Observing Technology Enhanced Literacy Learning

Cory Cooper Hansen
Arizona State University

Abstract

Developmental concerns challenge technology use with young learners; however, critical areas of literacy have increased when technology is available. This study was designed to measure when and what kinds of technology were integrated into literacy teaching and learning with second graders. The OTELL (Observing Technology Enhanced Literacy Learning) instrument was created to record teacher and student use of technologies over five components of best practice in literacy instruction. Observations and interviews established pre-intervention literacy practice in year 1, and the OTELL was used to measure technology use in year 2 after district and professional development support provided technology-rich classrooms. Thirty-five random hours of observation over a 7-month period revealed that the curriculum remained stable after intervention and that technology was used in literacy learning and teaching approximately 39% of the time. Within that increased use of technology, students used technology the most when applying their literacy knowledge, and teachers used technology 70% of the time when presenting literacy minilessons.

Teaching children how to read is a politically charged issue in the United States today. Literacy instruction is occurring amid unprecedented, standards-based, high-stakes accountability measures. Pressured in part by the mandates of the *No Child Left Behind Act* signed into legislation in 2002, scrutiny of early childhood classrooms has never been more intense. Trends include pushing the curriculum down the grade levels so children can gain basic skills faster (Stipek, 2006), focusing on the five elements of effective reading instruction, as determined by the National Reading Panel Report (summarized by Armbruster, Lehr, & Osborn, 2003), and expectations from parents, administrators, and society for teachers to use technology to adequately prepare our children for the 21st century.

Despite the billions of dollars invested in educational technology (Cuban, Kirkpatrick, & Peck, 2001) many teachers do not feel prepared or know how to juggle technology into an already full curriculum. This article summarizes a 2-year study that began by observing and interviewing three second-grade teachers who taught literacy at an inner-city school in a large metropolitan city. The next year, all three teachers enrolled in a yearlong professional development experience that provided both resources and support as the teachers integrated technology into their existing literacy curriculum. This paper reports when teachers used technology in their literacy teaching and when students used technology in literacy engagement, and it highlights what kinds of technology were part of this process.

Technology Use with Young Learners

Researchers and practitioners have changed the question of *should* technology be integrated in early literacy instruction to *how* can early literacy instruction be enhanced with technology in the best interests of beginning readers and writers. As Dede (2000) noted, we need to prepare young children for a future quite different than the immediate past. Researchers have explored both developmental and literacy possibilities when technology influences reading instruction.

Blanton, Moorman, Hayes, and Warner (1997) found that children loved working with computers and actually socialized, talked, planned, and collaborated more around computers than around other traditional play materials. Resnick (1998, 2000) called for consideration of computers as just one other resource in the early childhood classroom and to view them in the same way as finger paints, blocks, and other traditional materials for making things. Rochelle, Pea, Hoadley, Gordin, and Means (2000) reiterated that computer-based technology is only one element in effective early childhood literacy education. Increased comprehension, vocabulary, fluency, and achievement have been documented when young children interact with technology.

Comprehension. Interacting with technology in the form of CD-ROM storybooks has been shown to increase comprehension. Doty, Popplewell, and Byers (2001) found a significant difference in ability to answer comprehension questions after a CD-ROM format over children who used the print version of the same book. Matthews (1997) assessed comprehension based on story retelling and, again, a significant effect favored the CD-ROM users. Labbo and Kuhn (2000) found CD-ROM stories supported a kindergarten child's understanding, retelling, and meaning-making responses. According to Kamil, Intrator, and Kim (2000), children created mental models more effectively and improved their comprehension due to the dynamic nature of multimedia.

Vocabulary. Vocabulary development has also been increased through student interaction with storybooks on CD-ROMs. Higgins and Cox (1998) found that attention to animated clues produced more effective learning of unfamiliar words. In another study with third-graders, Higgins and Hess (1998) discovered supplementary instruction with synonyms, together with animated clues, increased posttest results of identification of meanings of unfamiliar words.

Fluency. Fluency, the "neglected reading goal" (Allington, 1983), benefits when technology is available to model and promote reading accurately, automatically, and with prosody. Humble (2000) concluded that a CD-ROM picture book was an effective substitute when a supportive adult was not available. Language and communication development increased in a study conducted by Hutinger and Johanson (2000) along with progress in all developmental areas.

