Using tablets in a prekindergarten classroom to foster phonological awareness

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Abstract

Today's young children are exposed to a variety of digital technologies in their home and school environments. While the presence of these technologies is increasing in US prekindergarten classrooms, teachers must critically analyze the role these tools will play in the quest to provide early learners with developmentally appropriate practice. The benefit of using tablet-based applications, compared to traditional concrete materials, to teach phonological awareness skills is the focus of this study conducted in 2014. The sample consisted of 27 four- and five-year-old children, who attended a half-day early childhood program, 5 days a week, in a Midwestern university laboratory school in the US. Children participated in similar small-group instruction once or twice a week for 4 months, from September to December, targeting phonological awareness skills. A comparison was made between those who were instructed using the traditional materials and those who used tablet-based applications. Both groups were found to make progress toward mastering the tested skills. There was no significant difference between the two groups' acquisition of these skills. Students were able to achieve targeted phonological awareness skills using either method of instruction.

Keywords

Prekindergarten; phonological awareness; emergent literacy; technology; tablets; mobile technology

ISSN 1838-0689 online

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Introduction

The question of whether or not to use computer technology in early childhood classrooms to promote student learning is an important one. While some scholars and practitioners continue to question the effectiveness of technology in early childhood classrooms (Cordes & Miller, 2004; Laffey, 2004), a growing body of evidence supports its positive impact on student learning (e.g., Clements & Sarama, 2003b; Couse & Chen, 2010; Lentz, Seo, & Gruner, 2014; Marklund & Dunkels, 2016; Schacter & Jo, 2016; Yelland, 2005). Technology has also been linked with children's growth in social/emotional development, math, and literacy skills (Flewitt, Messer, & Kucirkova, 2015; Neumann & Neumann, 2017), especially when facilitated by adult guidance (McManis & Gunnewig, 2012). While tablet devices have become more popular for educational purposes (Bajovic, 2018; Couse & Chen, 2010; Hutchison, Beschorner, & Schmidt-Crawford, 2012), there is limited empirical evidence to substantiate their effective use in early childhood classrooms across the curriculum.

Phonological awareness, an essential element of early literacy, is foundational in fostering an ability to read words (Sari & Acarr, 2013). It involves an awareness of the sounds within words, as well as the ability to manipulate those sounds (Gillon, 2004; Yopp & Yopp, 2000); for example, knowing a word like "party" is comprised of two syllables, or the words "hat" and "cat" rhyme. Research suggests a predictive relationship between early literacy experiences, such as activities associated with phonological awareness, and literacy development in later years (National Early Literacy Panel, 2008), as well as a causal factor associated with struggling readers (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003; Wagner & Torgesen, 1987). It is important to consider how current technologies may work to support phonological awareness. The purpose of this study was to examine the effectiveness of technology, specifically applications (apps) accessed via touch-tablet devices, in comparison to traditional instructional approaches of phonological awareness skills in an early childhood classroom comprised of 4- and 5-year-old children who attended a half-day program, 5 days a week.

Literature review

Research on early literacy skills repeatedly indicates critical elements such as phonological awareness, print awareness, and oral language development are crucial for future reading success (Pinnell & Fountas, 2011; Vellutino, Tunmer, Jaccard, & Chen, 2007). However, students come to school with varying literacy abilities, creating a reading gap between students. This is evident even before children enter school (Lee & Burkam, 2002). Massetti (2009) found the reading gap between students from low and middle/upper income families can be closed through the appropriate teaching of critical early literacy skills such as phonological awareness. Massetti's research, along with the results of others (Isaacs, 2008; Whitehurst & Lonigan, 1998), has led to an increased emphasis on academic readiness in early childhood. The challenge to meet high academic demands and still maintain the use of developmentally appropriate practices can be addressed through effective instructional design and implementation. Developmentally appropriate practice is an educational philosophy where educators consider a child's stage of development and identified goals to promote optimal learning when designing instruction (Copple & Bredekamp, 2009; Swim, 2015); they include pedagogical approaches such as the use of play and hands-on experiences. These same practices and principles apply to the

ISSN 1838-0689 online

implementation of technology as a learning tool when guided by digitally literate teachers (Clements & Sarama, 2003a; Finegan & Austin, 2002; National Association for the Education of Young Children [NAEYC] & Fred Rogers Center, 2012; Parette, Quesenberry, & Blum, 2010; Smith, Burrow, Fite, & Guerra 2016).

Importance of phonological awareness

Phonological awareness is the ability to recognize that words are comprised of smaller, interchangeable units of sound or phonemes (Snow, Burns, & Griffin, 1998). For example, the word cat consists of three individual sounds: /c/, /ă/, and /t/. A significant body of research has supported the importance of this ability and its connection to reading for early elementary learners (e.g., Carson, Gail, & Boustead, 2013; Ehri & Wilce, 1985; Lonigan et al., 2009; Tyler, Osterhouse, Wickham, McNutt, & Shao, 2014; Whitehurst & Lonigan, 1998), as well as over time (Hulme et al., 2002). In addition, phonological awareness has proven to be a reliable predictor for future reading success (Lonigan, Schatschneider, & Westberg, 2008; Scarborough, 1989; Stanovich, Cunningham, & Cramer, 1984). For example, Schatschneider, Fletcher, Francis, Carlson, and Foorman (2004) conducted a longitudinal study of 945 children in grades K–2 and found phonological awareness to be one of multiple measures used to predict various reading outcomes in the first and second grades. In fact, this particular reading skill, along with the ability to rapidly identify letters, was "most predictive" (p. 270). A meta-analysis conducted by the National Reading Panel examined 52 peer-reviewed studies (Ehri et al., 2001). Phonological awareness instruction was determined to help readers at all ability levels, as well as any socioeconomic status. While effect sizes were larger for studies using more experimental protocols, phonological awareness instruction had a statistically significant impact on reading acquisition. So significant in fact, that Stanovich (1986) established "a causal link running from phonological awareness to reading acquisition" (p. 363), particularly for beginning readers. With so much riding on the acquisition of phonological awareness skills, it is in the best interests of students for educators to consider the potential effect technology can have for early literacy instruction.

