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Author

Neumann, Michelle M, Neumann, David L

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The use of touch screen tablets at home and pre-school to foster emergent literacy

Michelle M. Neumann^a and David L. Neumann^b

^aGriffith Institute for Educational Research

Griffith University, QLD 4222, Australia

^bSchool of Applied Psychology

Griffith University, QLD 4222, Australia

Please direct correspondence to:

Michelle M. Neumann: Griffith Institute for Educational Research, Griffith University,

QLD 4222, Australia. Telephone: +61 (0) 7 56788307. E-mail: m.neumann@griffith.edu.au

Abstract

Young children living in technology-based communities are using touch screen tablets (e.g., iPads) to engage with the digital world at an early age. **The intuitive touch screen interface, easily downloadable apps (applications), and mobility of tablets drive their increasing popularity with pre-schoolers. This review examines research to date on tablets, apps, and emergent literacy in young children in the home and at pre-school. Evidence is building that suggests tablets have the potential to foster emergent writing and letter knowledge.** Although the impact of tablets on emergent literacy is not yet fully known, developing themes highlight potential benefits and hindrances of tablets for emergent literacy. Two important considerations are the quality of emergent literacy apps and the importance of scaffolding young children's use of tablets at home and pre-school to support emergent literacy development. Directions for future research and recommendations for parents and teachers are discussed.

Key words: Touch screen tablets, iPads, apps, emergent literacy, pre-school, home, parents, teachers

Introduction

Compared to other digital devices such as laptops, personal computers, and mobile phones, touch screen tablets (e.g., iPad) are currently the most popular among young children and this trend is rising (Livingstone et al., 2014; Ofcom, 2014; Siegle, 2013). With increased access to tablets in homes and pre-school settings, young children are spending a significant amount of their time using tablets for entertainment and educational purposes, exploring the internet, and communicating with others. Interviews conducted with parents of 3 to 4 year old children ($N = 731$ in 2014) in the UK showed that 65% of children have access to a tablet at home, 11% own their own tablet, and 41% are playing games on tablets (Ofcom, 2014). **A more recent UK survey of 2000 parents showed that 36% of 3 to 5 year olds own their tablet with 0 to 5 year olds using tablets for 79 minutes per day on average (Marsh et al., 2015). Half of 0 to 2 year olds and two-thirds of 3 to 5 year olds can independently open apps, swipe and turn the pages of e-books, and trace shapes on a tablet screen with a finger (Marsh et al., 2015).** A smaller Australian parent survey ($N = 109$) found that 61% of 3 to 5 year olds have one or more tablets at home and are using them for an average of 20 minutes per day. The most popular apps used by children were gaming apps (e.g., Angry Birds; Fruit Ninja) followed by literacy apps (e.g., Pocket phonics, Sesame ABC) (Neumann, 2014).

Unlike personal computers that require more complex fine motor skills to operate, the intuitive touch-based interface of tablets make them easy to use for even 0 to 2 year olds (Marsh et al., 2015). This has been a critical feature of tablets that enables toddlers and pre-schoolers to quickly acquire the technical skills to use these devices and begin interacting with printed letters, symbols, and words on the screen (Crescenzi, Jewitt, and Price, 2014; Fletcher-Watson, 2013; Goodwin and Highfield, 2012; Michael Cohen and USDOE, 2011). For example, 8 to 10 month old children can use their fingers to explore and experiment with

mark making using tablets (Crescenzi et al., 2014) and 3 to 4 year old children can independently use apps to write their own stories (Verenikina and Kervin, 2011) **and read interactive e-books (Miller and Warschauer, 2014; Salmon, 2013) on tablets.** The engaging and multimodal features of tablets afford a range of opportunities for fostering emergent literacy development. **Due to the increasing popularity of tablets as digital devices for young children it is important to explore the effects tablets have on emergent literacy.** A pilot study based on a parent survey by Neumann (2014) found that pre-school children's ($N = 109$) home access to tablets was positively correlated with letter sound and name writing skills and the author suggested that tablets may be a promising tool for fostering aspects of emergent literacy. The present review will examine the recent research that has used tablets at home and in the pre-school setting to foster emergent literacy skills.

