

## **Re-envisioning Early Childhood Education: Technology and Tots**

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### **Abstract**

Young children are naturally inquisitive and enter school technologically savvy. Crib toys and those for toddlers light up, buzz, and engage young children in independent learning activities from just a few months of age. By the time these digital natives arrive at school they have experienced fast moving, on-demand learning delivered at their own pace. They are comfortable pushing buttons and exploring their world through technology. Currently schools are tentative in their use of computer games and applications in early childhood classrooms. The instructional challenge facing educators is to build on young learners' technology skills to facilitate problem solving, literacy and numeric concepts. This manuscript examines guidelines for the development of appropriate early childhood classroom policy, best practices for the use of computers in early childhood classrooms, and staff development strategies for teachers who want to educate digital natives.

### **Introduction**

Developmentally appropriate teaching and learning in early childhood education is giving way to standardized tests, strict classroom rules, inflexibility and unending worksheets in preparation for high stakes testing and student growth objectives that determine whether teachers will be able to keep their jobs. In 2011, and in reaction to that change in kindergartens, the *Journal of Early Childhood Education* produced a series of editorials to “describe the crisis that exists in kindergarten today related to maintaining developmentally and culturally appropriate practice while at the same time addressing the academic standards set forth by most states.” (Gullo and Hughes 2011, 323) This article re-envision early childhood education by introducing well-chosen, developmentally appropriate applications of technology that meet very diverse student needs in engaging ways.

The technology that young children use at home is geared to their abilities and interests whereas the technology in school may only consist of a Smartboard or a computer program that resembles an electronic workbook. Often that computer program is purchased at a district central office to teacher-proof learning because there isn't the basic understanding that, no matter how good the computer program, teachers will always be key to creating bridges of understanding through caring relationships. Such masterminding lacks recognition that learning is interactive, relationship driven, social and that children need mediation and guidance in order to prosper (Neff n.d.) .

### **Boundaries Pushed**

Many children enter school curious and with a love of learning having played computer games and learned on apps. Some of those children have teachers who know how to use technology to engage their young minds. They realize that young children enter kindergarten having taken photographs and with a general understanding of how a browser works including opening and closing windows and using the “back” key, know how to move the cursor to a target on the screen, and use important keys such as “enter”, “delete”, and the “space bar”, know the difference between clicking the right and left mouse as well as possess a basic computer literate vocabulary (Buckleleitner n.d.). Because children come to school already using technology, schools can take advantage of this and guide their learning using the best that technology has to offer. Use of digital media removes the boundaries of learning and permits children to explore their own paths to learning. This presents a challenge to teaching unless the teacher is prepared for it. The instructional challenge facing educators is to build on young learners' technology skills to facilitate problem solving, literacy and numeric concepts.

In his 2001 book, *The Digital Game-Based Learning Revolution*, Marc Prensky explains that we have to realize that the world is being turned upside down as more and more young children are learning to read with the help of technology even before they enter school and with the assistance of competent adults. The promise of digital game-based learning is coming to fruition. National Association of Educators of Young Children (NAEYC) states, “The pace of change is so rapid that society is experiencing a disruption almost as significant as when there was a shift from oral language to print literacy, and again when the printing press expanded access to books and the printed word. The shift to new media literacies and the need for digital literacy that encompasses both technology and media literacy will continue to shape the world in which young children are developing and learning.” (NAEYC, 2012, 2)

Creative instructional designers are developing learning materials that were unheard of only a few years ago. Developed by graduates of the Stanford Learning, Design, and Technology program at the Stanford University School of Education, Motion Math uses apps to teach mathematics more effectively than traditional teaching (edSurge n.d.). John Seeley Brown of the Illinois Institute of Technology Design discusses student learning communities as environments for constantly learning and teaching one another, in which works in progress are always public and teams of children work together to improve their products; identity is defined by a child’s contributions to the learning community (Brown 2008). Exploration and experimentation are key in John Seeley Brown’s vision of education as they are in the exciting e science movement as well.

A 2011 report from the American Federation of Teachers and American Institutes for Research shows that “Gen Y [young] teachers tend to be very enthusiastic about instructional and social networking technology, but expect more from technology than what many schools can deliver” (Coggshall and Behrstock-Sherratt 2011, 6). Those young teachers are entering the workforce with every intention of staying but educational environments are failing to retain them. A couple of computers in a room with or without a Smartboard isn’t 21<sup>st</sup> Century teaching. Well-equipped early classrooms need more than that. They need mobile devices that individual and small groups of students can operate and opportunity for cross device syncing of learning games of which Minecraft is only one.

