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Using Technology to Support Learning in a First Grade Animal and Habitat Project

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This qualitative study described the uses of technology by a first grade teacher and her students in each phase of a project on animals and their habitats. Some experts, for example, Cordes and Miller (1999), have written about the potential dangers of using technology by young children. Others such as Labbo, Eakle, and Montero (2002) and Turbill (2003) have studied early childhood teachers and their students who have made the transition from using age appropriate practices such as the language experience approach to the digital language experience approach. This study investigated how an experienced first grade teacher used technology in multiple ways to complete phases of an Animal and Habitat Project. The authors also described the attributes of technology that allowed the teacher to share students' products: portability and duplicability. These attributes make possible "just-in-time" documenting of student progress for parents. Finally, the authors conclude that technology may be used in meaningful ways in an early childhood classroom to enhance learning for students and facilitate positive communication with parents.

Keywords: Early Childhood, Project-Based Learning, Technology Integration

INTRODUCTION

By first grade students are exposed daily to many hours of media including TV, Internet, video games, music and radio, and reading print. Prensky (2001) estimated that children ages 8-18 use media eight hours per day, and even toddlers are exposed to media two hours per day. Further, students' media of choice is TV or video games. In this media rich environment, children exhibit both passive and active responses. We sought to study whether students who are growing up in a technology rich environment can also use

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digital technologies in a first grade classroom in ways that require active student participation, foster meaningful learning, and produce projects easily shared with parents.

PROJECT-BASED LEARNING, LITERACY PRACTICES, AND DIGITAL TECHNOLOGY

Two frameworks of learning, scaffolding and social learning, provide the underpinning for many effective practices in early childhood classrooms, and set the stage for the infusion of digital technology. Vygotsky (1978) explained that learning is socially mediated and teachers or other adults provide scaffolding for students to help them move from their current level to their potential level of development. Project-based learning is an approach commonly accepted in early childhood education. For this study, projects are defined as in-depth investigations that involve students in design and investigative activities and that culminate in a final product or debriefing event (Clark, 2006). These investigations are "structured around complex, authentic questions" (Buck Institute of Education, 2007, Defining Standards-Focused PBL section, para. 1) within important topics or issues for students. Projects usually take shape as an individual or group investigation that goes on over a period of time, has milestones whereby the teacher can review students' progress and provide the necessary scaffolds in a formative way, and results in a product, presentation, or performance (the project).

In general, projects have three phases: planning and beginning the project, investigating, and concluding the project in a culminating event (Helm & Beneke, 2003; Katz & Chard, 2000). During the first phase, the teacher selects a topic based on desired learning outcomes (e.g., standards) and helps the children articulate specific questions that will guide their investigation. During the second phase, the children work in small groups to investigate subtopics that are connected to the larger topic. The final phase of project work is characterized by a culminating event or activities (e.g., art display) that summarize the findings of the investigation (Helm & Beneke, 2003). Researchers found evidence that project-based approaches may lead to cognitive development such as problem solving (Brown & Campione, 1996), transferring ideas across learning contexts (Brown & Campione, 1996; Scardamalia & Bereiter, 1991), as well as enhancing self esteem (Katz & Chard, 2000).

Project-based learning may also provide an opportunity for students to develop emergent literacy. For example, children may read picture books, take notes, draw pictures, dramatize, and present findings as appropriate in various phases of their projects. Kinzer (2003) suggests that technology can facilitate these kinds of effective literacy practices that are based on sound theory. Labbo (2005) agrees, and adds that these activities must fall within a teacher's comfort zone. As an example, she describes a writing activity called "Morning Message." The early childhood teacher talks aloud and models writing a simple two to three sentence message on a large chart tablet such as "Today is (fill in day of week) the (fill in date, month, year)." A child leader of the day contributes oral news to share such as "The weather is sunny and clear today." The child then writes known letters or words from this sentence on the chart with the teacher completing the sentence. Then, the children read the message together and the leader of the day circles the letters or words they recognize. This common practice, with technology incorporated, becomes a "Digital Morning Message." Here, the teacher enters the text dictated orally by children while they watch her large monitor. From her example, children learned that mistakes can be corrected and changes are made easily using technology. In addition a children's program like KidPix makes it easy to add an icon to depict the day's weather. After the teacher and children type the words, the computer's text-to-speech program reads them back so the students hear the connection

between words on the page and speech. The teacher then prints a copy of the morning message for each child so the child could re-read it, illustrate it, or add more descriptive text to it. Finally, the child's individualized copy becomes a school-to-home connection to be signed by the parent and returned.