The literature search was conducted using Proquest, Eric, and Google Scholar databases and was limited to 2011 to 2015. The key words searched were (tablets or iPads or touchscreen or apps) AND (emergent literacy) or (early literacy) AND (pre-school and home) and yielded 139 results. The abstracts were reviewed and the search was further limited to studies that examined emergent literacy development in pre-schoolers who interacted with tablets and apps in the home and/or the pre-school setting. Studies reporting on school age children (>6 years old) were excluded from the review. Following screening, there remained 16 relevant articles. The articles comprised of 11 pre-school and 5 home based studies that examined tablets and literacy based apps and/or aspects of emergent literacy development. Twenty-four articles on more general early childhood use of tablets and apps in the home and pre-school setting were also reviewed to further inform emerging themes about tablets and recommendations. Theoretical perspectives, use of tablets as tools to foster emergent literacy in the pre-

school and home settings will be discussed followed by emerging themes and recommendations.

Theoretical Perspectives on Emergent Literacy and Tablet Use

Digital devices and their print-based interfaces have the potential to influence the development of emergent literacy (Hisrich and Blanchard, 2009). Emergent literacy skills include a range of knowledge and understandings about letter sounds and names, print concepts, phonological awareness, and early writing skills that serve as the precursors to conventional reading and writing (Storch and Whitehurst, 2002; Whitehurst and Lonigan, 1998). From birth, children's understandings about literacy emerge as they begin to make sense of their world through experiences and explorations of surrounding print (Clay, 1991; Sulzby and Teale, 1991). This print may be present in a child's environments in digital (e.g., tablets) and non-digital (e.g., paper-printed books) forms. Viewed from a Vygotskian perspective (Vygotsky, 1978), young children's independent and shared interactions with the printed interface of socio-cultural tools such as touch screen tablets have the potential to foster emergent literacy (Neumann and Neumann, 2014). Through the use and exploration of tablets young children also develop a range of technical and operational skills such as unlocking the device, navigating through interfaces, menu selection, and using different touch gestures such as drag or pinch (Michael Cohen and USDOE, 2011). For example, a study of ten UK families (with children aged 0-5) in their homes found that young children were competent users of tablets as shown by being able to navigate between icons and apps using visual and audio stimuli, and adjust multimodal features (Livingstone et al., 2014).

Although young children are capable of using tablets independently, tablets may also be used by parents and teachers to scaffold young children's emergent literacy

development (e.g., McManis and Gunnewig, 2012; Neumann and Neumann, 2014). Scaffolding (Wood, Bruner, and Ross, 1976) is the process whereby a more knowledgeable other (e.g., parent, teacher, peer) provides a child with assistance to complete a task. The guidance for that specific task is removed once the child has mastered the required skill. Räisänen, Korkeamäki and Dreher (2015) highlights how through the use of technology in early childhood classrooms teachers are beginning to move from a traditional model of teaching to a model that more broadly supports emergent literacy development. Räisänen et al., (2015) describes how over the school year Finnish students in grade one increasingly engaged in a variety of digital activities for a range of meaningful and social purposes. For example, through teacher scaffolding, children's use of digital and non-digital tools for literacy purposes became more sophisticated as children wrote emails, read books, searched the internet, wrote stories in both handwriting and with computers, and created a web shop.

Use of touch screen tablets at pre-school

In the pre-school setting, tablets are viewed as a tool for play, communication, and expression (Geist, 2014), that stimulates positive social interaction, meaningful talk, motivation to learn (Flewitt, Messer, and Kucirkova, 2014; Hatherly and Chapman, 2013), and promotes ownership of learning (Conn, 2012; Lee, 2015). Tablets may be used in the classroom to integrate learning, increase levels of challenge, and provide feedback and rewards (Riconscente, 2013). Accordingly, tablets have been used for whole class instruction, independently, and in small groups for a variety of purposes to support emergent literacy growth in the pre-school classroom (Beschorner and Hutchison, 2013; Huang, Clark, and Wedel, 2013; Northrop and Killeen, 2013).

Qualitative studies in the pre-school setting have examined how tablets support emergent literacy skills such as emergent writing (e.g., Beschorner and Hutchison, 2013, $N =$

35; Bigelow, 2013, $N = 15$; Crescenzi et al., 2014, $N = 7$) and letter knowledge (Huang et al., 2013, $N = 2$). For example, Huang et al. (2013) described how a pre-school teacher used ABC Matching apps (e.g., dragging letters across the screen with a finger to make words), and ABC Letter Tracing apps to support pre-school children with their literacy learning. This case study reported that through the use of iPads the students made improvements in their letter name and sound knowledge and in their confidence, motivation, and attention span.