Achievement. Blanton et al. (1997) found that children who participated in a technology-rich afterschool program scored higher on traditional achievement tests in reading. They also achieved a higher level of knowledge and understanding for reading, the use of grammar, and computer knowledge than did their counterparts who were not part of the program. Loveless (2002) documented that technology supported creativity in early childhood classrooms through developing ideas, making connections, inventing, collaborating, communicating, and evaluating. Studies that explore the use of technology for reading and writing found that children who used word processors produced compositions of better quality than did students who used pen and paper (Bangert-Drowns, 1993). As well, children were more motivated to read and write when computers were available (Kamil et al., 2000).

Despite these initial studies, two comprehensive reviews of research in technology use in early childhood literacy (Lankshear & Knobel, 2003; Yelland, 2005) both concluded that much needs to be done to address the paucity of research in the area of technology and literacy, that educators need to reconceptualize the integration of technology in effective early childhood instruction, and that innovative teachers need to build on student enthusiasm for technology to keep education relevant in our contemporary society.

Integrating Technology in the Early Childhood Classroom

Clearly, technology within literacy instruction has the potential to benefit young learners. Less clear, however, is how to go about integrating technology effectively in the critical content area of early literacy. Often districts provide technology resources for their teachers without the training or ongoing support to use the resources well. For example, many teachers are introduced to technology through a traditional staff development model of required attendance at an afterschool workshop taught by an expert who delivers the program and then leaves the school. According to Schrum (1999), little evidence exists that this type of staff development makes a difference in the classroom.

Turbill (2001) identified three factors that inhibit early childhood educators: lack of time and expertise to explore and understand the software, narrow definitions of literacy held by teachers, and lack of understanding about the capabilities of new technologies and the confidence to use them effectively within literacy instruction. One way to scaffold understanding and confidence for early childhood educators is to present vignettes of how other teachers found time to expand and include technology in their existing literacy curricula.

Accordingly, the purpose of this study was to develop a rich picture of technology integration in second grade literacy instruction. The guiding questions for the study were: (a) When is technology integrated into literacy instruction? and (b) What kinds of technology were used during literacy teaching and learning?

To meet these purposes, Sun's (2000) definition of integration was adopted: "the use of technology by students and teachers to enhance teaching and learning and to support existing curricular goals and objectives" (p. 55). Based on Sun's definition, anytime technology was used it was considered to enhance teaching and learning. A second need was to develop an instrument to record technology use in literacy instruction. The few instruments discovered in a review of the literature would not capture the required information to structure the study, so it was necessary to create a specific literacy observation instrument.

The OTELL Instrument. A variety of data collection methods were considered and rejected before designing the OTELL (Observing Technology Enhanced Literacy Learning) instrument. Initially, an instrument based on the *National Education Standards for Teachers* (NETS-T; International Society for Technology in Education [ISTE], 2000) and the *National Education Standards for Students* (NETS-S; ISTE, 1998) was consulted. The Integration of Technology Observation Instrument (ITOI; ISTE, 2003), although effective in collecting data concerning the use of five categories of instructional technology (Zambo, Wetzel, Buss, & Padgett, 2003), did not allow for the concentrated literacy focus.

The instrument used in an early childhood study by Hutinger and Johanson (2000) focused on behavioral aspects of young children at the computer so did not meet the needs of this study. Other data sources were considered: lesson plan analysis (existing lesson plans were deemed too sketchy as a reliable source), survey data (too often self-reported instruction and observed instruction present different pictures), and assessment of process-oriented versus product-oriented activity (Does technology implementation provide additional gains in the learning environment or is it merely a wasteful use of resources?).

Buoyed by the issues raised by Painter (2001) regarding the difficulties in measuring the degree of technology use, the OTELL was designed to record accurate observations, to inform conclusions drawn regarding degree and appropriateness of technology integration, and to provide a normative standard for teachers venturing into the use of technology. Joseph Ryan, WestEd Senior Research Associate, was consulted to provide expertise in its design and focus. The instrument was designed around the five components of effective reading instruction and available technology resources, and it measured technology use in 5-minute increments.

