Fall 2019

The Effects of Early Technology Use on the Development of Young Children

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A Literature Review Presented

In Partial Fulfillment of the Requirements

For the Degree of Master of Education

December 2019

Dr. Syed

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Abstract

With technology becoming a prevalent part of daily life, early childhood experts, teachers, and parents have concerns as to what is appropriate for young children to do and use. Research shows both benefits and potential risks associated with technology use. Benefits can include enhanced creativity and collaboration with peers and adults, literacy achievement gains, language and vocabulary development, and opportunities for independence. These benefits generally occur in purposeful situations with developmentally appropriate educational content alongside adult guidance and scaffolding. Risks include health factors, cognitive and behavioral challenges, displacement of traditional developmental activities, and fewer personal interactions. These risks are more prevalent when technology is used in passive manner, with violent or aggressive content, or with developmentally inappropriate requirements. Teachers and parents have a vast amount of research to educate themselves on best practices in the classroom and at home from experts in the medical and early childhood fields. However, in the grand scheme, technology is a fairly new topic to be researched and more time is needed to understand the long term effects.

The Effects of Early Technology Use on the Development of Young Children

Technology is ever increasing in the world around us. Adults, and in recent years, children alike have constant access to media, and often carry technology devices with them everywhere (Parikh, 2012). As a result, children being born into current society do not know a world without technology (Laidlaw, O'Mara, & Wong, 2019; Fantozzi, Johnson, & Scherfen 2018). In a short time, access to mobile devices has dramatically increased, and traditional TV watching, though still prevalent, has declined (Teichert, 2017). This means young children most likely have access to several screens and devices at any time (Fantozzi et al., 2018). Parents report using technology devices for learning opportunities, entertainment, and documenting life (Teichert, 2017). Technology is also being used more frequently in the education setting (McManis & Gunnewig, 2012). Great debates have emerged amongst parents, educators, and other early childhood professionals to know what is appropriate for young children to be exposed to and the possible influences of technology on their developing bodies and minds.

Research has been done in many areas of technology use, including when young children (age 8 and under) are using devices (Teichert, 2017). The most common interactive devices for this age group are mobile devices and those with touchscreens (Elkind, 2016). Touchscreens do not require a high level of fine motor skills or an understanding of the button symbols; therefore, these devices are the most developmentally appropriate in terms of physical use (Geist, 2014). The mobility of the devices allow for lightweight carrying and adjusting compared to desktop computers, as well as alternative sitting or laying rather than being at a traditional upright desk (Neumann & Neumann, 2014). Questions surface when looking into the impact and effects technology use can have on the overall development of the child. In this paper, several areas of

early childhood development including social-emotional, literacy, language, and fine motor will be reviewed. The overall potential benefits and risks associated with early childhood technology use will be outlined for each developmental area. Suggestions and guidelines will be given for optimal early childhood technology use both at home and in the classroom, backed by the American Academy of Pediatrics, the National Association for the Education of Young Children, and the Fred Rogers Center.

Tech Use and Social-Emotional Development

The late Fred Rogers can be referenced in his support of building relationships with children to enhance their learning. He was a pioneer of connecting early childhood development and media (Parikh, 2012). Technology can be used in ways that enhance the connections and relationships between children and also with adults (Parikh, 2012). While working with the National Association for the Education of Young Children (NAEYC), the Fred Rogers Center for Early Learning and Children's Media found several different types of relationships that a child must learn to navigate: a relationship with themselves, relationships with others, and a relationship with the larger community and world (McManis & Gunnewig, 2012). When thinking of themselves, children may use technology to express themselves, while gaining confidence. To build on relationships with others, technology can be used to connect and communicate. It can be used to share ideas or collaborate on a project. For growing a relationship with the world, children can enhance their understanding of the natural world, or take on different perspectives of others' lives (McManis & Gunnewig, 2012). In all this, Fred Rogers still gives warning that there must be a balance with human interaction as a child develops socially and emotionally. There must be adult support and responsiveness (Parikh,

2012; Geist, 2014) so technology does not replace human interaction, but rather enhances it (Allvin, 2014).

The American Academy of Pediatrics and other researchers heed caution with early technology use and social-emotional health, having found links between viewing violence on TV or in video games and aggressive behavior- though some would argue it is usually only a short-term effect for young children (Mitrofan, Paul, & Spencer, 2008). In an overview of studies that focused on children with identified behavioral and/or emotional difficulties, some found that children viewing aggressive situations were more likely to inflict harm on others or imitate characters compared to peers without difficulties (Mitrofan et al., 2008). The same studies also showed that children with behavioral and/or emotional difficulties an average watched more hours of TV and played more minutes per day of video games than peers and were more likely to regularly view violence in both TV programs and video games (Mitrofan et al., 2008). The children themselves and their families who watched the violent, thriller, or horror content reported insomnia, restlessness, and headaches (Mitrofan et al., 2008).