Mobile technology for emerging literacy skills

The interactive touch screens found on tablet devices require fewer fine motor skills than for personal computers, making it easy to use even for the very young learner (Technology and Play, 2015). While the focus tends to be on the device, it is important to remember that technology is effective when it facilitates student learning (Edwards, 2005; Parette & Blum, 2013). However, to be considered more than an add-on, technology must be an integral part of the curriculum. In other words, it is crucial that the activities incorporate technology in an embedded manner as something that can be eliminated without any consequence. This is what Hutchison et al. (2012) consider curricular integration rather than technological integration. As an integral part of instruction, technology can be an effective tool when the intent is to use technology to introduce or reinforce emergent literacy skills with preschool children (Beschorner & Hutchison, 2013; Saine, Lerkkanen, Ahonen, Tovanen, & Lyytinen, 2011; Shamir, Korat, & Fellah, 2012).

Rikala, Vesisenaho, and Jyllari (2013) suggest some features found in mobile forms of technology, such as "mobility, intuitiveness, attractiveness, and ease of use of the touch screen" (p. 115), have helped to increase their popularity in the world of education. Flewitt et al. (2015) examined the initial use of iPads in three early literacy settings. Through a

ISSN 1838-0689 online

series of interviews with the instructors and the children, along with video-recorded observations of literacy activities using new and traditional technologies, such as books and comics, they determined increased levels of motivation, independence, and concentration. Children's willingness to collaborate and support the challenges and successes of their peers was also noted. In addition, the authors contend these mobile devices impact the perception of a child's identity as a learner:

> Children's engagement in iPad-based literacy activities sometimes brought about changes in the ways they were perceived by their peers and teachers in the classroom, which in turn offered the potential for them to form new identities as "good spellers" and/or more able readers (as in the case of Harry), or as "good drawers" (as in the case of Matthew) or being seen as "talkers" rather than "quiet" children (as mentioned by the reception and nursery teachers). (Flewitt et al., 2015, p. 305)

Additional research has found mobile technologies, including the touch tablet, to be an effective instructional tool for early childhood students (Couse & Chen, 2010), noting that this particular tool has the capacity to reduce some of the challenges faced by young children when using computers. Touch screen capabilities increase ease of access due to this feature, as well as the mobility factor, which can facilitate collaboration (Peirce, 2013).

Neumann and Neumann (2014) reviewed the existing literature pertaining to the use of touch tablets for early literacy development (e.g., alphabet knowledge, print concepts, and emergent writing). Based on their analysis, they proposed a theoretical framework to illustrate the potential for tablets to assist in the development of emergent literacy. While children may develop an awareness of print as they explore and interact with touch screen devices, the authors suggest purposeful scaffolding by parents and/or teachers, along with access to quality literacy apps. It is argued that this tends to increase the effectiveness tablets have for early literacy learning.

Various apps have been designed for use with mobile devices such as smartphones and touch tablets, which are becoming more readily available to young children. AVG Technologies (2015) keeps an ongoing digital diary of technology's influence on children aged 0–9 years. In an online survey of over 6,000 parents in the UK, US, Canada, France, Germany, Spain, Brazil, and New Zealand, it was determined that 47% of children, aged 3 to 5 years, could navigate a smartphone or touch tablet and 57% could manipulate at least one app on these devices, while only 14% were reportedly able to tie their own shoes. This familiarity is echoed in studies that find preschool children were able to use mobile devices independently with ease and confidence (Couse & Chen, 2010).

It is necessary to go beyond access to digital apps and consider the nature of the app and its potential influence on student learning. Palmer (2015) determined particular relationships between the app and the students' uses of these. Both the students' level of participation and verbal interaction with the teacher increased when the apps had multiple solutions. However, whether the conversations pertained directly to the subject area depended on both the connection between the app and the content as well as the teacher's content knowledge. Kevin (2016) suggested apps can go beyond the focus on drill and practice (those similar to Palmer's designation of strong classification and control) and offer a variety of literary experiences within authentic contexts to provide meaningful and purposeful learning opportunities.

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Amidst an increased acceptance and integration of tablets and other technologies into the lives of young children (Rideout, 2013, 2017) comes a caution regarding the amount of screen time such children now experience. While the American Academy of Pediatrics Council on Communications and Media's (2011) statement restricting exposure to any screen media is directed toward children under 2 years of age, screen time has been found to have adverse effects on school-aged children. Hale and Guan (2015) analyzed 67 studies that examined screen time and sleep. They found a significant correlation between the amount of exposure to screen time, loss of sleep, and increased sleep issues associated with a variety of screen media in 90% of the studies investigated.

The NAEYC and Fred Rogers Center (2012) have said, "technology and interactive media are here to stay" (p. 2) and, when used appropriately, can empower children to be creative, solve problems, and think critically to make decisions. As digital apps are integrated with meaningful instruction, they become effective tools for teaching early literacy skills (Northrop & Kileen, 2013). Based on the strong association between phonological awareness and future success in reading (e.g., Ehri et al., 2001; Lonigan et al., 2008; Storch & Whitehurst, 2002) and the increased presence of tablets in home and school environments, this current study was designed to examine the use of such digital apps when specifically used for phonological awareness.

Methodology

This study explored the effectiveness of using tablet apps to teach phonological awareness skills at the prekindergarten level and compared it with traditional methods, which included clapping the number of syllables and using commercially produced games. Both of these are widely used methods of teaching phonological awareness (Cunningham, 2011; Morrow, Tracey, & Del Nero, 2011).

Research questions

The purpose of this study was to examine whether instruction of phonological awareness skills in small groups using tablet apps was effective compared to using traditional methods of instruction. The research questions used were:

1. Are children able to develop phonological awareness skills using apps via tablet devices?
2. Do children who use tablets show any differences in phonological awareness when compared to their peers using traditional methods of instruction?

Research design

Quantitative data were collected using the Phonological Awareness Screener for Intervention (PASI; 95 Percent Group, 2007). A comparison of the progression along the skills continuum of the PASI was made between two groups of children. One group used tablets during small-group instruction and the other used traditional methods of instruction. Students were only given access to the phonological awareness tablet apps during small-group instruction time.

