Developing Literacy Skills with E-books and Other Technology in the Early Childhood Classroom

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Abstract

Technology is increasingly a part of the early childhood classroom. The purpose of this article is to review current research on electronic books (e-books) and other technology for supporting literacy development in typically developing children, children with special needs or at risk for special needs and children living in lower income families. Findings suggest high quality e-books and other technology can be used alongside traditional forms of teaching to support children in the early childhood classrooms to increase literacy skills. There seems to be clear evidence that teacher training is necessary for e-books and other technology to be successful in early childhood classrooms as not all forms of technology are going to be suitable for all children. Characteristics of quality e-books and how they can be used in the classroom is provided. Future research designs are also suggested.

Early childhood is a time when a vast amount of development occurs. Literacy development is one of the many areas that early childhood teachers focus on. Oral language development, phonological awareness, alphabetic knowledge, print knowledge and inventive spelling are all characteristics of children ages birth to 5 that are linked closely with later achievement in literacy (Strickland & Shanahan, 2004.) Being exposed to books and print at an early age is important in gaining these literacy skills (Davidse, de Jong, Bus, Huijbregts, Swaab, 2010; Vrinda, 2007). This holds true for typically developing children, children with special needs and children living in lower income families (Vrinda, 2007).

It cannot be ignored that technology has entered into children's lives. Many early childhood classrooms have access to a variety of technology tools and most teachers have begun using computers with children by the time they are three years old (Haugland, 1997). The National Association of the Education of Young Children (NAEYC) recognizes that "young children live in a world of interactive media [and] they are growing up at ease with [the] digital devices that are rapidly becoming the tools of the culture at home, at school, at work, and in the community" (NAEYC, 2012, pg. 2). The next generation of children in the school system will be using technology to support their learning. Children are now coming to early childhood settings with more technical abilities than children of other generations. Early childhood educators should be aware of this and attempt to develop new learning experiences for these children (Logan & Zevenbergen, 2008; Wood, 2005). The International Reading Association (2009) acknowledges the change in the way adults and children read, write, and communicate in the 21st century and are calling for a change in the way that teachers are teaching literacy to include more technology.

Korat (2010) explains the advances technology "seem to comprise good support for children's literacy development" (Conclusion Section, para.1). One way teachers can begin to integrate technology into literacy development is by using electronic books (e-books). A large majority of the digital storybooks available to young children in the past have been in the form of a computer based CD-ROM storybook. Though CD-ROM storybooks are still used in early childhood classrooms, newer technology is becoming more prevalent and is showing a greater presence in early childhood classrooms. Technology such as interactive white boards (IWB) and tablet computers often are now available to early childhood teachers. The newer forms of e-books are internet based and can be downloaded to a variety of devices. Both types of e-books give the child an illustrated text with audio narration. Options such as whole text reading or word only reading can help individualize a text. The narration of text, music, definitions of words, and any animations of the story enhance the connection to the story which can be a great motivator for children (Flevegi & Matthew, 2012; Talley, Lancy, & Lee, 1997; Shamir & Shlafer 2011; Cavanaugh, 2002). Other options such as the ability to change text size, highlighting of words, text-to-speech capabilities and word definitions not only has potential to help typically developing children, but also children with special needs and children living in low-income families (Cavanaugh, 2002).

This paper will focus on the use of e-books for literacy development of typically developing children, children with special needs and children who are living in low income families. It will also include information on how other technologies can be used to help foster literacy development in the early childhood classrooms and how teachers' perceptions and knowledge base effect how they use technology in the classroom. Following the review of research, suggestions about how e-books and other technology can be used effectively in the

early childhood classroom will be presented and recommendations for future research will be discussed.

