Revisiting the Early Use of Technology: A Critical Shift from "How Young is Too Young?" to "How Much is 'Just Right'?"

How young is too young? How much is just right? This article will give you insights into using technology appropriately with young children.

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Introduction

The conversation about young children and their use of technology has dramatically changed over the past ten years in the early childhood education community and in the general public. It appears the debate has moved forward from the question posed by Vail (2001) in her article titled, "How Young Is Too Young? When It Comes to Computer Use, Reasonable People Disagree." Cautions about technology use with our young children provide important guidance (American Academy of Pediatrics, 2011), but it is also evident that technology use with young children is expanding rapidly (Kaiser Foundation, 2010). Therefore, the more important question for educators to ask and answer should be, "How much technology use by young children is 'just right'?" Much as Goldilocks went through trial and error finding the porridge, chair, and bed that was "just right," it may be some time before the answer to this question is clearly agreed upon. Using knowledge about appropriate practices with young children will help guide the search for these important answers.

Reflecting the changing conversation, the National Association for Education of Young Children (NAEYC) has recently expanded the age range of their technology position paper to include children from birth (NAEYC, 2012). The previous position paper did not include advice about children younger than three, as technology use was not seen as relevant for that age group. However, current research shows that up to 70% of children ages birth through two years old are using electronic media in their daily lives (Vandewater, Rideout, Wartella, Huang, Lee, & Shim, 2007). Therefore, early childhood professionals must use their expertise and knowledge about the healthy development of young children to create environments that support the integration of technology use in ways that are developmentally appropriate (Rosen & Jaruszewicz, 2009).

> **Understand both the positive and negative effects of technology.**

In order to support educators as they debate how much technology use is appropriate for young children, it is helpful to build an understanding of both positive characteristics of computer use as well as negative aspects currently described in the literature. Following is a review of research which considers both positive uses with young children and cautions about technology use to provide a balanced perspective on how technology can detract from learning and development as well as enhance them.

Positive Effects of Early Technology Use

Currently, a growing body of literature is providing examples of effective uses of technology to enhance children's early learning in a variety of subjects. Computers were used successfully with preschool age children in emergent literacy (McKenney & Voogt, 2009; Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2011; Shamir, Korat, & Fellah, 2012) and geometry (Clements & Sarama, 2011) as well as for Internet searches (Spink, Danby, Mallan, & Butler, 2009). We discuss children's use of technology related to emergent literacy, mathematical learning, touchpads and tablets, and computer gaming more in detail below to provide guidance on integrating technology into early childhood classrooms.

Emergent Literacy

The use of technology to teach emergent literacy has been supported through several studies. One study utilized computer-assisted instruction to empower at-risk readers from Finland to overcome reading problems and catch up to their peer group in the areas of comprehension, fluency, and spelling by the third grade (Saine, et al., 2011). More importantly, students only used the program 15 minutes a day over one school year to achieve these results. E-books are also being used to support emergent literacy. With young children at risk for reading disabilities, an educationally designed e-book was found to produce significant learning gains in the areas of phonological awareness, vocabulary, and concepts about print as compared with the control group (Shamir, et al., 2012).

Computers can be successfully used with preschool children to support emergent literacy.

Targeted at young children's emergent literacy skills, the software *PictoPal* affords children the opportunity to begin producing authentic writings through a combination of clip art and print (McKenney & Voogt, 2009). After creating their writing artifact, the children are encouraged to re-enter the dramatic play areas of the preschool classroom and integrate their writing into their play with other children. *PictoPal* is a good example of a more open-ended use of technology that supports children's writing in a social, play-based environment. As children observe the adults in their lives using different technologies, they become interested in learning more about those new technologies as did a classroom of second graders who saw their teacher listening to a podcast (Vasquez & Felderman, 2013). The teacher began to allow for time to listen to podcasts created by other children, and soon the children wanted to learn to create their own podcasts. Choosing topics, planning out the text of their talk, and delivering the audio broadcast all provided rich language development as well as added motivation.

Mathematical Learning

The research-based math curriculum called *Building Blocks* (Clements & Sarama, 2011) has consistently been shown to improve math scores when compared to control and comparison groups. Of particular interest are gains of students from lower-economic backgrounds who made equal gains to those from higher-economic backgrounds. In addition, manipulation of geometric shapes by children on the computer was found to be equally or more effective than non-computer manipulatives in teaching geometric principles.