A social experience with technology use is the biggest part of making tech time effective for young children (Lerner, 2015; Donohue & Schomberg, 2017). Adults that take an active part in interacting with the media and the child provide richer experiences and more in depth learning opportunities (Lerner, 2015). In fact, Lerner (2015) says that toddlers are 22 times more likely to transfer skills they learn from technology into everyday life if an adult is interacting with them compared to no socially interactive experience. Donohue and Schomberg (2017) compiled general consensus statements from research, reviews, guidelines, and recommendations over a 5 year period. It is said that what matters most in technology use is that it can enhance and

strengthen relationships, encourage parent interaction, support a child's mindfulness, creativity, and initiative, and not take away from imaginative or outdoor play (Donohue & Schomberg, 2017).

As part of the 2012 National Survey of Children's Health, nearly 20,000 interviews were conducted in relation to toddler and preschool age kids' screen use and their overall wellbeing (Przybylski & Weinstein, 2019). Questions were asked to determine if there were any connections between children with more than the recommended amount of daily screen time (taken from the American Academy of Pediatrics) and possible impacts on their curiosity, resilience, attachment, and positive affect ("wellbeing") (Przybylski & Weinstein, 2019). The result was no connection to any effects on wellbeing, even with extensive screen time use- though they did note that their definition of wellbeing was not the same as what literature refers to when discussing the effects of technology on executive functioning and physical health (Przybylski & Weinstein, 2019).

Unfortunately, some children have a harder time with social interactions and a technology device can become a safe spot with limited social interactions (Lerner, 2015). These children may feel in control when using their device and become dependent on them. Medical and psychological research has been done about the potential for adolescent addiction to the internet and video games, and the resulting social and behavioral consequences (Yau, Crowley, Mayes, & Potenza, 2012). Addiction is considered a substance abuse disorder, and addiction to technology can be further identified as an impulse control disorder (Yau et al., 2012). Many similar traits can be found between those with general substance abuse disorders and those with internet or video game addiction (Yau et al., 2012).

When a person is engaged with a gaming tablet or device, the brain responds with dopamine- a neurotransmitter associated with pleasure and reward (Yau et al., 2012). The child then expects immediate responses and instant gratification in real life, and can become upset when this does not happen (Lerner, 2015). Pivotal years of brain development happens from birth to age 3 when the brain learns and develops based on outside stimuli (Trawick-Smith, 2018). Overstimulation, such as excessive exposure to digital screens, hinders the development of the brain (Trawick-Smith, 2018). Specifically the frontal lobe is more prone to being affected, which is responsible for social skills and feelings of empathy (Trawick-Smith, 2018). This underdeveloped frontal lobe can cause issues later on with impulsivity, hyperactivity, and emotional regulation (Trawick-Smith, 2018). Overexposure can also lead to greater chances for attention deficit hyperactivity disorder (ADHD), mood disorders, anxiety, and/or personality disorder (Yau et al., 2012).

The term "technoference" is used to describe the interruptions from an electronic device in time spent with others and personal interactions (McDaniel & Radesky, 2018, p. 100). It was formerly referred to as *absent presence*, or in other words a person is physically present but they are not mindfully engaged in the situation or interaction (McDaniel & Radesky, 2018). Everyday activities such as meal time or play-time can experience technoference, and therefore have an effect on the relationships between parent and child, including fewer interactions, lowered responsiveness, and increased frustration or hostility (McDaniel & Radesky, 2018).

McDaniel and Radesky (2018) conducted a study on the amount of daily technoference that occurs on average in a select set of families and the child's resulting behavior. Parents reported their perceived amount of technoference in a day and also the reactions of their child.

As a result, it was found that technoference involving the mother was likely to result in internalized and externalized behaviors from the child (McDaniel & Radesky, 2018). Internalized behaviors included whining, sulking, and sensitive feelings, while externalized behaviors included restlessness, hyperactivity, and tantrums (McDaniel & Radesky, 2018). In contrast, technoference involving the father did not result in any reported behaviors from the child. This could be because of the amount of time the mothers spent with the child compared to the fathers (roughly twice as much), but in all it gave warning to emotional and behavioral trends in young children caused not by their own technology use, but by the use of those taking care of them.

