



## Reading Horizons: A Journal of Literacy and Language Arts

Volume 48  
Issue 3 April/May 2008

Article 4

4-1-2008

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### Recommended Citation

Moore-Hart, M. A. (2008). Supporting Teachers in their Integration of Technology with Literacy. *Reading Horizons: A Journal of Literacy and Language Arts*, 48 (3). Retrieved from [https://scholarworks.wmich.edu/reading\\_horizons/vol48/iss3/4](https://scholarworks.wmich.edu/reading_horizons/vol48/iss3/4)

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## Supporting Teachers in their Integration of Technology with Literacy

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### Abstract

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This study investigates how two elementary teachers begin to use technology in a private school that had access to technology at many levels. Using a collaborative teacher-research model, the researcher specifically examined how to support teachers' practice as they integrated technology tools within their literacy curriculum. Due to a supportive context, the teachers refined their writing instruction to include technology tools, and students improved their literacy through challenging learning experiences.

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In 1988, the Office of Technology (OTA) asserted, "Most teachers want to use technology, but few have found ways to exploit its full potential. Technology will not be used, and certainly will not be used well, unless teachers are trained in the use of technology, provided goals for new applications, supported in doing so, and rewarded for their successes in meeting these goals" (1988, p. 114). Even though many teachers continue to show an interest in using technology, our educational systems often fail to address the needs of teachers who have limited instruction in technology or know how to integrate it with the curriculum (Pianfetti, 2001).

While authorities (Bork, 1987; IRA & NAEYC, 1998; Labbo, 1996; Labbo & Kuhn, 1998; Leu, 2000; Leu, Leu, & Coiro, 2004; Papert, 1993; Reinking, 1995, 1998), claim that technology offers a revolutionary and important instructional medium for improving the quality of academic learning for all students, the potential

impact of technology on academic learning remains untapped. Equally discouraging is the fact that computers remain isolated from the content of the curriculum. Compounding these issues, technological innovations continuously expand and frequently become more complex. In order to overcome these barriers, educational systems need to closely examine how to help teachers acquire the expertise to use computer technology, integrate technology with the curriculum, and use technology to improve literacy.

This qualitative study is designed to examine how two teachers, both immersed in a technological learning environment, changed their use of technology to enhance and support the literacy learning of their students through a mentor/researcher relationship. Specifically, the major research objectives are to investigate how (1) two elementary teachers change their use of technology to support young students' reading and writing, (2) elementary students feel about using technology with their reading and writing, and (3) elementary students' reading and writing is enhanced through the use of technology.

## Research Perspectives

Despite possible teacher interest in using technology, efforts to reform teacher use of technology in teaching and learning document only subtle changes in its instructional use (Cuban, Kirkpatrick, & Peck, 2001; Pianfetti, 2001). Other research studies reveal that reform efforts seldom involved teachers in the design of the study nor did the efforts provide sustained support for ongoing professional development (Cohen, 1990; Cuban, 1993; Spencer, 2000).

While reform efforts reveal subtle changes in teachers' instructional use of technology, research studies do show shifts in reported classroom use of technology. In the 1980s the majority of teachers were nonusers of computers in their classrooms (Cuban, 1986). Since the 1990s, one third of elementary and middle school teachers are occasional users of technology; one out of ten are daily users; and one half are nonusers (Means & Olson, 1995; Schofield, 1995). Although these studies indicate shifts in reported classroom use of technology over the years, there is a need to consider more specifically how teachers use computers.

According to the National Educational Assessment Program (1996), software and hardware use are the prevailing classroom practices in technology, and is frequently used for drill and practice. Other studies suggest that while a larger number of teachers use technology for drill and practice, a smaller number of teachers use it for higher level thinking and problem solving activities (National Educational Assessment Program, 1996; Pianfetti, 2001; Wenglinisky, 1998).

Several recent studies have attempted to address these challenges by examining how teachers become users of technology in their classrooms and what factors shape their thinking (Margerum-Leys, 2002; Vannatta & O'Bannon, 2002; Windschitl & Sahl, 2002). These studies reveal important findings related to teacher use of technology and what factors motivate teachers to change their instructional practice to include it. Studies associated with the Apple Classrooms of Tomorrow (ACOT), for example, suggest that teachers learning to use technology move through five stages of technology integration, ranging from the entry to invention stages, over time (Sandholtz, Ringstaff & Dwyer, 1997). These studies further suggest that teachers need time to incorporate technology into their curriculum.

Other studies indicate that teacher beliefs about learning and student and teacher roles in the learning process influence how they use technology (Sandholtz, Ringstaff, & Dwyer, 1997). Becker (1994) found that teacher use of technology thrived in environments where they experimented with its use. Several studies further claim that support networks stimulate teacher use of technology and its integration within the curriculum (Becker & Ravitz, 1999; Franklin et al., 2002; Jayroe, Ball, & Novinski, 2002; Labbo, Eakle, & Montero, 2001; Margerum-Leys, 2002; Myers & Halpin, 2002; Vannatta & O'Bannon, 2002; Windschitl & Sahl, 2002). The findings from these studies suggest that teachers become willing to integrate technology with the curriculum when they see how it can be used as a tool to accomplish their learning goals and to promote student learning.

