

Bridging the Gap: Meeting the Needs of Early Childhood Students by Integrating Technology and Environmental Education

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Children come from diverse backgrounds, particularly in terms of their access to the environment and technology. It is our job as teachers to help level the playing field and provide all students an equal chance to succeed. By integrating these two seemingly opposed curricular areas we can create an opportunity for young children to become both environmentally and technologically literate. This article explores how technology tools can be used to encourage students in early childhood programs to engage in activities that will help them appreciate natural resources while exploring environmental issues. Our goal is to examine the use of integrated technology within the environmental curriculum that will support the development of environmental and technology literacies in young children 3-6 years of age.

Nature deficit

Over 80% of the United States population now lives in urban areas, meaning that most of today's students live in either an urban or suburban environment (U.S. Census Bureau, 2010). Children are increasingly disconnected from outdoor pursuits and some never experience the natural world nor do they understand how they are a part of their community. If students go outside, they often see only streets, buildings, shops, cars, and more people. They not only have little understanding of their natural surroundings, but often have no opportunity for experiences that will help them develop an

appreciation for the serenity of a stream or the call of a bird. Many never visit a park, a natural area, observe wildlife, or plant a garden. Some may see a bird fly over but do they understand their place within their environment? Young children are often exposed to the importance of reducing pollution and recycling, but may not be taught or fully understand the reason behind these concepts. They may know that they can only water their yards on designated days, but do they understand why water rationing is necessary? How do they develop their environmental disposition without effective, meaningful environmental education? Early childhood programs make little if any effort to expose their students to environmental issues such as water rationing, contaminated water supplies, or pollution even though it is estimated that over 42% of the nation lives in areas where pollution levels are too high or too dangerous to breathe (American Lung Association, 2013).

In 1987, Jim Greenman postulated that children were losing habitat (the real world of people, nature and machines) and their ability to explore their world. Later, Richard Louv coined the phrase “nature-deficit disorder” in his book, *Last Child in the Woods* (2006). He discussed how today children lack the connection to the natural world when compared to previous generations. He stressed that children need to reconnect to the natural world. Environmental education is necessary to encourage students to become good stewards and to think globally but act locally regarding the environment and environmental issues. While today’s children appear to be more comfortable at the computer or playing with electronics than being outside, educators are encouraged to draw upon their interest in and comfort with electronics to “re-introduce” them to the wonders of nature.

Environmental education is more than just learning about plants and animals and the environment. It is an invaluable tool for teaching critical thinking skills and applying these skills to the students’ everyday world. Proper selection and use of technology can not only enhance these skills but stimulate interest and engagement in the world around them. The children of today are the decision makers and voters of tomorrow. The ultimate goal for environmental education is to create environmentally literate global citizens (Disinger & Roth, 1992). In order to accomplish this, educators must help students acquire a better understanding of their environment and natural resources as well as environmental issues affecting them.

For young children, environmental education is addressed through the basic premises of scientific inquiry: exploring, observing, communicating, organizing, applying, relating, and inferring (Arce, 2013). Children learn about the environment anytime they experience their natural surroundings. Educators can enhance children’s explorations by providing them with interesting and enriching experiences that help them to explore outside of their direct environment and make connections and inferences within and between different phenomena in the environment. We create meaningful learning experiences when we help children to move beyond simple observations to more complex activities that require higher-level thinking and collaboration with peers. Many

of these experiences will be hands-on activities in the classroom or on supervised excursions (Arce, 2013). But educators can also integrate technology and media with environmental education through activities that encourage children to explore, create, problem solve, communicate, collaborate, document, investigate and demonstrate their learning about the world outside of their classroom. The North American Association for Environmental Education (NAAEE, 2010, p. 7) “beckons families, educators, and community leaders worldwide to take action, to strengthen children’s connection to nature—making developmentally appropriate nature education a sustaining and enriching, fully integrated part of the daily lives and education of the world’s children.” We contend that developmentally appropriate technologies can be used to supplement experiences in the natural world especially when the curriculum is 1) Based on research and theory, 2) integrates authentic experiences, 3) is child-directed and inquiry-based and 4) related to the whole child (NAAEE, 2010).