Finally, the American Academy of Pediatrics (2016) cautions the use of technology as a means of soothing or a way of calming down a child. There are extreme cases when a child needs to be distracted (e.g. medical procedures), but most daily disappointments and frustrations do not require a tech device. Children need to learn appropriate ways to regulate emotions on their own without relying on technology to help (American Academy of Pediatrics, 2016). Infants and toddlers can begin to learn this at their young age when parents are in control of what media, screens, and activities they are exposed to (Duch, Fisher, Insari, & Harrington, 2013).

Tech Use and Literacy Development

If a search was done for kid's apps that support literacy, a vast number would appear. However, according to the American Academy of Pediatrics (2016), the only apps that have truly been researched enough to prove they provide adequate literacy impacts are those from Sesame Workshop and PBS. Most apps are not actually of quality educational practice (American Academy of Pediatrics, 2016). A study of over 300 apps resulted in only about 50 to be

educational (Neumann & Neumann, 2014). Recommendations for essential app features include age-appropriateness, links to curriculum, high interactivity, building on previous knowledge, creativity and problem solving, regular feedback, and guided performance (Neumann & Neumann, 2014). Most early literacy apps include only a portion of these features (Neumann & Neumann, 2014). One small study gave 90 children, ages 3-7, two different PBS literacy apps to play for 2 weeks. Using pre-test and post-test data, it was determined that gains were made in letter sound knowledge, rhyming, and sentence completion. The most gain was seen in the 3 year olds (Neumann & Neumann, 2014). This shows positive effects are possible when the right content is presented to children on their devices.

A foundational practice to teach and enhance literacy skills in young children is through story read-alouds between adult and child (Salmon, 2014). Becoming more popular, are electronic books (e-books). E-books are electronic/digitized versions of printed books (Neumann & Neumann, 2014). These electronic books usually have all of the same features of books including text, pictures, titles, and more; however, they also have other features such as embedded interactive multimedia or highlighted text (Neumann & Neumann, 2014). There is usually the option to also have the device read the story aloud which gives independence to young readers.

E-books are said to have some positive impacts on literacy development (Neumann & Neumann, 2014). According to Neumann and Neumann (2014), benefits can be seen in vocabulary, comprehension, phonological awareness, word recognition, and motivation. The features including music, animation, or narration change the experiences of traditional read alouds. They can help engage young readers and motivate reluctant readers (Salmon, 2014).

Features that present definitions or questions aide comprehension and vocabulary development. Studies show a particular positive impact for low SES students in improving word meaning by way of e-books compared to those receiving regular instruction (Salmon, 2014; Neumann & Neumann, 2014). Highlighted text has proven to create student gains in print concepts, while segmented speech features influenced gains in phonological awareness (Salmon, 2014). These gains in literacy achievement were further supported when e-books were used in collaborative ways compared to independent use (Salmon, 2014).

The American Academy of Pediatrics (2016) does present some warnings associated with e-books. Some concerns are that the visual effects could be distracting and deter comprehension. Other concerns are that children may be passive readers with e-books if the device and features will do all the reading for them (Salmon, 2014). These concerns seem supported when extra games and features are included in the e-books but are not relevant to literacy outcomes (Salmon, 2014). Salmon uses the terms "considerate" and "inconsiderate" to describe e-books with features that are in line with educational literacy outcomes and those that are not (2014, p. 88). It is hard to determine which commercial e-books are supportive of literacy skills- "considerate". Salmon (2014) also admits that research done on the effects and influences of e-books are usually strictly inclusive to "considerate" e-books. If "considerate" e-books are utilized, studies show that concerns of distractions can be curbed (Salmon, 2014). One proved kindergarteners to have comparable comprehension and story retell skills regardless of e-book use or traditional read aloud of the same story (Salmon, 2014). Another benefit of e-books is the chance for multiple readings of the same story. The e-books can provide repetitive practice or independent opportunities for rereading and reinforcement after a traditional print book was presented

(Salmon, 2014). The American Academy of Pediatrics (2016) also stands by their suggestion that the best outcomes will happen when e-books are used with parent guidance and support, just as a read aloud of a print book would be. The US Department of Education (2016) also speaks to the popular use of e-books as bedtimes stories. They caution the use at bedtime because of the backlighting emitted and the effects on sleep.

Prewriting is another area of early literacy development in young children. Neumann and Neumann (2014) give notion to the tactile and sensory nature of touch screens, and the ability to have apps that allow for tracing and letter/word formation lead to an extension of traditional writing. Other apps allow for independent creation and recording of thoughts by young children that are not developmentally at a traditional writing level (Laidlaw & O'Mara, 2015). It can also be argued that the more prevalent digital communication becomes, that this digital form of "written" literacy could become the norm. Some worry that the use of only digital writing will lead to traditional handwriting becoming unnecessary. Laidlaw and O'Mara (2015) argue that it seems logical because the written word and the tools used to write have changed over time since the creation of the alphabet.