Researchers and educators (Morrow, Gambrell, & Pressley, 2003; Tompkins, 2006; Weaver, 1994) have generally agreed that effective reading instruction flows along five essential components:

1. Prereading. When a purpose for reading is set, schemata are activated and comprehension is enhanced (Blanton, Wood, & Moorman, 1990).
2. Reading. Students can access the words in a text in multiple ways: through hearing a readaloud, shared reading with a partner, in small group instruction, through interaction with electronic text, or reading independently.
3. Responding. Sharing response through talk or writing connects readers to the text, to others, to their own lives, or to other books they have read (Peterson & Eeds, 1990).
4. Exploring. A teacher directed time to engage students in exploring the text analytically through minilessons on procedures, concepts, strategies, and skills (Tompkins, 2006).
5. Applying: Students apply their new knowledge in projects and activities that extend comprehension, provide for reflection, and increase the value of the reading experience (Weaver, 1994).

An Excel spreadsheet was used as the basis of the OTELL instrument. Cells in the far left column listed each of the components of reading instruction. Lists of the technology resources available and appropriate for use in each component followed in rows under each heading. Different colored fills helped differentiate sections. The rest of the spreadsheet was divided into 12 columns with 5-minute headings at the top so each spreadsheet page could be used to record 1 hour of literacy instruction. The OTELL instrument is presented in Appendix A (pdf - 11kb).

To record data, the researcher entered field notes by component of reading instruction by 5-minute intervals and indicated nonuse of technology by entering data into the white row. It was possible to record simultaneous use of technology simply by entering data into more than one column. It was helpful to freeze the top row so time intervals were always at the top and to wrap data within each cell. Recording data directly into a laptop eliminated hours of time transferring data from paper to electronic form.

Prototypes of the instrument were forwarded to colleagues, in-service teachers, and participants for review. Feedback included suggestions to include technology not considered by the researcher in the initial draft (overhead projectors, listening centers that used tape recorders, and LeapPads®), and to delete empty rows so that the instrument was shorter. Participants were introduced to the instrument before use in their classrooms for their feedback. Unanimously, they were comfortable with the researcher joining their classrooms as a participant observer and with the instrument itself. As data were collected, copies of results were made available to the observed teachers and, consistently, they agreed the instrument accurately captured their literacy instruction.

Methodology

Participants

The participants in this study were three second-grade teachers who taught at an inner city public school in a large metropolitan city in the southwestern United States. The school population was 57% Hispanic, 22% White, and 21% other ethnicities. Of those students, 32% were English language learners and 73% were eligible for free or reduced lunch. Two participants were second-year teachers (one male and one female), and the other female teacher had more than 15 years of experience. All three participants were part of a larger study – Arizona Classrooms of Tomorrow Today (AZCOTT) – a collaborative effort between Arizona State University (ASU) and six local school districts funded through an Improving Teacher Quality grant sponsored by the Arizona Board of Regents (Hansen, in press).

The AZCOTT professional development experience was based, in part, on two previous models: Intel Teach to the Future and the Apple Classroom of Tomorrow (ACOT) project. The goal of the Intel Teach to the Future program is to help teachers already familiar with technology to integrate those skills more effectively in the curriculum to enhance student learning (Kanaya, Light, & Culp, 2005). The ACOT project, a 10-year study of the impact of an infusion of technological resources and sustained professional development on teaching and learning (Sandholtz, Ringstaff, & Dwyer, 1997), is student centered, driven by an essential question, encompasses the use of technology by both teachers and students, and culminates in a student-created project. AZCOTT included key features of the Intel and ACOT projects and was patterned after the work of Wetzel, Zambo, and Padgett (2001) with the goal of providing high-quality professional development that could transform teaching practice.

The participants were accepted as a grade-level team in the AZCOTT workshops based on personal goals to integrate technology in their literacy instruction and commitment to the yearlong, 60-contact hours of professional development. Two past AZCOTT participants, who were active members in the local educational technology community, led the workshops and created curriculum based on best practice in effective technology integration in literacy instruction (McKenna, Labbo, & Reinking, 2003).

The researcher was the principal investigator of the AZCOTT grant and an early childhood language and literacy instructor at the collaborating university. A number of factors influenced selecting the participants within the larger AZCOTT study:

1. The researcher had worked with the district in previous studies and was aware of its reputation for effective literacy instruction.
2. The researcher knew the principal and was regarded as an ethical investigator.
3. The school was within close proximity to the university.
4. The participants, although not previously known to the researcher, were invited to be part of a focus group and were amiable to the study.
5. The participants planned together and taught within a common literacy block.