The digital divide

One of the most remarkable changes in the classroom over the past two decades has been the incredible advances in classroom technology (Duncan & Young, 2003; Kozma & Voogt, 2003; Knapp & Glenn, 1996). The declining costs of technology have enabled schools to gain access to new technologies, while increases in access to advanced technologies offers classrooms new opportunities to explore different ways to explore and learn about the world around them (CEO Forum, 2000; SCANS, 1991; Solman & Wiederhorn, 2000). Schools and educational agencies are placing an emphasis on the use of technology as a teaching and learning tool because technology encourages teachers and students to work together as they explore ways to improve the teaching and learning process (Kontos & Mizell, 1997; Skarr & Spagnolo, 1995).

The International Education Technology Standards (ISTE, 2007) indicate that in order to be competitive workforce, children need to acquire basic skills in technology by the time they are five years old. For children from affluent families, with full access to technology, these skills are highly developed by the time they enter school but for children from less affluent homes, the ability to develop technological skills typically occurs in the school setting (National Association for the Education of Young Children [NAEYC], 2012).

According to the U.S. Census Bureau (2009), 31.3% of households do not have computer and/or Internet access. This number is higher for black (45.5%) and Hispanic (47.2%) households. This means that many students rely on the school setting to provide them with the necessary technological practice to prepare them for success as they go through the school system and prepare for the workforce or higher education. For young children, this includes becoming familiar with technological terms and the use of different hardware and software (Clements & Serama, 2003). They need plenty of time to explore and become familiar with the mechanics of these devices before we can expect them to use them purposefully and effectively (NAEYC, 2012).

The National Association for the Education of Young Children (2012) asserts, “when used wisely, technology and media can support learning and enhance relationships” (p. 1). When educators intentionally use interactive media to enhance the foundations that have already been established in their classrooms, children can explore and benefit from virtually endless resources. We are not advocating for the use of passive media or games that do the work for the children or simply entertain them. Our approach uses interactive technology in ways that help children to build connections to and dispositions toward the natural environment.

In addition to developing technology skills, integrating technology into the regular school curriculum provides students with additional tools to enhance their learning experiences. Technology can address different learning styles by helping students understand their experiences through verbal, written, spatial, quantitative, and/or graphical means. As a result of technology infused instruction more students become engaged in the learning process (Laird & Kuh, 2005). Technology can also be used to support a multidisciplinary approach to learning. The integration of different disciplines helps students combine their mathematical, logical, scientific, linguistic, artistic, and social knowledge to make their lives and interactions with the world clearer.

Technology can motivate today’s children and be used to develop independent thinkers. Technology can provide opportunities for student-centered instruction, cooperative learning, and increase the interaction between the teacher and the student.

In order to introduce technology in age-appropriate and educationally effective ways, NAEYC and the Fred Rogers Center recommend that early childhood educators:

- Select, use, integrate, and evaluate technology and interactive media tools in intentional and developmentally appropriate ways, giving careful attention to the appropriateness and the quality of the content, the child’s experience, and the opportunities for co-engagement.
- Provide a balance of activities in programs for young children, recognizing that technology and interactive media can be valuable tools when used intentionally with children to extend and support active, hands-on, creative, and authentic engagement with those around them and with their world.
- Prohibit the passive use of television, videos, DVDs, and other non-interactive technologies and media in early childhood programs for children younger than 2, and discourage passive and non-interactive uses with children ages 2 through 5.
- Limit any use of technology and interactive media in programs for children younger than two years to those that appropriately support responsive interactions between caregivers and children and that strengthen adult-child relationships.
- Carefully consider the screen time recommendations from public health organizations for children from birth through age five when determining appropriate limits on technology and media use in early childhood settings.

Screen time estimates should include time spent in front of a screen at the early childhood program and, with input from parents and families, at home and elsewhere.

- Provide leadership in ensuring equitable access to technology and interactive media experiences for the children in their care and for parents and families.

According to Copple and Bredekamp, in developmentally appropriate environments, educators use classroom technology “not to replace children’s experiences with objects and materials but to expand the range of tools with which children can seek information, solve problems and perform transformations” (2010, p. 174). Further, they encourage shared learning and interaction, which includes increased amounts of talking, cooperating, and supporting.