Children have been observed to independently use tablets and writing apps (e.g., iWrite, Doodle Buddy, Drawing Pad) in the pre-school setting to create messages containing letters, drawings, and typed text (Beschoner and Hutchison, 2013; Bigelow, 2013). Tablets and apps supported emergent writing in a range of ways such as message making through self-portraits, joint construction of emails, and name writing. Writing activities included drawing images with fingers, typing with one or two hands, and engaging in hunt and peck typing with the pop up keyboard. A range of touch screen interactions (e.g., taps, prints, undo) were used by children, including altering the appearance of their marks by varying the thickness of the digital paint brush and selecting from a range of colours, glitter, and stamps (Beschoner and Hutchison, 2013). Interestingly, children also attempted to read what they wrote even though their writings were often strings of random letters. Also writing talk (e.g., “I am writing this for my mom”, Beschoner and Hutchison, 2013, p. 20) occurred during these tablet activities.

It has also been noted that tablets allow children with limited letter shaping ability to write because they can use the pop up keyboard to type words (Beschoner and Hutchison, 2013). The pop up keyboard feature enabled children to independently use story book apps (e.g., Three Little Pigs) to create their own digital stories, which may be a difficult task if using non-digital tools (e.g., paper and pencil). Writing may also be fostered through literacy apps that allow children to move letters on the screen to form words (e.g., Magnetic Letter

app). These apps can be advantageous because they provide opportunities for children to move around the classroom to search for environmental print on walls and form these words on their tablet (Beschoner and Hutchison, 2013).

Pre-school teachers also play a key role in scaffolding emergent writing activities on the iPad by using a variety of approaches such as providing physical prompts (e.g., this is the T button), assisting with message generation (e.g., spelling words by identifying letters on the popup keyboard), modelling the construction of email messages, providing encouragement (Bigelow, 2013), and asking questions (Beschoner and Hutchison, 2013). The easiest touch movements for children were tap and swipe, although children asked their teacher for technical help if movements were difficult (e.g., pinch or stretch; Bigelow, 2013).

By examining differences between message making with tablets versus non-digital tools it may be possible to identify what literacy behaviours are facilitated by tablets. Crescenzi et al. (2014) compared the creation of messages using iPad apps (e.g., Doodle buddy, Colouring Zoo, Finger Paint Magic) with non-digital materials of paper and paint palette (finger painting). Tapping touches and straight and circular strokes were mostly used with the iPad and press touch occurred most frequently in the paint-paper medium. Repetition of touch occurred across both tools but was greater with the iPad and children made more sequences of continuous touch on the iPad than with on paper. Crescenzi et al. (2014) concluded that tablets may be beneficial for activities requiring a series of continuous touch movements. Engaging with such a digital tool may foster pre-drawing behaviour and assist children's "digit skill" development, further extending touch experiences. Tablets may also allow a continuous flow of children's focus on their message making in contrast to paints that require a break in the sequence of touch to shift back and forth between the paper and paint palette (Crescenzi et al., 2014).

However, some aspects of tablets may hinder young children's experiences with the non-digital environment (Crescenzi et al. 2014). For example, children may develop reduced awareness that different amounts of pressure applied to objects may result in varied effects (e.g., pressing hard with a crayon on paper will produce a darker and thicker mark). Also, tablets limit particular sensory experiences (e.g., the cold, oozy, gooey substance of paint, varied consistency, and rich colour of paint texture) reducing opportunities for important sensory and haptic experiences. Therefore, it is suggested that both non-digital and digital tools are needed to support a greater range of tactile experiences. Children's environments and types of touch experiences engaged in meaning making should be carefully considered by early childhood educators (Crescenzi et al., 2014).

The aforementioned studies (Beschoner and Hutchison, 2013; Bigelow, 2013; Crescenzi et al., 2014; Huang et al., 2013) have been largely descriptive in their approach. To draw stronger conclusions on the causal effects of pre-school use of tablets on emergent literacy development, quasi-experimental studies have been conducted (Brown and Harmon, 2013; Cubelic, 2013). Cubelic (2013) non-randomly assigned 16 pre-school classes ($n = 144$) to an iPad intervention group or a control group ($n = 147$) where children did not receive iPads. Teachers selected their own apps (e.g., ABC phonics, ABC Touch n Learn, Pocket Phonics) to foster phonemic awareness and the alphabetic principle and children used the apps for approximately 20 minutes per week. The children were assessed three times throughout the year on letter naming, first sound fluency, phoneme segmentation, and nonsense words. Although a large pre-post-test effect was found for both groups ($d = .87$; control group and $d = .84$; treatment group $p < .001$), there was no significant difference between the control and the treatment group on the early literacy measures.