Methods

The researcher observed literacy instruction in each of the three classrooms during May 2004. Each classroom was visited four times (once a week for 4 weeks), and field notes captured 24 hours of literacy instruction. Those field notes, together with individual, informal interviews with the teachers, became the initial data set. Patterns in literacy instruction emerged, and a composite vignette (presented in the data analysis section) was created to encapsulate a description of literacy instruction before the technology intervention. Intervention began at the end of May 2004 when the participants began the AZCOTT professional development program.

The participants' school district supported AZCOTT participation by supplying each teacher with six laptops, a storage container that served as stand for a projection device, a SmartBoard to share with one other teacher, and the services of a district technology coordinator. After the teachers had a chance to establish literacy routines with their new students (end of October 2004), the researcher joined each classroom as a participant-observer once a month during the 2-hour literacy block. From November 2004 to May 2005, random observations occurred over a total of 35 hours. Literacy instruction and activities were recorded on the OTELL Instrument.

Data Analysis

Pre-Intervention Analysis: The three participants planned together and taught within a daily, 2-hour literacy block. Instruction is literacy based and assessment driven. Reading levels are determined for each child who practices reading daily – individually and with a partner – from leveled library book choices that are changed weekly. While the children are reading independently, small groups are pulled for guided reading instruction to develop skills and strategies to help them become better readers and writers. Small group instruction continues throughout a center time, when children have the opportunity to self-select from a variety of reading and writing activities, including literacy-based projects, practicing spelling words, listening to books on tape, writing in journals, etc. A whole-group instruction time provides guidance and direction to complete required center activities successfully. All three teachers had a hexagon-shaped computer center at one end of the room. During the 24 hours of observation that occurred randomly during early May 2004, there was a single observation of technology use: one student started a letter to his father on a computer. Other than children listening to audiotaped books played at a listening center and teacher use of an overhead projector, there was no other indication of technology integration in literacy instruction.

Intervention. Each participant completed the rigorous, 60-hour AZCOTT professional development experience conducted as a series of workshops throughout the school year.

Instruction focused on the development of standards-based instructional units that integrated technology into teacher and student activities, project-based learning, capturing classroom practice on video, graphic organizer creation software (Inspiration/Kidspiration®), Internet resources, technology integration strategies, classroom management, and reflection on classroom practice.

Post-Intervention Analysis: Data analysis began by compiling the total number of minutes of literacy instruction across each of the five components of reading instruction and then dividing instructional time into traditional (no technology) and technology-enhanced activity. A total of 2,110 minutes of literacy instruction over a 7-month period was observed, recorded, and analyzed. The breakdown of instructional time over the 35 hours of observation is presented in Figure 1.
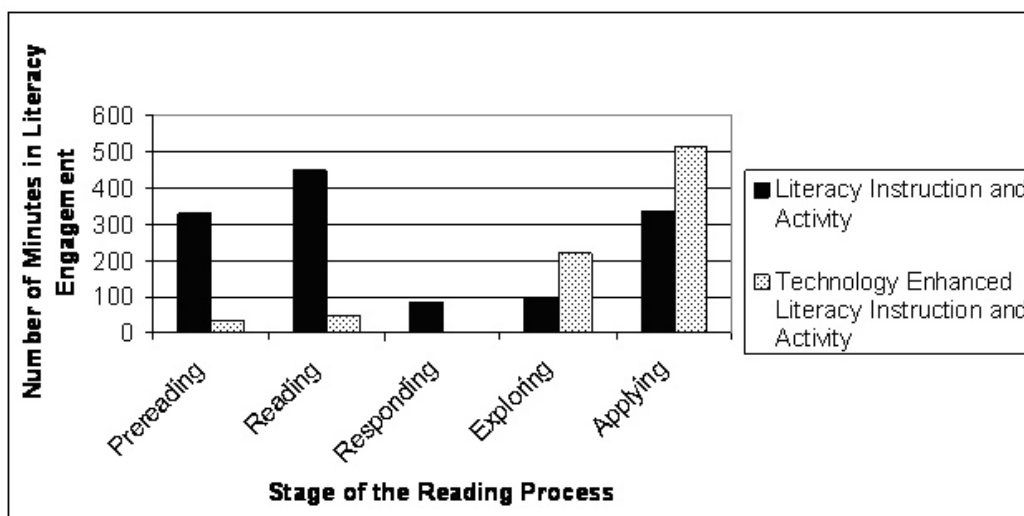