Research Review

As Logan and Zevenbergen (2008) found, children are already using technology for computer games, digital drawing and access to child focused websites. Since technology is already being used for entertainment, it would be a natural progression to use technology when motivating children in learning situations (Plowman & Stephan, 2006). Children show more persistence and motivation when using computers or tablet computers than they normally would in during typical preschool activities (Couse & Chen, 2010; Lui, 1996). This motivation and persistence does not disappear as technology becomes a normal part of the curriculum. They also stayed continuously interested in using technology over the course of an entire school year (Boone, Higgins & Notari, 1996). Couse and Chen (2010) found children enjoyed using touchscreen technology and stayed motivated to use the tablet computer even when they initially struggled with the device. Children were more willing to spend time at an activity when the technology was involved. Lui (1996) suggested that using technology could increase the attention span and act as a motivator for children in educational settings. "[Technology] has a role to play in developing children's dispositions to learn by increasing self-esteem and the confidence gained from accomplishments as well as supporting independence and persistence in the face of initial difficulties (Plowman & Stephen, 2006, pg. 8)

Typical first exposures to literacy come in the form of print books. An e-book is then a logical place to start when integrating technology into literacy development for early childhood children. Children are already exposed to a variety of books in an early childhood classroom

and adding e-books to the curriculum would be an easy transition. The benefits of adding technology to classrooms can be applied to all levels of literacy development. Korat (2010) found that both kindergarten and first grade children benefited from exposure to an e-book compared to children of the same age who received the regular literacy program at the same school. Kindergarten and first grade children have different levels of literacy development, yet both age groups benefited from exposure to technology in the form of an e-book. The e-book exposure provided support for children in both developmental levels even if the older children had an academic advantage.

Typically Developing Children

Research in this area has provided evidence that e-books and other technology resources can meet children's developmental demands in different ways. Typically developing children were able to increase their knowledge of print concepts, learn new vocabulary, increase comprehension and improve phonological skills while using technology (Korat, 2012; Shamir &Shlafer, 2011; Smeets & Bus, 2012; Talley, Lancy, & Lee, 1997). Print concepts are one of the first literacy skills that children begin to pick up on. These concepts include an understanding that a book is read in a certain way and pages turn from one side to the other. Shamir and Shlafer (2011) found that educational e-books can provide information to children about print concepts similar to that of a printed version of the book. If e-books and CD-ROM storybooks are designed with print concepts in mind, children can learn the same print concepts in digital form (Talley, Lancy, & Lee, 1997).

Smeets and Bus (2012) showed using multiple choice questions during e-book reading significantly contributed to an increase in vocabulary knowledge. This increase was in both a

receptive and an expressive level. By asking children questions, they use higher level thinking skills and therefore are able to recall new words. Kindergarten children also showed significant progress in word reading when exposed to five sessions of e-book software (Korat, 2010). They gained 2-3 new words after only five exposures.

Another skill important to the reading process is being able to comprehend what happens in a story. The use of e-books and other technology has been shown to support children in this area of literacy development. Kindergarten and first grade children were shown to have an appropriate level of story comprehension after reading e-books (Korat, 2010). The level of comprehension during e-book reading is comparable to readings done with print versions of the same story. When nine and ten year old children read a book both in print and in electronic form, they were able to comprehend the story in a similar way (Grimshaw, Dungworth, McKnight & Morris, 2007). The study used quality books that appealed to the specific age group and children were able to attend and understand the story when both types of book were given. De Jong and Bus (2004) found similar results when examining pre-readers who were in the beginning stages of comprehension of books. The kindergarten aged children were able to retell a story both when they listened to it independently with an e-book and after adult-led readings. When technology is involved, story comprehension occurs with both children who can independently read and those who are not yet reading.

E-books can be used to provide gains in phonological awareness in children (Shamir & Shlafer, 2011; Wild, 2009). Phonological awareness provides children with critical knowledge about reading words. Technology is already being used to increase phonological awareness and word reading in early childhood children. When preschool children use technology at home, parents have reported an increase in literacy skills such as the ability to recognize and

type letters and words (Logan & Zevenbergen, 2008). "Handwriting, an early academic task, can be a challenging and often arduous process for children due to developing fine-motor skills" (Couse & Chen, 2010, pg. 76). The use of technology allows children to begin writing words and their names in proper form before they may be able to construct the well-formed letters using traditional materials (Couse & Chen, 2010; Logan & Zevenbergen, 2008). The children are using technology to use their literacy skills at a younger age than would be possible without technology. Similarly, Wild (2009) found five year old children gained significant phonological skills when exposed to literacy software. In contrast, Wood (2005) did not find significant differences in phonological awareness between children who used an e-book and children who had one-to-one tutoring. However, she did find the children reading the e-book produced more gains in rhyme detection abilities which are also an important literacy skill.