As the number of technological innovations continues to increase, the need for support networks, as well as effective in-services and ongoing professional development programs, becomes heightened (Hawisher & Selfe, 1989; Labbo, et al, 2001; Margerum-Leys, 2002; Moore & Karabenick, 1992; Reinking, 1995, 1998). Specifically, teachers need ongoing support to accommodate their understanding of evolving communication and technological tools. They also need ongoing support to determine what possibilities these tools offer for student learning. In-services and ongoing professional development opportunities are ways to increase teachers' expertise in changing technologies. In addition, teachers need supported practice to consider possibilities for enhancing student learning and for integrating technology with the curriculum (Franklin et al., 2002; Moore, 1988, 1989; Moore-Hart, 1995; Myers & Halpin, 2002; Vannatta & O'Bannon, 2002; Windschitl & Sahl, 2002). Once teachers assume more of the responsibility and begin to function independently, this support may gradually be decreased. However, these studies emphasize that when innovative technology emerges, support should increase once again.

Desiring to determine if supported practice would facilitate teachers' knowledge and understanding of technology, as well as enhance student literacy learning,

I investigated how supported practice affected two elementary teachers' use of technology. The two teachers taught in a private school where technology was abundant and advocated by teachers and administrators.

## Methodology

Using the collaborative teacher-researcher model, I addressed the dual needs of increasing teacher expertise in the use of technology and supporting their practice as they integrated technology tools with the curriculum. By collaboratively posing questions about ways to use technology to improve literacy learning and investigating possible answers to these questions, I hoped to show respect for teacher knowledge. Using this supportive structure might give teachers a voice in how they reshaped their instructional practice to include technology. At the same time, this supportive structure might simultaneously facilitate student literacy. If the potentials of technology are to be realized, there is a need to consider the contexts of the classroom, the school, and the community (Windschitl & Sahl, 2002). Using a collaborative model placed me within these contexts. As a result of using this model, perhaps the evolving instructional changes might become fundamental and realistic to classroom teaching.

## Participants and Setting

The teachers and young learners (ages five through eight) who participated in this study attend a private school located in southeast Michigan. The multi-age classrooms in this school were created so that children might advance to new levels of learning at their own rate. Following a balanced approach to learning, teachers organize the curriculum around thematic learning. Throughout the day, children participate in a variety of learning experiences, including oral and written language using a variety of literacy tools, such as technology and literature. Under the direction of a media specialist, all children visit the computer lab twice a week to learn about keyboarding, word processing tools, email, publishing tools, and digital cameras. The computer lab is also open for classroom use during the day on a sign-up basis. All classrooms further had two computers and a printer.

The two teachers, both European Americans, were beginning level teachers. Both teachers had taken two courses in technology during their undergraduate work at a nearby university. These courses specifically familiarized them with the use of word processing tools, email, hypermedia, and the Internet. The second course further included educational uses of technology.

The first teacher, Michelle, was a beginning level teacher who had been teaching for three years. Her multi-age classroom included emergent learners, ages five and six. The second teacher, Lynne, had just completed her student teaching the previous spring; this was her first year of teaching. Her multi-age classroom included young learners, ages six through eight. Even though both teachers shared that they felt comfortable using computers, they did not integrate technology within their literacy program. They did say, however, that they were interested in learning new ways to use technology.

The young learners in Michelle's class included European American students (82%) and culturally diverse students (18%) primarily from middle class income families. The class contained diversified students with respect to ability levels and age levels (five first graders and eight kindergartners). Similarly, the young learners in Lynne's class included European American students (71%) and culturally diverse students (29%) also from primarily middle class income families. Again, the class contained diversified students with respect to ability levels and age levels (one first grader, three second graders, and ten third graders).

### **Materials/Equipment**

The computer lab included fifteen MacIntosh computers, two laser printers, one color laser printer, and two digital cameras. Computer software included several software programs such as Claris Works™, Pagemaker™, and Adobe Photo Shop™. In addition, keyboarding software, a variety of computer games, and Internet connections were available. All students also had their own email address.

### **Procedures**

Using a teacher/researcher collaborative approach, I met with Michelle and Lynne prior to the beginning of the study in order to formulate specific questions they wanted to explore regarding technology. During this meeting, I wanted to learn how they currently used it in their classrooms and how they felt about integrating technology with their curriculum. I also visited their classrooms to gain a fuller picture of how literacy evolved. During the meeting, I explained that I would observe and record the impact of computer technology on their students' literacy learning on a weekly basis. I further shared that I would serve as an enactment facilitator (Singer, Karjick, & Marx, 1999), giving support by working with students and sharing responsibility for teaching and technology use. During subsequent reflective planning sessions, we discussed what they discovered about their students as they used technology and what new questions they wanted to explore as we continued our inquiry.

