

# TEACHING SCIENCES AND MATHEMATICS CONCEPTS IN THE EARLY GRADES: K-3 TEACHERS ENGAGING DEVELOPMENTALLY APPROPRIATE PRACTICE WHICH INCORPORATES TECHNOLOGIES

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## ABSTRACT

This paper examines the practices and concepts used in teaching science and mathematics concepts to young children (kindergarten through grade 3) while integrating computer and multimedia technologies and hands-on activities into developmentally appropriate classroom environments using goals and standards set out by the National Association for the Education of Young Children (NAEYC). Observational data is drawn in the form of vignettes from three classroom sites. The first teacher uses a high level of integration of technology and hands-on experience to support math and science education. The second teacher uses technology mainly to support literacy activities and is working toward fully integrating technology into math and science teaching. In the third classroom, the teacher uses technology to support family involvement and to inform family members of classroom activities and curriculum. This paper is part of a proposed symposium for teachers titled: Technologies for Teaching Science and Mathematics in the K-12 Schools: Reviews, Observations and Directions for Practice in the Southern United States.

## KEYWORDS

Technology integration, lower elementary, science teaching, mathematics teaching, access to technology

## INTRODUCTION

Goodman (1986) and Perlmutter, Bloom, and Burrell (1993) suggest that developmentally appropriate investigation for young children should include engagement in activities that are relevant, interesting, natural, and real. Computer and multimedia technology provide a valuable tool for creating such experiences. The potential benefits of technology for young children's learning and development are well documented (Wright & Shade, 1994). However, there has always been concern in the early childhood community about the appropriate use of technology in early childhood classrooms. In response to this concern, the National Association for the Education of Young Children (NAEYC) in 1996 published a position statement titled *Technology and Young Children—Ages Three Through Eight* (National Association for the Education of Young Children, 1996) and made recommendations addressing the following seven issues:

- In evaluating the appropriate use of technology, NAEYC applies principles of developmentally appropriate practice and appropriate curriculum and assessment. In any given situation, professional judgement by the teacher is required to determine whether a specific use of technology is age-appropriate, individually appropriate, and culturally appropriate.
- Used appropriately, technology can enhance children's cognitive and social abilities.
- Appropriate technology is integrated into the regularly learning environment and used as one of many options to support children's learning.
- Early childhood educators should promote equitable access to technology for all children and their families. Children with special needs should have increased access when this is helpful.

- The power of technology to influence children's learning and development requires that attention be paid to eliminating stereotyping of any group and eliminating exposure to violence, especially as a problem-solving strategy.
- Teachers, in collaboration with parents, should advocate for more appropriate technology applications for all children.
- The appropriate use of technology has many implications for early childhood professional development.

Acknowledging that technology plays a significant role in all aspects of American life today, and this role will only increase in the future, NAEYC urges early childhood professionals to seek ways to integrate technology into early childhood settings.

## **METHODOLOGY**

The authors have participated in the New Orleans Consortium for Technology Integration and Implementation in Teacher Education (NOCTIITE, Speaker, 2002), studying and observing teaching with technology in the schools. We have collected various data streams related to technology in the teaching of science and mathematics and analyzed it for technology integration in teaching. This data is qualitative in nature, leading to narrative analysis (Bruner, 1990, 1996; Clandinin, & Connelley, 1999), case study methods (Merriam, 1999), and portraiture (Lawrence-Lightfoot, & Davis, 2001) within a post-modern, interpretivist stance (Foucault, 1972). Each observer acts as a tool recording and interpreting the situated events in classroom contexts. The goal of the evaluation system for NOCTIITE was to provide both formative and summative information about the ongoing and cumulative effect of the project. Thus, the system was designed to summarize, analyze, and interpret data collected systematically within and across the three years of the project itself by various stakeholders and the follow-up years beyond the scope of the project. For this paper, we provide three descriptive cases to elucidate the teaching of sciences and mathematics with technology in the preschool and early elementary classroom. The methodology for this paper is more fully discussed in Speaker (2003).

### **Technology Framework**

To function in a technological environment, the teacher needs control over a variety of technologies and access to others. This implies that the teacher needs equipment with software which is easy to use, input systems, internet access, a plan for the level of learner activity with technology and various multimedia, the abilities to evaluate websites and communicate with students and their parents, basic troubleshooting skills with technology and an awareness of the ethical and legal issues for using technology. Thus, we have created a framework with the following categories: Equipment, Software, Ease of Software Use, Input System Use, Internet Use, Level of learner Activity with Technology, Multimedia, WebSite Evaluation, E-mail for Students, Communication with Parents and the School Community, Trouble Shooting, and Ethical and Legal Issues.