The use of virtual manipulatives can be a part of an interactive whiteboard experience (IWB) as described by Linder (2012) where a classroom of 4-year olds sits on the rug viewing a display of elephants all of differing colors, heights and shapes. After a discussion about multiple ways of counting the elephants, children are invited to come up to the board and create a set of elephants by placing

their finger on an elephant image and dragging it to a location, adding similar elephants until finished. Later in the lesson the children are given a chance to work in small groups with plastic animals, sorting and counting them for additional practice.

Touchpad and Tablets

The recent advance in computer technology of the touchpad and tablet-sized devices has opened up a new world of interactivity and technology for young children, even as young as two years old (Geist, 2012). Previously the keyboard and mouse had set up a barrier to the youngest children, but with the development of touch screen devices, exploration by toddlers and preschoolers has begun to be reported in the literature (Couse & Chen, 2010; Giest, 2012; Shifflet, Toledo, & Mattoon, 2012). Children ranging in ages 3-6 years old used tablet computers and a stylus to draw self-portraits. Researchers reported that children needed no more than an hour to learn to use this new medium for drawing, with some adult support as well as peer modeling (Couse & Chen, 2010). In another preschool classroom, the teacher reported that she introduced the tablet in a whole group setting, moving to a supervised small group setting until she was ready to allow them independent use of the tablets within her classroom (Shifflet, et al., 2012). It was reported that instead of isolated play with the tablets, children shared ideas and asked each other questions, even as they used their own individual tablet.

Computer Games, Virtual Worlds, and Play

While the academic learning described in the previous articles had elements of play, other technologies have play as their central objective such as video games and virtual worlds. Marsh (2010) reported that children, ages 6-7, engaged in many different types of play when using technology: "fantasy play, socio-dramatic play, ritualized play, games with rules, and what might be called 'rough and tumble' play" (p. 30). She suggested that the online virtual world should allow children to play with issues of identity through the use of an avatar and the different roles they undertake in the virtual world. Through their play in the virtual world, children engaged in play that was similar to the way they played without technology such as engaging with peers, taking on new identities through pretending, and making up rules for the games they were inventing. While studies of children's online virtual play are limited, there is evidence that this play is meaningful to children and may have similar benefits of social interaction and symbolic play when compared to offline play.

> *Create boundaries to avoid the overuse of technology.*

In a small study involving two children ages 5 and 7, observations were conducted playing a variety of computer games on numerous occasions (Verenikina, Herrington, Peterson, & Mantei, 2010). It was observed that group play increased the complexity of the play and that children extended make-believe aspects of the play beyond time spent on the computer. Adult supervision and selection of games for qualities such as discovery-oriented paths, simple, clear screens, and a con-

nection to daily life, appeared to improve the level of interaction and growth the children received from the technology experience.

Issues and Problems with Early Technology Use

It is important to note that there are also areas of serious concern related to overuses of technology in young children's lives such as computer addiction problems (Seo, Chun, Jwa & Choi, 2011), Internet safety issues (Dodge, Husain & Kuke, 2011), and risks for obesity (Epstein, Roemmich, Robinson, Paluch, Winiewicz, Fuerch, & Robinson, 2008). We discuss these issues more in detail below.

Computer Addiction

Related to young children's computer use is the problem of computer addiction. Research conducted in Korea with 179 five-year old children looked at computer use in both home and school settings. It was found that the younger the child started using a computer, the longer they used the computer, playing mostly computer games, and having computer time that was less supervised created higher scores on the Internet Addiction Scale for Young Children (IASYC), designed to measure levels of computer habituation (Seo, et al., 2011). In addition, Seo and colleagues (2011) found children with the highest scores on IASYC had the lowest scores on the Socio-Emotional Development Evaluation Scale used to measure "independence from teachers, self-control, peer interaction, adaptation to kindergarten and incentives for accomplishment and curiosity" (p. 248). Conversely, children with the highest socio-emotional develop-

ment scores had the lowest scores on the ISAYC. Home computer use had a much stronger effect than did computer use in educational settings on habituation, but use in classrooms could still contribute to addiction. Therefore, early childhood educators must understand the risk of computer addiction and its effects on the emotional and social well-being of young children when deciding appropriate uses of technology with this age group.