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Participants

This study was conducted in a university laboratory school in the Midwestern US. The laboratory school is closely tied to the University's College of Education thus allowing it access to resources other schools may not have. A symbiotic relationship exists between the College of Education and the laboratory school, enabling preservice teachers to witness theory as it is applied to instructional practice. Teachers at this school typically have more flexibility than other government-funded schools. The laboratory school has a selection process that aims to mirror the population of the local community. This convenience sample group consisted of 27 four- and five-year-old children from various socioeconomic and ethnic backgrounds, attending the year prior to kindergarten. Approval was received from the Institutional Review Board, and informed parental consent and assent were obtained from all participants included in this study. Two classes within the same school were used as the sample. The children in both classes attended the prekindergarten program 5 days a week for 3 hours a day with the same teacher. The teacher, one of the authors, is a female with a master's degree in curriculum and instruction with an emphasis in early childhood education. She had been using tablets for instruction in this setting for the past 6 years.

Group selection. The morning and afternoon prekindergarten classes were predetermined by the district administration prior to the initiation of this study. A conscious decision was made to maintain a single style of instruction within each group for the purpose of consistency.

Tablet group. The morning class was arbitrarily selected to be the tablet group and consisted of 13 participants. Two participants had a lower socioeconomic status based on their qualification for government subsidized lunch. There were five girls and eight boys in this participation group.

Traditional group. The afternoon class became the traditional group and consisted of 14 participants. No students qualified for government subsidized lunch. Eight girls and six boys were in the traditional group.

Instrumentation

The PASI (95 Percent Group, 2007) is a screening instrument used to assess the phonological skills that a student has mastered and those that need continued instruction. The PASI is designed for students in grades prekindergarten through first. The skills assessed, such as rhyming, counting syllables, and identifying beginning sounds, are typically taught in prekindergarten classrooms, making the use of this instrument to monitor progress appropriate. There are three alternative forms of the PASI; two were used for two different assessment periods during this study. For each section of the PASI, the assessor explains the task, models one example for the child, completes an example with the child, and then the child completes examples on their own (see Table 1).

The initial assessment, which provided the baseline information for children's phonological awareness skills, was administered in September. All administrators of the test received district training. The data obtained from this instrument were used to design appropriate instruction to help children acquire pre-reading skills prior to entering kindergarten.

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Table 1
Skills assessed on the PASI continuum

Skills from simple to complex	Description	Example		Mastery score
		Teacher	Child	
Words in a sentence	Children move one bead for each word in a given sentence, count number of beads, state number of words in the sentence	"We ate rice"	Moves three beads and says "3"	4/5
Syllables	Assessor says a word, child repeats word, child says and counts syllables	"octopus"	"oc-to-pus", "3"	4/5
Onset Rhyme	Assessor says a pair of words, child gives a thumbs up if they rhyme and a thumbs down if they do not	"bell" "shell"	Thumbs up	4/5
Beginning sound isolation	Assessor says a word, child repeats word and then child says the beginning sound	"cut"	"cut", /c/	4/5
Final sound isolation	Assessor says a word, child repeats word and then child identifies the ending sound	"foot"	"foot", /t/	4/5
Blending	Assessor says the individual phonemes(sounds) in a word, child says the word	/m/ /a/ /p/	"map"	9/10
Segmenting	Assessor says a word, child repeats word, child breaks the word apart and says each individual phoneme	"chip"	/ch/ /i/ /p/	9/10

Procedure

Student groupings. Children were first assessed in mid-September using the PASI. A passing score on a specific skill was given if a student reached the given mastery score for each individual skill. Assessment continued until two consecutive skill tests were missed, based on the assessment guidelines. The scores were entered into a spreadsheet. Scores below mastery level were highlighted providing a visual indicator of skills needing to be addressed by individuals and the group. This information was then used to determine the skill at which to begin instruction. Children were divided into three groups based on ability so that activities could be designed to teach the targeted skill (see Table 2).

Children participated in small-group instruction once or twice a week for 12–15 minutes. Formative assessments in the form of anecdotal notes from each session were used to determine mastery of the targeted skill during small-group instruction. The final assessment for the study was completed at the beginning of December.

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Table 2
Student groups based on initial PASI assessment

	Number of students	
Skill(s) being taught	Tablet group	Traditional group
Words in a sentence/Syllables	5	3
Syllables/Rhyming	3	5
Beginning Sound Isolation	5	6

Lesson design. When designing activities for small-group instruction, the teacher kept in mind that the first step in developing an effective curriculum to teach phonological awareness skills is to develop a scope and sequence for acquiring skills (Roskos, Christie, & Richgels, 2003). The scope and sequence for teaching skills in this study was based on the developmental continuum laid out in the PASI instrument. The teacher intentionally considered the skill to be taught and chose developmentally appropriate activities for both groups based on the instructional level of the students in each group (Phillips, Clancy-Menchetti, & Lonigan, 2008). Activities were chosen from those available in the classroom, school resource room, and apps installed on the tablets. Activities were evaluated on the ability to differentiate instruction, level of individual practice, and accuracy in teaching the specified skill. Traditional activities were ones the teacher has used in the past, such as the use of Unifix cubes to count words in a sentence or a final sounds bingo game. A few of the apps, such as ABC Magnetic Alphabet and First Words Deluxe, had been used by the teacher in the past, but additional apps, such as Pocket Charts! Pro and ABC Phonics Rhyming Bee, were chosen to best parallel activities in the traditional group.

*Gradual release of responsibility***.** Lessons were taught 1 to 2 days a week depending on the school schedule. Each lesson lasted approximately 12 to 15 minutes. Both the tablet and traditional method groups met for the same number of small-group lessons each week and throughout the study. Following the gradual release of responsibility model (Pearson & Gallagher, 1983), instruction included a demonstration (the teacher modeling how to complete the activity), guided practice (the teacher working with the entire group as they practiced the skill), and once an understanding of the activity was established, independent practice (where the teacher monitored and provided necessary scaffolding). This instructional procedure was followed explicitly for both the traditional and tablet groups.