For children in kindergarten through grade 3, the emphasis of technology must be as a transparent and flexible tool for teacher and student use, which the teacher uses to support a developmentally appropriate curriculum in a supportive learning environment. Equipment in the classroom should include computers, projection devices such as a large screen television connected to a computer or a powerful data projector, printers (both black and white and color laser printers are ideal), floppy drives, CD-drives, web connections, scanner. The teacher must be familiar with issues related to the number of computers in the classroom and planning for their appropriate use with young children, using intuitive software that is mostly graphic-driven, such as KidPix, Hyperstudio, and some introduction to Word. Children need easy beginning software to develop comfort with input systems including the keyboard, mouse and various touch pads. At some point in the future, voice recognition software may become easy enough for young children to use, but currently the training period is too difficult for most children.

The teacher will control and direct much of the technology use for young children as part of the integrated lessons that are age appropriate. For instance, internet use will involve viewing selected, age-

appropriate web sites and selected multimedia software, and e-mail will be teacher controlled and filtered. Children should be engaged in discussions about the appropriateness of certain materials for the classroom and displaying their work whether based on technology or not. A major function of technology for the teacher should be communication with the parents and school community.

### **Three Cases**

The following brief descriptions show developmentally appropriate use of technology in early childhood classrooms. The first teacher, David Heightmann, uses a high level of integration of technology and hand-on experience to support math and science education. The second teacher, Angela Tifton, has used technology to support literacy activities for years and is just beginning to fully integrate technology into math and science teaching. In the third classroom, the teacher, Sharilyn Soutler, is in the beginning stages of using technology to support parent involvement and to inform family members of classroom activities and curriculum.

#### **Case 1: A Kindergarten Teacher Integrated Technology**

David Heightmann's kindergarten classroom was bright and crowded with tables, nooks, shelves, bulletin boards with children's drawings, a big screen TV and six computers, placed in the front right corner of the room. David, a tall man with graying hair and beard, was seated in the front center of the room near the TV with children on a rug at his feet. His aide, Rosa Gomez, greeted me because David was already reading Eric Carle's *The Grouchy Ladybug* (1977). This was familiar ground, the typical morning reading of children's literature to a class. The children sat, listening, occasionally fidgeting, touching or bumping. Most of the 22 students were African-American with three Asians, two Hispanic and one white child.

David finished reading and held a lively discussion about the book and its images, then he lifted a laptop from the TV cart and said, "One thing I learned from searching the web is that there are many different types of lady bugs." The computer woke up and displayed David's web page. He pointed to a picture of a big red and black lady bug on the page and clicked it, saying, "This is the new link to my lady bug pages." The computer displayed a list of links. "When you have your turn at the computer, explore these links to see the many different kinds of lady bird beetles which is the real name of lady bugs." He clicked several links to show the children many different kinds. Talk buzzed louder as he showed different colors of ladybugs. He moved to the left of the room and brought a container to a small aquarium where he released the red and black ladybugs for the science center. He dismissed children by table-group to work on lady bug drawings, and then took his large copy of *The Grouchy Ladybug* to the library corner in the left front of the classroom where he placed it with several smaller copies of the book. Each table was ready with paper and crayons, and the children settled into drawing and talking about the book, their drawings and ladybugs in general.

David came over, and I introduced my self. We started moving around talking to the children as they drew and talked. Several announced they would draw different colors of ladybugs; some asked how many spots were on ladybugs. Some ladybugs were mostly black with a little red. Rosa saw that each table was working, moving from table to table. David called a group to work on mathematics, following up on reading clocks, an important part of the story about the grouchy ladybug, and doing some activities with movable clock hands. One table-group went to the computers and began looking at the various ladybug pages; one group went to the science center and began counting and drawing the ladybugs in the aquarium; another went to the library tables while some continued to draw with Rosa offering comments, discussion and encouragement. David joined another group at the math table, working with movable clock hands and digital displays. David's appropriate use of technology in early grades integrates it seamlessly into the whole instructional process, tying together literature, art, mathematics and the sciences into the classroom day.

#### **Case 2: Bayou St. John science and mathematics with technology**

Angela Tifton teaches an inner-city, second-grade class that focuses on writing process. She is constantly trying to integrate science and mathematics and through the writing process. Her goal, over

many years, has been to get her children to produce their own books. When she received five computers and training in HyperStudio, she began using that software for presentations of her projects and school activities. She modeled the construction of HyperStudio stacks of her own and then worked with her 29, mostly African-American children to collaborate on the production of group or individual, multimedia stories. First, she had children do sensing and inventing using brainstorming to come up with the basic ideas for their stories. Then students produced storyboards and rough drafts. The story topics, all of high relevance to the children, focused on such things as babies, the big football game, animals, fairy tales, beach adventures, the rugrats, and stories modeled on classic children's literature. Some children took digital photographs to illustrate their multimedia books, others drew and then scanned their drawing, but most chose to learn to draw on the computer, using the tools in HyperStudio and other drawing software.