After meeting with the teachers in early January, my graduate assistant and I collected all pretest data. Following the collection of pretest data, the collaborative research study began as I visited the two classrooms weekly in order to provide assistance, guidance, and dialogue opportunities. During these class visitations, I observed students using technology and participated in the literacy learning of the students by co-teaching literacy lessons that often included technology.

### **Data Sources and Data Analyses**

The data collection period extended from January to June. During this period, my graduate assistant and I gathered information related to process outcome measures. These measures included informal observations, structured and semi-structured interviews with students, and student writing samples. Specifically, I recorded the informal observations immediately after the classroom visitations and gathered writing samples from students throughout the data collection period. At the conclusion of the study, my graduate assistant interviewed the students to discover their feelings about writing with computers and how they used computers in their daily lives and in school. Throughout data collection, I generated working hypotheses through ongoing constant comparative analysis (Glaser & Strauss, 1967; Strauss & Corbin, 1990) of the data.

Since data analysis was ongoing and occurred throughout the research study, I informally discussed the field notes and interviews with all participants. Together, we then used feedback from these dialogues to develop working themes and patterns about the data. We first examined, compared, and categorized the data to create these themes independently. We then met to discuss both similar and additional reoccurring themes. As the study continued, we confirmed or disconfirmed these hypotheses through new emerging themes. Once we reached consensus about the themes and patterns, we applied them to the data analysis. To enhance the analysis, we used both triangulation of sources (i.e., teachers, students, my own observations) and triangulation of methods (e.g., observations, interviews, writing samples) to interpret the evolving data. Through this ongoing inductive analysis of the data, we attempted to assimilate the emerging patterns into a grounded theory (Miles & Huberman, 1984; Patton, 1990).

## **Results**

To investigate how supported practice affected two elementary teachers use of technology, inductive analysis of the observational data was performed through constant comparative analysis. This analysis yielded three themes related to the

teachers: (1) teachers' interests guided the direction of how technology became integrated with their literacy curriculum; (2) teachers gradually began to incorporate technology into their literacy curriculum, as well as their professional needs; (3) teachers' levels of comfort using technology gradually changed.

To investigate the effects of technology on literacy learning of the emergent learners, analysis of the observational and interview data was also performed through the use of constant comparative analysis. This analysis revealed the following themes related to the students:

- Students were highly motivated while using technology with their writing.
- Students became more comfortable using technology and acquired the skills needed to use the technology, often helping their peers learn new skills.
- Students naturally explored and experimented with word processing tools while writing.
- Students learned strategies to improve their writing while using word processing tools.

Combining holistic analysis (Tompkins, 2008) and inductive analysis to the writing samples, we discovered the following themes related to the students' writing samples:

- Students' writing became longer as they became more comfortable with writing and using computer tools, especially when encouraged to use their temporary spelling without spell check while drafting.
- Students' writing improved as they specifically learned how to use word processing tools (i.e., tools to delete, insert, or rearrange text) during the revising and editing stages of writing.
- Students' writing improved through teacher guidance and conferencing, facilitated by the computer screen, which displayed the writing in a readable format, and by the printed copies, which were more easily read by teachers and students during the revising and editing stages.

### **Findings from Observations of Michelle**

Prior to the study, Michelle sent her students to the computer lab to receive instruction in keyboarding and simple word processing skills under the direction of the computer specialist. Students also went to the computer lab during the



week to play computer games or use keyboarding software to increase keyboard familiarization.

*Michelle's interests guide her use of technology.* During our early reflective planning sessions, Michelle expressed an interest in learning ways to integrate technology with journal writing. Similar to many classrooms, Michelle's students wrote in their journals daily. Students typically wrote one or two sentences about topics of their choice or an assigned topic in their journals.

Picking up on this interest, I showed her how students could do their journal writing on the computers. I circulated among the students, modeling how to ask students questions as they wrote, helping them extend their writing. The importance of having students use their "temporary spelling" as they wrote was emphasized. I further suggested that spell check be turned off while students wrote in their journals as the young learners became frustrated when their temporary spelling turned red.

Once we turned off spell check and re-encouraged them to use their temporary spelling, the students gradually became more comfortable writing. They were able to concentrate on the message rather than the spelling of the words. Asking them questions as they wrote, helped the young writers think of additional things to write in their journals. As they concentrated on their messages, adding sentences, the drafts gradually became longer. Specifically, students' journal entries extended from one or two sentences to five and six sentences.

Seeing her students' enthusiasm and interest while using the computer, Michelle became more interested in using computers with journal writing. As we discussed this during our reflective sessions, Michelle shared that she would like to use the computer more, but she could not go to the computer lab every day. I suggested that she allow one student to use the computer in her classroom during journal time. Following this suggestion, a rotating schedule was designed so all students would have access to the computer at least once a week. She also began to take her class to the computer lab once or twice a week.