Based on the earlier work of Labbo, Eakle, and Montero (2002), Turbill (2003) adapted the language experience approach to the digital language experience approach for his study in an Australian context. He showed how literacy practices could migrate to the digital environment and concluded that the digital language experience approach maintained the advantages of the language experience approach and added digital literacy. This study will examine whether a project-based approach could migrate to a digital environment.

Just as in print media, the audience factor has an impact on student motivation and reflection on digital work. Young people who prepare multimedia productions for a wider audience, even if the audience is just one stage in the process, are more motivated to do the work and willing to reflect on their work (Buckingham, 2007; Foulger & Jimenez-Silva, 2007).

The child's family is one possible audience for student work. Further, substantial research indicates that family involvement in schools is positively related to student achievement. The benefits of family involvement include higher grades and test scores, better attendance, more homework completed, and more positive attitudes and behaviors (Decker & White-Clark, 1999; Henderson & Berla, 1994; Eccles & Harold, 1993). In addition to regularly scheduled parent-teacher conferences, schools communicate to families through such means as informal discussions, work sent home, phone calls, emails, and print or online newsletters. There are many ways to use technology to communicate with parents such as computer-generated and computer-scored tests, adaptive assessments, electronic gradebooks, and electronic portfolios (National Foundation for the Improvement of Education, 2000). However, technology can go beyond the digitalization of standard practices and become a means of improving common assessment practices as well as providing new modes of authentic assessment, particularly those relevant to project-based learning (Moursund, 2002). This study focuses on process-based projects that were communicated to parents through the facilitation of digital technologies.

It appears that technology holds promise when used in ways that support sound literacy practices. However, we found little in the literature that described the use of technology in more complex, project-length applications with young children. Our investigation asks in what ways technology may be used effectively in the phases of a project with first grade students and communicated with parents.

STUDY OVERVIEW

This collaborative case study was conducted by a first grade teacher and three teacher educators. The first grade teacher, whose class was the focus of this study, was selected as a participant because of her extensive experience using technology in a project-based and language experience approach in early childhood classrooms. Drawing on teacher and student interviews, classroom observations, and student artifacts, we explored how the teacher and students used technology with the children throughout all stages of a science project identified by the teacher and the researchers as ideal for this study.

The teacher's science focus was on biomes over the school year where a biome was defined as a major community of organisms adapted to live in a certain climate. Within this project, students investigated one animal and its habitat where the habitat was defined as the place an organism lives. This study was limited to this student project. As

part of the students' projects on animals, earlier in the year they studied various topics associated with their single animal such as the skeleton, nutrition, and the life cycle. Through each investigation they applied their new learning to their individual animals and their habitats.

The following overarching descriptive research question guided the study: How did the students and their teacher use technology to support project-based learning in a science project?

METHODOLOGY

RESEARCH DESIGN

The researchers designed the study as a single-case study. A case-study approach was selected because the teacher practices observed had not, to the best of the researchers' knowledge, been studied in the past. As such, this study represented an opportunity to conduct a "revelatory case study" – this is, a case study in which a real-life situation can be examined for the purposes of discovery and theory development (Yin, 2003). In this case, we were particularly interested in observing "how" the teacher and her students used technology to learn throughout each phase of a project and to communicate with parents.

A systematic process was used to develop the case study that included the following steps: (a) selection of case-study participants, (b)plan and conduct interviews and observations, (c) analyze the data, (d) conduct member checks, and (e) write-up.

PARTICIPANTS

When selecting a case for this study, we used a procedure known as "information-oriented sampling." In contrast to random-sampling, information-oriented sampling is one in which an extreme or atypical case is selected because it is a richer source of data for the phenomenon being studied. Ms. Rathkey was selected as the focus participant of the case study because she is regarded within her school and community as an "exemplar" teacher, particularly with respect to her use of technology and project-based teaching methods. She is a thirty-six year veteran first grade teacher. She is National Board Certified and has received district and state awards for exemplary teaching. Ms. Rathkey has experience teaching in a variety of settings including urban, low socioeconomic, and moderately high socioeconomic areas.