Figure 1. *Proportional representation of literacy instruction without and with technology.*

Observation dates were scheduled around the researcher's teaching commitments and the participants' regularly scheduled literacy blocks, with a goal of monthly observations in each classroom from November 2004 until the end of the 2005 school year in May. During that time, 34 separate observations yielded 35 hours of data. Total instructional observations were divided across the components of reading instruction as follows: Prereading (17%), Reading (23.5%), Responding (4%), Exploring (15%), and Applying (40.5%). Differentiating traditional versus learning with technology revealed that, on average, 39% of literacy activities included use of technology. The median amount of time with technology within literacy instruction and activity was 33% and, interestingly, the mode was 0% of technology use during literacy teaching and learning. Proportional representation of instructional time is presented in Appendix B (pdf - 33kb).

Student use of technology. The design of the OTELL instrument allowed differentiation between student and teacher use of technology. The largest amount of time in observation and the greatest variety of technology use was by students during the applying stage (40.5%). During applying, students are actively involved in utilizing knowledge gained through literacy minilessons to extend comprehension, provide for reflection, and increase the value of the reading experience. To accurately assess the amount of time

students used technology during applying, technology use was averaged by the number of students. For example, if half the students were using technology while the other half were working at their desks, the number of minutes was appropriated across both activities. Over the 7-month observation period, students used technology in application more than without technology (61% of the time). The kinds of technology used, in order of frequency of 5-minute episodes, were PowerPoint (25), Internet and Word (both at 18), Web sites (15), digital still cameras (nine), video cameras (six), iMovie (five), KidSpiration (four), and electronic books, a listening center and computer software (each at one).

Accessing the text through variations of reading activities accounted for the next largest amount of time (23.5%). During reading, students were engaged in teacher readalouds and independent, partner, and group reading of a variety of texts. Actual reading involved technology only 9% of the time. That 9% was made up of episodes with audiotaped books at a listening center (five), Internet stories (three), and an electronic book (one).

Response by students included genuine talk about connections to stories that were read aloud and accounted for 4% of the observed hours. Technology was not used during the response component of literacy instruction and activity.

Teacher use of technology. Teacher presentation of minilessons to the whole group – exploring – accounted for 15% of the total observation time. This stage documented the greatest percentage of teacher use of technology. Seventy percent of the observed lessons included technology to engage students in learning of literacy-based skills, strategies, concepts, and procedures. Web sites were used most often by episode (15), followed by KidSpiration (10), PowerPoint (nine), SmartBoard (seven), and an author Web site (three).

Prereading is the first component of reading instruction and is most often directed by the teacher. Much of the observed time (17%) was spent in transition, school routines, etc. However, technology was observed in seven episodes to pique student interest in the literacy engagement to follow: SmartBoard and Web sites (both at three) and one episode using a CD player. Most typically, a purpose for reading was embedded in minilessons during exploring or developed through a morning meeting in which individuals were encouraged to set literacy goals.

Limitations of the Study

The use of the OTELL instrument would be stronger if an additional researcher was available to record the same classroom practice so interrater reliability could be established. Corroboration of the researcher's interpretation of literacy learning activities was limited to participant reviews. Although reviews were conciliatory, more rigorous use of the instrument is warranted. As it stands, the instrument is specifically designed for recording literacy data. However, an expert in another field could easily adapt the design to record technology integration in different subject areas.

Another area unaddressed is the elusive goal of measuring student achievement in technology-integrated classrooms versus achievement in more traditional classrooms. Much work needs to be done in this area; however, it was outside the scope of this study. Technology use in planning effective lessons is another area that would shed more light on the issue of integrating technology in literacy learning.

