Technology: A Tool for Knowledge Construction in a Reggio Emilia Inspired Teacher Education Program

Seong B. Hong[1,2] **and Mary Trepanier-Street**[1]

This article describes the application of technology in Reggio Emilia inspired early childhood and teacher education programs at the University of Michigan-Dearborn. We have found that technology used in a Reggio inspired program can be a valuable tool for the representation and organization of ideas, collaboration among a specific learning community, visualization and reflection on thinking, and communication of learning to the broader community. Our experiences and reflections suggest that the integration of technology in a Reggio inspired curriculum supports knowledge construction of both children and student teachers.

KEY WORDS: technology; Reggio Emilia; project approach; documentation.

OVERVIEW

The University of Michigan-Dearborn offers an undergraduate program and a graduate program in early childhood education. We have been implementing elements of the Reggio Emilia philosophy for 15 years in both our teacher preparation programs and in our on-campus early childhood center, the Child Development Center (CDC) (Saltz, 1997; Trepanier-Street, Gregory, & Donegan, 1998). The CDC is accredited by the National Association for the Education of Young Children and serves as a teacher preparation site and campus education and child care center. Approximately 140 children, between the ages of one to six, are enrolled each term.

We espouse an educational philosophy of constructivism and a genuine and deep respect for children, their families, and their cultures, which are all, viewed as integral players in the educational process. The university students prepared in our teacher education program and their cooperating teachers

implement long-term projects in the CDC classrooms. Projects begin and continue with the student teacher and cooperating teacher carefully documenting the children's work. Using this documentation, the student teacher, teacher, and children collaborate to explore the children's theories on a given topic. When children and student teachers are allowed to make more decisions, they tend to have a vested interest and are more responsible for their learning. For the student teachers, the systematic documentation process allows them to research the children's learning and reflection on their own development as a teacher. Learning becomes more visible and meaningful for both the children and student teacher (Gandini & Goldhaber, 2001; Hong, 1998).

Our Reggio Emilia inspired early childhood program is continually growing in knowledge and application of technology into the curriculum (Trepanier-Street, Hong, & Bauer, 2001). Several forms of technology (e.g., computer, computer software, digital camera, video camera, digital video camera, video capture card, scanner, and the Internet) are used in the documentation process to enhance reflective thinking and creativity in both young children and their teachers. Our prior experiences, consistent with the study reported by Hong

[1]School of Education, University of Michigan-Dearborn.
[2]Correspondence should be directed to Seong B. Hong, School of Education, University of Michigan-Dearborn, Fairlane Center, 19000 Hubbard Drive, Dearborn, Michigan 48126; e-mail: seong@umich.edu

(1998), suggested that the effective use of technology enhances the student teachers' success at understanding young children's learning and becoming a more reflective teacher (Trepanier-Street, Hong, & Donegan, 2001).

Currently, we are involved in a federal technology grant, Preparing Tomorrow's Teachers to use Technology (PT3). The major goal of this three-year project is to have student teachers gain the knowledge, skills, and confidence in integrating new technologies into their teaching repertoires. Consistent with the Reggio philosophy of collaboration, this project created Network Learning Circles (NLC) where student teachers, cooperating teachers, university supervisors, educational technology specialists and an early childhood method professor, discuss how to enhance early childhood curriculum and methods through the use of cutting edge technology. Collaboration among the NLC members is a valuable learning experience because professionals from various disciplines bring their expertise and perspective to the early childhood classroom. The NLC members listen to one another and reflect on how children's learning and the student teacher's classroom teaching could be enhanced through technology.

The focus of this paper will be on how technology supports knowledge construction in student teachers and the children they teach. It is based on our experiences, data, and reflections gained from our prior experiences and the work during the technology grant project. This article presents how the application of technology in conjunction with the Reggio Emilia inspired approach is a powerful vehicle for promoting children's learning, teacher reflection, and in turn, improving the quality of learning and teaching in the classroom. Technology can be a valuable tool in a Reggio Emilia inspired early childhood program for the: (a) representation and organization of ideas in a different medium, (b) communication of ideas and collaboration among members of a specific learning community, (c) visualization and reflection on thinking of children and teachers, and (d) extension and communication of consolidated learning to the broader community. All of these components contribute to the student teachers' understanding of children's development and the teaching and learning process, resulting in their significant professional growth and construction of knowledge. We will describe with classroom examples and reflections the ways technology supports knowledge construction in children and teachers.