We are not advocating for the use of digital media or technology tools to replace interactions and hands-on experiences, but believe that we can use technology to build skills and interests in the environment even though these two curriculum areas are seemingly opposed. The overall goal is literacy; literacy that prepares students to be contributing citizens of tomorrow.

Integrating curriculum to close the gap

New digital technologies are providing access to information, communication, and environments across the globe. Appropriate use of technology can have a positive effect on education because it offers all students equitable access to information and knowledge (Solman & Wiederhorn, 2000). Technology can be used to enhance student learning through involvement with authentic, challenging tasks, provide new roles for students and teachers, and create a culture that supports learning both in the classroom and beyond the school walls (Singh & Means, 1994). Technology can provide children with the opportunity to experience the natural world virtually when it cannot be experienced directly, for children who have limited access to the natural environment, technology can provide a realistic, interactive supplement or simulation. Screen media can expose children to people, animals, places and things that they may never have an opportunity to see and encourage them to get outside and experience the environment around them. In addition, with Web 2.0 tools, they can explore even further. For example, with the aid of technology students can not only see video clips of a Whooping Crane, but they can track its migratory route as it flies across states. For very young children, who are egocentric in nature, the teacher might explain that birds, like humans, go “home” on a regular basis. Relating the topic back to what the child already knows helps them to make connections and make sense of the curriculum in meaningful ways (Copple & Bredekamp, 2009).

When used appropriately, technology offers opportunities for interaction, modeling, and feedback, which can dissolve the current boundaries of the classroom environment. How can you simulate a nature walk through the forest if you are in downtown Chicago?

How can you simulate the sounds of nature when nature is far removed from the city setting? Technology can bridge those gaps in opportunity.

“Emerging technologies are steadily increasing their presence in classrooms and reshaping what and how students learn and the way teachers think about teaching, learning, and organizing the classroom” (Knapp & Glenn, 1996, p. vii). From using the World Wide Web (WWW) to using mobile tools, technology connections can excite the student about their environment and assist them in understanding environmental issues. Students, in collaboration with their teacher and parents, can create their own environmental messages or create a website promoting their school habitat. There is little doubt technology will continue to play a prominent role in education, and the education system must undertake the challenge of restructuring to prepare students to be productive in today’s society (Kent & McNergney, 1999; Means, 2000). This requires the creation of more demanding goals for all students and providing curriculum and instruction that stimulates thinking and problem solving. As part of the goal of environmental education and developing an environmentally literate individual, these skills are necessary as students strive to address complex environmental issues. “If we have a vision of schooling that calls for students to work to their capacity, at their own pace, at tasks they find to be challenging and enjoyable, we are likely to be successful only if we take advantage of opportunities afforded us by new technologies” (Mehlinger, 1995, p. 22).

Teachers can use a variety of technologies such as the WWW, webcams, application software, digital tools, mobile devices and much, much more to enhance lessons and provide opportunities for children to interact with the environment. Children can learn about the place in which they live and environmental issues while increasing their readiness skills and literacy. These lessons can ignite the interest of children regarding their natural world and introduce them to the joy of discovery while instilling a sense of place and influencing their environmental disposition.

TOOLS FOR TEACHERS

Many technology connections are available that can be used to introduce children to the natural world and provide opportunities for interaction with the outdoors when the possibility of interacting with the outdoor environment is inaccessible or unsafe. Children can use technology to not only explore and examine their local neighborhood but also examine global issues. The following section provides descriptions of age-appropriate, interactive tools and resources and examples of how they can be utilized in the classroom.

Webcams

In simple terms, a webcam is a real-time camera that takes repeated images uploads the images to a webpage that can be accessed on the World Wide Web (WWW). Webcams can offer teachers effective ways of engaging learners with the environment in an interactive way. Webcams can bring distant places to the classroom and allow learners to observe events in “real time” Webcams can be used for videoconferencing and collaboration with learners and experts across the town, the state, the nation, or the world. Learners can observe and monitor changes in environments through inquiry-based activities that focus on higher order thinking skills. Webcams can bring environments from around the world into the classroom bringing the world beyond the classroom to life, inspiring curiosity and imagination while nurturing globally aware citizens.