The first grade students in Ms. Rathkey's class lived in a suburban, middle-class area and attended a PreK-6 elementary school with 988 students. The school's student body consisted of 86% Caucasian, 6% Hispanic, 5% Asian, and 3% black; 16% of the students qualified for free or reduced lunch. The research took place during a six-week study of biomes the second semester of the school year. Per teacher preference, all students were fully integrated into all classroom activities, no matter what their learning abilities. This particular year there were 22 students, 12 girls and 10 boys. One of the students spoke Spanish as his first language, four were identified as gifted, one was identified as autistic, and one student was an early-entry student due to relocating from another state.

The research took place during a six-week study of animals and their habitats the second semester of the school year. Half of the students had been with Ms. Rathkey during their Kindergarten year, which was a multi-age K-1 classroom, while the other half were newly assigned to this teacher for their first grade year. All of the parents of the students had computers with Internet connections at home or at work.

THE CLASSROOM SETTING

This classroom did not have separate student desks; instead, learning areas were defined as needed according to physical needs and group size. Students usually worked with lapboards on the floor either individually, in partners or groups, or as a whole group by sitting in a circle where they could see the teacher and the computer monitor. Centers, manipulatives, models, tools and supplies, and other items were located in strategic, child-accessible places in the classroom, and students were encouraged to tend to their own needs and interests. Technology tools consisted of a digital camera, two computers with printer, and a larger computer monitor the teacher used primarily for group demonstration and class routines. Here students sat on the floor on rugs in a semi-circle viewing the larger monitor and interacting with the teacher. Also, both computers were used for individual or small group student projects. The school's computer lab was shared by all classes and Mrs. Rathkey's class was scheduled for the computer lab for 30 minutes every six days.

DATA COLLECTION

An initial meeting was held between the three teacher educators and the classroom teacher in which conversations were focused on the broad topic of Ms. Rathkey's teaching philosophy and practices, goals, values, the structure of student projects, and the place of technology in the classroom. The teacher also discussed future opportunities in her classroom when researchers could potentially observe most of a project from beginning to end. A six-week period was identified for observation, and this time frame was further divided into six, smaller observable class sessions. The planning meeting was audio taped and transcribed for use in final data analysis.

Each of the three teacher educators videotaped two separate one-hour classroom observations spread across the project. The six observations took place during the major phases of the project. During each observation the researcher independently took notes using the observation template. Some observations were followed by interviews with students.

During each observation the assigned researcher took copious notes on teacher practices, student behaviors, and technology tools, and also video taped the session for future reference. To increase the credibility of the data, Ms. Rathkey was asked to meet with the researcher following each observation. The purpose of these "member check" meetings was to ensure researcher subjectivity and trustworthiness of the results (Lincoln & Guba, 1985). The conversations with Ms. Rathkey would "infuse researchers' interpretations in a way that the boundaries between the two become at once distinct and blurred" (Jones, 2002).

DATA ANALYSIS

Based on a review of the relevant literature on early childhood project-based approaches and technology integration in early childhood classrooms, the authors worked collaboratively to draft a coding system.

In the first phase of coding, all six of the observations were coded according to the predesigned observation categories included in the observation template. Observation focus and codes included the following: teacher roles (being honest, creating vision, addressing individuality), student roles (independence, ownership, responsibility), and technology used (value added to students, value added to teacher, value added to parents). To accomplish this, each of the three researchers independently coded the observation

notes of the two observations they conducted. Since videos were taken of the observations, researchers had the opportunity to review each observation multiple times. Next, the researchers compared and discussed the coding from each observation, obtaining an inter-rater reliability of >.80. This process established an overview of teacher practices, student behaviors, and technology tools, and guided the development of emergent themes.

The researchers then engaged in a collaborative process of comparing and collapsing emergent themes. The following themes were ultimately agreed upon within which observations could be categorized: the phases of the project, types of technology (Power Point, digital cameras, web resources), student and teacher uses of technology, student learning about animals and habitats and technology skills, and technology used to communicate with parents.