REPRESENTATION AND ORGANIZATION OF IDEAS IN A DIFFERENT MEDIUM

Within our CDC early childhood classrooms, the student teachers use an emergent curriculum and incorporate long-term projects which build on the interest of the children. The children are encouraged to represent their ideas regarding the project topic through many forms of media (Trepanier-Street, 2001). One of the technological media the children and the student teachers found particularly valuable for representing the children's conceptions was Kid Pix software program. The following is an example of one student teacher's reflection on how the use of Kid Pix enhanced children's representational ability and supported high level thinking skills.

> The biggest "A-HA" moment came when I realized that by using the Kid Pix software program, the children were able to make more complex representations of their work. For example, when the children used letters to stamp words on their drawings, they were able to think about their story without worrying about letter formation. The children were able to use the picture stamps and the pen to draw more complex pictures.

Another student teacher shared her experience using Kid Pix with children with special needs.

> I have found that I was able to get the best words and pictures from the children with special needs using Kid Pix. I found that the children were not able to get the image in their mind to look like the image on their paper. This seemed to frustrate the children. . . .when writing about their pictures, they forgot which words they were trying to write. . . they were able to use the letter stamps and write more complicated words and sentences.

As evident in the descriptions, young children's conceptions of their world are often more detailed and at a higher level than their fine motor skills permit them to represent with conventional tools. As seen in Figure 1 (see Figure 1), the software medium enables children to represent and to interpret their work at a higher level. Simultaneously, the student teachers, observing and reflecting on the phenomena, came to recognize children as powerful and competent learners.

Another software tool that can enhance children's representation and organization in project work is Kidspiration. The student teachers noticed that this software is a valuable tool to web and to visually represent children's thoughts and ideas in pictures as well as in print (see Figure 2). This web can be shared with a
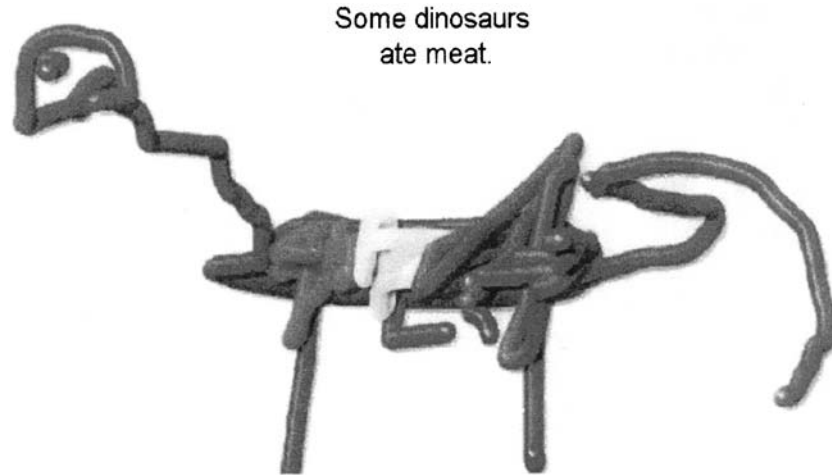
Some dinosaurs
ate meat.

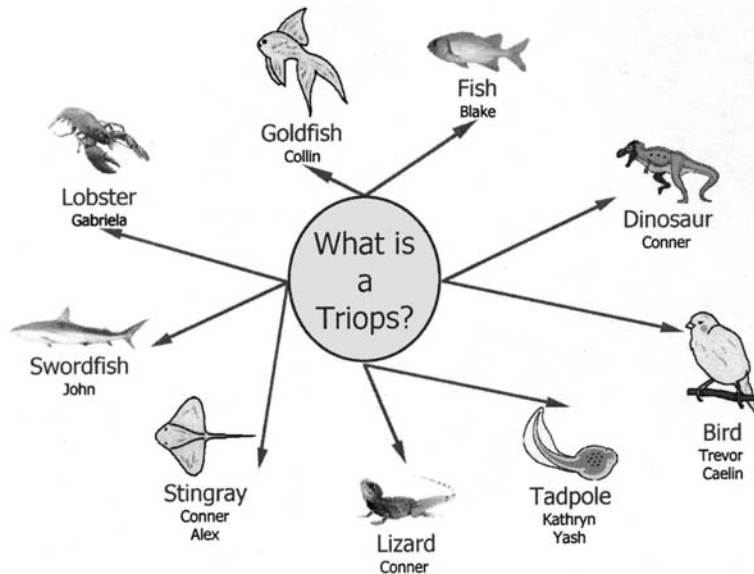**Fig. 1.** Kid Pix representation of a child's drawing and writing.