The currently available research has shown that e-book reading sessions are equal to or better than an adult-child reading session or print version of a book. Wild (2009) found that kindergarten children who used digital software to build on literacy skills saw a gain in knowledge higher than children who had paper versions of the same materials. In a different study, word reading was found to be no higher in e-book reading for kindergarten children than those who read the same book in a paper version (de Jong & Bus, 2002). This may be a result of the number of words that children were exposed to since the e-book version contained less than half of the words that the print version did. The e-book was condensed so other interactive pieces could easily be integrated into the story. As stated earlier, Wood (2005) had a similar finding when children using digital book software and children experiencing one-on-one tutoring with the same book showed similar gains in phonological awareness. It was found that

typical adult-child reading was no better than an individual e-book reading. Most of the previous research was focused on finding an increase in skills with digital versions of typical print books; it could be argued that a gain equal to print books is also acceptable. This would be especially appropriate when one-to-one adult-child situation are not always available such as in a typical classroom setting. E-books can be used to support children's learning without demanding constant adult-child interactions (de Jong & Bus, 2004).

E-books can be used as an additional form of reading that is available to children. As de Jong and Bus (2002) found, children repeatedly read paper versions of the same book more times than an electronic version. With the repeated readings, the children knew the story content better and had more knowledge of word reading (de Jong & Bus, 2002). The study participants however were children who had no formal reading or writing instruction and adult interaction was kept minimal for the e-book group. It is plausible that the adult interactions during the reading of the print version were a motiving factor for the children. Interestingly, the same researchers later found pre-reading children listened to an e-book the same number of times as children listening to the same books during adult-lead readings (de Jong & Bus, 2004). Children who are not independently reading print books may be more willing to listen to e-books for repeated sessions.

Children with Special Needs and Children at Risk for Learning Disabilities

Typically developing children are not the only ones who can benefit from the use of technology in the classroom. E-book and other technology can benefit children with special needs and children at risk for learning disabilities. Children who are at risk for learning disabilities generally have lower abilities than typical peers although they do not qualify for

special needs services (Boone, Higgins & Notari, 1996). Coyne, Pisha, Dalton, Zeph and Smith (2010) discuss typical literacy instruction for children with significant intellectual disabilities. They describe it as mostly skill-based using drill and practice. These drill and practice programs have limited benefits for children's development (Boone, Higgins & Notari, 1996; Haugland, 1997). Coyne et al.'s (2010) research showed a more comprehensive approach using technology and e-books to help develop literacy skills in a meaningful way. Being meaningful in instruction is important to helping children use their knowledge in a wide variety of settings. The e-book Coyne et al. (2010) used provided several opportunities for the children to practice responding to embedded comprehension prompts. Unfortunately the e-books used in the study were developed especially for the research process. Commercially available e-books may be able to provide this same support and scaffolds needed during independent reading that specifically designed e-books do.

As discussed earlier, phonological awareness, the understanding of print concepts and vocabulary and are three essential literacy skills that support future success in learning tasks (Shamir, Korat & Fellah, 2012). With the added support that an e-book offers, children at risk for learning disabilities were shown to increase their phonological awareness (Shamir & Shlafer, 2011) and progressed more in this area than children who had been read to only in a print text version (Shamir, Korat & Fellah, 2012). Though the Shamir and Shlafer (2011) study was a shorter intervention, the children at risk for learning disabilities showed higher gains than that of typically developing children. Van der Kooy-Hofland, Bus and Roskos (2012) provided children at risk of literacy delays in kindergarten with an intensive computer intervention to help the children gain code-related knowledge. With only a brief intervention period in kindergarten, children were able to better follow future literacy curriculum when code-related

skills were being taught. This brief technological intervention provided children with enough added support to continue gaining knowledge two years after intervention. Children who are diagnosed with a significant special need can also benefit. In a small study of 16 children, the word-by-word highlighting that demonstrates the left-to-right motion of reading text was shown to help kindergarten children with significant intellectual disabilities to understand print concepts (Coyne, et. al., 2010). The multimedia features of the e-book helps to support the understanding of print concepts (Shamir, Korat & Fellah, 2012). The unique designs of e-books are also a good support for learning new vocabulary words. Many e-books offer children a dictionary definition of words in the story matched with a visual support of the word. Children were able to gain more vocabulary knowledge from the e-book dictionaries than from common teacher given explanations of the same words (Shamir, Korat & Fellah, 2012).