The validity of this study was strengthened through a second member check process whereby the researchers reported preliminary findings to the first grade teacher. Mrs. Rathkey read the drafts and provided important feedback that helped to clarify her rationale for implementing this project and the implementation strategies.

Findings

This research study focused on an Animal and Habitat Project and the technology used by the teacher and students in the project. The project described in this study, although implemented in distinct ways, generally followed the phases of project-based learning as outlined by Katz and Chard (2000). Below we describe how technology was used in the first grade classroom we observed by separating our report into the phases of the project, (planning and beginning the project, investigating, and concluding the project in a culminating event). This organization scheme is intended to allow the reader to see the technology tools used and the associated purpose(s) of each tools, based on the specific task at hand. Also, Labbo's (2005) Digital Language Experience Approach described earlier helped us conceptualize the digital integration for the project.

TECHNOLOGY USE DURING PLANNING PHASE OF THE PROJECT

Planning processes. As explained, the groundwork for the animal and habitat project began at the start of the school year when students chose an animal to study, and continued through learning cycles that helped them learn about topics such as the skeleton, nutrition, and the life cycle. Throughout the year, students created PowerPoint slides reporting on the application of their new learning to specific animals. Students also learned to use shapes in PowerPoint to draw their animal on a PowerPoint slide. The Animal and Habitat Project was the subject of our observations. We observed Ms. Rathkey explain to students that in this project, they were going to develop an understanding of how the environment affects the animals' survival by meeting basic needs for nutrition and shelter.

She also provided an overview of the process that would lead to the PowerPoint presentation (examples of the guided process are described in the "Concluding the project in a culminating event" section). She explained to students that by the end of this project the students would draw a habitat for their animal using PowerPoint tools. This habitat drawing would form a background for the PowerPoint drawing of the animal that the students had made earlier that year.

In addition, students would use the habitat background and previously drawn animal to produce a separate animated PowerPoint showing the movement of their animal through its habitat.

Planning phase findings. During the planning stage of this project, the teacher used the students' prior research on their focus animal's body, and the finished PowerPoint

drawing they created, as a springboard to the project on habitats. This allowed the student to extend their prior experience with how they used technology, and to more easily relate to Ms. Rathkey's vision for the use of technology in the current unit. Students were less clear about using technology tools they had limited experience with (creating an animation), but were enticed by the idea nonetheless.

TECHNOLOGY USE DURING INVESTIGATION PHASE OF THE PROJECT

Research processes. During the second phase, students gathered information from picture books, and viewed teacher-selected web sites and short videos, taking notes on small sheets of paper with pencils or crayons. Ms. Rathkey created a web page titled *Interactive Learning* with pictures that were linked to specific web sites for the students and parents (see Figure 1). These links were selected for their scientifically accurate information with many pictures of animals and their environments that students viewed at school and at home. Ms. Rathkey emailed the parents with a note reminding them to go over the web sites with their students and learn together about the animal and what the animal needed for survival.

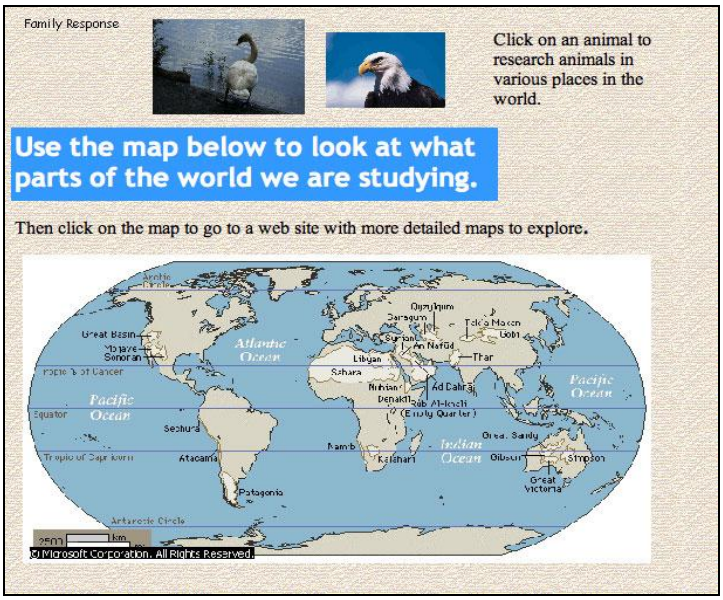

Figure 1. Ms. Rathkey's Web page.