Fig. 2. Kidspiration Web of the children's ideas about triops.

whole group during group instruction for the expansion of ideas regarding the project topic.

In the beginning teachers were doubtful that the children would be able to use or understand the technology. In fact the opposite was true; the children found things in the software that the teachers did not know and actually taught the teachers. The student teachers also remarked that there were several experiences that would not have been as memorable without the use of technology. The student teachers found that using several software programs and computer technology helped the children reflect and expand their understanding in different ways and on different social and cognitive levels.

COMMUNICATION OF IDEAS AND COLLABORATION AMONG MEMBERS OF A SPECIFIC LEARNING COMMUNITY

One of the key points and valued aspects of the Reggio Emilia approach is collaboration among teachers, children, and parents (Bersani & Jarjoura, 2001). The teachers, through working together, gain different perspectives and collaboratively generate worthwhile educational experiences for the children. Modeling collaboration, teachers also expect children to demonstrate a high level of collaboration during project work. Children are encouraged to voice their opinions and work out any disagreements with each

other in a meaningful way. They dialogue, critique, compare, negotiate, hypothesize, and problem solve with each other in their group work. Differing perspectives and ideas are considered valuable in the children's co-construction of concepts. Moreover, children are encouraged to think of their class as a small community, making decisions about what topics to study and what classroom rules should be enforced (Edwards, Gandini, & Forman, 1998). Parents are involved in project work by contributing materials, participating in classroom activities, and extending the children's learning at home (Cagliari & Giudici, 2001).

The following is an example of how one specific learning community of children, teachers, and parents communicated and collaborated in a classroom project. The project began when one of the parents donated a "Grow Your Own Triops" kit to the classroom. Since the teacher had no idea about triops, the teacher and student teacher researched various sites on the Internet; they discovered that triops are part of crustacean family. The children talked among themselves and with the teachers about their ideas and theories about triops. These ideas were written on a flip chart and later incorporated into a web using the Kidspiration software as seen in the previously cited Figure 2. When searching the Internet, teachers also discovered sites displaying other people's experiences with triops. These sites and the information gathered were shared with parents to inform them of the classroom activities. Teachers, the children and their families observed the triops' growth and recorded their growth with the digital camera.

During their study, the children and the teachers were fascinated to discover that the triops' origins could be traced back to prehistoric times, the same time as dinosaurs. This led to discussions on why the triops have survived and why dinosaurs were extinct. After listening to the children's ideas, the teachers planned a lesson exploring extinction theories. Clip art pictures representing various scientific extinction theories were downloaded from the Internet and placed in a Microsoft PowerPoint® presentation. During a whole group discussion, the children were able to click on each picture and discuss how the theory might have led to the demise of the dinosaurs (see Figure 3).

The children explored other software programs and visited websites to further their understanding of dinosaurs. Due to the children's strong interest, the teacher visited the natural history museum, took digital camera pictures of dinosaurs, and incorporated the pictures into another PowerPoint® presentation. Although the children didn't go to the museum, they were able to take a pictorial field trip through the PowerPoint® presentation.

In a follow up activity, the children further represented their learning about dinosaurs using the computer and computer software. The teachers

Fig. 3. A small group of children discuss their theories about the extinction of the dinosaurs by using a PowerPoint® presentation.

noticed that when the children worked on the computer the children collaborated and communicated with each other extensively. They often worked together to create their Kid Pix pictures and talked about what should be included in their work. They shared and taught each other what they had learned. Working with peers on their project work, the children listened to each other's ideas, discussed their own and others' understandings, challenged and negotiated differences, developed solutions to problems and tried them out (see Figure 4). Observing this, the student teacher said, "... the children learned more from each other than they did from me... their learning [was] more meaningful because they were able to share it with their peers and explain it in a language other children could understand."