As with typically developing children, when e-books do not outperform traditional print forms of book with children, they show comparable learning gains. Shamir & Shlafer (2011) provided children at-risk for learning disabilities with e-book intervention. These children gained knowledge from the e-books similar to children who were exposed only to paper versions of the same books. However, technology may offer an additional incentive in literacy tasks for children with lower abilities. Children at risk for learning disabilities showed more enthusiasm and interest when technology was involved in the literacy curriculum (Boone, Higgins & Notari, 1996). If this is the case, then literacy curriculum that encourages children to use technology may help motivate learning more than a typical print book can.

It is important to consider that not all children with disabilities or at risk for disabilities have the same level of functionality. Because of this, some technology may not work for every child. In Liu's (1996) study, a participant with low abilities was shown to have difficulty using

the mouse to interact with the computer. This took away from the benefits that other children in the study saw. Although this was a small study and only one participant struggled, it brings forth an issue that needs to be considered when providing children with a typical computer and mouse set-up. Some children may struggle with this configuration and may benefit more from using touchscreen technology instead. Other children may struggle with the currently available touch screen technology. Baird and Henninger (2011) found that accessibility to e-books for visually impaired individuals was less than optimal. While using e-books on the Apple iPad, some applications interfered or limited the effectiveness of features that are often used to help visually impaired children to utilize the device successfully. Children who are visually impaired may need other forms of technology if e-books are going to be beneficial to them. Similar to other curriculum tools, teachers would have to choose technology to best accommodate each child's individual needs.

The inconsistencies within different e-books may also be a challenge to children with disabilities. Many children with special needs often require a more predictable application of information. For example, some e-books present page turns on the top of the screen while others use a "swipe" action across the screen to turn the page. Most typically developing readers could adapt to this difference with ease. However, children with disabilities may have difficulty with the changing operational aspects and be less successful at them (Baird & Henninger, 2011). It would be imperative that the teacher check for all possible discrepancies or challenges before providing e-books or other technology for literacy curriculum.

Children in Low Income Families

When proper technology is integrated into the classroom for literacy development, children living in low income families can also benefit from its use. It could be suggested, that this group of children could actually benefit the most since low income families are less likely to introduce early childhood aged children to technology. Logan and Zevenbergen (2008) surveyed families of young children and found that 87% of children are coming into early childhood settings with considerable experience with computers. However, of the mostly middle class participants, at least 5% of preschool aged children in the study did not have access to a computer. The number of children without access to technology increases when low income families are examined. In a study conducted with low income families, only 56% of children have a computer at home or have access to a computer outside their homes (Atkins & Li, 2004). This lack of access to technology makes it even more important for early childhood teachers to utilize it in the classroom. By providing access to technology in an early learning setting, teachers have the ability to help reduce the digital divides among children at an early age (Logan and Zevenbergen, 2008). Atkins and Li (2004) found that family SES is significantly associated with children's accessibility to technology. Early childhood aged children in low income families are less likely to have experiences with technology to the degree that other children of the same age have.

The technology skills learned in an early childhood classroom can assist the child in future classroom settings. Access to a computer has been associated with better performance on school readiness and cognitive development (Atkins & Li, 2004). Grimshaw et al. (2007) found that even children who were 9-10 years old had difficulties with a computer task when they had less time allocated to learning technology skills at school. It's unclear in Grimshaw et al.'s (2007) study if the children had prior computer training, but it can be suggested that skills

taught at an early age can only increase the likelihood of future technology success. Matthews and Seow (2007) discussed the importance of knowing the "metaphorical language" that is used during interactions with technology. They stated, "We talk of 'going into', of 'dragging' 'windows' around; of 'dropping' something in to something else. We talk about the computer 'doing something', that it is 'thinking ' about something, and even that it gets 'sick', like us, and does not always 'work' properly" (pg. 261). If children are not exposed to this unique language at an early age, they may have a harder time being able to interact with technology as they continue in their schooling. By providing this access in the early childhood classrooms, teachers are giving children additional opportunities for increased learning in later grades. The use of e-book technology in the classroom can also provide children with additional reading opportunities that they may be missing at home.