Michelle's interests guide her integration of technology with her literacy curriculum. As we continued our sessions, Michelle expressed an interest in using the computer to publish children's narrative stories. Since her students were studying fairy tales during reading, we decided to have students compose fairy tales about their favorite stuffed animal. We collaboratively modeled the process for the students during a mini-lesson, showing them how to create a web about a stuffed animal and how to use this web to create a fairy tale. Observing our bunny, the children came up with describing words for the bunny, and things to do with it. We webbed their ideas on chart paper.

Following this prewriting activity, children used their knowledge of fairy tales to create one about the bunny, using the language experience approach. First, we quickly reviewed the story elements in fairy tales. Next, we began talking about our fairy tale, discussing the characters and setting. Using the children's words, we then recorded the first few sentences on chart paper, having the children assist us with the beginning and ending sounds of some words. After composing these sentences, we stopped to talk about what the problem in our story would be and how the characters would solve it. After voting on our favorite idea, we continued to record the students' ideas on the chart paper.

In order that students might have their own copy of their fairy tale (Figure 1), we published the class fairy tale using Michelle's computer so that she could print out a copy for students to take home and share with their parents.

Once upon a time there was a fuzzy, white bear who lived with Mrs. Moore-Hart. The cute, loveable bear loved the pink bear with the white heart and the gray and white sea otter. The pink bear, the white bear, and the sea otter played with each other all day. One day they had a sleep over. When they woke up, the white bear was missing. The sea otter and the pink bear went to find the gorgeous white bear. They looked and looked and found her wandering in the black forest. The white bear was lost. They called to her, and she came back. They were so happy, they had a party.

**Figure 1.** Class Created Fairy Tale

During our reflection session, we discussed how Michelle could link the computer to an LCD projector or the TV monitor when writing language experience stories in the future as the LCD would display the story in large print for everyone to see. I explained that this would help her record the story faster.

Students, using pencil and paper, then created their own fairy tales using our model. Interestingly, all the children included a problem in their fairy tale, illustrating the importance of modeling the process before students compose. Once the young learners finished their drafts, they word processed their fairy tales on the computer. Having them draft their fairy tales with pencil and paper first gave the children more time to use the computers for revising and editing. For example, some children made simple revisions by changing a word or adding a new sentence. To help all the students learn how to make simple revisions with the insertion and deletion keys, we decided to show them how to insert a title for their fairy tale. As the students independently inserted their titles, we reminded them about the importance of capitalizing its name, just as they capitalized their own names.

Some children also discovered how to use spell check with some of their words. Interestingly, they shared this discovery with their friends, and before long, a few others also tried using spell check. Even though some children left their stories with the temporary spelling, all the young learners wanted to change the print font, and others wanted to change the color of the font as well. Once again, those who knew how to change the print font showed their friends how to make this change causing a ripple effect. The fairy tales were then compiled into a book for all to take home (See Figure 2 for Doug's story).



**Figure 2.** Doug's Fairy Tale for the Class Book.

*Michelle's changing perspectives about technology.* During our reflective sessions, Michelle remarked that she was amazed to see the children word process their hand-written drafts so quickly. She was also intrigued with how the children taught one another how to change the print font or color. Emerging themes suggest Michelle was beginning to see ways to integrate technology with literacy. Rather than use the computer for games or skill and drill activities, Michelle began to see ways that computers might extend her emergent learners' writing. Through our reflective sessions, she also discovered that students' knowledge of word processing tools expanded through experimentation (changing the print font), as well as guided instruction (inserting titles). She also noticed how students taught one another.

Thus, the supportive context helped Michelle modify her instruction. In addition, Michelle began to use the computer to create instructional activities, send letters to her parents, and prepare a narration of her students' performance for report cards. Knowing that she could easily receive support seemed to encourage her to take more risks with technology. She was not yet ready, however, to use technology independently or modify her instructional practice independently.

### **Findings from Observations of Lynne**

Similar to Michelle, prior to the study, Lynne merely sent her students to the computer lab to receive instruction in keyboarding, word processing skills, email, or desktop publishing. Her students also played computer games or used keyboarding

software during computer lab. During class, some students used their classroom computer for writing or playing computer games. Students who used the computer, however, were those already comfortable with it.

*Lynne's interests guide her use of technology.* During our early reflective planning sessions, Lynne wanted to see how to integrate computers within her writing curriculum. An important part of her writing curriculum also included the use of journal writing, so, similar to Michelle, I showed her how to set up a schedule so that all students might rotate to the computer once a week during journaling. When we reflected about this during our reflective planning session, Lynne pointed out that all her students were motivated to use the computer for journaling.