The collaboration and team effort between the student teacher and the cooperating teacher on the previously described project was apparent. When one teacher was teaching, the other was using technology to document the children's actions and dialogue. Together, they reviewed and reflected on the digital photographs and videotapes documenting the day's events. This documentation was used to plan extension lessons. With the addition of technology, collaboration between the cooperating teacher and the student teacher was intensified, became more productive and resulted in professional growth for both teachers. This can be seen following reflection statement of the cooperating teacher.

> I think the collaboration between the student teacher and myself was one of the most valuable components of the project. I assumed that since I was the 'teacher', I would be leading the way through this project. Boy, was I wrong! Both of us were familiar with

Fig. 4. The children collaborate on their project work in front of a computer.

technology and its uses. Although we had many of the same skills, I found that our knowledge differed. As a result, we learned a great deal from one another.

Her student teacher commented on her experience working with the cooperating teacher:

> Her technological know-how, her classroom expertise, and her willingness to share motivated me to use the available technology to support the children's construction of knowledge. Ours was truly a collaborative effort from the start—a wonderful learning experience in and of itself. I found that the old adage, 'two heads are better than one,' definitely held true in our situation and that our discussions and reflections generated new ideas as well as continued enthusiasm for the project.

The other essential member of the specific learning community, the family, was also included into the classroom project through technology. The teachers documented examples of children's project work and created documentation panels, daily learning webs, and concept maps for display. Parents look at the documentation panels in the classroom and search for photos or work samples of their own child and discuss prior activities. Parents are able to keep up-to-date on classroom events and the children feel pride in their work. At the same time, teachers, particularly student teachers, find that the panels provide an easy starting point for conversation and interaction with parents (Trepanier-Street et al., 2001). Parents, children and teachers all feel pride in the children's accomplishments. Parents' input and classroom participation in the project was consistently requested. The student teachers and the cooperating teachers mentioned that the more they posted pictures of parents working with the children in the classroom, the more the parents volunteered to participate. It was as if the pictures gave the parents permission to visit and participate in the classroom. As seen in the described example, technology was a valuable medium for collaboration and the communication of ideas among all the members of the specific learning community.

VISUALIZATION AND REFLECTION ON THINKING OF CHILDREN AND TEACHERS

In our early childhood classrooms, technology is an essential tool for visualizing and reflecting on children's thinking and behavior, as well as teaching practices. In the past, using only written transcriptions, student teachers often did not understand the true intent of the children's actions and words. However, using the digital camera, video camera, and

digital video camera, the learning and teaching pro-
cess became more visible, affording the teachers to
pay closer attention. This efficient documentation
process, enhanced by visual and auditory represen-
tation, can promote the teachers' understanding of
children's thinking and their role as facilitator. For
example, a teacher may think the children are inter-
ested in building with blocks when, in fact, the chil-
dren are interested in the blocks falling and hitting
the ground. Using video technology can help the
teacher to focus on the children's intention and their
theories and provide the children with new experi-
ences to explore their concepts.

Digital video technology, permitting instant vi-
deo revisiting of children's experiences, is a valuable
documentation tool (Forman, 1999). With this tech-
nology the capturing, storing, browsing, revisiting,
and creating of documentation of children's work is
both convenient and enhanced. Instant video revis-
iting provides a rich problem-solving context that
invites thinking and reflection by both children and
teachers. Using the digital video camera as a VCR
playback instrument, together they are able to see
their actions in the flip out screen and immediately
revisit their experience.

The following example describes how utilizing
the digital video camera for instant revisiting assisted
the children's and teacher's understanding of a social
conflict. One preschool teacher, challenged by the
children's behaviors, videotaped the children in-
volved in social conflicts. She revisited these conflicts
with the children on the foldout screen of the video
camera. This instant video revisiting provided
opportunities for the children's discussion of feelings,
reflection on their behavior and generation of
potential solutions to their conflicts (see Figure 5).
This experience also helped the teacher visualize and
reflect upon children's development and her role as a
teacher. The teacher remarked the following after
reviewing the videotape:

> Most of the time, T [the challenging child] wants to
> maintain a friendship. T wants to play with other
> children. However, when the other child is done
> playing with T or moves on to something else, T does
> not know how to continue to be included in the play.
> To him, it does not matter how he keeps connected
> to that child. It might mean taking something away
> from another child or disrupting the other child's
> play. Realizing this, it became less frustrating when
> having to handle his challenging behaviors.