Selection of instructional activity materials. The apps used for the tablet group were selected based on their ability to support instruction of the targeted skill. For example, the tablet app used for the rhyming skill, read the word for the child. This ensured that reading ability was not a consideration for completing the activity. Children were required to use the same auditory processing skill as the traditional group to identify a pair of rhyming words. In practice, counting words in a sentence required some form of tangible object that the children could manipulate for each word in the sentence. Children in the traditional group typically used Unifix cubes to represent each syllable, so a similar object was needed for the tablet group. The selected app provided individual objects for the children to manipulate and count. Therefore, children in both groups were able to listen to the sentence given by the teacher, move an identified object, and then count those objects in a similar fashion to complete the task.

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Beginning and final sound isolation for both groups began with teacher-led practice in identifying these sounds. Children in the tablet group then began individual practice matching objects with the same beginning or final sound as prompted by the app while the traditional group continued more teacher-led practice. For example, the Pocket Charts app provided two problems for matching, while the teacher limited the number of puzzle pieces to match with the traditional group. This kept the activities similar. The tablet and traditional activities were directly related in that they each asked a student to blend together individual phonemes in a word or segment the sounds of a word. The greatest difference again was the role of the teacher in providing individual practice to the traditional group, thus resulting in less individual practice due to work in groups.

Table 3 shows a sampling of the activities used for each group and each phonological awareness skill. In the table, the traditional method lists more activities than the tablet activities appearing as if the traditional group was exposed to more activities. This, however, is not the case, because the apps included multiple ways to practice skills and various levels of instruction.

Table 3
Activities used

Skill	Tablet activity (app)	Traditional method
Words in a sentence	ABC Magnetic Alphabet[a]: children moved one circle magnet up to top for each word	Unifix cubes were used to represent each word
Syllables	ABC Magnetic Alphabet[a]: children moved one magnet up to top for each syllable	Children used body parts to separate words (head, shoulders, waist, knee, foot)
Rhyming	ABC Phonics Rhyming Bee[b] Pocket Charts! Pro[c]	Lakeshore Rhyming Box Game Lakeshore Puzzle Match Lakeshore Rhyming Houses
Beginning sound isolation	Pocket Charts! Pro[c] ABC Magnet[a]	Lakeshore Box Game Lakeshore Puzzle Match Lakeshore Pop Game
Final sound isolation	Pocket Charts! Pro[c] ABC Magnet[a]	Lakeshore Box Game Lakeshore Puzzle Match FCRR Final Sound Bingo
Blending	First Words Deluxe[d]	FCRR Puzzle FCRR Say and Slide
Segmenting	ABC Magnetic Alphabet[a]	FCRR Puzzles FCRR Say and Slide

Note. app = application; FCRR = Florida Center for Reading Research.
[a]ABC – Magnetic Alphabet HD (Version 2.6.4; Dot Next, 2012). [b]ABC Phonics Rhyming Bee (Version 1.3; Abitalk, 2012). [c]Pocket Charts! Pro (Version 3.1; Good Neighbor Press, 2012). [d]First Words Deluxe (Version 5.6; Learning Touch, 2012).

Unintentional phonological instruction. Both classes participated in other phonological awareness activities during the week. These whole-group activities were from *Phonemic Awareness* (Heggerty & Turso, 2010) and targeted the same skills as the PASI. They were completed two to three times per week for about 8 to 10 minutes each. Participation varied

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from child to child: some were involved and attentive the whole time, while others were not. The level of involvement varied for each activity. The teacher did not feel that it was practical to refrain from all phonological awareness activities in the classroom. It would have caused more disruption to the classroom routines to even attempt to refrain from all other phonological awareness activities.

Controlled access to apps. An effort was made to restrict the children in both groups from choosing to play the same apps and games during free choice time to maintain equal levels of exposure. If a child chose one of the same activities that was used during small-group instruction, they were redirected to another activity. It should also be acknowledged that the apps selected were limited to those that were available during the time of this study. Each app was selected in an effort to mirror the traditional methods used. Finally, since the teacher was part of the research team, it must be acknowledged that her participation may have contributed biases to her interpretation of the results; however, other members of the team assisted in data analysis to limit this effect.

Data analysis

The analysis of data consisted of two parts: a descriptive analysis and a statistical analysis. For the descriptive analysis, the assessment scores for both groups were placed into a chart. A separate chart was then made to show the patterns of growth from one skill level to the next for each group. The data in the charts were then analyzed by looking for patterns, similarities, and differences.

The statistical analysis involved conducting independent sample and paired sample *t* tests. Independent sample *t* tests were used to compare the tablet and traditional groups on each of the phonological awareness skills to determine if any differences between the two groups existed. Paired sample *t* tests were calculated for both the tablet and traditional groups on each of the phonological awareness skills to determine if increases occurred between pre- and post-administration of the PASI.

Findings

Figure 1 shows the number of students in each group that mastered the listed skill from the PASI instrument administered in September. For example, 8 of 13 in the tablet group mastered the "words in a sentence" skill, while 11 of 14 in the traditional group mastered this same skill. The five students in the tablet group and the three students in the traditional group who did not demonstrate mastery of "words in a sentence" began small-group instruction on this skill.

The data shown in Figure 2 indicate the final results of student progress over the 16-week semester alongside that of the initial results.

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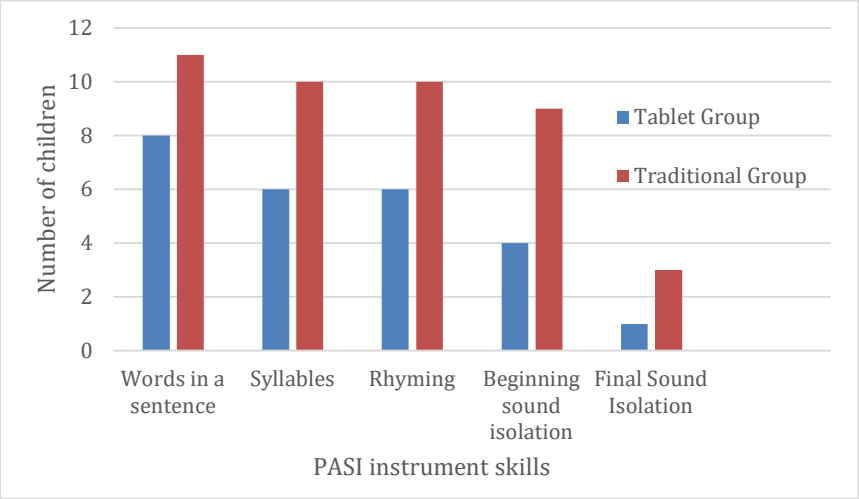

Figure 1. PASI scores for each group, tablet and traditional, on the initial assessment used to determine beginning instructional level.