As we continued our reflective planning sessions, Lynne also expressed an interest in using the computer with the writing process. She wanted to extend her understanding of the writing process and how word processing tools might be integrated within it. Since her students were studying African American people and culture during reading class, we decided to have students follow the writing process to compose an informational piece about Elijah McCoy, a local African American who invented the easy oil can. To help her students first learn about Elijah McCoy, we read the story, *The Real McCoy* by Wendy Towle (1993). As students listened to the story, we showed them how to take notes, explaining that this would help them remember the information about McCoy. We further pointed out that they could use their notes to write about him later. After completing this prewriting activity, students used their notes to write a pencil and paper rough draft about his life, beliefs, or accomplishments. As students composed their pieces, Lynne noticed that her students completed the rough drafts quicker and easier due to the note taking activity. Once students finished the drafts, they typed them up in the computer lab.

Continuing with the writing process, we modeled how to make revisions on triple spaced, word processed drafts. We demonstrated the process using the overhead and one student's writing. We then encouraged the class to give the author praise for his ideas which helped him become comfortable with his writing. Next, we had the class asked him questions about his piece—additional information readers might want to know. As the class asked questions and he responded to their questions, we showed him how to insert this information into his writing, using carets or arrows. We further reminded him that he was the author, so he could decide whether or not to make the changes.

Once students practiced the revising process as a class, they worked in groups of four, helping their peers revise. Using peer feedback, students used colored pens to insert additional information or deleted incorrect facts on their drafts. All students made at least three revisions on their drafts. Following this process,

students completed the revisions on the computer. Their resistance to revising softened since there was no need to recopy their writing. Christine shared, “With a pencil you’d have to start all over again. With a computer, I can rewrite it the correct way and everything will be fine.”

The following week, students learned how to edit their drafts. Using the overhead and the same student’s writing, we again modeled how to find words we wanted to spell correctly and how to look for missing punctuation or capitals. After seeing the process modeled, students self- and peer-edited their writing with colored pens. As they worked in pairs, Lynne and I circulated, becoming the “top editors.” If they overlooked misspelled words or errors in punctuation or capitals, we placed dots next to the lines. The two students then reviewed the line, finding the errors. Once they completed these edits, students returned to the computer lab to correct their drafts. They also used spell check to further check their spelling .

Finally, students changed the print font for their writing pieces and published their final drafts (See Figure 3 for Nathan’s story). Thus, students’ knowledge and understanding of the writing process, as well as word processing tools, expanded through guided instruction and experimentation. Seeing their enthusiasm inspired Lynne to further integrate computers with her writing curriculum.

### **Elijah McCoy**

Elijah was born in Canada on May 2nd, 1844. His mother's name was Emillia his dad's name was George. His parents were slaves that escaped to Canada where Elijah was born. His dad got 160 acres as a soldier. When he was 16 he went to school in Scotland for a mechanic degree. He came back to Ypsilanti Michigan. When he got there people thought that it was unusual he was educated. He also became a fire and oil man for the train. It was hard being a oil man to stop every mile, so he built the oil cup. He built other things like: The ironing board, the sprickler, the thick tire, and the rubber heal. He got married twice his second wife died in a car accident. After that he got lonely. He made a company to make oil cups. He died on 1929.

**Figure 3.** Nathan’s Paragraph About Elijah McCoy.

*Lynne’s changing perspectives about technology.* During our reflective planning sessions, Lynne pointed out that her students were more willing to revise and edit their writing as previously, students omitted these stages of writing. Through

our ongoing discussions, she realized that young writers had gone back and forth between word processing and writing with pencil and paper during revising and editing. Most important, Lynne noticed computers eliminated the recopying penalty. Given this supportive context, she independently explored the use of technology with a writing lesson. Following the same steps we applied, she had her students compose, revise, edit, and publish a thank you letter for a guest who came to the school. Knowing that she could easily receive help as she tried these activities, Lynne felt more comfortable taking risks. Interestingly, she also decided to take a graduate class on writing to extend her knowledge of the writing process. Different from Michelle, Lynne already used computers to design lessons or send letters to parents. As the study progressed, she also began using the computer to prepare student narratives for report cards.

### **Findings from Reflective Sessions**

The reflective sessions appeared to help both Michelle and Lynne begin to discover how technology might be used to guide and extend young learners' writing. Throughout, their interests and needs determined how we integrated technology with their literacy program. As a result, technology was better correlated within their curriculum. Having the support of a facilitator to explore their interests and needs helped them gain more technological expertise. Sharing the responsibility for teaching and using technology gave them a model of how to efficiently manage instruction in computer rich environments. Having a mentor also seemed to help them become comfortable taking risks. Each teacher, however, moved through stages of technology integration at differing rates. Becoming more comfortable with how to use technology with her instruction empowered Lynne as she began to take new risks independently. In order for her to move to higher levels of technology integration—using the Internet, email, or PowerPoint™, for example, she might need ongoing support systems. Michelle, in contrast, still needed additional support and guidance at her current level.

### **Findings from Observations of Young Learners Using Technology with their Writing**

Data analysis consistently suggested that all the young learners were highly motivated while using technology. As observers watched the children work at their computers, they consistently noticed the children seemed to stay on task. Nathan's words illustrate this engagement, "Well, it's sort of like a really good activity. It's something you could do for an hour...It's really fun."