Angela taught children how to link pages, to use buttons with text, and to import sounds. They had "recording times" when everyone in the classroom became very quiet so the authors could record their voices reading segments of their stories on a page. They made the text on most pages active so that clicking on it would activate the oral reading by the authors. Children peer edited and reworked their stories, tinkered with buttons and sounds, and perfected their multimedia presentations over three months before formally presenting them to other classes at the school and parents.

As part of her school's special projects, Angela participated in activities related to a nearby bayou. This set of activities became her major technological integration into science and mathematics while in her classroom, she continued using the textbooks, prepared worksheets and tests for the standard second grade curriculum without technology. At the bayou, children wrote observations of plants and animals, compiling a census of inhabitants in the water and along the shore, and took pictures. Back in their classroom, the children went to computers and wrote journal articles from their observations, made graphs of the census and used the photographs. They posted these projects on a bulletin board in the classroom.

### **Case 3: A novice teacher focuses on parent involvement using technology**

Sharilyn Soutler is in her first year of teaching in an inner-city public kindergarten where her students are from low-income homes. While working on her master's degree, she and her major professor participated in the New Orleans Consortium for Technology Integration and Implementation in Teacher Education (NOCTIITE). She comes to the classroom with a through background in both developmentally appropriate strategies and the use of technology. However, there are very limited technology resources at her school. She does have one classroom computer, with access to the web. Sharilyn believes that one important factor in student success is family involvement. During preliminary meetings with family members, Sharilyn conducts a survey to see how many families have access to the web and e-mail. She finds that 50 % of these families have internet access, if not in their homes, in their workplace, or at community centers in their neighborhood. After visiting the city's main library, she learns that other members of the classroom community could access the web at a conveniently located branch library. The key seemed to be to provide family members training in the availability and use of these facilities and to access the web and use of publicly supported e-mail accounts.

Sharilyn regularly conducts evening and Saturday training sessions and supported guardian-child dyads as they learned to access the web and use e-mail at various locations easily accessible to their homes. She uses volunteers from her college to assist her both in the technological training and in taking care of younger children during sessions. She has developed a web page and regularly posts material related to the curriculum studied in the class. For example, she often posts the words of songs that the children are learning, and sometimes records and posts a popular story the children are studying in class. She adds links that would not only extend the curriculum but provide resource information useful to the families she serves. She sends e-mail regularly to students and family members, discussing daily activities, student accomplishments, and suggesting related activities that family members and children could engage in together.

Sharilyn is in the process of writing a grant that would provide more equipment and developmentally appropriate software for use in the classroom. First on her list is a scanner and a digital camera. She would like to begin developing electronic portfolios that would reinforce the values related to her developmentally appropriate teaching methods. She also hopes to be able to loan some software to interested families who then could foster valuable home-school connections.

## **CONCLUDING REMARKS**

One goal of early childhood education is to help young children prepare for the elementary school years. By taking advantage of the valuable resource that technology offers and integrating computer and multimedia technology with hands-on math and science experiences, early childhood educators can support this goal. As with all endeavors in education, the teacher's role is crucial. Early childhood educators are charged with the responsibility of evaluating the appropriateness of technology methods as they relate to the individual students in their classrooms, integrating technology with hand-on strategies, and making all activities relevant to the lives of the children and families they serve. In addition, many teachers also inherit responsibility related to finding resources necessary and providing training to families or other staff members in order to make the invaluable home-school learning connection and insure that the development of technological expertise is equitable across student populations. The cases presented in this paper serve as examples of how early childhood educators in the southern regions of the United States are striving to meet these responsibilities.

These three teachers illustrate the abilities to select and incorporate developmentally appropriate technology into their science and mathematics teaching. They are critically selecting technology activities which relate to the science and mathematics concepts in early elementary curricula and gradually adding to their repertoire of technological skills in ways which they envision as developmentally appropriate. Their goal is to use technology seamlessly as a portion of their curriculum and for communication purposes rather than to focus on teaching children to use technology. The technological use for children in their classrooms is intuitive and gradually unfolding in its complexity, but not a substitute for experiences with real ladybugs or the real flora and fauna of the bayou. Just as children's literature motivates with narratives, the unfolding of science and mathematics is a story which children learn to tell as part of their schooling and cultural experiences. The inequities of technological access in some schools has become an issue for some teachers and they are seeking funds and support to be sure that their classrooms contain the technological tools that they and their children need.

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