The pre-alphabetic phase of reading (environmental logos, icons, etc) is easily introduced and practiced with touch screen devices. The icons and symbols lead to an understanding that meaning can be derived from print (Neumann & Neumann, 2014). A small study observed preschoolers who were able to "read" buttons such as stop, play, go back, start, and exit (Neumann & Neumann, 2014). This mastery of the pre-alphabetic phase can lead to beginning letter-sound correlations and eventually phonetic decoding (Neumann & Neumann, 2014).

A popular trend is the use of mobile technology at home to support literacy development (Eutsler, 2018). In a review of literature, Eutsler found that a majority of parents believe education is improved through the use of technology and almost all have adopted the use of some kind of mobile technology in the home (2018). However, parents admitted that the use of computers and laptops in their home was primarily for entertainment and gaming, not educational literacy or e-books (Eutsler, 2018). Eutsler (2018) further broke down the intent of parents to support literacy at home to those reluctant, indifferent, and eager. Those reluctant were fearful of technology addiction and negative social media. Parents who felt indifferent mostly viewed electronics as rewards, and maintained an intention of balanced literacy. Those that were eager felt some social influence to adopt the educational mobile technology and recognized the possible benefits as portrayed by their child's school (Eutsler, 2018). Knowing how a parent feels about their child using technology at home for learning and literacy development can help teachers create a collaborative education partnership (Eutsler, 2018).

Tech Use and Language Development

Very early language can be affected by technology use. The American Academy of Pediatrics (2016) speaks about technology use and language development. They share that toddlers as young as 15 months can learn new vocabulary from educational apps. Interactive programs that encourage children to speak and participate can positively impact language use and vocabulary (Russo-Johnson, Troseth, Duncan, & Mesghina, 2017). It is also said that video-chat can be an interactive experience for toddlers and children, and regular use can promote oral language (American Academy of Pediatrics, 2016).

On the other hand, excessive exposure to non-quality media can have the opposite effect and hinder language development (Lerner, 2015). In a study, toddlers under age 2 learned fewer words from TV watching than peers did learning directly from an adult. There is a "transfer deficit" that can occur with young children learning words from a device but not being able to make the connection to real-world situations (Russo-Johnson et al., 2017). Having an interactive experience with an adult while learning new words can help with the transfer and application of the new learning to outside situations.

Watt (2010) describes a form of communication through technology referred to as "written speech." It is a hybrid of verbal speech and formal written language. Through communication technology (i.e. text, email, chat, etc), written speech is done in an instant written format but can be read to sound as it would be spoken and is sent in an instant manner though the recipient is not face-to-face (Watt, 2010). It is inferred that children have all the necessary knowledge of technology use by age 5, and as they begin their formal schooling in traditional reading and writing, they can also begin to use written speech (Watt, 2010). It is not known if this form of electronic communication requires a new set of language skills to be learned or if traditional skills are adapted (Watt, 2010).

Concern is raised that if children are not participating in face-to-face conversations, then they lose out on social communication norms such as interpreting context and verbal cues, turn-taking, timing, appropriateness, relevance, and formality (Watt, 2010). The opposite has actually been found in adolescents that communicate regularly through technology and use written speech (Watt, 2010). They exhibit enhanced pragmatic skills in the ability to provide context, and change tone and complexity based on the recipient of their message (Watt, 2010).

Watt (2010) still argues that communication technology should supplement and not substitute traditional communication.

Communication technology has shown to be very effective for young children with language impairments (Watt, 2010). Research based software paired with adult interactions to include gestures and nonverabal cues has also been shown to help children with autism and also second language learners (Watt, 2010). Parent/adult involvement is also crucial at early ages before children are able to adequately determine the appropriateness of electronic forms of communication coming at them. Young children may have the skills to access information and modes of communication, but not be able to evaluate or assess its legitimacy (Watt, 2010).

Though there are positives to communicating electronically, too much technology use, especially of the wrong kind, can sometimes lead to dependence on the devices. This is especially true for children of low SES families, which report to use touchscreen devices two to three times more minutes per day than higher SES families (Russo-Johnson et al., 2017). This frequent use may actually cause language delays, attention problems, and less lingual parent-child interactions on a daily basis. (American Academy of Pediatrics, 2016). One study showed a direct correlation between the amount of screen time and the level of parental involvement and stimulation in the household (Duch et al., 2013).