*Specific Behavioral Patterns.* Specific behavioral patterns of the multi-age learners suggested that they were comfortable using technology. Observations revealed that students, especially boys, experimented and explored with the word processing tools, continuously learning new ways to use the computer. Even though some of the girls were more conservative in their use of word processing tools, they continued to learn new ways to use the computer, especially from their peers. Whenever students learned new computer strategies, they spontaneously shared these “tricks” with their friends. For example, some girls showed their friends how to use spell check, save files, or print their work.

Observations further indicated that students who initially had difficulty using word processing tools often became more proficient through practice. Their peers frequently helped them whenever they forgot how to use the tools. Examples of ways students supported their peers included finding letter keys on the keyboard (especially the five and six year old children), changing the print font in their writing, changing the color of the print, using deletion or insertion keys, and using spell check.

Observations also showed that in the computer lab, students had opportunities to talk about their ideas for writing with their teacher and neighbors, share their writing with others, and help one another gather ideas for their writing. The computer screen, which was easily visible to their neighbors, seemed to facilitate these social interactions. The arrangement of the computer lab in a “U” shape further supported teacher guidance as students wrote. This shape helped teachers circulate easily and quickly among the learners. With a quick glance, teachers could move and help students wherever needed. As a result of these social interactions and guided instruction, many students learned how to extend and improve their writing. As Hannah shared, “I’m writing more this year on the computer. It’s fun.”

Data further indicated that the word processing tools, for example, the print fonts and styles, fascinated students when publishing their writing. Interestingly, boys especially enjoyed trying different ways to display their writing, using different font styles, backgrounds, or pictures. Some even learned how to use Pagemaker™ on their own. Even though many of the girls were more hesitant to experiment with the computer, they would willingly apply these strategies once someone showed them how to use the tools. However, data suggested a need to have students first complete their drafts in pencil and paper, including the revision and editing, otherwise, they often lost focus on their writing and their message as they tended to keep playing with the features of the tools instead of writing.

*Observations of Emergent Learners While Using Technology.* Observations revealed some distinct differences in how the younger writers, ages five and six, used technology with their writing. For example, emergent learners, still learning about the alphabet and the sounds and symbols of letters, gradually acquired keyboarding skills and simple uses of word processing due to their interest in using technology. Many of the emergent writers, in fact, seemed to be able to write easier and faster with the computer as the year continued. Pressing a key, rather than thinking about the formation of the letters, seemed easier for some students.

Nevertheless, observations revealed some tensions for a few of the emergent learners. For example, some students initially had trouble finding the letters. As Gabrielle explained, “Usually it is hard to find the right keys.” However, she added, “The more I look at the keyboard the faster I can type.” Other students experienced difficulty with deleting letters or words. If they pressed the delete key too hard or too fast, they lost all, or most of their writing. Consequently, it must be remembered that whenever young learners first begin typing on the computers, teachers may need to consistently monitor them, helping them carefully press keys. Once students learned to press the delete key one letter at a time, losing text became less problematic.

Social interactions also appeared to play an important role. For example, David shared, “I can get help from my teacher, my friends, and other people.” Having students work close to one another while writing on the computer also encouraged them to help one another use the delete key, find a specific letter, change font sizes or the color of the font, use spell check, or insert/delete information. Even though these social interactions were important, observational data indicated a need to encourage emergent writers to begin their writing independently with minimal social interactions when first arriving in the lab giving them time to concentrate on their message.

Additional observations revealed that the computer addressed different learning styles and abilities of the emergent students. For example, using the keyboard seemed to help many learn the symbol-sound system due to its kinesthetic-tactile approach. Data also suggested that students learned how to space between words more easily with the computer. Once they learned how to space, Michelle noticed that they applied this skill when writing with pencil and paper. Other children learned the correct spellings of words by using spell check. Elizabeth explained, “It helps me with my spelling...It teaches me from my mistakes that I make.” In fact, seeing a word spelled correctly helped some students remember how to spell



the word. Thus, technology tools seemed to help the emergent writers learn more about print and writing. They gradually improved their writing as shown by Tyler who announced, “I can write better with a computer. It is faster.” The computer screen also provided a way for the children to easily read their own writing, as well as the writing of their peers. As children read and reread their own writing or the writing of their peers, they seemed to increase their word recognition skills and reading fluency.

*Observations of Developing Learners, Ages Seven to Eight.* Technology tools also helped the developing learners gain more knowledge about writing – how to express their ideas or how to apply word processing tools in their writing. Already familiar with keyboarding and word processing, students began to use word processing tools to improve their writing by inserting, changing, or deleting information. Specifically, word processing tools seemed to make it easier to make changes. Students appeared to be less resistant to revising their texts because the recopying penalty was eliminated. In Nick’s words, “You can’t mess up. If you do mess up, just use your clicker and press delete and fix your mistakes. It doesn’t mess up your paper, but it would if you erased with a pencil.”