A similar study with pre-schoolers was conducted by Brown and Harmon (2013). Twenty Head Start children aged 4 to 5 years old were randomly allocated to an intervention

group or comparison group. The intervention group was instructed (one hour per week for 10 weeks) to use three apps (names of apps were not reported) that targeted specific academic areas (literacy and numeracy). Children spent 20 minutes using each app during each session. The comparison group interacted with iPads using different educational apps to the treatment group. Children were pre- and post-tested on letter knowledge, matching, and number concepts. No statistically significant differences were found between the groups on any measures.

The findings by Brown and Harmon (2013) and Cubelic (2013) may be taken as evidence that there is no advantage to using tablets for the acquisition of literacy skills. However, the findings may also reflect aspects of the methodology. For example, home use of tablets was not controlled for, app selection criteria were not reported, and it may have been difficult for the classroom teachers to facilitate the iPad program due to practical constraints (e.g., class routine demands). In addition, the length of time that children engaged with the iPads may have been too short or more sessions may have been required to see significant effects. Finally, the null findings suggest that there may be other factors that mediate the effectiveness of tablets such as teacher scaffolding, the quality of the apps, and child's level of engagement and digital skills.

Overall, the research reviewed (e.g., Beschorner and Hutchison, 2013; Huang et al., 2013) suggests that tablets and apps are a positive tool that can support aspects of emergent literacy learning (e.g., letter knowledge and emergent writing). However, the experimental studies (Brown and Harmon, 2013; Cubelic, 2013) have shown that tablets and literacy apps do not significantly improve literacy skills (phonemic awareness, alphabet knowledge). These studies have been limited by factors such as non-randomised allocation of participants to experimental groups, varied treatment times, home use of tablets, and sample size. Therefore,

further empirically designed studies in the pre-school setting will help to clarify the effects of tablets and apps on emergent literacy development.

Use of touch screen tablets at home

Young children's understandings about print may emerge at home through their interactions and play with tablets (McManis and Gunnewig, 2012). For example, Livingstone et al. (2014) observed UK pre-schoolers in their home independently using tablets to locate information on the internet and play a range of educational and entertainment apps. Pre-readers in Livingstone et al.'s (2014) study were observed to identify basic words on tablet screens (e.g., Play, OK, Click, Next) and used their early phonetic skills to type words on Google or YouTube. An increasing awareness of print and icons on tablets and computers may be developmentally similar to the way children develop understandings about non-digital environmental print (Neumann and Neumann, 2014). The extent that young children's exposure to print embedded in touch screens (e.g., explorer or safari app icons) fosters print awareness during independent play is unknown. However, there is building evidence that joint parent-child interactions with tablets may play a key role supporting young children's emergent literacy development.

To date a lack of studies exist that have examined aspects of emergent literacy and tablets in the home context (Kucirkova, Messer, Sheehy, and Flewitt, 2014). **However, the use of tablets to support emergent literacy development through parental scaffolding in the home setting may be a promising area of enquiry. Kucirkova et al. (2013) described how a mother and her 33 month old daughter shared stories on their iPad and used the Our Story app at home to jointly create a personalised story. The mother comfortably held the iPad with her right hand whilst embracing the child and used her left-hand index finger to point out pictures and text on the screen whilst asking the child questions. Such support facilitated the child's understanding that the printed words on**

the tablet screen have a relationship with real-life objects and events. Kucirkova et al. (2013) also highlighted that using the iPad and Our Story app provided an effective way for the mother to build on her child's sociocultural experiences with print, sounds, and pictures.

Toddlers' and pre-schoolers' emerging awareness of print in the home may also be fostered through interactions with reading e-books on tablets (Hoffman and Paciga, 2014; Morgan, 2013; Salmon, 2013). For example, research that has used e-books presented to pre-schoolers on personal computers have been found to enhance phonological awareness (Chera and Wood, 2003) and emergent writing and word recognition (Shamir and Korat, 2007) particularly if a parent mediates their e-book interactions (Korat and Or, 2010; Korat, Shamir, and Arbiv, 2011). However, there has been research to suggest that the multimodal features of e-books may distract young children and parents from the story itself (e.g., De Jong and Bus 2003; Shamir, 2009).