Home book reading is an important part of gaining literacy skills (Davidse et al., 2011; Vrinda, 2007). Children who are not read to at home have been shown to have significant gains in their literacy skills when given time to explore CD-ROM storybooks (Talley, Lancy, & Lee, 1997). CD-ROM storybooks and e-books can play a role in providing a similar parent-child experience that is so important to literacy knowledge. Korat and Shamir (2007) explain that a literacy gap can be seen as early as kindergarten. Children living in lower socieoeconomic status (SES) typically have a less rich literacy environment (Talley, Lancy, & Lee, 1997). By providing additional support in the classroom environment, children can gain valuable knowledge that they may be missing in their home environments. "Children who are more persistent with storybook reading tasks may experience more opportunities for participation" (Moody, Justice & Cabell, 2010, pg. 306). As with typically developing and children with special need, children with low SES are more motivated and engaged by stories

read in an e-book format (Moody, Justice & Cabell, 2010). The more engaged a child is with a literacy task, the more opportunities the child has for improving emergent literacy skills.

Similar to typically developing children and children with special needs, children in low income families can benefit from technology. Verhallen and Bus (2010) followed ethnic minority preschool children whose parents were of low education and economic levels for over two years. These children showed progress in both receptive and expressive vocabulary building when repeatedly exposed to digital storybooks. Improvement in phonological awareness, word recognition, and print concepts were also seen when children were exposed to a brief two session e-book intervention for children with low SES in kindergarten (Shamir, Korat, & Barbi, 2008). In the research by Korat and Shamir (2007), both children with low SES and middle SES showed improvement in vocabulary scores and story comprehension. Children in the low SES group showed the most significant increase in phonological awareness. These results suggest that children with lower SES have more to gain from the use of technology in the classroom than their peers in higher SES families.

Verhallen and Bus (2006) concluded that typical print versions of age-appropriate storybooks may be too difficult for low-income, immigrant children. By providing the children with video and audio support during storybook reading, they are more able to build their literacy skills. Although it took children with lower SES longer to show gains while using an e-book than children with middle SES, after five readings they had gained significant knowledge in word meaning, word reading, and phonological awareness (Korat & Blau, 2010). These gains were seen while using technology that was easy for the children to use without adult interventions. Typical print storybooks do not provide this built in support to assist children during independent literacy tasks. The word meaning knowledge that children are

gaining with e-book technology has also been linked to story comprehension (Korat & Shamir, 2012). When low SES grouped children are able to understand the meaning of words on a higher level, they can also understand the story better.

Challenges to E-books and Other Technology

Though benefits have been seen in typically developing children, children with special needs and children in low income families, it is important to consider that not all e-books are the same. E-books lack the uniformity that a print book has. In print form, all books open the same way, pages are turned in the same way and there is a consistency in how the book is read. De Jong and Bus (2003) investigated commercially available digital books and found that only 80% had an introductory screen, oral reading, forward button and printed text. Even less had a back button or interactivity within the story such as games or hotspots. These important features help children gain knowledge from the e-book and the researchers concluded the e-books available when the study was published were giving teachers and parents few choices in quality software. However, almost ten years have passed since this study was published. It could be assumed that with time and available research, a wider variety of digital books are available. If teachers are able to introduce quality e-books to children they can be used in an effective manner. In more recent research, high quality and commercially available texts have been used in research with young children. Shamir, Korat and Barbi (2008) used a commercially available e-book to study children in a low income neighborhood while Verhallen and Bus (2010) used two versions of a commercially available CD-ROM story when studying vocabulary building. The stories that were used incorporated narrated text and multimedia activities that did not distract from the reading of the story. The e-book used and others like it are available to teachers and parents alike.