Teachers were also able to help the children refine their writing by showing them how to change the order of sentences or how to add an ending to their piece with word processing tools. Guiding and assisting students through questioning seemed easier due to the reader friendly print font and computer screen. The computer screen also helped authors do peer editing as they could point to words or sentences and talk about why they made certain changes.

The computer lab, which included tables and chairs, as well as computers and printers, also made it easier to manage literacy learning when students were at different stages of writing. They could work on drafts at tables, work in revising groups, peer edit in twos on the computer, or work independently on the computer. The interactive arrangement of the computer lab also supported other social interactions. For example, the computer environment facilitated cross-age writing activities as older students taught younger students how to send emails to their parents or friends. As younger students practiced the skills, the older students guided them while others helped the emergent writers read the emails.

### **Findings from Interviews with Students**

To investigate how students felt about computers and writing with computers, inductive analysis of the student interview data was performed through

constant comparative analysis. Consistent with the data from the observations, the evolving data suggested that children enjoyed using computers with their writing. For example, one student explained, “Well, it’s sort of like a really good activity. It’s something you could do for an hour and type a story and do all those fun things. It’s really fun.” Aaron added, “I’d stay in from recess to use the computer.”

Interestingly, most children responded that they liked playing games on or writing with the computers. They further shared that they had a computer at home, which they used for playing games, writing, or homework. This indicated that students might have also practiced the skills they were learning at home. Students consistently explained that the computer helped them with their writing because they could type faster than they could write; many added that it was easier to write with the computer. For example, Nathan shared, “The computer is faster than writing with a pencil.” Christine added, “It’s easier and funner. The computer is a great invention.” A few students also reported that they could more easily revise and edit with computers.

Most children expressed that their writing was neater with the computer and that typing/writing on the computer made writing fun for them. Annika shared, “I use it to help me write because it’s neater and it doesn’t make my letters wiggly.” The young learners especially remarked that they enjoyed using the different fonts, colors, spell check, or printer. Elizabeth, for example, commented, “You can type whatever you want and type lots of pages. You can type it in a color and print it in a different color. You can only change the story on paper if you write it in colored pencil.”

Even though it was difficult for them to learn keyboarding at first, the children explained that they could find which keys to type by looking down and practicing. For example, Mitch explained, “I’ve practiced so much that I know where they all are. I sometimes have problems with some of these (points to special keys...like escape, delete, etc.)” Many shared that it was easier to push the keys than write with a pencil. In fact, keyboarding did not seem to hinder or frustrate most students. Most students, nevertheless, shared that they preferred writing their first draft with paper and pencil. Several children further commented that they preferred to work independently at the computer because they could think better and write easier with the computer. Many also reported that the computer helped them write better and helped them with their spelling (See Figure 4 for additional responses from all students in the study).

**How do you feel about using computers?**

- "Good. Because it's fun. You get to type on it and play games."
- "Good. I feel good because it gives me time to type things I don't normally get to write in my journal."
- "I really like using a computer. Meaning if I had the opportunity to I would type on it some of the time of the day at least from D.O.L. to after snack. And I'd stay in from recess to use the computer. On a scale from 1-10, I like using the computer at 9."

**How does the computer help you?**

- "It helps me with my spelling with spell check. It teaches me from my mistakes that I make."
- "I use it to help me write because it's neater and it doesn't make my letters wiggly."
- "The computer is faster than writing with a pencil."

**How does the computer help you with your writing?**

- "I delete mistakes on the computers, with a pencil you have to erase. It's easier to fix mistakes on a computer"
- "It helps me because if I have a word wrong, I can rewrite it the correct way and everything will be fine."
- "Well, it's because there are a lot of fonts and it is much easier than actually writing because your pencil might break and you might mess up your writing and with a pencil you'd have to start all over again. With a computer you can't mess up."

**Why do you like computers?**

- "Thinking of the stories is usually fun for me. I like making the titles. I don't like it when the computer makes me angry — When spell checker isn't right sometimes, it makes me angry."
- "You can like email people these messages."
- "You can type whatever you want and type lots of pages. You can type it in a color and print it in a different color. You can only change the story on paper if you write it in colored pencil."

**What are some ways you use the computer to help you?**

- "When I do emails the word turns red when it's wrong. It helps me to know it's wrong so I need to change something. I'll try to see and add something and take away something to see if the red goes away. I sometimes ask somebody for help with spelling."
- "I can learn how to spell a word from spell check, but sometimes it's wrong, so you have to be careful. Like I put N.P. for north pole and the computer didn't recognize it."
- "I like type and type and type and redo stories and stuff. Making stories and stuff makes me better at it."