Javorsky (2014) explored the distractive features of e-book apps by comparing them with paper-based books and found that e-book apps contain several unnecessary features that children attend to and process (e.g., digital operations, interactivity, and icon use). For example, a sequence of technical procedures is required before reading a story on a tablet (e.g., turning it on, adjusting the volume, selecting an e-book app icon). Children are continually stimulated by audio (e.g., story narration and music) and visual (e.g., animated pictures) information and story option selections that contain highlighted words and embedded games within the illustrations or text. In contrast, paper-based story books consist of one front cover that is simply located and opened and tangible pages are turned without digital interruptions.

The disparity between e-books and paper books was further investigated by Krcmar and Cingel (2014) who compared parent-child shared reading of paper-based books with an

e-book presented on an iPad ($N = 70$; child age = 24-60 months). **Parents read their child two books (Quiet Bunny, Noisy Bunny) in paper printed form and on the iPad for 10 minutes for each book and children's recall of the stories was assessed.** Parents were observed to engage in more distractive talk with their child about the e-book format and environment when sharing an e-book. In contrast, parents provided more evaluative comments and asked more questions about the story in the paper printed book format. Children recalled more events in the story after parent-child sharing of the paper-printed book than with the e-book. It is suggested that electronic features of e-book apps distract young children and may not be the most optimal tool for parent-child shared reading activities at home. Alternatively, e-book apps for tablets may need to be better designed by app developers to reduce potential distractions for learning (e.g., include a feature that allows music and animations to be turned off). Providing parents with guidance on how to best share e-books on tablets at home is also important to consider.

Studies have shown how media software used on digital devices such as mouse operated personal computers (e.g., reader rabbit, KidPix word program) can support emergent literacy (Hisrich and Blanchard, 2009; Yost, 2003). Easily downloadable tablet literacy apps also have the potential to support emergent literacy development through parent scaffolding. Petkovski (2014) observed the types of scaffolding strategies parents used during iPad play with their children. The parents ($n = 72$ mothers and $n = 32$ fathers) and their 2 to 6 year old children were video-recorded for 10 minutes playing seven reading apps (e.g., Super Why app: alphabet search, letter formation, and rhyming activities; Reader Rabbit app: letter skills, reading, and phonics) and five math apps (e.g., Teach Me app and Monkey Math School: number and patterning skills). Parents were free to select any of the apps for their child to play with during the iPad session.

A range of parent scaffolding behaviours were coded and parents were found to provide physical (e.g., adjusting the iPad viewing angle, holding the iPad, pointing to screen), verbal (e.g., reading aloud screen instructions, asking their child questions relevant to the app content, clarifying game instructions), and emotional (positive feedback such as saying “good job”, giving a “high-five”) support. The verbal support during the app activities was the most frequent behaviour with parents providing an average of 79 verbal supports during the 10 minutes of iPad play. Although conclusions regarding the effects of literacy apps on emergent literacy cannot be made from this study it is possible that parent scaffolding during child tablet use may have a positive influence on emergent literacy. However, such a notion may depend upon the type of scaffolding used and how it guides the child during their interactions with tablets and literacy apps.

In addition, Petkovski (2014) surveyed parental beliefs about their children’s tablet use at home. The participants reported that children used tablets at home for mainly entertainment and half the parents indicated that they believed tablets and apps would help their child’s reading and language skills. However, nearly a quarter of parents indicated concerns about their child’s independent use of tablets at home. Such concerns included that tablets could become addictive, overused, and reduce time for non-screen activities (e.g., reading traditional paper printed books). Research has shown that the most popular apps children play at home are not literacy or e-book apps but gaming apps (Livingstone et al., 2014; Marsh et al., 2015; Neumann, 2014). For example, it has been reported that in the UK, the most popular apps young children used consisted mainly of gaming and entertainment apps (e.g., Angry Birds, Temple Run, Candy Crush Saga; Marsh et al., 2015). Such gaming apps tend to have more repetitive and addictive-like features in their game design with learning benefits not clearly apparent. As one recent UK report showed that 0 to 5 year olds ($N = 731$) play on their iPads at home for on average of 79 mins per day (Marsh et al., 2015)

it is important to study the impact of such apps not only upon young children's emergent literacy but other developmental domains (e.g., physical, cognitive, and social/emotional).