After having an opportunity to view the web pages at home, students discussed with Ms. Rathkey the pictures they viewed of their animals and habitats, and then the students cut and pasted the animal pictures into their electronic folders. They also added information from the discussion with their parents and teacher to their note cards.

Ms. Rathkey and the students discussed different habitats on different continents such as deserts, grasslands, and rain forests. Then students in groups of five selected a continent and took notes on large pieces of chart paper on the characteristics of each habitat as it was studied in class for their specific continent.

Students gathered more information through a field trip to the zoo. Here they took digital pictures of their animal and its habitat in the zoo. After returning to the classroom the students again wrote notes or drew with crayons to capture their new learning. Ms. Rathkey instructed students to write in their reports "….whether the zoo provided a good

habitat for your animal. Explain everything that will let people understand if it provided a good habitat for your animal." Students needed to evaluate the zoo habitat by applying prior knowledge regarding previously studied topics such as vegetation and prey/predator to answer this question; their photos needed to illustrate whether the habitat created by the zoo adequately mirrored the natural habitat.

Research phase findings. While students gathered information about their animal's habitat, they were directed to use a variety of resources, many of which were technology based. These resources were teacher-selected for their relevance and appropriateness for first grade students, and were then made available to students in the classroom, in the computer lab, and even at home. The teacher-generated, Web-based archive served the students' research needs; students also used digital tools to act as scientists by recording their observations at the zoo. The photos ultimately became archives for future reference, which allowed students to become information gatherers and knowledge producers through technology-based means.

TECHNOLOGY USE DURING CONCLUDING PHASE OF THE PROJECT

Learning PowerPoint procedures. To demonstrate the results of their investigations, students created a PowerPoint slide showing the habitat for their individual animals. But before going to the lab, students sat on rugs in a semi-circle around the teacher, who was positioned in front of her computer. Ms. Rathkey asked the students what they would need for their habitats. A student said, "Trees." Ms. Rathkey asked, "How would you make trees?" Students talked about the specific shape tool to use, and the color or fill for the shape. As students watched her computer monitor, she demonstrated how to use a particular tool, drew the tree, added the color and then erased it. She discussed another type of tree, illustrated how to draw it and erased it. Then students were asked to talk to a partner about what they would do next. After the brief pair-share, Ms. Rathkey asked, "What would you do next?" A student said, "Add clouds." Ms. Rathkey asked, "What shape tool would you use? What menu would you use?" A student answered and came to the monitor and keyboard and selected the tool. Finally, Ms. Rathkey reviewed how students would access their folders and asked them what they would do to save and put away files. They explained the procedure orally. Then Ms. Rathkey called on a student to demonstrate the procedure using the keyboard and screen. Ms. Rathkey reminded the students that they were creating the habitat for their animals and the PowerPoint slide needed to show how their animals would survive.

In the lab, Ms. Rathkey moved from station to station to talk to students about what they would do, to help those who needed help locating their PowerPoint files, and to ask a student to assist another student who needed help. In order to encourage students to solve problems independently, she would frequently respond to students' questions by asking questions; also, when children helped each other they were to follow the "hands off rule" by explaining orally, without touching the keyboard or mouse.

Most students completed their habitat picture in one session; however, Ms. Rathkey arranged for a few students to continue to work on their habitat slide on a computer in the classroom by accessing their document on the school server. All of the students were able to use the PowerPoint draw tools and were successful with creating their animals and habitats using PowerPoint.

Students also were required to make an animation of their animal using PowerPoint. Before our observations, Ms. Rathkey had guided students to choose shapes to represent various parts of their animals and the students used the drawing tools in PowerPoint to create the animal. First grade student Ashlynn created a horse using PowerPoint tools (see Figure 2).