Concerns have been raised that just as early childhood classrooms work to minimize stereotyping in off-line play, it is important to be aware of stereotypical images and gender- biased approaches to using technology with children (Kirmani, Davis, & Kalyanpur, 2009). Computer games can often have extreme images of masculine and feminine stereotypes, and educators may need to talk with children about these images or make sure they are limited in the classroom.

Internet Safety

Researchers observed children, ages 4-5 years, conducting surpris-

ingly sophisticated Web searches both with teacher assistance and independently (Spink, et al., 2009). Children were seen using a variety of cognitive skills related to seeking information on the Web such as judgments regarding the relevance of search results, collaboration with other children, and multi-tasking. This study reminds educators that young children may be more capable with technology than adults would imagine and that giving children opportunities to show these skills is an important aspect of a developmentally appropriate classroom.

As younger children's use of the Internet increases, supervision and instruction is vital in order to minimize negative risks associated with Internet use. In a study where researchers conducted interviews and observed 37 children in grades kindergarten through second grade, using the Internet, 78% of the children reported that the Internet offered benefits, while only 42% said there were negative aspects to the Internet (Dodge, et al., 2011). Of particular concern was the fact that when describing "bad" things about

the Internet, no child mentioned that there might be dangers related to people, misinformation, or inappropriate photos. It appears young children have either not been taught about these problems or are too young to conceptualize them easily. Also, 75% of the children said they had used the Internet by themselves, without adult supervision, leaving them vulnerable to the problems mentioned previously. Clearly, while children may enjoy and even gain cognitively from Internet use, there are concerns about their unsupervised and naïve use of this medium. It is important that adults take responsibility to instruct, supervise, and protect young children from the dangers associated with Internet use.

Health Concerns

Young children's health is of great importance to all who care for this age group, and the use of technology with young children has risks that must be considered. The use of TV and computer screen time has been linked to risks of obesity (Epstein, et al., 2008). In a study of children ages 4-7, conducted by Epstein and colleagues (2008), reducing TV and computer use was found to have a positive effect on lowering body mass index. In a study of over 2000 children, ages 6-20, spending more than two hours watching TV or using the computer was significantly associated with cardiovascular risk, even when adjusted for physical activity (Choi, & Kong, 2011). While it is difficult to measure activity levels of very young children, it has been hypothesized that large amounts of screen time for infants and toddlers may be contributing to a decline in activity levels for this age group (Cardon, Van Cauwenberghe, & De Bourdeaudhuij, 2011). Forgetting to take breaks, children's bodies do not get

Ensure that children work together or in parallel play when using new technologies.

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the circulation they need as they immerse themselves in games for hours. Therefore it is important to limit time on the computer and make children get up and move during the breaks (Straker, Maslen, Burgess-Limerick, Johnson, & Dennerlein, 2010). In order to support healthy habits and development adults may need to help children limit their use of computers, TV, and other passive uses of technology.

In conclusion, it is important to realize that children's well-being depends on adults making wise choices regarding early technology use. In making those decisions educators can use information gleaned from academic research on technology use and principles of developmentally appropriate practices for young children.

Guidelines for Appropriate Technology Use with Young Children

As the debate changes from choosing sides, either for or against the use of technology, to the more complex decision of how to use technology with young children, the research studies discussed above help inform these decisions. Based on our review on these studies, we present a set of guidelines for appropriate uses of technology, designed to protect children from the negative aspects of technology while allowing them to experience this important new aspect of modern life. In addition, vignettes are provided to illustrate how to practically apply the ideas for immediate use in early childhood classrooms.

Children Need to Move

Limiting the amount of time spent sitting in front of a TV or computer

screen is advised even if the time is spent learning academic skills or playing a game determined to be well-designed for children. It has been suggested that children work no longer than 30-60 minutes without a break (Straker, et al., 2010). Even less time may be appropriate for preschool and toddler age children before insisting on a break from sedentary or repetitive fine-motor movements. Also, it is important that breaks provide full body movements to contrast with constrained movements of time on the computer. Therefore, when children do take breaks, it is advised that they are active breaks such as running or dancing in order to encourage gross motor movement.