Revisiting gave the teacher the opportunity to
discover the challenging child's true intent and to see

Fig. 5. The children reflect their actions with the teacher using the
foldout screen of a video camera.

the child's actions in a new light. In other words, it
changed the teacher's perception of a child's seem-
ingly inappropriate behavior to a more positive
behavior of friendship seeking. Further revisiting of
other videotapes of social interactions involving this
child, revealed that T did indeed have a meaningful
and positive friendship with a specific child in the
classroom. Through revisiting with T on the video-
tape, the teacher discussed with T strategies for
enhancing positive interactions with the children in
the classroom. The digital video technology permit-
ted better visualization and reflection resulting in
positive growth for both the children and teacher.

EXTENSION AND COMMUNICATION OF
LEARNING TO THE BROADER COMMUNITY

Student and cooperating teachers also use tech-
nology to extend classroom learning to the larger
community, that is, administrators, policy decision-
makers, and the wider professional community.
Technology used to create documentation panels and
classroom website can facilitate effective communi-
cation with this broader community. Technology re-
sources maximize the collection and analysis of data,
the interpretation of results, and the communication
of findings.

For example, the student and cooperating
teachers create technology enhanced documentation
panels using photographs of children involved in
projects that were downloaded from the digital cam-
era or captured from video clips. Teachers connect the
digital video camera via firewire to the computer, play
select sections, and capture and store photographs on
the computer. From these photographs teachers cre-

ate still pictures of the exact frame desired for the documentation panel. The audio portion can be transcribed and displayed with the still pictures. These documentation panels can be posted and displayed in the classroom or on the website and used for a variety of purposes with different audiences. While documentation panel making and website maintenance can be time consuming, the result is a quality product. These technology enhanced documentation panels and classroom web site is also an effective communication tool to communicate with administrators and policy makers. They provide an accountable record of individual child and classroom learning. Making learning visible, the panels and website demonstrate how the state curriculum and assessment requirements are met within the classroom (Siedel, 2001). Through project work many curriculum requirements in core areas can be accomplished beyond the expected level. Observing and documenting children's learning while they are actively involved in their everyday activities, links the curriculum and assessment process leading to truly authentic assessment (Horm-Wingered, 2002; Rinaldi, 2001).

Finally, technology can be used to extend learning and communication to the professional community. Documentation panels and classroom website can be shared with the early childhood community at conferences for the purpose of discussion and professional development. Archieved documentation panels can be a valuable database for the study of child development and teacher practice. Also information about the early childhood and teacher education program can be easily accessed and disseminated.

CONCLUSION

When technology is integrated in a meaningful way into an early childhood curriculum, the possibilities for the construction of knowledge in both the children and teacher are greatly expanded. We found that the application of technology into Reggio Emilia inspired classroom projects and their documentation was a powerful vehicle for fostering improvement of children's learning, teachers' reflection, and the quality of education.

Various forms of technology used in classroom projects were cognitive partnership tools for teaching and learning. Computer software programs, such as, Kid Pix and Kidspiration, allowed the children and teachers to better represent and organize their ideas in a different medium. Technology also supported discussion, sharing, and collaboration among the children, their families, and teachers. The use of technology such as the digital camera and digital video camera, was a highly effective tool for visualizing and reflecting on the development of children and teachers. It provided a rich problem solving context and invited thinking and reflection. The documenting of children's learning on panels and a classroom website made learning more visible and easier for teacher interpretation and use for assessment and curriculum planning. These same documentation panels and the classroom website extended and communicated classroom learning to the broader community, provided an accountable record to administrators and policy makers, and offered a valuable data base for study among early childhood professionals.

Technology is an invaluable tool for knowledge construction for people of all ages. It is available to enhance the curriculum, not to replace it. New forms of technology constantly offer great possibilities and challenges for enhancing the educational experience. The early childhood community must be committed to these possibilities and challenges.

ACKNOWLEDGMENTS

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