Conclusions

There is a place for use of technology in effective early childhood literacy instruction, and this study helps define that place. Children are not curling up with a laptop in the reading center. Rather, they are interacting with real books, cozily social during partner reading, and transacting with text during extended periods of independent reading. Spelling is still a big part of early childhood literacy instruction, and the spell check feature in Word processing programs has not relieved children of that important responsibility. Rather, weekly spelling words are animated through PowerPoint presentations challenging young learners to shout out the correct spelling before the word fades in or repeat the spelling after it boomerangs and exits. Notebook pages still are smudgy with pencil tracings and erasures as young children record the important details of their lives in journals. Written pieces that have been carefully revised and edited in draft books escalate to professional publications through Word processing programs. Research by young children is eagerly anticipated when easy access to current information is afforded. Perhaps the days of text carefully copied from the encyclopedia are over!

Visuals are no longer limited to pages of a textbook when streaming videos can focus young children on sounds and actions that make learning come alive. This was particularly apparent when one teacher was teaching about Martin Luther King, Jr. The students had been reading, writing, and talking about the meaning behind the upcoming holiday weekend in his honor. Their teacher pulled up a video recording of King's famous march and speech. After watching this powerful experience, one student exclaimed, "I never knew there were white people there." That simple comment and the extended conversation that followed brought a deeper meaning to the learning experience. Table 1 summarizes other examples of technology use included during literacy learning in these classrooms.

Table 1
Minutes in Traditional (no technology) and Technology Enhanced Literacy Instruction

Observed Component of Reading Instruction	Total Minutes	Minutes Without Technology	Minutes With Technology
Prereading	365 (17%)	330 (90%)	35 (10%)
Reading	495 (23.5%)	450 (91%)	45 (9%)
Responding	85 (4%)	85 (100%)	0 (0%)
Exploring	315 (15%)	95 (30%)	220 (70%)
Applying	850 (40.5%)	335 (39%)	515 (61%)
Average		1295 (61%)	815 (39%)

Teachers used technology most often in presenting whole-group minilessons that brought deeper meaning to the learning experience. Technology was used to set a purpose for the reading experience that followed, to enrich literacy lessons with visuals and increased background knowledge, to motivate response, and to teach technology skills within the literacy lesson. For example, one teacher used a Kid's Poetry Page Web site to introduce similes within an ongoing unit on poetry. Prereading began by reviewing features of the site and the reading portion included choral recitation of poems other children had published on the site. Then the students and the teacher talked about what the poetry meant to them by making self-to-text and text-to-text comprehension connections.

The minilesson was introduced by examining a sample poem for features of a simile. Then the teacher engaged the students in creating similes from an electronic word bank. One student would drag a word from the word bank to the "_____ as a _____" template. All the students would read the word and "as a," and then visually search the word bank for the corresponding half. Another feature of the site was an electronic version of the classroom's magnetic poetry kit.

After the exploring minilesson, children broke into groups to apply their new knowledge to create their own poems. Half the children worked in literacy centers, and the other half went to the laptops where they used templates, moveable words, word banks, and a rhyming dictionary in their writing. Children filtered through centers, computers, and guided reading groups until time for the literacy block came to a close. This component of effective literacy instruction – applying – was the time when students used technology the most. This practice extended comprehension, allowed for reflection, and increased the value of the literacy experience. Of note during observation is that these second-graders were adept users of technology. They learned collaboratively with peers and their teacher and were highly motivated to share their knowledge of literacy and technology.

This study can help beginning users of technology know where to begin in their early childhood classrooms. For example, PowerPoint emerged as an effective teaching tool and a way young children could share their growing literacy abilities. Second graders used PowerPoint to create ABC books for their kindergarten buddies, to organize research information on Arctic animals, and to practice their spelling words. Basic computer skills, from the most simple to the most complex, can be introduced, practiced, and mastered by using PowerPoint for a myriad of literacy based, student projects. Using PowerPoint can incorporate Word processing skills, Internet research, and focused exploration of Web sites, thereby becoming much more than an electronic poster (Walery, 2006).

Results also inform educators about when technology is used most appropriately. Technology should not be used at the expense of known best practice. Literacy instruction in the focus classrooms was based on common ground themes related to best practice (Mazzoni & Gambrell, 2003), and technology integration was one of many different ways by which students grew as literate beings. Significantly, the curriculum did not change when technology resources became available. Rather, literacy learning was enhanced with the integration of technology as the teachers and their students grew together.

