachers from this school have traditionally brought at least one parent along. This teacher brought Alma. In all of the sessions, the teacher and Alma sat beside each other, and they learned together. During some sessions, Beatrice sat with them. Over the course of the training, Alma began to use the computer with more confidence, and when Beatrice came to training sessions, Alma explained her new-found skills to her daughter.

By the end of the school year, Beatrice and Alma began to make regular trips to the library to use the computer catalogue and discover new books they could explore together. Since she no longer felt threatened by computers, Alma extended the confidence she learned from training into another experience which created the potential for even more learning. Alma now provides the kind of modeling which encourages Beatrice to explore new experiences and opportunities. At school, Beatrice's teacher uses the techniques she learned during training to provide Beatrice with additional exposure to computers. Beatrice regularly uses the computer in her classroom to learn how to read, write and manipulate images on screen. She is taking the first steps toward being the type of multi-literate learner who can navigate the levels of knowledge and resources she will later need to master. As an added bonus, she shares her knowledge of computers with other students in her class. Beatrice has become a leader in her class when all prior indications show she most likely would have experienced computers as a barrier to her learning.

Present and Future Directions for the Project

Initially, CAST staff trained parents and teachers in the CAST computer lab. This year, a grant from the Hasbro Children's Foundation is funding a Family Learning Center in Salem, MA. In addition to training, the Family Learning Center will be open for parents and children to drop in for unstructured access to the technology that parents learn to use during training. This access includes use of available software and the World Wide Web. The creation of a community-run center is critical to the future success of this project. Community-operated and controlled centers provide the clearest chance to maintain and build upon the success of this project. The current funding provides for a community coordinator who will contact additional parents in the community who can benefit from the center. Additionally, this staff member will forge links with other agencies to ensure articulation of services for parents who visit the center. The center will also rely on volunteers to provide ongoing staffing and peer training to parents in the community.

In developing this project further, CAST is building on factors that have supported the project's early success. The most practical factor has been Head Start's built-in capacity for reaching new audiences. Each year, a new group of children and their parents enter Head Start, while another enters primary school. Equally important is Head Start's family-centeredness: Head Start views the support, development, and empowerment of parents as integral to its mission. To meet that goal, North Shore Head Start creates a safe, supportive and nurturing environment for parents who

may lack the confidence they need to become advocates for themselves or their children. In addition to the CAST training, Head Start provides other family-centered services to support parents and their children. The agency provides career and educational counseling. It also offers parents practical supports such as transportation to classes.

While all these reasons make Head Start programs ideal for replication of this project, CAST believes that this model will work in other types of agencies as well. Therefore, in addition to the existing program, CAST is developing additional partnerships to expand this model. CAST will train and support these partners in creating Family Learning Centers at their locations. Using the model developed at the North Shore Head Start Center, each Center will provide computer access and training to adults and children who might not otherwise have that access. These Centers will provide this within the context of helping parents and teachers use computers and other technologies to support children's learning

CAST will select three additional sites: One in the urban Boston area, and two remote to the greater Boston area. The urban Boston site will participate in developing replication methods for agencies outside of Head Start; the remote sites will participate in developing replication methods for sites not in close proximity to CAST. CAST staff will support the urban Boston site through on-site training, consultations and telecommunications. The long-distance replication sites will receive initial, on site training and ongoing telecommunications consultation. Training and consultation for the Boston site will begin in January of 1997, and the other two sites will begin their participation in September of 1997. CAST is also providing funding for some staffing at the selected sites. Organizations interested in participating in the project may obtain a Request for Proposal by contacting CAST, or via the World Wide Web at www.cast.org.

Preliminary Results

Although the pilot phase of the project was not formally evaluated, the following information suggests that this project has been successful:

- Twenty-six parents participated in the training during the first three years
- Of the first and second year groups, only two of 12 parents were enrolled in formal education when they began classes. To date, five others have enrolled in adult education or community college classes. One of the five has completed an associate of arts degree in computer applications and is working for a local school system, and the other has completed a certification in early childhood education and works for North Shore Head Start.
- Over the three years, seven parents have volunteered in the project as peer tutors and/or bilingual translators after their initial training
- 50 elementary (K-3) and pre-school teachers received training over the three year period. The 50 teachers each are implementing the tools they developed with 20 to 25 students each year. Over the three year period, that translates into 1,000 to 1,250 students being taught with the methods that teachers learned in training or during consultation

Evaluation of the Model

In the first year of the project, five parents participated. In the second year, seven more parents attended training. In the third year, that number increased to 14, and this next year, 32 parents are scheduled to participate. That increased participation suggests that this project is meeting parents' needs. During the next two years of the project, CAST has established a formal evaluation protocol to measure the project's impact on the parents and teachers who participate.

Hypothesis

This project assumes that adults who become successful learners will model the learning that foster success in their children. It moreover assumes that parents will, in the process of learning how to use early and pre-literacy software, learn ways to support their children's emerging literacy. By coupling this training of parents with the training of teachers, the project encourages collaborations between parents and teachers.

Therefore, the evaluation will test the hypothesis that all of these factors are necessary to support children's ability to gain the complex literacies they need for educational and future occupational success.

Methods

The evaluation of the hypothesis will consist of two levels: program evaluation and a study of participants' experiences. The program evaluation will use quantitative analysis, while the study of participants' experiences will use qualitative methods. These complementary methods will provide a glimpse into the complex context of participants lives, while identifying how the program impacts the people it serves.

All the people who enroll in training (from all four sites) will participate in the quantitative analysis of the project. Each person will complete a pre-study and post-study attitudes questionnaire (using Likert-type scales) to measure changes in affective responses to computers. Also, CAST researchers will complete pre-study and post-study formal surveys of skills to identify what skills that participants gain during training sessions.

A carefully selected sampling, as with any other study, will provide useful results while providing efficient use of resources. Therefore, we will conduct the qualitative segment of the project selectively. Ten parents or teachers will be studied at the North Shore Head Start and Boston sites. These people will participate in ongoing video ethnographies of their computer experiences to discover how they use and perceive the technologies they learn. Unlike quantitative methods, which rely on numbers of participants to achieve a representative sampling, the numbers of participants will be limited to allow for in-depth qualitative analyses of each participant's experience.

A preliminary project report will be available in June of 1996, and a final report will be ready in

June of 1997. The report will be available on the Internet at www.cast.org. For information about the project, contact:

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