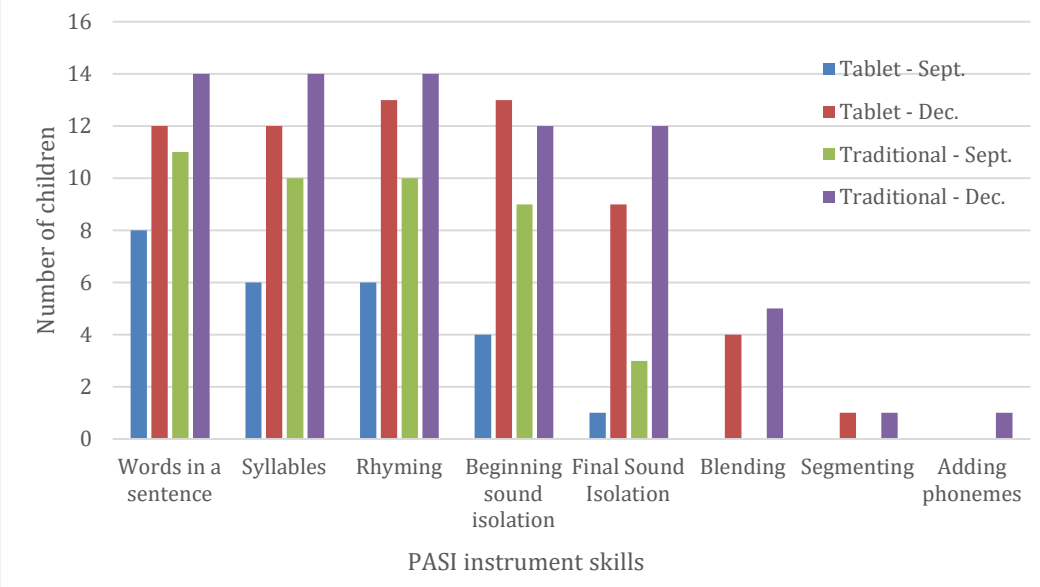

Figure 2. Summary of the number of students who demonstrated mastery of each skill on the PASI in September and December for each group, tablet and traditional.

Based on the December PASI test results, it can be seen that students in each group progressed their capabilities regarding one or more skills. Table 4 indicates students' progression along the PASI continuum based on the December testing.

To further investigate research question 1 ("Are children able to develop phonological awareness skills using apps via tablet devices?"), a paired *t* test, which compares means between two groups, was conducted to determine if there was a significant difference between the September and December tests. The mean score for each phonological awareness skill scored in the September and December tests is listed in Table 5.

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Table 4
Student progress following the September testing in December

	Number of skills progressed			
Group	One	Two	Three	Four or more
Traditional	3	4	4	3
Tablet	0	5	3	5

Table 5
Descriptive statistics and t *test results for phonological skills: tablet group*

	September		December		
Phonological skill	*M*	*SD*	*M*	*SD*	*t*
Words in a sentence	3.38	1.12	4.15	1.07	2.38*
Syllables	3.08	1.32	4.08	1.32	2.94*
Rhyming	2.54	2.11	4.69	0.48	3.48*
Beginning sound isolation	2.08	2.40	5.00	0.00	4.40*
Final sound isolation	0.69	1.55	3.62	2.14	4.76*
Blending	0.62	1.71	4.08	4.19	3.47*
Segmenting	0.00	0.00	1.46	2.96	1.78

Note. $n = 13$; $df = 12$.
*$p < .05$.

The results of the *t* tests, also listed in Table 5, show significant differences between the September and December testing dates in each phonological awareness skill except for segmenting in the tablet group, suggesting that the use of tablets increased their performance. No student in the tablet group reached the adding phonemes section of the PASI. Table 6 shows the means and paired sample *t* test results for each phonological awareness skill in the traditional methods group. As with the tablet group, significant differences were found in most skills for the traditional methods group between the September and December testing dates, suggesting that the traditional methods also increased performance on these skills. Significant differences were not found in the "words in a sentence" skill nor the "adding phonemes" skill, indicating no or little increase in these skill from September to December.

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Table 6
Descriptive statistics and t *test results for phonological skills: traditional group*

	September		December		
Phonological skill	*M*	*SD*	*M*	*SD*	*t*
Words in a sentence	3.93	1.38	4.57	0.51	1.66
Syllables	4.00	0.96	4.50	0.52	2.46*
Rhyming	4.00	1.24	4.79	0.43	2.47*
Beginning sound isolation	3.36	2.31	4.86	0.53	2.62*
Final sound isolation	1.43	1.91	4.43	1.50	5.51*
Blending	2.00	3.21	5.50	4.40	3.29*
Segmenting	0.36	1.34	3.00	3.28	2.88*
Adding phonemes	0.00	0.00	0.14	0.53	1.00

Note. $n = 14$; $df = 13$.
*$p < .05$.

To further investigate the differences between the tablet and traditional method groups, independent sample *t* tests were conducted to examine the differences between each group both in September and December. There were only two significant differences found, and they were both found in September. The first, in the skill of syllables between the tablet ($M = 3.08$, $SD = 1.32$) and traditional ($M = 4.00$, $SD = 0.96$) groups; $t(25) = 2.09$, $p = .047$. The second, in the skill of rhyming, between the tablet ($M = 2.54$, $SD = 2.11$) and traditional ($M = 4.00$, $SD = 1.24$) groups; $t(25) = 2.22$, $p = .036$. However, by December, there were no differences between the groups in these or any other skills.

Comparison of instructional approaches

Assessment and instruction of phonological awareness skills are necessary components of early childhood literacy acquisition. In this study, two student groups were taught phonological awareness skills using two different approaches: one group used traditional, concrete materials, such as puzzles and games, while the other group used apps available via touch-tablet devices. Each group received the same teacher-led instruction for the same amount of time each week. The teacher was intentional in her use of touch tablets to teach phonological awareness skills. Rather than being used as a supplemental tool, these devices served as an instructional tool to teach skills embedded in the curriculum (Couse & Chen, 2010; Hutchison et al., 2012).