## **Diversity and Diversification**

Technology brings magic to the classroom by making it possible for a single teacher to 1) present ideas in multiple ways using videos, interactive websites, e books, etc., 2) create enticing learning environments that help learning to stick by using a variety of approaches which include music, e drawings, etc., and, 3) create opportunities for students to show what they have learned by dictating, making videos, using avatars, writing, etc. It is like having an encyclopedia, a dictionary, a thesaurus and a whole library at one’s fingertips. Technology is revolutionizing education at all levels because it makes learning accessible to every child in every classroom (Bonk 2011; Clemens 2013).

Multiple forms of presentation ensure that all learners engage and are not difficult to deliver when, for example, the teacher uses a computer to explain a concept in a language a child understands or has the computer read text aloud to a youngster who is not a fluent reader or to show a video about the concept to supplement the text. It used to be that learning depended on reading but we know that, even those who cannot read are still able to learn if the material is presented in a way.

So much of what turns children off to learning can turn them on to it when technology is employed judiciously. Take, for instance, reading. A few children will have trouble breaking the Code but that doesn’t mean they can’t learn other things.

Helping diverse learners take in and process information as well as practice learning is a snap if their teacher is aware of appropriate interactive games, touch screens and web-based manipulatives.

When a child struggles with handwriting but can dictate thoughts and see them on a screen as those thoughts are formulated, when that child draws with animated gifs or records a song that the child made up, that little person accesses the curriculum and is able to demonstrate that s/he is learning in non-traditional ways. Teaching centers have always been part of early childhood classrooms. E-centers enable young children to work singly and in small groups to practice and create while the technology monitors accuracy. Feedback is immediate and many software programs adjust upward or downward based on student readiness. This frees the teacher to take a more active role with students who need additional adult intervention during class time.

Early childhood has recently begun to use technology as a teaching tool and the initiatives are substantive, research based, highly effective and give a glimpse of the future. Take, for instance, the University of Illinois's Institute of Design at the Institute of Technology which gave us Smart Objects that encourage a child to think and discover while tinkering. The term used is "Thinkering" which is very much like discovery learning with a technological twist. Thinkering uses technology to let children play around with complexities and think as they do so. Some examples include small blocks called siftables that create mathematical sentences and are always accurate numerically so children learn operations and their tables painlessly. Other siftables like these are colors that can be "poured" together virtually and blend into new colors. Siftables (n.d.) can also be used as letters of the alphabet which let a child know whenever a word has been spelled out. Thinkering gives children control over the technology. According to the 2009 Horizon Report by Microsoft (2009), Leap Frog toys use this technology with the tag reader that allows children to tap on a word or move over a sentence to read it aloud. Leap Frog tag lets a child tinker with the words on the page or listen to the story.

### **Sound Practice**

Of course, applications of technology can be either appropriate or inappropriate for children just as they can be appropriate or inappropriate for adults. The Fred Rogers Center for Early Learning and Children's Learning at St. Vincent's College together with the National Association for the Education of Young Children (2012) offer these key messages:

- When used intentionally and appropriately, technology and interactive media are effective tools to support learning and development.
- Intentional use requires early childhood teachers and administrators to have information and resources regarding the nature of these tools and the implications of their use with children.
- Limitations on the use of technology and media are important.
- Special considerations must be given to the use of technology with infants and toddlers.
- Attention to digital citizenship and equitable access is essential.

Although more research needs to be done to fully illuminate the effects of technology on young children, some controversy remains (Healey 1998; Yelland 2005; McCarrick and Xiaoming 2007; Lankshear and Knobel 2003). One very hopeful advance has to do with the well-researched domain of brain functioning and gaming. Researchers are unveiling the ability for games to enhance brain functioning including visual attention and speed of processing, just to name a few of research interests (Bavelier et al. 2011). Michael M. Merzenich, one of those researchers and a leading pioneer in research on the plasticity of the brain, tells us that the intensive use of video games specially designed to target perception, cognition and social control make significant improvements in cognitive functioning can predict academic success in children. He cautions, however, that technology takes time away from reading and other academic pursuits and can impact them negatively.

Studies about brain-based learning and video gaming target populations beyond the ages of birth to age 8 (Burnett 2010) which means that what we know is not completely definitive for early childhood

at the present time. What is true, however, is that what we know seems to also be common sense: If children play violent games, they get good at it and are apt to be less empathetic and more ready to fight. For children who are not good at perceptual things or social issues, video games can make a difference in their ability because of practice and because video games follow the principles of motivation and learning which we all know about (Bavelier et al. 2011). Video games, then, are only as good or as bad as they are designed to be and, like anything else, too much of a good thing is a bad thing. So, when too much time is spent playing video games a child becomes one sided and is removed from reading and interacting with others. If a child plays video games all alone all the time, that youngster is probably going to be lonely. In a nutshell, what we know about life is also what we know about video games.