Another area of debate with e-books is the integration of games or interactive options within the e-book. De Jong and Bus (2002) found that game integration into stories took attention away from the text. Trushell, Maitland and Burrell (2003) discussed a similar finding in 8 and 9 year old children. They found the interactive play during a story decreased the ability to recall story details. In de Jong and Bus' (2002) study, the electronic book used was chosen because "both a paper and electronic version were commercially available" (pg. 147). The quality of the electronic text was not critically examined prior to the study and although both versions of the book were similar, they were not identical text. Smeets and Bus (2012) used stories that were the same in both paper and e-book formats and found that interrupting the e-book to ask multiple choice questions actually helped increase vocabulary in preschool aged children. If e-books are used in classroom settings, teachers will need to be sure the interactive sessions are useful and beneficial to children's learning. Teachers can follow Smeets and Bus' (2012) suggestion of making sure the software is giving children the opportunity to interact on a higher mental level. This simulates the adult's questioning that often happens during adult-child shared reading. Teacher can also follow Talley, Lancy and Lee (1997) recommendation to use a storybook that includes interactive experiences before and after a text is read. This format allows children to think about the story before it is read and understand the story on a deeper level afterwards. When children are allowed to interact mentally during the reading process, e-books can increase learning.

Teachers Perceptions of Technology and the Importance of Teacher Training

Though research can provide ample evidence of the benefits of using technology to teach literacy instruction, teacher beliefs and their perception of technology will effect what is ultimately used in the early childhood classroom. If teachers do not fully support the use of

technology, then they are less likely to integrate it into the curriculum (Ihmeideh, 2010). Recent studies have shown that a large majority of early childhood teachers have a positive view of using technology in the classroom and strongly agree that computers should be part of a print-rich early childhood classroom (Chen & Chang, 2006; Eyadat & Alodiedat, 2010) Most also agree that developmentally appropriate literacy software should be available to children (Ihmeideh, 2010; Eyadat & Alodiedat, 2010). However, some teachers disagree about how technology should be used. Many do not believe it should be used to teach phonological awareness or for reading and writing on a daily basis (Ihmeideh, 2010). Ihmeideh (2010) suggests that teachers could be underestimating young children's abilities. The underestimation could be due to teacher's own personal experiences. Teachers who have been teaching less than three years and who own a computer have a more favorable attitude toward using them in the classroom (Eyadat & Alodiedat, 2010). Data in this study was collected in the Sultanate of Oman and may not completely representative of the United States. It might be suggested that teachers in the United States have more access to technology for personal use. If this is the case, teachers in the United States should have even more of a positive view of using computers than those in the study. There are numerous opportunities for a teacher to use technology in the classroom from providing e-books for independent reading to creating teacher-made digital picture books using programs such as Microsoft PowerPoint. However, this technology is not an effective tool if teachers do not know how to use it (Lin, 2012). As Plowman and Stephen (2005) found, "[Technology] does not always act as a support for learning" (pg. 153). This is especially true if teachers do not have a basic comfort level and understanding of technology. Having a favorable attitude toward computers, does not necessarily mean that a teacher will be able to effectively integrate the technology into the

classroom (Chen & Chang, 2006). Teachers need to be better prepared to use technology in early childhood classrooms.

Teacher training is both beneficial and needed. To enhance the learning process when involving technology, teachers need to provide guided interactions and detailed instructions to children (Plowman & Stephen, 2006). "The importance of the role of the adult companion cannot be overemphasized," (Matthews & Seow, 2007, pg. 261). Teachers need to have a strong teaching role even when technology is imbedded into curriculum. Plowman and Stephen (2005) describe guided interactions as actively assisting children while using technology. This assistance includes explaining how the software works, demonstrating how tools can be used and offering help when errors occur (Matthews & Seow, 2007). Additionally, adult led readings improved interactions during e-book instruction (Moody, Justice & Cabell, 2010). Children will do better and be more successful on tasks when an adult is available and can fully support their experience with technology.

Considering the support that children need when using technology, it is concerning that Chen and Chang (2006) found "many early childhood teachers are not ready to integrate computers in the classroom" (p.178) and only half of the teachers in the study reported feeling confident teaching young children to use a computer. Almost half of the teachers in the study actually needed help from another person when using a computer themselves. Ihmeideh (2010) found similar results when asking early childhood teachers about their use of technology for teaching literacy. When children use computers in an early childhood classroom, they most often come into technical difficulties if the software was not first introduced and taught by a teacher (Plowman & Stephen, 2005). Although research has not specifically studied other forms of technology, it can be suggested that young children should be taught how to use

technology for the most effective results. If teachers are not able to easily use the available technology themselves, it is unlikely they will be able to teach it or utilize it effectively in the classroom.