Emerging themes and recommendations

Although only a limited number of studies on tablets and emergent literacy in the pre-school and home setting have been conducted to date there is some evidence that tablets may support aspects of emergent literacy such as emergent writing and letter learning (e.g., Beschorner and Hutchison, 2013; Bigelow, 2013; Crescenzi et al., 2014; Huang et al., 2013). However, the relationship between tablets and emergent literacy in young children is likely to be complex. From the research reviewed, two key themes have emerged. These are the quality of emergent literacy apps and how parents can effectively manage children's use of tablets to best support emergent literacy development.

Tablet experiences and emergent literacy outcomes may be dependent upon the quality of the literacy apps and variability in the quality of literacy apps has been noted by researchers (e.g., Sandvick, Smørðal, and Østerud, 2012; Verenikina and Kervin, 2011). For example, the See and Say app for pre-schoolers was examined by Sandvik et al. (2012) and found to be less cognitively challenging than the Puppet Pals app. Also, Verenikina and Kervin (2011) discussed how some apps are advertised as educational but observations suggested that children were not being engaged by the literacy app quickly losing interest. In contrast, children preferred the imaginative Puppet Pals picture story making app but required additional scaffolding support by a parent to use it. The quality of an app may also be reduced by distractive features (e.g., hotspots, distracting animations) that have the potential to divert children's attention to print and the story line, reducing story recall ability (Northrop and Killeen, 2013). It is suggested that such distractive features may increase cognitive load and impact upon learning (e.g., Bigelow, 2013; Krcmar and Cingel, 2014). In addition, More and Travers (2013) argue that several early literacy apps targeted for young children are akin to

unengaging worksheets or flashcards and recommend that teachers frequently change apps, vary the time spent on apps, and avoid rote/skill and drill apps.

Apps designed for literacy based tasks may also possess features that reduce children's focus on reading and writing activities. For example, Bigelow (2013) reported that some children in their study became distracted from their message making task by the stamping feature in the iWrite app. Further concerns about teachers' and parents' selection of quality literacy apps involves the extent of commercialisation embedded in some of the more freely available apps (e.g., external links and pop up adds), which has the effect of annoying children and disrupting learning (Holloway, Green, and Love, 2014). It is clear that the importance of supporting parents and teachers in critically evaluating and selecting quality emergent literacy apps for children's learning cannot be underestimated (Chau, 2014; Graves, 2012; More and Travers, 2013). By adopting a critical approach at the design level and through the informed selection of apps it will be possible for parents and teachers to optimally use tablets to enhance emergent literacy development in young children (Lee, 2015; More and Travers, 2013).

However, the process of ensuring that quality emergent literacy apps are being designed, released, and selected may be difficult. Currently, two major players dominate the app market with both the Apple iOS app store and Google android play store containing over one million apps each (Chau, 2014) with over 75 billion apps downloaded from the Apple app store to date. This figure will continue to rise as app developers constantly upload new apps, making the selection process for parents and teachers potentially overwhelming. This task is made particularly challenging because the Apple app and Google Play stores do not provide rigorous critical testing and evaluation of the apps targeted at young children (More and Travers, 2013). Apple provides a superficial review of each app that adhere to legal requirements (e.g., privacy conditions) and gives little information to the purchaser about app

content such as specific learning outcomes in relation to early childhood learning and curriculum (Chau, 2014). As a result, most apps marketed as being educational often lack basic pedagogical design features required to support learning (Flewitt et al., 2014; Goodwin and Highfield, 2012).

General app guidelines that can be used by parents and teachers to initially evaluate emergent literacy apps include that apps should have clear instructions, be animated, have appropriate multimodal features, do not contain any violent characters or actions (e.g., Angry Birds, Fruit Ninja, Talking Tom Cat app) or reflect negative social values (e.g., Subway Surfer), and refrain from cultural or gender stereotyping (Chau, 2014; Goodwin and Highfield, 2012). Chau (2014) further identified non-child friendly tactile features that should be considered such as pinch, tilt, multitouch, flick, and double tap and emphasised that more intuitive operational touch gestures should be used for young children such as tap, trace, swipe, drag, and slide.