**How do you feel about using the keyboard ?**

- "To find the right keys is hard. It sometimes takes longer if I have to look for the right key."
- "Probably now that I'm 7, I can memorize the keyboard so I'll get faster."
- "It's not hard to find the right keys to type. Because you like memorize where the keys are."
- "It's easy. Because I know what letters they are and what sound they make. I know where they are on the keyboard. I've learned where the letters are because of my teachers."

**How does the computer helped you write?**

- "Because it really helps me read. More people come up to me and say, 'Oh that's wrong,' and they help me spell it right."
- "I know how to spell better and the computer helps me with this."
- "I've learned how to spell other words that I didn't know before because of the computer."
- "It has corrected more things. I learn from those corrections."
- "Of course! Because I'm older and I'm getting better as I get older."

**Figure 4.** Additional Student Responses from Interviews.

### **Findings from Writing Samples of Emergent Learners**

Analysis of the writing samples revealed that emergent students' writing increased in length over time. Prior to the study, students' concerns with spelling limited how much they wrote with pencil and paper. While writing on the computer, students became less concerned about their spelling once they realized it could be changed with spell check. Making spell check initially invisible, however, was important. Consistent with the observations, writing samples revealed that the younger writers learned how to make simple revisions with their writing. For example, they learned how to insert additional sentences or a title through teacher conferencing and modeling. Many also learned to edit their spelling with spell check. A few children even practiced punctuation and capitalization strategies through teacher conferencing. Observational data also showed that some of the younger children began to do additional writing. Some children, for example, enjoyed going back to a previous journal entry or story. Sometimes they spontaneously added to the writing or they used spell check to correct their spelling; still other times, they changed the writing font.

### **Findings from Writing Samples of Developing Learners**

Similarly, analysis of the writing samples revealed that developing learners' writing increased in length and quality. For example, students' writing became clearer as they inserted more details or descriptive words and as they changed the sequence of information or added an ending to their writing. Gabrielle shows how she thought carefully about her message when writing: "When writing I read the words and if it doesn't make sense, I try to correct it. If I can't, I ask a teacher to help me." Through teacher guidance and peer feedback, students learned strategies for expressing information clearly, adding details to explain their message, or inserting descriptive words to paint pictures of scenes for their readers. The writing samples further demonstrated that they learned how to edit their own writing, as well as that of their peers. According to Lynne, students did not revise or edit their writing prior to the study.

Observational data similarly indicates that some children began to do additional writing. For example, one student wanted to type up his list of questions for an interview to take place the following day. Others requested to type journal entries or drafts on the computer. Cory remarked, "I write more this year. I feel happier about my writing this year." Hannah added, "I know I have improved because I've practiced more."

## Implications

The findings of this study must be viewed with caution. Similar to other qualitative studies, the study is highly contextualized including multi-age classrooms within a private school that had access to technology at many levels. In addition, the two teachers received ongoing support. Given these contexts, the teachers refined their writing instruction and changed how they used technology. Consistent with earlier studies (Labbo, et al, 2001; Margerum-Ley, 2002; Moore & Karabenick, 1992; Myers & Halpin, 2002; Vannatta & O'Bannon, 2002; Windschitl & Sahl, 2002), supported practice seemed to help these teachers determine how to integrate technology with their curriculum and how to use technology to improve student learning.

When helping teachers learn new ways to use technology, there is a need to consider the context of the specific school, the classroom, and their concerns. Teachers seem more willing to think about innovative ideas when they perceive that these contexts are taken into account. As technology continues to advance, school districts need to consider providing additional funding to support teachers in the implementation of technology. For example, they may consider using Technology Specialists to model how to implement technology within the classroom, guiding and assisting teachers along the way. Using Technology Specialists who are familiar with the curriculum and the reading and writing processes might facilitate more successful implementation of technology. As shown in this study, teachers need opportunities to clarify their questions and thoughts about technology through reflection. As a result of these reflections, new opportunities for integrating technology within their curriculum may evolve while giving teachers ownership in the process.

Given the context of this study, the findings further suggest that children extended their literacy learning through challenging experiences. The multimodal tools of technology and the technological environment seemed to stimulate literacy learning. Specifically, with teacher guidance, children learned how to revise and edit their writing with word processing tools, how to expand and develop their writing through questioning, and how to publish their writing using word processing tools. In addition, opportunities for problem solving, language development, and higher-level thinking evolved naturally.

In order for changes in students' writing to occur, we encourage teachers to follow the writing process. Using technology tools will not necessarily improve all students' writing. As teachers begin to consider more advanced forms of technology—the Internet, email or PowerPoint™—they will also need to implement them while following the principles of effective writing instruction.

Importantly, these findings provide hypotheses to be generated and tested in future studies. Studies will need to investigate how differentiated support helps teachers consider alternative ways to integrate technology with the curriculum. Other studies could investigate how ongoing professional development and mentoring supports teachers' use of more advanced technology tools. Additional studies will need to focus specifically on how young learners improve reading/writing performance while using these advanced forms of technology. Still other studies could examine alternative ways for schools to provide teachers with supported practice as technology continues to dominate how we function in society.

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