Possible uses. Students can observe animals in the wild or at zoos. This allows the student to go to sites (locations) where they may not be able to go. For example, students can observe the behavior of the panda bears at the Atlanta Zoo. If migration is the topic of the day, watching the polar bears migrate in Canada can be accomplished via the Polar Bear International webcam. Of course, with webcams, sometimes the animals are active and sometimes not. However, you can often see snippets of the animals’ activities from previous days or review the data recorded by scientists. With geological structures, students can actually keep up to date with such things as volcanic eruptions, shuttle launches, or tropical storms. For younger children, teachers can also set up webcams in the schoolyard, at the bird feeder, or at the garden. There are relatively inexpensive wireless cams available even some that record when they are tripped by motion sensors.

Resources.

- Panda Cam Atlanta Zoo (http://www.zooatlanta.org/1212/panda_cam)
- Eagle Cam (<http://www.conservewildlifenj.org/education/eaglecam/>)
- Polar Bear International (<http://www.polarbearsinternational.org/>)
- Volcano Webcams (<http://bigthink.com/ideas/26619?page=all>)
- NOAA Webcam (<http://www.ssd.noaa.gov/VAAC/cams.html>)
- National Geographic Education and Critter Cam (http://education.nationalgeographic.com/?ar_a=1)

Cameras and video

Digital cameras and video equipment offer learners an opportunity to share their views of the environment with their classmates as well as with other classes around the world. Young children have difficulty understanding the perspectives of others, but images and video can help even the youngest learners to see the perspectives of others, including where they live, where they learn and the environment around them. With the aid of

digital cameras and video tools the eyes of the learner can be used to capture elements of their environment. A digital image can capture a moment in time and allow learners to revisit an event or location over an extended period. Observing changes, asking questions, and making predictions over time allow learners to become directly involved in the processes they are monitoring. Digital image technologies allow learners to bring various elements of their environment into the classroom for extended discussion and examination. Learners can obtain images of various environments and makes comparisons of the differences they find. Digital cameras or videos can be taken along on field trips or be used to document classroom activities to create presentations, brochures, or posters of the experience. Digital images allow teachers to take their learners out of the classroom to capture “real-world” examples of environmental changes. Interacting with the environment with the use of High Order Thinking Skills (HOTS) will support awareness and understanding of the world outside the classroom.

Possible uses. Students can use cameras and videos to record data, conduct observations, or document events. Those that have access to a school habitat, can have the students take photos of the trees and shrubs throughout the year and document the different changes over time. They can document where they see specific insects or birds with digital cameras. Another option is to have them take pictures of specific shapes or colors or see what shapes they can find in the pictures they take.

Resources.

- Meaningful Connections : Using Technology in Primary Classrooms
<http://www.eric.ed.gov/ERICWebPortal/detail?accno=EJ784131>
- Flip Video - Pre-K Pages <http://www.pre-kpages.com/flip-video/> (Note: Flip Video camcorders are no longer being produced but the activities found on this link can apply to any camcorder)
- Using a Digital Camera in the Early Childhood Classroom
<http://www.examiner.com/article/using-a-digital-camera-the-early-childhood-classroom>
- Digital Camera in the Preschool Classroom
<http://learningandteachingwithpreschoolers.blogspot.com/2011/03/digital-camera-in-preschool-classroom.html>
- Digital Cameras for Kids: Cool Tools and Windows into the Minds of Children
<http://www.parentingscience.com/digital-cameras-for-kids.html>
- Photo Factory <http://www.pbs.org/parents/photo/>
- Windows Movie Maker Live <http://windows.microsoft.com/en-US/windows-live/movie-maker-get-started>

Mobile technology

Mobile technology is entering the classroom at a rapid pace. Teachers and students have a variety of mobile technologies at their fingertips. Technologies that include

smartphones, iPods, iTouchs, iPads, tablets, and eReaders are providing learners access to a vast amount of interactive and collaborative tools. Each of the tools discussed above are now readily available on one of the mobile technologies. Placing access to the world outside the classroom walls in the hands of the learner opens up many opportunities for exploration, inquiry, and experience with other classrooms in their own neighborhood or on the other side of the world. Mobile applications (apps) provide tools that are developmentally appropriate, affordable, and culturally diverse. Students can quickly access a variety of music, images, video, and books that are representative of the many cultures around the world. Images, audio, and video can be captured and shared with a simple click of a button. The vast numbers of apps that operate on touch or motion support the developmental needs of the student.