Northrop and Killeen (2013) provide a practical example of how to evaluate an emergent literacy app such as a phonics app. They describe the Pocket Phonics app as a positive early literacy app because it supports learning of letter formation, sounds and word blends with practice on short or long vowel sounds. The positive features include audio that provides letter sounds and movable letters to form words. However, it also has negative features as it does not provide letter names, contains limited words for blending practice, and leads children too quickly onto more complex phonics concepts. Therefore, to work with such an app Northrop and Killen (2013) suggests that it is important to ensure children have achieved blending skills before moving to the next level of the app.

The following app instruction framework was recommended by Northrop and Killeen (2013) for teachers when using apps as part of an early literacy program. First, introduce the target literacy skill (e.g., letter knowledge) using non-digital materials and activities (e.g.,

plastic letter shapes or magnets). Next, model and explain the literacy content of the app with an emphasis on linking it to the target literacy skill. Finally, actively guide children through the app (how to operate it) with reference to the target literacy skill and encourage children to independently practice the skill with the app. It is also important to create home-pre-school links by sharing effective apps used at pre-school with parents. Northop and Killeen (2013) recommend the following types of emergent literacy apps: alphabet letter knowledge (e.g., iWrite words), phonics (e.g., Word Connex), sight words (e.g., Fry sight words), and comprehension (e.g., Toontastic).

A second less researched theme that has emerged from the present review is how to best help parents manage child use of tablets in the home setting to support emergent literacy. Parents have been observed to naturally use a range of tablet scaffolding strategies (e.g., physical: pointing to words, letters, and numerals on the screen, verbal: asking questions, and emotional: providing positive feedback) to guide their child's learning during interactions with literacy apps (Petkovski, 2014). However, reports indicate that during independent use, children use tablets at home mainly for entertainment purposes (e.g., Livingstone et al., 2014; Marsh et al., 2015). Therefore young children may be playing apps that are not age or developmentally appropriate and lack clear learning features. Some parents also indicate they are struggling to manage their child's use of tablets (Holloway et al., 2014) and believe that increasing use of tablets may decrease young children's appreciation of traditional emergent literacy activities such as reading paper-based books (Livingstone et al., 2014). It is important for policy makers to provide families with evidence-based strategies to help create positive learning experiences with tablets that not only fosters emergent literacy but also helps families select high quality apps and manage tablet use (Lauricella, Wartella, and Rideout, 2015; Veldius, van Gricken, Renders, Hirasing, and Raat, 2014).

Future research

The research to date suggests that tablets and apps may have potentially positive and negative effects on children's emergent literacy development. For example, a tablet may be a more effective tool to foster children's letter shaping through its continuous touch based features when compared to a paint palette that requires breaking a child's concentration to re-dip their finger in the paint. Alternatively, reading a paper-printed story book may be better at fostering aspects of emergent literacy than reading an e-book on a tablet due to an app's distracting features. Young children may gain positive opportunities for emergent literacy learning through tablets, apps, and parent and teacher scaffolding. However, further research using randomised control designs and quantitative measurements (e.g., Fletcher-Watson, 2013; Livingstone et al., 2014) are needed in a diverse range of home and pre-school settings to determine exactly what emergent literacy skills tablets and apps promote (Chau, 2014; Sandvik et al., 2012). In addition, the types of strategies parents and teachers can use to best manage and scaffold tablet use (e.g., app selection, screen time, internet access) and positively support emergent literacy learning requires further examination. **Finally, it would be important to evaluate how digital devices such as tablets create diverse multimodal spaces for young children's literacy learning and meaning making. This approach could be viewed from a literacy education framework where interconnections between digital tools and home, pre-school, and community experiences are used to create spaces for text-making (Pahl and Rossell, 2011). As noted by Pahl and Rossell (2011), this may require "redesigning the classroom to reflect the reality of the outside world" (p. 147).**

Conclusion

Young children learn about literacy through a range of experiences with non-digital print materials like paper printed story books, paper/pencils, environmental print signs/labels and with digital print on computer and tablet interfaces. Both non-digital and digital print experiences have the potential to foster emergent literacy and help young children learn to use a symbolic coding system to communicate. However, the benefits of tablets for emergent literacy development require further investigation. Researchers, educators, app developers, and policy makers need to ensure that apps for young children are designed with rigour, have a strong theoretical basis, and are finished at a high standard. Providing parents and teachers with effective strategies for scaffolding young children's tablet use and advice on selecting quality literacy apps has the potential to enhance emergent literacy learning in young children.

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