If teachers can carefully chose well-designed technology tools for the classroom, they can be implemented in an early childhood classroom as an additional learning experience to increase literacy development (Ihmeideh, 2010; Korat, 2010; Wood, 2005). However, Chen and Chang (2006) found that only 32% of early childhood teachers reported being knowledgeable about criteria on children's educational software. If teachers do not have the appropriate training, they are unable to choose well-designed and effective technology to integrate in the classroom. Shamir, Korat, and Barbi, (2008) found that children who were pre-taught how to use a program showed the greatest gains in knowledge. Teachers need to be the ones to teach children how to effectively use a new device or program that is being integrated into the curriculum.

A brief session of technology training may not be enough to encourage appropriate and well guided integration into the classroom. In a small study teachers who watched a brief online tutorial demonstrating how to use touchscreen devices during shared reading sessions found they needed more training to fully understand the best ways to use the device (Brueck, Burstein, O'Brian, Roskos & You, 2011). However, teachers that reported having more than a week of instructional technology training found it to be effective in improving their computer skills. These teachers also had a higher rate of using different teaching methods that integrated technology in the classroom (Chen & Chang, 2006). Interestingly, Eyadat and Alodiedat (2010) found teachers with no training actually had a more positive view of using computers in the classroom. In that study, it was unclear what kind of training was provided for the teachers that

had attended training sessions. It could be suggested that this result was due to not enough training or training that was not useful for the teachers.

Providing effective training for teachers should be a top priority. Chen and Chang (2006) suggest that effective technology training for teachers includes updated and specific information that builds on skills that the teachers have already acquired. It should also provide information on how to use best practices when integrating technology into the classroom. A teacher that is somewhat knowledgeable about technology is going to need different skills taught than teachers who do not use technology on a daily basis. With proper training, teachers can integrate technology in a positive way in early childhood classrooms.

Conclusion

When technology is integrated into literacy curriculum appropriately, typically developing children, children with special needs and children in low-income families all show benefits. If teachers have appropriate training they can incorporate e-books and other technology into literacy curriculum for early childhood children. Whatever the curriculum includes, it must be applicable and age appropriate for the children in the classroom. The technology that is included in literacy curriculum needs to also adhere to the limits and understandings of developmentally appropriate practices (Cooper, 2005; NAEYC, 2012). Lin (2012) describes the importance of technology but reminds that the successful use of technology is not determined by how much it is used in the classroom but how well it is chosen and integrated into the program. E-books can be used as a supplement to regular print books. This will add an overlapping and complementary experience for children (De Jong & Bus, 2002).

Application into the Early Childhood Classroom

E-books and other technology can be utilized as an additional supplement for children, especially those who may not have had robust literacy opportunities at home (Korat & Blau, 2010; Talley, Lancy, & Lee, 1997). When quality e-books are chosen, teachers can utilize them similar to a traditional print book. They can be used during independent reading times or with curriculum that has already been integrated into the classroom. Peer reading sessions are often already used in early childhood classrooms. Low SES kindergarten children who were placed into technology based peer reading situations gained more phonological awareness, emergent word recognition and story production abilities than children who read the same e-book independently (Shamir, Korat, & Barbi, 2008).

Quality technology software is going to vary depending on the needs of the children and goals of the curriculum. The verbal narration of a story and multimedia aspect of e-books will allow children to gain more from the interactions (Grimshaw et at., 2007). The interactive sections of e-books and other software should support specific literacy skills (de Jong & Bus, 2003) and link current classroom instruction to the technology being used (Boone, Higgins & Notari, 1996). For example, if the teacher is trying to increase a child's understanding of words, a program that incorporates direct teaching of words using a dictionary would be the most beneficial to the students (Korat and Shamir, 2012). Video formats are especially beneficial when compared to a static digital version of the same story (Verhallen & Bus, 2010). Software should contrast typical drill and practice type media by being meaningful and instructional (Boone, Higgins & Notari, 1996) while giving children the opportunity to use higher mental functions to better understand the specified literacy skills (Smeets & Bus, 2012; Korat & Shamir, 2007).