Growth in skills. Evidence indicates that both groups of students, those with and those without the use of tablets, were able to develop phonological awareness skills. In almost all of the targeted skills, both groups showed significant improvement on the PASI from September to December, indicating that both instructional methods are beneficial to students' development of phonological awareness skills. Students in both groups progressed one or more skills from September to December.

The tablet group appears to have progressed across a wider range of skills. However, more children in the tablet group began instruction targeting the first three skills (words in a

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sentence, syllables, rhyming), whereas a majority of the traditional group had already mastered these skills prior to small-group instruction. Therefore, the traditional group started, as a whole, on a more advanced skill allowing them to work toward mastering more advanced skills over a longer period of time. Additionally, at the end of instruction, the tablet group was able to close the gap on those initial skills and reach the same skill level on the PASI continuum as the traditional group. Furthermore, there were no significant differences between the tablet and traditional group in December on any of the phonological awareness skills assessed even though there were differences between the groups initially in September. Students in the tablet group were able to "catch up" in terms of the number of students who demonstrated mastery of those skills.

Instructional variances between groups. The results of this study did not reach the same conclusions as some existing studies. For example, findings such as those from Shuler (2009) and from Segers and Verhoeven (2005) have found a positive correlation between computer intervention time and development of phonological awareness skills. Nonetheless, the teacher in the study described herein noticed some instructional variances between the two groups. After watching the teacher model the activity or app, the tablet group was able to complete the task independently allowing for multiple repetitions. The traditional group had to take turns, one at a time, as a whole group, or with a partner, resulting in the completion of fewer examples. However, these students were able to learn from each other through social interaction. It must also be noted that performing multiple repetitions should not be perceived as a direct benefit. Students were observed "guessing at" an answer and clicking a button until the correct answer was displayed, not stopping to think why their initial answer was incorrect. The teacher could directly observe each student's response with most of the traditional activities providing immediate feedback and guidance. This was only possible with one or two members of the tablet group at a time, as they primarily worked independently.

Additional considerations

Potential for unintentional instruction. It must be considered that other ancillary phonological awareness instruction took place, which may have influenced student understanding of these skills. It is also necessary to acknowledge the phonological awareness activities that children may have interacted with in other environments, such as at home and/or with other caretakers. Additionally, the nature of the apps used and their influence on interactions between teachers and students, which can in turn impact student learning (Palmer, 2015), must be examined.

Conclusion

While this study showed no statistically significant differences between the tablet and traditional groups, students in both groups demonstrated statistically significant growth in the targeted skills. Children in both groups were able to achieve the same level of mastery for the skill sets tested on the PASI. This suggests that using tablets as a tool for early literacy instruction is a viable option for increasing children's phonological awareness skills. It is also interesting to note that when the study began, the traditional group performed at a higher skill level than the tablet group. This study showed that the tablets were successful in closing this initial gap between the two groups. These findings show the use of either instructional approach has value in teaching phonological awareness. This can support findings from other studies that have shown that, in early childhood settings, there are

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benefits to using technology, such as the positive effect on phonemic awareness skills like blending and segmenting (Segers & Verhoeven, 2005), the variety of methods for which tablets can be used as a resource for emergent literacy instruction (Beschorner & Hutchison, 2013), and the "reduced the cognitive and psychomotor challenges of young children using computers" (Peirce, 2013, p. 36). When multiple approaches are used, the probability of meeting individual learning needs and preferences increases. There is often debate over whether or not technology should be used with young children. Based on these findings, teachers should not be hesitant to use technology for phonological awareness. Tablets proved to be an equally effective instructional tool for students as compared with traditional methods.

The need for more empirical investigation of this instructional tool is evident. Based on his research, Shuler (2009) described mobile devices, such as touch tablets, as "pockets of educational potential [that] must not be dismissed" (p. 9). While not a purpose of this study, the apps and programs being used by students on these devices merits further investigation. The instructional design and intent of the app can have a bearing on student interaction and learning (Hsin, Li & Tsai, 2014; Palmer, 2015). If and how a teacher engages with students while they interact with the apps is yet another dimension worthy of study. Further research can help to determine how best to use such technologies to develop phonological awareness skills in prekindergarten and beyond.

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References

95 Percent Group. (2007). Phonological Awareness Screener for Intervention (Version 2) [Diagnostic tool and user manual].

Abitalk. (2012). ABC Phonics Rhyming Bee – Preschool kindergarten (Version 1.3) [iPad application].

American Academy of Pediatrics Council on Communications and Media. (2011). Policy statement: Media use by children younger than 2 years. *Pediatrics*, *128*(5), 1040–1045.

Anthony, J. L., Lonigan, C. J., Driscoll, K., Phillips, B. M., & Burgess, S. R. (2003). Phonological sensitivity: A quasi-parallel progression of word structure units and cognitive operations. *Reading Research Quarterly*, *38*(4), 470–487.

AVG Technologies. (2015). *AVG digital diaries – A look at how technology affects us from birth onwards*. Retrieved from https://fdocuments.us/document/avg-digital-diaries.html

Bajovic, M. (2018). Playing and learning across the concrete and digital realms: A new context for the new learners. *International Journal of Play, 7*(2), 199–209.

Beschorner, B., & Hutchison, A. (2013). iPads as a literacy teaching tool in early childhood. *International Journal of Education in Mathematics, Science, and Technology*, *1*(1), 16–24.

Carson, K. L., Gail, T. G., & Boustead, T. M. (2013). Classroom phonological awareness instruction and literacy outcomes in the first year of school. *Language, Speech, and Hearing Services in School*, *44*(2), 147–160.

Clements, D. H., & Sarama, J. (2003a). Strip mining for gold: Research and policy in educational technology--A response to "fool's gold". *AACE Journal*, *11*(7), 7–69.

Clements, D. H., & Sarama, J. (2003b). Young children and technology: What does the research say? *Young Children*, *58*(6), 34–40.