In their 2012 position statement, NAEYC points out that we are still learning how technology fully impacts children and where the boundaries lie at different ages. Ongoing research is needed. At the same time, technology has become a cultural force from TV programs to websites like Starfall.com, Skype and interactive apps on mobile devices to name a very few. Children need to learn how to use it meaningfully to extend what they know and to do research on their own as well as with their peers. Young children are capable of doing research and checking information using web browsers. Youngsters interested in trains, dinosaurs or astronauts use browsers to view still and video representations. Only rudimentary spelling is needed as search engines are “smart” and close approximations is all that is needed. We already know that the appropriate use of technology can lead to improved social interactions, improved speech and language, and reading skills (Clements and Nastasi 1993; Coiro n.d.). It would, therefore, behoove us to optimize its use in preschools and in the early grades to maximize and even to accelerate learning.

Early childhood education needs to become lively, just as children are. Put in-seat behavior and blind attention aside. Children don't want to *hear about* airplanes, they want to *simulate* what it is like to pilot airplanes, build homes and communities, and to make videos that teach other people about the learning games they play. These activities give meaning to what they are doing and create the understanding that their work is not only meaningful but that they are important in understanding it and creatively expanding it. Learning through one's passion is learning that won't be forgotten as we recognize that learning not likely to take place while if students are bored (Craig et al. 2004; Prensky 2010). What's more, memory is contextual and active learning facilitates long term memory and application. In the role of guide on the side, teachers facilitate this process by using inquiry and key questions that enable children to talk through and extend their understanding. This is especially powerful because learning is most easily formed when students feel in control and safe and technology provides that type of environment (Sylwester 1994).

Children who have seen the future through technology are less apt to engage with inflexible print or teachers who tell them what to do and how to do it at every moment. The children know better than that. They live vicariously through avatars and simulated worlds and games. They control their technological environments and have learned to think for themselves. Schools are using games like Minecraft in the curriculum because they “They learn about city planning, environmental issues, getting things done, and even how to plan for the future,” as one teacher put it. And, as the New York Times article says, it has a lot of benefits not the least of which is that it might make some of them better doctors because it has been shown that surgeons do better if they play video games. (Bilton 2013)

Good teaching requires teachers who know how to evaluate which technology to use and when. Software selection is of great importance. When Haugland (1992) studied the effects of developmental and non-developmental software, she found that those four-year-olds using developmentally appropriate software showed gains in non-verbal skills, long term memory, intelligence, dexterity as well as self-esteem. Those children using non- developmental software showed a significant drop in creativity suggesting that drill and practice software must be critically evaluated before including them in early childhood classrooms. Haugland used over 10 criteria to evaluate developmentally appropriate software,

including the ability of the child to be in control, clarity of instructions, scale of increasing difficulty, non-violence, relationship to real world, technical features such as animation, color, etc., things that change, multiple languages, people of diverse cultures and diverse family styles and more.

### **Differentiated Teaching and Learning**

Susan Haugland was a visionary who merged developmental principles with use of computers and the emerging software in the 90s. Her developmental scales are seminal and continue to merit review especially given the fact that software programs and mobility devices and apps have grown exponentially. Although developmentally appropriate practice is being side-tracked in today's rigid and skills-based programs that include kindergartens, technology can help bring play back into learning (Gullo and Hughs 2011). This is not to minimize the role of more physical play-based learning, but to say that appropriately chosen play based software programs and games can provide another form of developmentally appropriate play-based learning.

As described by Gullo and Hughes (2011, 325), developmentally appropriate practice emphasizes “a safe learning environment that encourages exploration, initiative, positive peer interaction and cognitive growth” as well as areas for “silent reading, construction projects, writing, playing math or language games and exploring science.”

When structured by a knowledgeable teacher who understands technology in relation to developmental practice, instruction is all of these and highly differentiated as well to meet the needs of children who are culturally and linguistically diverse through varied levels of active cognitive engagement. The technology lets children not only discover the world through concrete objects and manipulatives but it increases their sensory experiences (visual, auditory and, in some cases, movement) through the technology. Well-structured early childhood environments bring children together in the use of technologies so they can think, share and construct together.

Early Childhood teachers are there to meet the needs of children of varying ages, (from about just under five years of age to seven years old age based on Gullo and Hughs 2011) varying degrees of intelligence, maturation and experience and varying levels of linguistic, literary and numeric competence. Each child's needs must be met and their interests challenged including the ones whose English is emerging. Though creating a learning environment for so diverse a group is something a magician might shrink from, early childhood teachers dare not. To set the stage for learning, then, early childhood teachers need lots of interesting props, materials, books, games and puzzles for children to experience, explore and discover on their own, sometimes with their peers and, other times, with the teacher mediator.