To help foster concepts about print, Shamir and Shlafer (2011) suggest providing e-books with large text, electronic page numbers that are clearly visible and forward and backward buttons to simulate the physical turning of the pages. The goal of this design is to create a format that children are already beginning to understand and use. Another design aspect to consider when choosing an e-book is the option for highlighted text. In print versions of books, children are often accustomed to using a bookmark or finger to follow text manually. That technique may not be as effective in and e-book format. E-books that are given to children for independent reading purposes should have the option of providing highlighting of words as the story is read (Grimshaw et al., 2007; Korat & Blau, 2010). Although less research has been done with this feature in mind, the most current research suggests using e-books that highlight and enlarge text as it is read (Korat and Shamir, 2012). With text size changes, children may be able to focus more on the words being read which helps to increase their reading abilities.

When considering what technology should be used in the classroom, a teacher should consider all available technology as well as ease of use for all the students. Teachers should consider utilizing touchscreen devices if they are readily available. This could be especially important if children with lower abilities are in the classroom (Cavanaugh, 2002). However, if touchscreen devices are shared among many classrooms, but computers are a classroom fixture, they may be a better option. As Liu (1996) found, short intervention periods tend to show less success than longer ones. Extended and repeated interactions with the same program are necessary to enhance the learning process. Technology that can be in the classroom consistently for children to utilize is going to give the best outcomes.

Future Research Suggestions

Current research, although showing great benefits of technology in the early childhood classroom, has largely been conducted using a typical computer with mouse interface. Although some four year old children quickly learn how to use a computer and mouse, some children find it difficult when trying to master the hand-eye coordination (Talley, Lancy, & Lee, 1997; Logan & Zevenbergen, 2008). Future research should investigate the benefits of newer technology such as interactive white boards (IWB) and tablet computers. The research in this area for the early childhood sphere is extremely limited and lags behind the research for older children. Many new e-books can be easily accessed using technology such as a tablet computer and IWB.

Research should clarify the viability, availability and outcomes of early childhood children when using this newer technology. It is currently being used in many early childhood classrooms but research is lagging as to best practices for these devices (Couse & Chen, 2010). The current research in this area, though hard to find, is beginning to provide data backing the idea that smaller handheld devices and tablet computers could be a viable resource for young children when learning new skills. Four kindergarten children were shown to be able to use a PDA successfully. They showed motivation and on-task behaviors while using the handheld device (Chang, Mullen & Stuve, 2005). However, this was an extremely small sample of students in only one classroom. Other studies have confirmed that children as young as three years old were able to easily manipulate stylus-driven and touchscreen tablet computers with minimal frustration (Couse & Chen, 2010; Matthews & Seow, 2007)

It is not enough to simply look at how this new technology can be used in a classroom but it must be determined what technology is actually available to teachers in early childhood classrooms. Further research should look into the availability of technology in the different

settings that preschoolers often find themselves in. Since preschool aged children do not have a designated place for learning, as older children do in the public school system, research into the different areas of early childhood is important. Investigating what types of technology are available to children in the home, community based program, private programs and in-home daycare settings would be important for understanding young children's access to technology. Logan and Zevenbergen (2008) suggest providing funding reforms to help early childhood teachers gain knowledge into the use of technology in the classroom. However, this would be difficult because of the fragmented structure of the early childhood sector. This fragmented structure may also provide an unclear analysis of early childhood outcomes when using technology.

Once technology access in the early childhood classrooms is discussed, extended outcomes of its use should be examined. Most of the current studies are short-term and examine only parts of literacy knowledge learning. Research needs to look more into the long-term aspects of integrating technology into early childhood classrooms on literacy development. What effects, if any, does technology have on children exposed to e-books and other technology from pre-reading to 3rd grade when "real" reading is in full swing? Does this then later affect their abilities to use and understand technology later in their learning years?

Lastly, future research should identify ways technology can be used with diversified learners. Within a classroom, each child may have a different way of learning the same presented material. Wild (2009) found that the girls in her study performed better with a computer trial than the boys did. It would be beneficial to conduct studies identifying which types of learners do best with e-books and other technology.

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