There is a "displacement hypothesis" that describes time spent on devices as time not spent doing other activities, including decreased physical and communicative interactions (Bedford, Saez de Urabain, Cheung, Karmiloff-Smith, & Smith, 2016, p. 2). This includes overuse by parents of their own technology devices in front of their children (American Academy of Pediatrics, 2016). Bedford et al. (2016) conducted research regarding the early use

of technology by infants and toddlers and their language development. It was determined that for children this young the displacement hypothesis could not be confirmed nor denied. The children in the study using technology, on average, began using 2-word utterances at roughly the same time as peers with no technology experience, leading the researchers to suggest that language development hindrances from technology use may become a concern in later childhood (Bedford et al., 2016).

Tech Use and Fine Motor Development

Touchscreens have been a game changer. Traditional computers with keyboards are not appropriate for young children that do not have the fine motor control to navigate them. Children as young as 2 are able to successfully manipulate a touch screen (Geist, 2014). The ease of a touch screen also gives children more independence in interacting with the device and therefore the content (Geist, 2014). Despite recommendations against independent touch screen use by infants and young toddlers, a majority of families report letting their child use a device regularly (Bedford et al., 2016). The screens provide sensory experiences, and become easier and easier to use as toddlers develop their cognitive executive functions and can understand what is being manipulated on the screen (Bedford et al., 2016). Learning is enhanced through haptic engagement when touch screens are utilized (Russo-Johnson et al., 2017).

There are some concerns about the ease of manipulating a touch screen and the impacts on fine motor skills with finger, hand, and wrist development (Bedford et al., 2016). Bedford et al. (2016) conducted research trying to see if there is a correlation between early use of touch screens and any possible impacts on fine motor development. The study did show a connection for the children that used touchscreens early on and their ability to do simple fine motor tasks

such as stacking blocks. Another similar study showed a positive relationship with fine motor skills and the age that specifically scrolling on a screen was first used (Bedford et al., 2016). However, it is not known if the touch screen use is influencing the fine motor skills, or if those with naturally greater fine motor skills are more likely to successfully use touch screens (Bedford et al., 2016). The researchers also pose the suggestion that the highly interactive and stimulating screen can motivate young children to experiment more with their finger and hand motions and later transfer this to real world objects, similar to a surgeon or pilot playing video games to hone special skills needed for their job (Bedford et al., 2016). In contrast, a study conducted by Lin, Cherg, and Chen (2017) showed there are possibilities for negative impacts on dexterity and pinch strength with extended touch screen use. It is important to note that all of these findings are preliminary and more research over time needs to be done to fully understand any possible fine motor development implications (Bedford et al., 2016).

Russo-Johnson et al. (2017) conducted a study to analyze the types of fine motor actions required to navigate a touch screen device including tapping, swiping, scrolling, and dragging. The researchers wanted to see if a certain type of movement aided or hindered learning with a touch screen device. It was determined that boys were more likely to learn when tapping was required, and girls were more likely to learn when dragging was required (Russo-Johnson et al., 2017). They went on to suggest that learning activities on touch screen devices could be customized to support this theory between genders to maximize the learning potential without the physical motor aspects getting in the way (Russo-Johnson et al., 2017). It is argued then that "how" an app is interacted with is just as important as the content of the app for developmentally appropriate learning (Russo-Johnson et al., 2017).

The touch screen is becoming an essential learning tool for children with physical disabilities as well (Laidlaw & O'Mara, 2015). Laidlaw and O'Mara (2015) give example scenarios of children with fine motor difficulties and ways that touch screens allow these children to still participate and show their learning and skills. Instead of traditional paper and pencil requirements, accommodating tools are utilized to "write" on screens, such as finger touch, styluses, buttons, and voice overs. Laidlaw and O'Mara (2015) want to argue that technology can be used to make sure the true knowledge is being drawn out of each child without physical impairments getting in the way.

Early Childhood Classroom Applications

Technology that is accessible and appealing requires daily decisions by adults in what children may come in contact with (Laidlaw et al., 2019). Though touch screens provide an easier access to technology for young children, the content they interact with may still lead to boredom or frustration (Neumann & Neumann, 2014). Allvin (2014) calls early childhood educators the "linchpin" of providing enriched and dynamic learning environments outside of the home; therefore, they are in a pivotal position to make decisions about technology use. The NAEYC and Fred Rogers Center are go-tos for early childhood educators to find research and best practice. In the past, their position statements were solely based on television and violent media, but together an updated statement was released to cover the many multitudes of screens and other types of technology (Donohue & Schomberg, 2017). A main message that can be taken from them is that teachers need information and resources to effectively and intentionally use technology in the classroom (Parikh, 2012). They also suggest preservice learning and ongoing professional development for teachers, knowing the industry needs more research on the

topic (Parikh, 2012). Similarly the US Department of Education gives four guiding principles for early technology use. This includes that appropriate technology is used as a learning tool, it can increase opportunities and access for all, it can strengthen communication between families and educators, and it is more effective when adults are part of the interactive experience (2016).