Until recently, it was incumbent on teachers to create the environment from anything they could find whether purchased or created by themselves and that remains essential. Enter, however, computers, websites, software, mobile devices, apps, toys with computer chips and, viola!, that teacher magically expands learning opportunities to meet the needs of all the children in meaningful and deep ways. Not only can the teacher meet all the children's needs, those same websites and apps may be just as helpful for parents so that learning extends beyond the school day. And parents, especially those whose first language is not English, need not shrink back from helping their children. Those resources may not only meaningfully assist children, but support parenting and parent education.

### **Best Practices**

When it comes to best practices in the use of computers and mobile devices, applicable principles of Child Development and Learning as stated by the NAEYC (n.d.) apply. Any competent teacher can apply those principles to the intentional use of technology. A 2012 joint position statement of the National Association for the Education of Young Children and the Fred Rogers Center for Early Learning and Children's Media at Saint Vincent College underscores the message as well.

**1. All areas of development at learning are important.**

Early childhood teachers need to foster interrelated areas of development including the, physical, social, emotional and cognitive domains. Balance is important in the time that children are permitted to access technology as well as balance in the areas tapped by it.

**2. Learning and development follow sequences.**

Developmental theory informs educators of how children typically develop. Teachers prepare classroom activities and structure learning based on that knowledge. Multiple forms of developmentally appropriate technologies form the starting point for inclusion in the classroom.

**3. Development and learning proceed at varying rates.**

Although theories inform teachers of typical developmental sequences, variation is to be anticipated and expected. Educators need to design varying level of enticing media that are as individualized as possible so they appear to children different from one another. Technology facilitates individual differences and accommodates wide variation in growth and development.

**4. Development and learning result from an interaction of maturation and experience.**

The power of this interaction of maturation and experience must be taken into account as educators prepare the classroom environment and curriculum. With a variety of learning experiences available in a classroom that includes technology, children of varying temperaments and developmental levels can be challenged and motivated to continue to learn.

**5. Early experiences have profound effects on development and learning.**

Technology is part of life. Children need to learn its appropriate and ethical uses. "Children's experiences with technology and interactive media are increasingly part of the context of their lives, which must be considered as part of the developmentally appropriate framework." (NAECY 2012, 5)

**6. Development proceeds toward greater complexity, self-regulation, and symbolic or representational capacities.**

Young children move from a very concrete relationship with their world to a representational one. Technology in the classroom can meet varying developmental levels by selecting materials on varying levels of complexity including from introductory symbols to complex representations.

**7. Children develop best when they have secure relationships.**

The development of social confidence and self-esteem comes from positive learning experiences. Children learn about their capabilities when they interact with adults, other children and with learning material that allow them to be challenged but not frustrated.

**8. Development and learning occur in and are influenced by multiple social and cultural contexts.**

A culturally sensitive developmental curriculum enables children to understand and respect differences in the way people live, learn, and celebrate. Classrooms that establish a wide array of learning opportunities expand children's appreciation of different ways tasks can be accomplished.

**9. Children learn in a variety of ways.**

Technology appeals to a variety of senses. Digitization allow for text to speech as well as vocalization. "Teachers incorporate a wide variety of experiences, materials and equipment, and teaching strategies to accommodate the range of children's individual differences ..." (NAECY 2012, 20)

**10. Play is an important vehicle for developing self-regulation and promoting language, cognition, and social competence.**

“...toys that contain computer chips, memory, voice recognition, and interactive connectivity has forever changed the landscape of play. User-generated content allows players not only to play, but to shape the games they play, and by so doing shape the effects that play has on them.” (Goldstein 2013, paragraph 1)

**11. Development and learning advance when children are challenged.**

Humans are driven to go beyond what they know and acquire greater knowledge and understanding. Technology enables children to stretch to that next level.

**12. Children’s experiences shape their motivation and approaches to learning.**

Technology promises to expand and extend children’s experiences. How children learn is as important as what they learn. Dispositions and motivation can be influenced by experiences children have both inside and outside of school. Providing experiences that build and strengthen varying approaches to learning can influence school success.

**Conclusion**

Young children engage in an environment filled with many forms of technology that not only engage them but teach them in subtle but effective ways. Designing and building new worlds can now be done with apps as well as with blocks. Both have a place in the classroom. Just as books enable readers to transcend their actual world and go beyond physical experiences, various electronic programs, apps and websites enable young children to use their imagination, expand their knowledge base, and extend their understanding of their world. Used judiciously, technology promises to level the playing field between children from various socio-economic backgrounds and enable teachers to differentiate instruction for students with many different learning needs and styles.

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