Possible uses. Students can use mobile technology in a variety of ways inside the classroom and beyond. Tools with touch motion technology such as the iPad or iTouch afford interactions to young children who have yet to fully develop fine motor or reading skills. A collection of environmental education apps offers the classroom teacher opportunities to take instruction outdoors. Achievement-oriented action-based activities can be controlled by simple touch or motions, reducing the need for fully developed motor skills to control navigational buttons or controls. The number of available mobile applications (apps) expands exponentially every day, providing educators with an almost endless source of classroom options.

Resources.

- iPods in Early Childhood: Mobile Technologies and Story Telling
<http://www.ascilite.org.au/conferences/melbourne08/procs/olney.pdf>
- Technology and Interactive Media as Tools in Early Childhood Programs Serving Children from Birth through Age 8
http://www.naeyc.org/files/naeyc/file/positions/PS_technology_WEB2.pdf
- Apps in Education: Early Childhood and the iPad
<http://appsineducation.blogspot.com/2012/03/early-childhood-education-and-ipad.html>
- 5 Great iPad Apps for Early Childhood Teachers <http://certificationmap.com/5-great-ipad-apps-for-early-childhood-teachers/>
- Teachers: Five Tips on When to use the iPad in the Early Childhood Classroom
<http://bridgingapps.org/2011/11/teachers-five-tips-on-when-to-use-the-ipad-in-the-early-childhood-classroom/>
- Environmental Education Apps (suitable for young children)
<http://eeinwisconsin.org/resource/about.aspx?s=103138.0.0.2209>

Scanners

Scanners are inexpensive tools that allow teachers to create digital images of a full range of objects that can be used in the classroom in a variety of creative ways.

Anything from learner work products to leaves from the campus trees can be digitized with the use of a scanner. Scanners can create digital images of plants, insects, or other specimens from the environment for retention and close-up examination. Once scanned images are created they can be integrated into numerous other programs for classroom activities.

Possible uses. Educators can scan in leaves from around the school or home and create keys for the identification of local plants. They could scan in any tangible product created by the children. The digital versions of the products could be archived in an electronic portfolio to be used for either alternate assessment or an end of school gift to the student and parents.

Resources.

- Using Digital Cameras and Scanners in the Early Years
http://ictearlyyears.e2bn.org/resources_65.html
- Snappy Ideas for using Scanners in the Classroom
<http://teacher.scholastic.com/professional/childdev/snappyscannerideas.htm>
- Five Creative Ways to Use a Scanner in the Classroom
http://www.eduquery.com/papers/Rice/techedge/Five_Ways_Scanner.pdf

Probeware

Probeware is another inexpensive way to integrate technology into the environmental curriculum with hands-on activities that support inquiry-based projects. Probeware is available to measure a variety of environmental elements and offer learners an opportunity to be immersed in the environment through data collection and analysis of information gathered from the “real world”. With the use of probeware an environmental experiment can be completed in minutes, devoting the rest of the time to discussion and analysis of the results obtained. This affords classroom time for learners to discuss their findings through classroom inquiry and collaboration. The portability of probeware offers convenience for field trips and use outside the classroom.

Possible uses. There are several types of probeware or educational applications of probes that students can use. Students can record data such as temperature, pH, visible light, and soil moisture. Once the data is recorded, they can download their data onto computers and analyze it (or look for trends). For the lower grades, educators may just want to focus on temperature or rainfall during calendar and weather discussions.

Resources.

- Article on children and probeware - <http://mshstechintegration.asb-wiki.wikispaces.net/file/view/Real+Time+Science.pdf>
- ProbeWare Resources <http://www.tvdsb.ca/programs.cfm?subpage=142430>

- Facilitate Student's Data Collection and Analysis with Probeware
http://www.peterli.com/spm/resources/articles/archive.php?article_id=1068

Global Positioning Systems (GPS) and Geocaching

Currently the U.S. Department of Defense Global Positioning System consists of 24 satellites that orbit the earth at very high altitudes. The satellites transmit signals that facilitate the location of GPS receivers (GPSr). The receivers can be fixed on a location on the Earth's surface, in moving vehicles, aircraft, or in low-Earth orbiting satellites. GPS can be used in air, land, or sea navigation. They can be used for mapping, surveying, or other applications that require accuracy of positioning (National Park Service, 2008). A GPS can determine an approximate location of a GPS receiver. Locations are provided in longitude and latitude and can be used for navigation from one location to another (Ground Speak, 2008).