The OTELL instrument effectively identified when technology was used across the five components of reading instruction. It was user friendly, and the participants found it captured the essence of their literacy instruction. The instrument, which was specifically designed for this study, could be used in a variety of situations to help other observers document and analyze integration of technology in regular classroom practice. Teacher educators could require preservice teachers to use it to focus observation in cooperating classrooms and to plan for the literacy experiences they design. In-service teachers interested in increasing their own use of technology could monitor peer classrooms to pinpoint how efficient teachers use technology within the already crowded curriculum. Principles could use the OTELL for formal observations to provide informative feedback on both teacher and student use of technology.

Technology may never replace teachers, but teachers who do not use technology will be replaced by those who do. It is apparent that the role of the teacher in this pedagogical rethinking is critical. Participants were actively engaged in using technology in innovative ways that presented young children with the opportunity to use higher order thinking skills, engage in critical and creative thinking, and develop socially and emotionally. Ongoing high quality professional development experiences contributed to that ease of

technology integration, and district support put access to technology at the fingertips of the second-graders.

Dede (2000) challenged educators to prepare students by "teaching new skills, not simply teaching old skills better" (p. 178). The teachers in this study rose to that challenge, and their experiences could be a catalyst for change in other early childhood classrooms.

References

Allington, R. (1983). Fluency: The neglected reading goal. *The Reading Teacher*, *36*(6), 556-561.

Armbruster, B.B., Lehr, F., & Osborn, J. (2003). *Put reading first: The research building blocks for teaching children to read kindergarten through grade 3*. Jessup, MD: National Institute for Literacy.

Bangert-Drowns, R. (1993). The word processor as an instructional tool: A meta-analysis of word processing in writing instruction. *Review of Educational Research*, *63*, 63-93.

Blanton, W.E., Wood, K.D., & Moorman, G.B. (1990). The role of purpose in reading instruction. *The Reading Teacher*, *43*, 486-493.

Blanton, W.E., Moorman, G.B., Hayes, B.A., & Warner, M. (1997). Effects of participation in the fifth dimension on far transfer. *Journal of Educational Computing Research*, *16*(4), 371-396.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Education Research Journal, 38*(4), 813-834.

Dede, C. (2000). Commentary: Looking for the future. *The Future of Children, 10*(2), 178-180.

Doty, D., Popplewell, S., & Byers, G. (2001). Interactive CD-ROM storybooks and young readers' reading comprehension. *Journal of Research on Computing in Education*, *33*(4), 374-84.

Hansen, C.C. (in press). Integrating technology in early childhood literacy instruction. In F. Columbus, (Ed.) *New research on early childhood education*. Hauppauge, NY: Nova Science Publishers, Inc.

Higgins, N., & Cox, P. (1998). *The effect of animation clues on third grade children's ability to earn the meanings of unfamiliar words*. (Faculty Released Time Project Final Report) Oakdale, NY: School of Education, Dowling College (ERIC Document Reproduction Service No. ED418686)

Higgins, N., & Hess, L. (1998*). Using electronic books to promote vocabulary development*. Faculty Released Time Project Final Report) Oakdale, NY: School of Education, Dowling College (ERIC Document Reproduction Service No. ED418687)

Humble, A. (2000). *A comparison study of the traditional reading strategy of reading aloud with an adult and the technology based strategy of computerized talking books.*

Unpublished master's thesis, Johnson Bible College, Knoxville, TN. (ERIC Document Reproduction Service No. ED450349)

Hutinger, P., & Johanson, J. (2000). Implementing and maintaining an effective early childhood comprehensive technology system. *Topics in Early Childhood Special Education, 20*(3), 159-173.

International Society for Technology in Education. (1998). *National educational technology standards for students*. Eugene, Oregon: Author.

International Society for Technology in Education. (2000). *National educational technology standards for teachers*. Eugene, Oregon: Author.

International Society for Technology in Education. (2003). *National educational technology standards for teachers: Resources for assessment*. Eugene, Oregon: Author.

Kamil, M., Intrator, S., & Kim, H. (2000). The effects of other technologies on literacy and literacy learning. In M. Kamil, P. Mosenthal, D. Reason, & R. Barr (Eds.), *Handbook of reading research* (Vol. 3; pp. 773-788) Mahwah, NJ: Lawrence Erlbaum.