The research that has been done on early childhood technology use has some overlapping themes. A major agreement among many researchers is that technology use should not be a mindless activity done in isolation by the child (Allvin, 2014). Instead, the technology should be used with active adult engagement so there are chances for interactions and relationships (Donohue & Schomberg, 2017). The content, context, and quality of the media used should always be developmentally appropriate, yet not completely replace the traditional learning that happens through unstructured play (Donohue & Schomberg, 2017; Geist, 2014).

McManis and Gunnewig (2012) give a few suggestions for choosing programs or software to implement in the classroom. The content should be educationally sound with ties to standards and follow a developmentally appropriate path. The program or software should be play-like with opportunities for choices and appropriate feedback given regularly. The child should experience success including multiple tries at answering and changing their thinking. It should have elements that promote independence and aides in engagement, along with creative aspects for open ended answers. Children will get the most out of the program if it can be individualized to each student's needs either by adapting to their answers or the teacher setting a level, and accompanying progress monitoring and reports for the teachers are utilized (McManis & Gunnewig, 2012).

Teachers in the classroom that choose to integrate technology into their students' learning have several opportunities to guide and assist the process. It is less about monitoring turn taking or setting up systems, but more about enhancing learning (McManis & Gunnewig, 2012). A study showed that children who had *daily access* to independently work with educational software made some gains, but children that met *once per week* to use the educational software with a guiding mentor made greater gains (McManis & Gunnewig, 2012). Scaffolding leads to higher order thinking, learning goals met, active engagement, interactivity, and feedback (McManis & Gunnewig, 2012). Scaffolding can be broken into cognitive scaffolding, affective scaffolding, and technical scaffolding (Neumann & Neumann, 2014; McManis & Gunnewig, 2012).

Cognitive scaffolding occurs when a teacher or adult models and questions to further the depth of knowledge the student may gain from the media (Neumann & Neumann, 2014). It is what most teachers are familiar with in other areas of teaching, and can include peer to peer collaborations (McManis & Gunnewig, 2012). When working with young children, the play aspect is still important, and cognitive scaffolding may occur spontaneously based on children's choices and creativity (McManis & Gunnewig, 2012).

Affective scaffolding refers to providing a student feedback or encouragement as the child works (Neumann & Neumann, 2014). It can be as simple as close proximal distance to keep a student on task, or nonverbal cues (thumbs up) to reinforce success (McManis & Gunnewig, 2012). Sometimes a program or app will have affective scaffolding built in, and the child will receive digital encouragement frequently as they progress (McManis & Gunnewig, 2012).

Technical scaffolding includes assistance with the physical use of a technology device and its features (Neumann & Neumann, 2014). This mainly includes troubleshooting or pointing out features (McManis & Gunnewig, 2012). A program or app that is adaptive and changes based on each students' individual level is said to have built in technical scaffolding (McManis & Gunnewig, 2012).

There are educators that are holding back a bit from implementing technology into their early childhood classrooms. Some reasons for this could be the lack of knowledge as to the impacts of its use (Neumann & Neumann, 2014). McManis and Gunnewig (2012) identify a lack of professional development as a common obstacle. Another may be that educators have only heard the negative impacts often associated with passive screen time. Laidlaw et al. (2019) compiled research from 2013 to 2018 regarding the information available to parents and educators searching for advice and guidance with early childhood technology use. They found trends in early articles and blogs that held a good versus evil perspective. The main ideas presented then warned against screen time and its imposing "addiction" stealing childhood. Many of these were not research-based but just loose correlations and opinions (Laidlaw et al., 2019). Newer, more recent articles tend to give more practical advice and innovative ideas for using technology with children, and The American Academy of Pediatrics changed their policy in 2016 to give new recommendations in "maintaining a healthy media diet" (Laidlaw et al., 2019, p. 7). If parents and teachers can get more information, resources, and training, as suggested by the NAEYC, then the perspectives on early technology use might change (Parikh, 2012; Neumann & Neumann, 2014). The most recent trends now show a new worry in online safety and media awareness (Laidlaw et al., 2019). Questions still exist for those that have

embraced early technology use, and how early it is required to start teaching digital citizenship and safety.