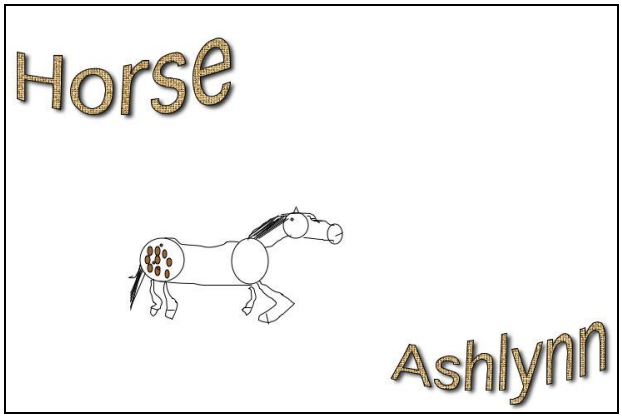

Figure 2. First Grade Student's Animal Created Using PowerPoint Draw Tools

When the animal was completed, Ms. Rathkey selected all the shapes and used the "group" command to create the finished drawing as a composite object in order to facilitate the students' ability to copy and paste the animal as one complete object. The teacher educators who were observing the students that day noted much variation in their drawings. Some animals were not easily recognizable, but all students used the tools to the best of their abilities and developed a Power Point drawing that worked.
Figure 3 shows the habitat slide a student created with tree and watering hole that will allow its animal to survive.

Figure 3. Ashlynn's Zebra in its Habitat

Approximately two weeks later, Ms. Rathkey had the students gather around the monitor on their rugs to discuss animating the animals in their habitats. Ms. Rathkey demonstrated the procedures and showed examples of other students' animations. She explained that they should move their animal a tiny bit by duplicating the slide and moving just the animal on the duplicate, then duplicate that slide again, etc. When the class went to the computer lab to animate their animals in the habitats they followed this procedure. (Some students had over 100 slides). Ashlynn repeated this procedure 10 times to move the animal from its position in Figure 4 to Figure 5.

Figure 4. Middle Slide in Animation Sequence

Figure 5. Later Slide in Animation Sequence

A few students also added words to their animations to accompany the action as illustrated in Figure 5.

One purpose of the animation in the habitat was to encourage students to demonstrate the movement of their animal in the habitat and demonstrate their understanding of the survival of their animals (e.g., movement toward water hole). Another purpose was to allow students to play with animation and learn the process of animation (see student example at http://sites.google.com/a/asu.edu/rathkeys-researchers/).

One of the options for students was to add PowerPoint slides to their larger reports on the animals in their habitats. For example, in Figures 6 and 7, Ashlynn added two different slides with pictures of her animal. She told the teacher what to type for each slide.

For Ms. Rathkey, a thread that ran through the lessons was that she wanted students to make connections between the newly acquired knowledge and the animal they were studying to apply their learning. Thus, the PowerPoint slides (see Figures 6 and 7) demonstrated the transfer from a general discussion to a specific animal.