Kanaya, T., Light, D., & Culp, K.M. (2005). Factors influencing outcomes from a technology-focused professional development program. *Journal of Research on Technology in Education, 37*(2), 313-329.

Lankshear, C., & Knobel, M. (2003). New technologies in early childhood literacy research: A review of research. *Journal of Early Childhood Literacy, 3*(1), 59-82.

Labbo, L., & Kuhn, M. (2000). Weaving chains of affect and cognition: A young child's understanding of CR-ROM talking books. *Journal of Literacy Research, 32*(2), 187-210.

Loveless, A. (2002). *Literature review in creativity, new technologies and learning*. Bristol, UK: NESTA Futurelab.

Matthews, K. (1997). A comparison of the influence of interactive CD-ROM storybooks and traditional print storybooks on reading comprehension. *Journal of Research on Computing in Education, 29*(3), 263-270.

Mazzoni, S. A., & Gambrell, L. B. (2003). Principles of best practice: Finding the common ground. In L.M. Morrow, L.B. Gambrell, & M. Pressley (Eds.), *Best practices in literacy instruction* (2nd ed., pp. 9-22).New York: Guilford Press.

McKenna, M.C., Labbo, L.D., Reinking, D. (2003). Effective use of technology in literacy instruction. In L.M. Morrow, L.B. Gambrell, & M. Pressley (Eds.), *Best practices in literacy instruction* (2nd ed., pp. 307-332). New York: Guilford.

Morrow, L.M., Gambrell, L.B., & Pressley, M. (2003). *Best practices in literacy instruction* (2nd ed.). New York: Guilford Press.

Painter, S. (2001). Issues in the observation and evaluation of technology integration in K–12 classrooms. *Journal of Computing in Teacher Education.* 21-25.

Peterson, R., & Eeds, M. (1990). *Grand conversations: Literature groups in action*. New York:
Scholastic.

Resnick, M. (1998). Technologies for lifelong kindergarten. *Educational Technology Research and Development, 46*(4), 43-55.

Resnick, M. (2000). Commentary: Looking to the future. *The Future of Children, 10*(2), 173-175.

Rochelle, J., Pea, R., Hoadley, C., Gordin, D., & Means, B. (2000). Changing how and what children learn in school with computer-based technologies. *The Future of Children, 10*(2), 76-101.

Sandholtz, J.H., Ringstaff, C., & Dwyer, D.C. (1997). *Teaching with technology: Creating student-centered classrooms*. New York: Teachers College Press, Columbia University.

Schrum, L. (1999). Technology professional development for teachers. *Educational Technology Research & Development, 47*(4), 83-90.

Stipek, D. (2006). No Child Left Behind comes to preschool. *The Elementary School Journal, 106*(5), 455-465.

Sun, J. (2000). *Planning into practice.* Austin, TX: SouthEast and Islands Regional Technology in Education Consortium.

Tompkins, G.E. (2006). *Literacy for the 21st century: A balanced approach.* (4th ed.). Upper Saddle River, NJ: Merrill Prentice Hall.

Turbill, J. (2001). A researcher goes to school: Using technology in the kindergarten literacy curriculum. *Journal of Early Childhood Literacy, 1*(3), 255-280.

Walery, D. (2006, October). Why are we still using PowerPoint? *T.H.E. Journal*. Retrieved from http://www.thejournal.com/the/printarticle/?id=19431

Weaver, C. (1994). *Reading process and practice: From socio-psycholinguistics to whole language* (2nd ed.). Portsmouth, NH: Heinemann.

Wetzel, K., Zambo, R., & Padgett, H. (2001). A picture of change in technology rich K-8 classrooms. *Journal of Computing in Teacher Education, 18*(1), 5-11.

Yelland, N. (2005). The future is now: A review of the literature on the use of computers in early childhood education (1994-2004). *AACE Journal, 13*(3), 201-232.

Zambo, R., Wetzel, K., Buss, R., & Padgett, H. (2003). Measuring the integration of technology through observation. In C. Crawford, N. Davis, J. Price, R. Weber, & D. Willis. (Eds.). *Technology and teacher education annual* (pp. 3933-3936). Charlottesville, VA: Association for the Advancement of Computing In Education.

Author Note:

Cory Cooper Hansen
Arizona State University
email: cory.hansen@asu.edu