> ### Technology can create environments that support healthy development.

A compounding problem of inactivity and computer use is the fact that children often ignore discomfort, especially when playing a game that is immersive and fun (Straker, et. al., 2010). This makes it even more imperative that adults monitor use, encourage breaks, and limit use. On the other hand, using new technologies where children can use gross motor movement to control input devices can provide a fun, physical outlet that includes technology and large motor movement.

One fun way to integrate technology with movement is to video-tape children's activities such as outdoor play, dancing or physical challenges,

later sharing these movies with the children and celebrating the excitement of their physical movement and skill development. A digital portfolio of movement activities is also a valuable tool to share with parents who will also enjoy seeing their child's progress and growth.

> Ms. Smith is outside with her class of 3-year olds who are physically active and enjoying a beautifully sunny day. Using her camera on her mobile phone, she takes multiple pictures of the children as they play. She exclaims in excitement as she verbally labels the activities; "Susie is running" or "Marcus is climbing." The children eagerly come over to see the pictures and then return to play. Later Ms. Smith downloads the pictures into PowerPoint, typing in the child's name and activity. She prints the PowerPoint slides, creating a fun book for the children to "read" about different kinds of movement with themselves as stars of the book.

Children Need to Connect with Living Things

While computers provide increasingly important support for academic skills, children still need to interact with plants, animals, and the outdoor world to develop an understanding and appreciation for the larger natural world they live in (Louv, 2005). It is important to have plants and animals in the classroom, and to encourage children to spend time outdoors playing and exploring with their senses. To integrate technology into the natural world, budding scientists and intrepid explorers can begin to track the growth and habits of living things through digital photography, both in and outside the classroom. Blending traditional activities, such as a

nature walk, stopping to touch, look and smell nature, can be augmented with digital snapshots taken on the walk. Later a photo-book of the walk can be created as children add leaves, twigs, and real world artifacts to the digital record of the outing. Connections can be made between digital images found on the Internet and real life examples of plants and animals found in the classroom, or encountered on a field trip. Time-release videos of plants growing, or the use of wild-life videos of animal activity, are examples that can support the curriculum but do not replace real world experiences that can be provided in most early childhood classrooms.

> After a field trip to the zoo, Mr. Tucker wants to extend the learning experience for his second graders by having them create a multi-media slide show using VoiceThread. Pairs of students work together to create a page devoted to one animal from the zoo, finding a picture to place in the slide or creating their own art work and scanning it into the computer. Creating a short script, they audio-tape a description of the animal and one interesting fact.

Children Need to be Social

It is important to evaluate the technology in light of its ability to provide social interaction and play opportunities. For example, one might expect Internet searches to be a solitary experience, but researchers found 4-5 year-old children interacting with each other socially as they constructed knowledge of how to conduct their searches. Some children were seen sharing websites they had found earlier in their searches, if the site seemed relevant to their neighbor (Spink, et al., 2009). Educators need to ensure that children work together

or in parallel play when using new technologies. Doing so can provide beneficial social interactions.

> Ms. Walker is nervous about the suggestion that she let her mixed-aged preschool class use a set of three tablet computers, in part because she is concerned they will fight over them. She also wonders if they will be so engrossed in the technology that they will lose opportunities for social interaction with their peers. Instead she is pleasantly surprised that after an initial introduction with supervised use and exploration, children begin to engage in parallel play. Over time, sounds of laughter and discussion arise naturally among the tablet users.

Children Need Warm and Caring Interactions with Adults

The role of a caring adult cannot be overlooked for the social, cultural, and emotional benefits provided. When using a new technology, some children were observed sitting passively (Spink, et al., 2009) or playing in a way that produced little progress (Plowman & Stephen, 2005) without adult guidance. Therefore, it is important that early childhood educators value their role in encouraging appropriate use of technology, recognizing the use of technology with young children can be enhanced through skilled interactions between the teacher and student.