According to Cameron and Cameron (2004), geocaching is "equal parts scavenger hunting, hiking, outdoor adventure, and gift-exchange-with a technological twist" (p. xiii). Technology in the form of GPS receivers guide the user to the location of the cache anywhere in the world. A typical cache is a small waterproof container containing a logbook and "treasure," usually toys or trinkets of little value. Today, well over 480,000 geocaches are registered on various websites devoted to the sport. Geocaches are currently placed in over 100 countries around the world and on all seven continents, including Antarctica". Geocaching can be a great hands-on environmental activity for learners of all ages that can be exciting and motivating. Educators can create geocaching activities within their classroom, school or outdoor environment to help children learn to navigate their immediate environment.

Possible Uses. Students can build upon their own current understandings of geography by exploring geography through hands-on visual technology. Young children are inherently curious; providing a tool like GPS that is built upon exploration opens a variety of outlets for exploration within a controlled environment.

Resources.

- US Government Official GPS <http://www.gps.gov>
- Geocaching Website <http://www.geocaching.com>
- Global Positioning System Units and Geocaching
<http://little.usd259.org/modules/cms/pages.phtml?sessionid=&pageid=243902>
&

Blog

A blog (short for weblog) is another example of social software that continues to grow in popularity across all age groups. Blogs are ongoing personal online logs. This Web 2.0

tool can be used for tracking projects or recording daily information on any selected topic.

Possible uses. Journals have been kept by children of all ages for many years. The interactive blog tools add a visual dimension to the blogging world that goes beyond printed text. Even young students can record their thoughts, feelings and successes with the click of a button and the help of a teacher who can dictate their thoughts. Student with access to drawing tool on a classroom computer or mobile device can add illustrations to their thoughts. Setting up a classroom blog offers students and parents a medium to share valuable classroom experiences throughout the school year.

Resources.

- Hello Kids: Blogs for Kids http://www.hellokids.com/t_2856/blogs-for-kids
- Kidblog <http://kidblog.org/home/>

Podcasting

Podcast (**iPod broadCast**) is an audio broadcast that has been converted to an MP3 file or other audio file format for playback in a digital music player or computer. The "pod" in podcast was derived from the term "iPod," the most prevalent portable, digital music player, and although most podcasts are verbal, but they "may contain music" (pcMAG, 2008). The interactive ability of podcasts allows learners to share their experiences with others in locations around the world making their learning meaningful and their assessment authentic. Teachers can use the podcast to bring cultural and social influences into the classroom to support cognitive development as learners seek to make sense of the world around them (Department of Education and Training, Government of Western Australia, <http://www.det.wa.edu.au/education/cmis/eval/curriculum/ict/podcasts/>, 2008).

Possible uses. Podcasts can be created from original audio recording by students in the classroom or existing audio can be incorporated into the podcast. A podcast can be used to record just-in-time activities such as the exploration of a habitat. Students can use the audio tools to archive their oral account of an event, a book, or even an imaginary tale.

Resources.

- Web Tools for Kids: Music and Podcast <https://sites.google.com/site/webtoolsbox/music-tools>
- Kid-Cast <http://kid-cast.com/>
- Podcasting for Kids <http://www.podcastingnews.com/content/2009/12/podcasting-for-kids/>
- Earth and Sky [http:// www.earthsky.org](http://www.earthsky.org)

Summary

Blending environmental and technology literacy into the existing curriculum will help early childhood educators prepare young children to be active, civic-minded adults. We recognize that children come from diverse backgrounds that may restrict their access to the technology and their world beyond their classroom. As 21st century educators, it is our charge to find strategies that level the educational playing field for all learners. Using age-appropriate, interactive technology tools to foster student engagement in activities that support appreciation of the environment and natural resources promotes understanding of environmental issues. Across the nation schools are increasing access to technologies in the classroom. Therefore, providing educators of young children with developmentally appropriate resources and strategies that support environmental and technology literacy should be an essential component of all technology plans.

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