Copple, C., & Bredekamp, S. (2009). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8*. Washington, DC: National Association for the Education of Young Children.

Cordes, C., & Miller, E. (2004). *Tech tonic: Towards a new literacy of technology*. Retrieved from http://files.eric.ed.gov/fulltext/ED485737.pdf

Couse, L. J., & Chen, D. W. (2010). A tablet computer for young children? Exploring its viability for early childhood education. *Journal of Research for Technology in Education*, *43*(1), 75–98.

Cunningham, P. M. (2011). Best practices in teaching phonological awareness and phonics. In L. M. Morrow & L. B. Gambrell (Eds.), *Best practices in literacy instruction* (4th ed., pp. 199–223). New York, NY: The Gulliford Press.

Dot Next. (2012). ABC - Magnetic Alphabet HD - Learn to Write! For Kids (Version 2.6.4) [iPad application].

Edwards, S. (2005). Identifying the factors that influence computer use in the early childhood classroom. *Australasian Journal of Educational Technology*, *21*(2), 192–210.

Ehri, L. C., & Wilce, L. S. (1985). Movement into reading: Is the first stage of printed word learning visual or phonetic? *International Reading Association*, *20*(2), 163–179.

Ehri, L. C., Nunes, S. R., Willows, D. M., Willows, D. M., Schuster, B. V., Yaghoub-Zadeh, Z., & Shananhan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly*, *36*(5), 250–287.

Finegan, C., & Austin, N. J. (2002). Developmentally appropriate technology for young children. *Information Technology in Childhood Education Annual*, *2002*(1), 87–102.

ISSN 1838-0689 online

Flewitt, R., Messer, D., & Kucirkova, N. (2015). New directions for early literacy in a digital age: The iPad. *Journal of Early Childhood Literacy*, *15*(3), 289–310.

Gillon, G. T. (2004). *Phonological awareness: From research to practice*. New York, NY: The Guilford Press.

Good Neighbor Press. (2012). Pocket Charts! Pro (Version 3.1) [iPad application].

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Medicine Reviews*, *21*(1), 50–58.

Heggerty, M., & Turso, C. (2010). *Phonemic awareness: The skills that they need to help them succeed* (Pre-kindergarten version). River Forest, IL: Literacy Resources.

Hsin, C.-T., Li, M.-C., & Tsai, C.-C. (2014). The influence of young children's use of technology on their learning: A review. *International Journal of Educational Technology & Society*, *17*(4), 85–99.

Hulme, C., Hatcher, P. J., Nation, K., Brown, A., Adams, J., & Stuart, G. (2002). Phoneme awareness is a better predictor of early reading skill than onset-rime awareness. *Journal of Experimental Child Psychology*, *82*(2), 2–28.

Hutchison, A., Beschorner, B., & Schmidt-Crawford, D. (2012). Exploring the use of the iPad for literacy learning. *The Reading Teacher*, *66*(1), 16–23.

Isaacs, J. B. (2008). *Impacts of early childhood programs*. Washington, DC. Retrieved from http://addictions.sthermanseminary.org/wp-content/uploads/2010/11/09_early_programs_isaacs.pdf

Kevin, L. (2016). Powerful and playful literacy learning with digital technologies. *Australian Journal of Language and Literacy*, *39*(1), 64–73.

Laffey, J. (2004). Appropriation, mastery and resistance to technology in early childhood preservice teacher education. *Journal of Research on Technology in Education*, *36*(4), 361–382.

Learning Touch. (2012). First Words Deluxe (Version 5.6) [iPad application].

Lee, V., & Burkam, D. (2002). *Inequality at the starting gate: Social background differences in achievement as children begin school*. Washington, DC: Economic Policy Institute.

Lentz, C. L., Seo, K. K., & Gruner, B. (2014). Revisiting the early use of technology: A critical shift from "How young is too young?" to "How much is just right?" *Dimensions of Early Childhood*, *42*(1), 15–23.

Lonigan, C. J., Anthony, J. L., Phillips, B. M., Purpura, D. J., Wilson, S. B., & McQueen, J. D. (2009). The nature of preschool phonological processing abilities and their relations to vocabulary, general cognitive abilities, and print knowledge. *Journal of Educational Psychology*, *101*(2), 345–358.

Lonigan, C. J., Schatschneider, C., & Westberg, L. (2008). Identification of children's skills and abilities linked to later outcomes in reading, writing, and spelling. In National Early Literacy Panel (Ed.), *Developing early literacy: A scientific synthesis of early literacy development and implications for intervention* (pp. 55–106). Retrieved from http://lincs.ed.gov/publications/pdf/NELPReport09.pdf

Marklund, L., & Dunkels, E. (2016). Digital play as a means to develop children's literacy and power in the Swedish preschool. *Early Years*, *36*(3), 289–304.

Massetti, G. M. (2009). Enhancing emergent literacy skills of preschoolers from low income environments through a classroom-based approach. *School Psychology Review*, *38*(4), 554–569.

McManis, L. D., & Gunnewig, S. B. (2012). Finding the education in educational technology with early learners. *Young Children*, *67*(3), 14–24.

Morrow, L. M., Tracey, D. H., & Del Nero, J. R. (2011). Best practices in early literacy: Preschool, kindergarten, and first grade. In L. M. Morrow & L. B. Gambrell (Eds.),

ISSN 1838-0689 online

Best practices in literacy instruction (4th ed., pp. 67–95). New York: NY: The Guilford Press.

National Association for the Education of Young Children & Fred Rogers Center. (2012). *Technology and interactive media as tools in early childhood programs serving children from birth through age 8* [Position statement]. Retrieved from http://www.naeyc.org/files/naeyc/file/positions/PS_technology_WEB2.pdf

National Early Literacy Panel. (2008). *Developing early literacy: A scientific synthesis of early literacy development and implications for intervention*. Louisville, KY: National Institute for Literacy. Retrieved from http://lincs.ed.gov/publications/pdf/NELPReport09.pdf

Neumann, M. M., & Neumann, D. L. (2014). Touch screen tablets and emergent literacy. *Early Childhood Education Journal*, *42*(4), 231–239.

Neumann, M., & Neumann, D. (2017). The use of touch-screen tablets at home and pre-school to foster emergent literacy. *Journal of Early Childhood Literacy*, *17*(2), 203–220.