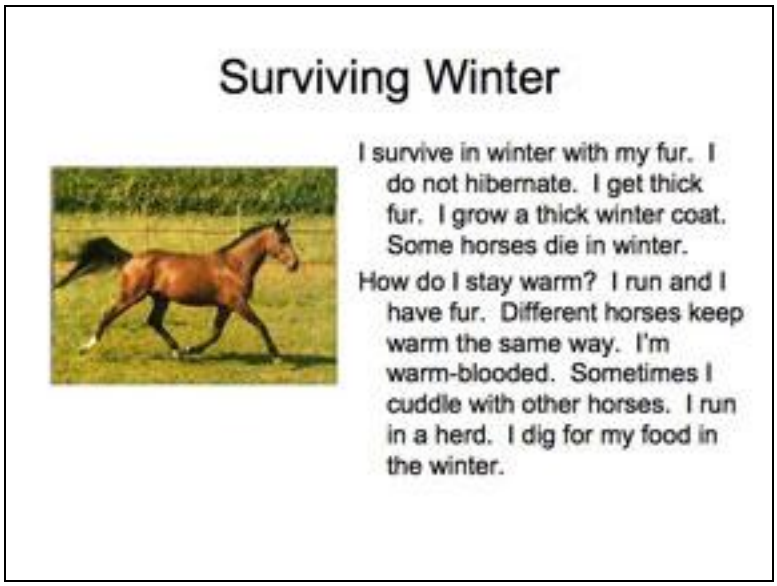

Figure 6. Ashlynn Adapts Concept to Her Animal

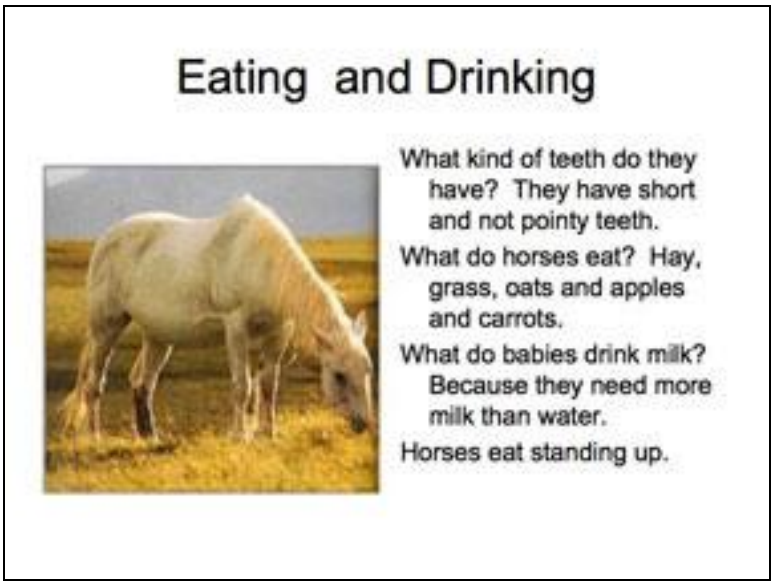

Figure 7. Application of a Newly Acquired Knowledge to an Animal

Learning PowerPoint findings. As students were taught how to use the drawing tools of PowerPoint, Ms. Rathkey was cautious to methodically introduce skills in a progressive manner, while helping students maintain their focus on the content, the habit of their animal. She also sought to instill as much independence as possible for the first graders, most of whom were learning features of PowerPoint they had never explored. Most important, however, was the impact of the long-standing computer lab procedure whereby students consistently turned to their peers when in need; the hand-off, oral help they received allowed students to maintain a high level of independence and advance their computer skills, even when they were in need of help. Once again the teacher educators observing the students noted that habitat pictures were at many levels and length of reports varied, but students were all successful according to their abilities.

Publishing procedures. Ms. Rathkey compiled the students' animations into a class set. Students received a CD to take home to their parents. Also, during the end-of-year family celebration, Ms. Rathkey reserved the school laptop cart so students could show their PowerPoint reports to their parents. Following the celebration, Ms. Rathkey printed each student's ten-page PowerPoint report and sent them home with students as books (see Figures 6 and 7). One parent reported showing the PowerPoint report to another parent who couldn't attend the classroom celebration. This allowed their child to explain the learning to the other parent.

Publishing findings. Ms. Rathkey once again emphasized the connection students made by making explicit their knowledge of animals and their habitats through their PowerPoint presentations. The printed PowerPoint booklet contained the new knowledge students learned about their animals and habitats. Ms. Rathkey explained that sending home student projects or books helped "parents be assured [their child] can learn, and [parents] can show them off to grandma and grandpa." This demonstrates that some technology-based projects can be used to help students demonstrate their learning to those outside the school setting, either in digital format or through printing, without regard to whether home access to technology is an issue.

DISCUSSION

The discussion is organized around two themes from this study: adding digital components to a project using widely accepted early childhood practices, and student learning and technology.

ADDING DIGITAL COMPONENT TO WIDELY ACCEPTED EARLY CHILDHOOD PRACTICES

Labbo, Eakle, and Montero (2002) provided a model for our understanding of the infusion of technology into widely accepted early literacy practices, demonstrating the use of technology in each step of the Language Experience Approach. Similarly, Ms. Rathkey infused technology in ways that built on the phases of a project (Katz & Chard, 2000) and extended it. Table 1 summarizes the uses of technology in each phase of the project by the teacher and students. The project also had paper-based literacy activities including reading books about the animals, creating pop-up books, taking notes on paper, and reporting in different formats.

Labbo (2005) found that early childhood teachers could digitize the morning message activity and Turbill (2003) found they could digitize the language experience approach; we found that an early childhood teacher could digitize the project-based approach. All of these practices built on emerging literacy skills with appropriate and creative uses of technology, demonstrating that the use of technology by young children need not be at odds with theoretical frameworks that support social and scaffolded learning.