The main point for the NAEYC position statements is to guide educators in developmentally appropriate practice. Its technology statement guides early childhood teachers to ask questions in regards to the best practice, either digital tools or traditional practices, that will lead children to meet their learning goals (Ashbrook, 2017). Considerations can be made for how technology and digital media can integrate into the curriculum and enhance learning in ways not possible before (Ashbrook, 2017).

Looking to the Future

The scientific evidence from the medical field about overall health when it comes to technology use or screen time cannot be ignored. The American Academy of Pediatrics (2016) outlines many potential risks and provides research based suggestions for appropriate technology use by young children. While they do agree that the right types of programs can enhance cognitive, literacy, and social development in preschool aged children, they also reinforce that many executive functions such as persistence, impulse control, emotional regulation, creativity, and flexible thinking are best learned through unstructured play and not on a digital screen (American Academy of Pediatrics, 2016).

Children under the age of 2, get very little benefit from technology and screens (American Academy of Pediatrics, 2016). The limited learning that may happen is not easily transferred into the real-world. Therefore a guideline is set by the Academy of Pediatrics for those under 18 months of age to not have any screen time, and children 2-5 should have one hour or less per day of only quality content screen time (2016). Children of low socioeconomic

backgrounds are more likely to have early access to screens, especially TV (Duch et al., 2013). Excessive use in the infant and toddler years can be predictive of excessive use later in childhood and adolescence (Duch et al., 2013).

The recommendations set by the American Academy of Pediatrics are based on research and potential identified risks. Excessive technology use is linked to obesity in children. The more technology use, the greater the chance for increased BMI and weight gain later in life (American Academy of Pediatrics, 2016). A child's sleep can also be affected by technology and screen use, especially if the device is in the bedroom. This can include fewer minutes of sleep at night, greater states of arousal, and suppression of melatonin (American Academy of Pediatrics, 2016). Devices in bedrooms are more prevalent in low SES households, and a relationship has been found with lowered school readiness as a result (Fu et al., 2017). In contrast, an inverse effect from the amount of screen time has been seen in homes with high levels of non-digital cognitive stimulation, including educational games, toys, and parent support (Duch et al., 2013) and restrictions on access to devices (Fu et al., 2017).

As stated before, excessive screen time and digital play does not help in the development of executive skills needed for formal schooling (American Academy of Pediatrics, 2016). Overexposure can start unintentionally as infants, when devices and screens are used to pacify or soothe children with more difficult temperaments. This may lead to other cognitive, language, or social-emotional delays (American Academy of Pediatrics, 2016). The content being viewed during this time is a crucial factor, as non-quality content can be a determinant in developmental effect as much as the amount of exposure (American Academy of Pediatrics, 2016). There is

evidence to show improvement in behavior when content was changed from violent in nature to educational (American Academy of Pediatrics, 2016).

Other professionals in the field have written guidelines as well. The NAEYC and the Fred Rogers Center for Early Learning and Children's Media have partnered and released a joint position statement regarding early childhood technology use. The statement is based on child development research and can be applicable to ages birth through 8 (Parikh, 2012). A few of the key messages that can be taken from the position statement are that technology can be effective for learning when it is used intentionally and in developmentally appropriate manners (Parikh, 2012). It can be a hands-on way to expand learning, rather than simply a passive experience. The NAEYC and Fred Rogers Center also agree that technology use should be limited for young children, and the content must be carefully selected (Parikh, 2012). When content is selected, considerations for age, sex, self-regulation levels, and physical requirements of a child should be made (Russo-Johnson et al., 2017).

What this research tells us is that children need to be successful in both traditional ways and be in tune with the technologically advancing world- complementing the everyday activities of drawing, playdough, and books (Neumann & Neumann, 2014). Without purposeful thought given to what a child is using technology for, it becomes a mindless activity (Fantozzi et al., 2018). In contrast, Fantozzi et al. gives guidelines for including the most appropriate and meaningful technology into lessons by focusing on "creation, collaboration, and communication" (2018, p. 89).

Creation apps allow students to make their own pictures, photos, videos, or recordings (Fantozzi et al., 2018). Play is purposefully supported and enhanced with these functions.

Dramatic play is video recorded, literacy is enhanced through voice recordings, or shared experiences are captured in animated e-book apps. Fantozzi et al. also gives the suggestion of creating memory books from pictures taken on field trips (2018). The creation must come from the students though. The children have to use the technology, become familiar and comfortable with it, and have their own ideas captured (Fantozzi et al., 2018).