Northrop, L., & Killeen, E. (2013). A framework for using iPads to build early literacy skills. *The Reading Teacher*, *66*(7), 531–537.

Palmer, H. (2015). Using tablet computers in preschool: How does the design of applications influence participation, interaction and dialogues? *International Journal of Early Years Education*, 23(4), 365–381.

Parette, H. P., & Blum, C. (2013). *Instructional technology in early childhood: Teaching in the digital age*. Baltimore, MD: Paul H. Brookes.

Parette, H. P., Quesenberry, A. C., & Blum, C. (2009). Missing the boat with technology usage in early childhood settings: A 21st century view of developmentally appropriate practice. *Early Childhood Education*, *37*(5), 335–343.

Pearson, P. D., & Gallagher, M. C. (1983). The instruction of reading comprehension. *Contemporary Educational Psychology*, *8*(1), 317–344.

Peirce. (2013). *Digital game-based learning for early childhood: A state of the art report*. Retrieved from http://www.learnovatecentre.org/wp-content/uploads/2013/05/Digital_Game-based_Learning_for_Early_Childhood_Report_FINAL.pdf

Phillips, B. M., Clancy-Menchetti, J., & Lonigan, C. J. (2008). Successful phonological awareness instruction with preschool children: Lessons from the classroom. *Topics in Early Childhood Special Education*, *28*(1), 3–17.

Phonological Awareness Screener for Intervention User's Manual (Version 2). (2007). Buffalo Grove, IL: 95 Percent Group.

Pinnell, G. S., & Fountas, I. C. (2011). *Literacy beginnings: A prekindergarten handbook*. Portsmouth, NH: Heinemann.

Rideout, V. (2013). *Zero to eight: Children's media use in America 2013*. Retrieved from https://www.commonsensemedia.org/file/zero-to-eight-2013pdf-0/download

Rideout, V. (2017). *The Common Sense census: Media use by kids age zero to eight*. Retrieved from https://www.commonsensemedia.org/sites/default/files/uploads/research/csm_zerotoeight_fullreport_release_2.pdf

Rikala, J., Vesisenaho, M., & Jyllair, J. (2013). Actual and potential pedagogical use of tablets in schools. *Human Technology*, *9*(2), 113–131.

Roskos, K. A., Christie, J. F., & Richgels, D. J. (2003). The essentials of early literacy instruction. *Young Children*, *58*(2), 52–60.

Saine, N. L., Lerkkanen, M., Ahonen, T., Tovanen, A., & Lyytinen, H. (2011). Computer-assisted remedial reading intervention for school beginners at risk for reading disability. *Child Development*, *82*(3), 1013–1028.

ISSN 1838-0689 online

Sari, B., & Acarr, E. A. (2013). The phonological awareness scale of early childhood period (PASECP) development and psychometric features. *Educational Sciences: Theory & Practice*, *13*(4), 2209–2215.

Scarborough, H. S. (1989). Prediction of reading disability from familial and individual differences. *Journal of Educational Psychology*, *81*(1), 101–108.

Schacter, J., & Jo, B. (2016). Improving low-income preschoolers mathematics achievement with Math Shelf, a preschool tablet computer curriculum. *Computers in Human Behavior*, *55*(A), 223–229.

Schatschneider, C., Fletcher, J. M., Francis, J. D., Carlson, C. D., & Foorman, B. R. (2004). Kindergarten prediction of reading skills: A longitudinal comparative analysis. *Journal of Educational Psychology*, *96*(2), 265–282.

Segers, E., & Verhoeven, L. (2005). Long-term effects of computer training of phonological awareness in kindergarten. *Journal of Computer Assisted Learning*, *21*(1), 17–27

Shamir, A., Korat, O., & Fellah, R. (2012). Promoting vocabulary, phonological awareness and concept about print among children at risk for learning disability: Can e-books help? *Reading and Writing*, *25*(1), 45–69.

Shuler, C. (2009). *Pockets of potential: Using mobile technologies to promote children's learning*. Retrieved from http://www.joanganzcooneycenter.org/wp-content/uploads/2010/03/pockets_of_potential_1_.pdf

Smith, S., Burrow, L., Fite, K., & Guerra, L. (2016). Considering instructional appropriateness of technology integration into early childhood education. *International Journal of the Whole Child*, *1*(2), 13–29.

Snow, C. E., Burns, M. S., & Griffin, P. (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly*, *21*, 360–407.

Stanovich, K. E., Cunningham, A. E., & Cramer, B. B. (1984). Assessing phonological awareness in kindergarten children: Issues of task comparability. *Journal of Experimental Child Psychology*, *38*(1), 175–190.

Storch, S. A., & Whitehurst, G. J. (2002). Oral Language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology, 38*(6), 934–947.

Swim, T. J. (2015). Theories of child development: Building blocks of developmentally appropriate practices [Article]. *Early Childhood News*. Retrieved from https://education.illinoisstate.edu/downloads/linc/linccurriculummodule/Theories%20of%20Early%20Childhood.pdf

Technology and Play. (2015). *Exploring play and creativity in pre-schoolers' use of apps: Report for the children's media industry*. Retrieved from http://www.techandplay.org/tap-media-pack.pdf

Tyler, A. A., Osterhouse, H., Wickham, K., McNutt, R., & Shao, Y. (2014). Effects of explicit teacher-implemented phoneme awareness instruction in 4-year-olds. *Clinical Linguistics & Phonetics*, *28*(7), 493–507.

Vellutino, F. R., Tunmer, W. E., Jaccard, J. J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific Studies of Reading*, *11*(1), 3–32.

Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin*, *101*(2), 192–212.

Whitehurst, G. J., & Lonigan, C. J. (1998). Child development and emergent literacy. *Child Development*, *69*(3), 848–872.

ISSN 1838-0689 online

Yelland, N. (2005). The future is now: A review of the literature on the use of computers in early childhood education (1994–2004). *AACE Journal*, *13*(3), 201–232.

Yopp, H. K., & Yopp, R. H. (2000). Supporting phonemic awareness development in the classroom. *The Reading Teacher*, *54*(2), 130–143.

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ISSN 1838-0689 online