Relationships can be enhanced through the use of technology when caregiver and child work together to build something that is more substantial than either could have accomplished without each other, nor the support of the technology. For example, using VoiceThread, a Web-based technology that allows communication between individuals and groups at a distance, provided

an avenue for extended discussions between preschoolers and their teachers who were traveling in California (Fantozzi, 2012). When the teachers sent a photo taken of an elephant seal, with audio comments describing details about the seal, students recognized the teachers' voices with excitement and continued the conversation through dictated text messages and audio-taped questions.

Whether in an early childhood classroom or at home, adults need to monitor children's use of technology, particularly the Internet, as young children do not understand possible downsides to the Internet related to safety and the reliability of the information presented (Dodge, et al., 2011). Supervision of Internet use can be turned into a time of learning and attachment as the adult enters into play with the child during searches.

Using technology, especially TV or videos, as electronic babysitters is a popular parent convenience, but research shows that without quality adult interaction infants and toddlers do not benefit. Instead, adult interaction is an important factor in whether children under the age of three are able to learn from screen media such as TV and video (Richert, Robb, & Smith, 2011). Having the TV on in the background has been shown to inhibit adult-child interactions (Vandewater, et al., 2007). Instead of mindlessly using technology as background, caregivers should purposively interact with the child, keeping the relationship paramount. Extending the child's interactions with a new technology may be as simple as showing excitement as the child uses the tool, or it may include specific modeling or instructions so that the child can more fully explore the application.

Photo courtesy of Knollwood Preschool/Knollwood Community Church, Burke, Virginia

Provide breaks that consist of full body movements to contrast with the constrained movements of time spent on the computer.

such as a water proof camera, that can be brought to the water table and integrated into these important sensory experiences. Another approach would be to encourage a multimodal use of technologies where young children combine the use of traditional paints, glue, and paper to which they add photos printed from the computer, to create a mixed medium piece of art.

This week in the art center, Ms. Thomas encourages her kindergarten students to create a self-portrait using a multimodal expression of mediums to include traditional paints, crayons, and pencils, while also giving students a choice to cut and paste photos from classroom snapshots of themselves into the portrait. Photos were printed in black and white, on inexpensive paper, to keep costs down while allowing for experimentation.

Children Need Symbolic Play

In response to the push for more academic learning at younger ages, advocates for play in childhood have become adamant about the importance of play to young children's health and development (Miller & Almon, 2009). While providing positive opportunities of "play for the sake of play" (Verenikina, et al., 2010, p. 154), technology can be problematic to children's play, with highly violent or commercialized content. When evaluating computer games, Verenikina, et al. (2011) suggest limiting use of games with overly constrained play and instead look for important qualities such as an orientation of discovery, multiple pathways and choices of symbol use, simple backgrounds and clear directions. Open-ended activities build play opportunities and a simple use of technology can facilitate a dramatic play, where children mimic

Ms. Tan spends the day with her small group of toddlers, providing a warm and stable relationship of care throughout their day in the center. Many times a day, she holds a child in her lap as the child "reads" a book pointing to pictures and naming items. Recently Ms. Tan brought in an e-book displayed on her e-reader that had barnyard animal pictures in it, as well as the option to hear the corresponding animal sound. With the child in her lap, she lets the child explore the e-book, responding to the child's interest in the option to hear the animal sounds. She doesn't concern herself with finishing the book, but stops when the child loses interest.

Children Need a Variety of Sensory Experiences

When integrating technology into young children's lives, it important to remember young children, especially infants and toddlers, learn through their senses (Honig, 2007). Water, sand, paint, and clay are traditionally used in childhood in part due to their ability to stimulate the senses. Early childhood educators need to make sure children do not have to give up these vital sensory experiences. Look for technologies,

the adult behaviors they see around them, on cell phones, sending text messages, or using their imaginary laptops to conduct business.

While some computer games may provide appropriate play opportunities for young children, care must be taken in supervising this type of play, as there are risks of computer addiction associated with computer games. Specific reactions in children when asked to stop using the computer included physical symptoms such as headaches, spasms, and stomachaches as well as emotional reactions of crying, blushing, and pouting (Seo, et al., 2011). Recognizing that playing computer games can be addictive, educators must watch for similar withdrawal symptoms.