STUDENT LEARNING AND TECHNOLOGY

Based on our reflection on the findings summarized in Table 1, we concluded that Mrs. Rathkey's students were able to use technology in phases two and three of project based learning and that the technology use enhanced their learning of science concepts. Ms. Rathkey has always viewed technology as a support for learning, not an object of learning. We observed that most uses of technology in her classroom became facilitators of connections between prior knowledge and new knowledge. Student work required the transfer of knowledge such as skeleton, nutrition, and the life-cycle to their specific

animals. Further the teacher educators found that project learning standards were revealed as we looked back at her classroom and the student accomplishments. Standards such as "Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources" (International Society for Technology in Education, 2007, National Technology Standards – Students) are consistent with Ms. Rathkey's use of technology to facilitate the connections students made as they developed their animal and habitat projects.

Table 1. Technology Uses in the Animal and Habitat Project

Phases of Project	**Technology Integration**
Planning and Organizing the Project	Ms. Rathkey discussed with students the activities they would be doing and the technologies they would use to accomplish them.
Investigating	Finding Information • Students used Internet resources on the teacher's web site. • Students took digital photos of the animals and their habitats at the zoo. Using the Information • Students created habitat backgrounds for their animals • Students cut and pasted pictures of their animals on a PowerPoint slide for later use in reports. • Students animated the animals in their habitats using PowerPoint. • The teacher typed student prepared information for student PowerPoint reports. Students made decision regarding picture selection and layout.
Concluding the Project in a Culminating Event	• Students showed parents their PowerPoint Representations at class celebration. • Teacher printed PowerPoint reports for students to take home.

We also concluded that students enhanced their understanding of technology through their use of digital pictures, file management strategies, and animation of slides in Power Point as well as Mrs. Rathkey's modeling of these procedures.

It should be noted that this study was conducted in one classroom, and therefore, care needs to be exercised in generalizing the findings to other classrooms. Generalizability can be strengthened, however, if individuals can identify with elements of this study's particular setting that are similar to their own, or interpret this study in terms of the theoretical framework.

IMPLICATIONS

Critics of the use of technology in early childhood classrooms (Cordes & Miller, 1999) argue that the benefits of computers for elementary students were vastly overstated. Criticisms range from too much and too early hands-on computer work leading to children with vision problems and other physical health issues, to the danger of

replacement of manipulatives such as clay, crayons, and Legos, with less concrete experiences on computer monitors and keyboards.

These arguments did not appear to apply to this classroom. In Ms. Rathkey's classroom, students used computers for 30 minutes every six days and often they used the mouse to draw rather than the keyboard to type. Further, they participated in the teacher's manipulation of the computer as a tool to record their words and their decisions about font size, picture placement, and the start of new pages that the students might illustrate later using crayons. We think the uses of technology described in this study supported well-established early childhood practices and supported student learning in each phase of the project.

Further, it appears that attributes of digital technology make possible "just-in-time" documenting of student progress for parents. In addition to the expected summative reports of student learning, in this technology-rich classroom, Ms. Rathkey provided additional opportunities for parents to support their students throughout phases of the learning process. The features of technology that enhanced these important exchanges were portability and duplicability. Portability made it possible for the delivery of original student work and photos of classroom activities to be delivered to home, and sometimes across great distances. The class website also assisted with parental access. Duplicability made it possible for students' final projects to be showcased in multiple venues, without diminishing the quality, through the duplication of digital files. These files could then be sent home on a CD, as in the case of the animal report and animation PowerPoint, or presented on the class web site. Parents were able to read and share student projects, an authentic method of documenting student learning. Furthermore, communications with extended family members about students' academic successes were made possible through sharing the digital products.

Finally, we recommend that the potential of newer Web 2.0 technologies to increase portability and duplicability in early childhood classrooms should be investigated. Web 2.0 technologies may provide new platforms for multiple-way communication among the teacher, students, content experts, parents, and the wider community. We think that Web 2.0 technologies such as Flikr, VoiceThread, and Google docs should be investigated for the promise they hold to enhance student learning and classroom communication, even for very young children.

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