Children's play is often a social and collaborative experience and using technology can be the same. Fantozzi et al. (2018) gives the examples of children recording a video. The kids must work together to assign roles, decide on the premise or plot of the video, take turns and negotiate on the technology use. Finding ways to purposefully include technology into collaborative opportunities will enhance the play and the relationships the kids are building.

Communication is a major part of technology use for adults and it can be for kids also. The use of video-chat (e.g. Skype, Facetime) is a simple way to have meaningful interactions with young children (American Academy of Pediatrics, 2016). Technology is also a helpful tool for communicating between parents, teachers, and caregivers. Fantozzi et al. (2018) reports using digital portfolios with samples of work, creations, and videos individually saved for each child. The parents can access the portfolio and be better informed about their child's learning. The child can also be the one to share and show-off new things that have been added to the portfolio.

Conclusions

Technology comes with both benefits and risks associated with early use by children (American Academy of Pediatrics, 2016). The act of passive technology use is to be avoided with young children that are in a constant state of development. Passive viewing occurs when

watching TV, videos, or programs with no reflection or participation required, and therefore, minimal learning happening (US Department of Education, 2016). All research shows that technology is the most effective on learning when an adult is there to guide and facilitate, not only the use of the device, but also the learning.

Scaffolding is an effective way to ensure children are gaining knowledge and deepening understanding while using technology (McManis & Gunnewig, 2012). Lessons can be enhanced through technology and digital formats so that extraordinary opportunities are being taken advantage of that would not normally be available. The ease of touch screen use by young children make independent use an engaging and motivating factor for students to learn. However, overexposure can happen with real consequences in behavioral, developmental, and cognitive changes (American Academy of Pediatrics, 2016; Yau et al., 2012). Many experts including the American Academy of Pediatrics (2016) give guidelines for effective and healthy technology use by young children. They provide a "Media Use Plan" for families to evaluate their current technology use and ways to make sure technology is positively affecting their family and child's development. The US Department of Education (2016) also highlights that technology use should unite families of young children to engage, communicate, learn and create together.

The content the child is encountering is a crucial component to choosing developmentally appropriate technology media. Violent content can lead to aggressive behavior (Mitrofan et al., 2008), passive content can lead to language delays, "inconsiderate" content can lead to fewer literacy gains, and content that is not developmentally appropriate can lead to frustration (Salmon, 2013). Unfortunately, a majority of commercially available apps are not aligned to

educational outcomes by experts (Neumann & Neumann, 2014). This reinforces the theory behind the Fred Rogers Center statements that not all screen time is beneficial (Fantozzi et al., 2018). This calls for the industry to step up and create educationally sound programs and apps for young children that are easily accessible (American Academy of Pediatrics, 2016). Also working against the cause is the gap between wealthier and poorer children. Disparities found in a study by Fu et al. (2017) show that there are great gaps in technology exposure and achievement between children of low SES and those of higher SES. In strictly a look at the number of devices placed in young children's bedrooms and the effects on school readiness, low SES children have more access with fewer restrictions placed on them, seamingly causing lower levels of school readiness (Fu et al., 2017). It is proposed that the children of low SES background use the devices in a more passive way and the content is controlled less by parents leading to the suggestion that in this circumstance, technology is actually widening the gap (Fu et al., 2017).

Early childhood educators hold a special role in implementing technology into purposeful learning. It could be a reinforcement to a lesson, a chance to explore during play, or a targeted intervention on specific skills. Technology use can become so intuitive that children view it as another way to play (Geist, 2014). Though technology is a part of our daily lives, teachers still feel unsure or unprepared to effectively use technology in the classroom. McManis & Gunnewig (2012) suggest to start with existing software to see if there are built-in tutorials, sample lessons, or reports that can help guide a teacher in using the software to its fullest. Another way to become more familiar with current trends and ideas for technology in the classroom is to build a learning community (McManis & Gunnewig, 2012). Small groups of educators can get together

to learn from an expert or from each other. Goals for classroom use can be set, curriculum can be developed with technology use embedded, and coaches can assist teachers in implementation (McManis & Gunnewig, 2012). Teachers have become more comfortable with teaching common standards, and teaching technology is no different (Fantozzi et al., 2018). The comfortable use of many forms of technology is a new global requirement and an essential 21st century literacy (Fantozzi et al., 2018). There is already a generation gap in which children can often times do more with technology than an adult (Watt, 2010). Watt (2010) reports that since 2005, there has been a steady trend of more access to technology and the internet with fewer restrictions on children, so some parents and even teachers do not know all of what is possible that children can do online or with a device. Parents and teachers alike must become more informed on the ever changing research associated with early technology use to make the best informed decisions they can for their young children using technology.

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