> Over the past few weeks, Mr. James notices several children sending imaginary text-messages with the blocks, pretending to type with their thumbs. He hears them request to be sent a text, mimic a signal that they have received the text, and then "read' the text out loud. Using a digital camera he keeps nearby for documenting the children's work, he captures this moment of imaginative play to share with his co-teacher and with the children's parents at a later time.

Children Need Sleep and Rest

As most adults realize by now, technology is hard to turn off. Children need guidance and boundaries to avoid overuse of technology. They need an adult to limit the amount of technological stimulation, to allow for adequate sleep and rest. Be alert to signs of overuse and addiction as described previously. As an early childhood professional, you may be called upon to help inform parents of current findings about technology use, for example, advising against the

use of TV in the bedroom (American Association of Pediatrics, 2011). Be ready to help parents with the difficult tasks of reducing their children's use of technology at home if necessary and become an advocate for the wise use of technology in the lives of young children.

> In the weekly newsletter to parents, a section is devoted to parent education on a variety of topics. Ms. Swenson recently read an interesting study about signs of technology overuse and she decided to share those signs with parents to help them manage their children's technology use at home. She also used the discussion about technology use as an opportunity to remind parents of the importance of sleep to their young children's learning and development.

> **Always keep children's developmental needs at the forefront.**

Conclusions

It is time to accept that rapid advances and an explosion in technological innovations have changed the world of adults and are also changing the landscape of modern childhood. No longer is the question *"How young is too young for children to use technology?"* a relevant inquiry, as technology permeates our world. Instead, we put forth a more helpful question: *"How much technology use is 'just right' for young children when balancing both the positive and negative aspects of its use in their lives?"*

Pursuing this quest becomes serious work for early childhood educators to assure answers fit each stage of child development. It is of utmost importance that what is already known about young children's healthy growth and development is applied to the use of new technological developments. Using these guidelines to highlight appropriate integration of technology can assist teachers in creating environments that support healthy development. As outlined in this paper, children need movement, a connection with living things, social learning, interactions with caring adults, sensory experiences, symbolic play, and time for sleep and rest even as technology becomes integrated into our daily lives. Assuring that these vital needs of childhood are not interrupted by technology takes careful thought.

By coupling current research findings with the guiding principles stated in this article, technology use can be adapted to assure that children's developmental needs are always at the forefront. Making sure that young children are not expected to use technology as if they were "little adults" is important. Instead young children need to be supported in their use of new technologies to enhance their natural inclinations to learn about and explore their ever changing and exciting new world.

Remembering the children's story of Goldilocks, as she tries out Papa Bear's bed that is too hard, and Mama Bear's bed that is too soft, and finally rests in Baby Bear's bed that is "just right," it is important for parents and educators of young children to help children find the "just right" use of technology in their young lives.

References

American Academy of Pediatrics Council on Communications and Media (2011). Media use by children younger than 2 years. *Pediatrics, 128*, 1-6.

Cardon, G., Van Cauwenberghe, E., & De Bourdeaudhuij, I. (2011). What do we know about physical activity in infants and toddlers: A review of the literature and future research directions. *Science & Sports, 26*, 127-130.

Choi, K. C., & Kong, A. P. S. (2011). Association between cardiovascular risk and prolonged television viewing and computer use in Hong Kong Chinese school children. *International Journal of Cardiology, 147*, S30.

Clements, D. H., & Saranma, J. (2011). Early mathematics intervention. *Science, 333*, 968-970.

Couse, L. J., & Chen, D. W. (2010). A tablet computer for young children?: Exploring its viability for early childhood education. *Journal of Research on Technology in Education, 43*, 75-98

Dodge, A. M., Husain, N. & Kuke, N. K. (2011). Connected kids?: K-2 children's use and understanding of the Internet. *Language Arts, 89*, 86-98.

Epstein, L. H., Roemmich, J. N., Robinson, J. L., Paluch, R. A., Winiewicz, D. D., Fuerch, J. H. & Robinson, T. N. (2008). A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. *Archives of Pediatrics & Adolescent Medicine, 162*, 239-245.

Fantozzi, V. B. (2012). Exploring elephant seals in New Jersey: Preschoolers use collaborative multimedia albums. *Young Children, 67*, 42-49.

