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Comparison of Early Literacy iPad Apps: Evaluation of Teachers' Perceptions

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A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

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ABSTRACT

Comparison of Early Literacy iPad Apps: Evaluation of Teachers' Perceptions

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A recent dramatic increase in the availability of early literacy applications (apps) for mobile devices has led teachers to incorporate them into their educational programs. This study explored teachers' perceptions and opinions regarding three early literacy apps: *Endless Reader*, *Preschool Matching Game: Rhyming Words*, and *Hideout: Early Reading*. The study consisted of 15 preschool teachers who interacted with each app and answered questions regarding their opinions about the apps and the use of digital devices in the classroom in general. Teacher responses were analyzed and categorized based on common topics that emerged from the data set. The results of the study imply that teachers prefer apps that include sound pedagogical principles as well as game-like features to keep students engaged in learning. Future research should explore the processes and guidelines teachers use when selecting apps for classroom use as well as investigating what students actually understand from early literacy apps and other apps used in the classroom.

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CHAPTER 1

Literature Review

While choosing educational apps may seem like a simple task, teachers are faced with the challenge of determining which apps, among many, will have the most positive impact on students' literacy learning. Some educational apps have been created based on sound pedagogical principles; others may be labeled "educational" yet are made by game developers and function simply like a game, with little to no pedagogical principles tied to them. Teachers must use their best judgement as they examine and select apps to use in their classrooms.

Differing opinions exist on what makes an app effective for children's learning and whether apps should be used with young children in an educational setting at all. In order for teachers to make educated decisions on selecting and incorporating apps into early childhood literacy settings, they should be aware of disadvantages and advantages of using instructional apps. Additionally, being aware of what other teachers and children value in apps can assist teachers in making the best decision. Ultimately, teachers need some mechanism to determine which apps are appropriate to use in promoting literacy skills in young children.

Positions Regarding the Use of Apps with Young Children

Researchers and educators have varying opinions on how and when apps should be used in educational settings with young children. The process of selecting literacy apps to use with children in an educational setting should include exploring what the literature says about the disadvantages as well as the advantages of exposing young children to digital materials.

Disadvantages. Some early childhood advocates believe that teachers and parents need to be aware of disadvantages to using digital technology with young children. Their concerns relate to reduction in face-to-face instructional interactions, the tendency to become preoccupied

or distracted by digital devices, and concern about negative impact of digital devices on children's overall health and development.

Reduce face-to-face learning interactions. One main argument from those who disagree with the use of digital technology to assist in teaching early literacy skills is the decreased number of face-to-face interactions that take place while individuals use the app. According to Mandryk, Inkpen, Bilezikjian, Klemmer, and Landay (2001), one shortcoming of students' use of handheld devices is the fact that "achieving the benefits of collaborative learning may be difficult given the personal nature of these devices" (p. 255). Liu and Kao (2007) also found that the use of handheld devices among students does not "facilitate group interactions and lead[s] to fragmented and ineffective communication" (p. 296). Using personal handheld devices can isolate users and prevent them from having meaningful interactions with peers.

Distract students in school settings. The excitement of using digital technology in the classroom may cause children to overuse or misuse devices in a school setting, which in turn may negatively impacting their learning. The multimodal features contained in many apps targeting children can be a distraction to learning. Some apps provide more opportunities for fun and games than actual learning (Chou, Block, & Jesness, 2012). Ebrahim, Ezzadeen, and Alhazmi (2015) discuss the difficulty of providing students with personal devices because of the lack of control and oversight teachers have over the use of the devices. Students may use the devices for other personal uses that could distract from the learning of the individual as well as peers in the classroom. It is imperative that proper training and supervision is provided students before beginning use of apps in an educational setting because studies have shown that "student achievement can actually be hindered by the use of technology" (Northrop & Killeen, 2013, p. 532).

Negatively impact development. Finally, an excessive amount of time spent using digital devices can have a negative impact on development – specifically language development – of young children. According to the American Academy of Pediatrics [AAP] (2016), the use of digital devices at or around bedtime can negatively influence an individual's sleep patterns, and in turn can negatively impact a child's ability to perform at school. Evidence also shows that an increased use of media in the home can cause poorer executive functioning skills, a decreased ability to self-regulate, and cognitive, social and emotional deficits in children between the ages of 3 to 5 (AAP, 2016). Because of this, it is recommended that children who are pre-school aged are exposed to no more than one hour of "high quality" or educational programs or apps per day (AAP, 2016). If the child is over-exposed to apps or games on mobile devices in either the school or home setting (or both), they may miss out on other learning opportunities around them. It is important to have a specific purpose for using apps in a learning environment whether it be at school or in the home, because "if used improperly . . . the mobility of [wireless handheld devices] can also be a barrier to learning" (Dieterle, Dede, & Schrier, 2007, p. 39).

Advantages. While the concerns about over-exposing young children to technological devices must be taken seriously, there are some advantages to incorporating instructional technology in educational settings.