Geist, E. A. (2012). A qualitative examination of two year-olds interaction with tablet based interactive technology. *Journal of Instructional Psychology, 39*, 26-35.

Honig, A. S. (2007). The power of sensory experiences. *Scholastic Early Childhood Today, 21*, (6), 16-17.

Kaiser Family Foundation (2010). Daily media use among children and teens up dramatically from five years ago: Big increase in mobile media helps drive increased consumption. Retrieved from http://kff.org/entmedia/entmedia012010nr.cfm

Kirmani, M. H., Davis, M. H., & Kalyanpur, M. (2009). Young children surfing: Gender differences in computer use. *Dimensions of Early Childhood, 37*, 16-22.

Linder, S. M. (2012). Interactive whiteboards in early childhood mathematics: Strategies for effective implementation in pre-k-grade 3. *Young Children, 67*, 26-35.

Louv, R., (2005). *Last child in the woods: Saving our children from nature-deficit disorder*. Chapel Hill: Algonquin Books.

Marsh, J. (2010). Young children's play in online virtual worlds. *Journal of Early Childhood Research, 8*, 23-39.

McKenney, S. & Voogt, J. (2009). Designing technology for emergent literacy: The PictoPal initiative. *Computers & Education, 52*, 719-729.

Miller, E., & Almon, J. (2009). Crisis in kindergarten: Why children need to play in school. The *Education Digest, 75* 42-45.

National Association for the Education of Young Children (NAEYC). (2012). Technology and interactive media as tools in early childhood programs serving children from birth through age 8 (DRAFT). Retrieved from http://www.naeyc.org/content/technology-and-young-children

Plowman, L., & Stephen, C. (2005). Children, play, and computers in pre-school education. *British Journal of Educational Technology, 36*, 145-147.

Richert, R. A., Robb, M. B., & Smith, E. I. (2011). Media as social partners: The social nature of young children's learning from screen media. *Child Development, 82*, 82-95.

Rosen, D. B., & Jaruszewicz, C. (2009). Developmentally appropriate technology use and early childhood teacher education. *Journal of Early Childhood Teacher Education, 30*, 162-171.

Saine, N. L., Lerkkanen, M., Ahonen, T., Tolvanen, A., & Lyytinen, H. (2011). Computer-assisted remedial reading intervention for school beginners at risk for reading disability. *Child Development, 82*, 1013-1028.

Seo, H. A., Chun H. Y., Jwa, S. H. Choi, M. H. (2011). Relationship between young children's habitual computer use and influencing variables on socio-emotional development. *Early Child Development and Care, 181*, 245-265.

Shamir, A., Korat, O., & Fellah, R. (2012). Promoting vocabulary, phonological awareness and concept about print among children at risk for learning disability: Can e-books help? *Reading and Writing, 25*, 45-69.

Shifflet, R., Toledo, C., & Mattoon, C. (2012). Touch tablet surprises: A preschool teacher's story. *Young Children, 67*, 36-41.

Spink, A., Danby, S., Mallan, K., & Butler, C. (2010). Exploring young children's web searching and technoliteracy. *Journal of Documentation, 66*, 191-206.

Straker, L., Maslen, B., Burgess-Limerick., R., Johnson, P., & Dennerlein, J. (2010). Evidence-based guidelines for the wise use of computers by children: Physical development guidelines. *Ergonomics, 53*, 458-477.

Vail, K. (2001). How young is too young? When it comes to computer use, reasonable people disagree. Retrieved from http://www.electronic-school.com/2001/06/060lfl.html.

Vandewater, E. A., Rideout, V. J., Wartella, E. A., Huang, X., Lee, J. H., Shim, M. (2007). Digital childhood: Electronic media and technology use among infants, toddlers, and preschoolers. *Pediatrics, 119*, 1006-1015.

Vasquez, V. M., & Felderman, C. B. (2013). Technology and critical literacy in early childhood. New York, NY: Routledge.

Verenikina, I., Herrington, J., Peterson, R., Mantei, J. (2010). Computers and play in early childhood: Affordances and limitations, *Journal of Interactive Research, 21*, 139-159.

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In Memory of

Gladys Louise Grantham Irby
Elvin B. Pippert

By Dr Pamela Schiller