Children are attracted to digital media. The fact that children are inherently attracted to digital technology makes the use of apps in educational settings an attractive opportunity for learning. According to Henderson and Yeow (2012) children are more motivated and engaged when digital technology is used as opposed to ordinary classroom materials. This could work to the teacher's advantage, because children who are not highly motivated to read books may be more motivated to do so if they are able to use a tablet or other digital device. Ebrahim et al.

(2015) found that "enhanced motivation to learn is directly related to the utilization of mobile device[s] instead of the completed task" (p. 72).

Learning can occur. Research has shown that learning can occur via apps and that children are receptive to this type of learning. There are certain skills that children can gain via iPad or digital delivery. According to Ebrahim et al. (2015) children can enhance their understanding of certain concepts when they use digital devices to learn. The "various collaborative techniques and delivery methods" offer extra motivation and ultimately increased learning for the child (p. 72). In addition, the quick feedback that can be provided to students who use mobile devices results in an increase in retention and memory. Culatta, Hall-Kenyon, and Bingham (2016) state that technology can be a useful instructional tool for literacy if the app is based on solid research-based principles. Exposing children to digital media can enhance their learning by allowing them to document and save activities worked on, as well as providing pictures, stories, sounds, and other materials that may not be available to the child otherwise (National Association for the Education of Young Children [NAEYC], 2012).

Instructional activities are easy to access. The ease of access to digital devices creates an opportunity for children to learn from exposure to apps in almost any setting, including locations outside of the classroom. The NAEYC states that interactive media can assist in effective learning for children when these tools are implemented and overseen by an early childhood educator. Using apps in the home and school setting can help increase the amount of supervision children receive while using literacy apps. The NAEYC (2012) also emphasizes the opportunity of adult assessment that arises due to children's use of apps in various settings. Through observing children as they use apps, parents and teachers can obtain an understanding of children's thought processes. Observations can also allow parents to become more involved

and informed in the type of activities the children are working on at school and can bridge gaps between school and home learning. As children use apps for learning in their home setting, parents can also provide scaffolding and feedback necessary to ensure that children are not being misled or misunderstanding what is being presented.

Children are prepared to handle multiliteracies. Allowing children to use apps for early literacy learning can prepare them to become more proficient and literate in modern-day technologies as adults. The International Reading Association (IRA) acknowledges the inevitable need for children to be enculturated in a society where individuals must be competent in multiliteracies. A position statement published in 2009 by the IRA states that in order "to become fully literate in today's world, students must become proficient in the new literacies of 21st-century technologies" (p. 1). There is no doubt that students who fail to become proficient in modern-day technologies will fall behind those who are able to use them to learn and work more efficiently. The responsibility to teach the literacies of the 21st century falls to educators. By teaching how to become literate in modern technology, teachers equip students with the skills they will need to be successful in a world full of endless technological advancements. Teachers have a responsibility to keep up with current research surrounding literacy and technology in the classroom. To be effective, they must also have a basic knowledge of what educational apps are available and how to implement the use of apps successfully in the classroom setting.

Guidelines for Incorporating Apps into Early Childhood Learning Settings

While researchers and educators may have concerns about the use of technological devices with young children, guidelines for introducing them can mitigate these concerns. One way to implement guidelines is to be consistent in using a framework used to teach children how

to effectively use apps in learning settings. Using apps that teach concepts directly related to class material can also reinforce students' learning.

Adopt an instructional framework for teaching children how to use apps for effective learning. Creating and following guidelines for using apps can provide an instructional framework that helps teachers ensure that students are learning specific, targeted skills effectively. Northrop and Killeen (2013) provide an example of an instructional framework that can be used in the classroom to assist students when using digital technology to teach a new concept in the classroom. The framework suggests that students require modeling and scaffolding in order to most effectively use iPad apps to increase literacy skills. The instructional framework they suggest includes four steps:

1. Teach the concept without the iPad
2. Explain the purpose of a targeted digital learning activity and model its use
3. Provide guided practice with the app
4. Arrange for opportunities for independent practice

Using an instructional framework such as this will ensure that the students are using the app to learn the targeted principle while the teachers add support and scaffolding as needed.

Relate the content or skill to the classroom curriculum. Apps incorporated into the classroom setting need to be relevant to the current curriculum. Doing this will allow the app to enhance learning and help student reach their learning goals, instead of becoming a distraction (Northrop & Killeen, 2013). As teachers create a framework and follow guidelines to implementing new apps in the classroom space, they can find places where the app can fit into their teaching that will enrich children's learning experience. The NAEYC (2012) states that educators must use "developmentally appropriate practices" (p. 8). In order to do this, the

specific purpose for using an app (or technology) in any given activity must be determined prior to allowing students to use these tools in the classroom. As these guidelines are implemented in the classroom, iPad apps can be used to enhance learning activities instead of being used as an isolated classroom activity to entertain students (2012, p. 5). The NAEYC also recommends that teachers consider the goals for each activity they plan and determine whether using an iPad or other handheld device will aid in helping children achieve the objective.

Making the decision to adopt apps into the classroom. There are additional concerns surrounding the decision to adopt apps into the classroom setting which need to be considered with the specified published guidelines (e.g., implement with interaction, reduce screen time, and relate to a higher-level curricular purpose). Teachers may be concerned with how children react to a certain app, or what elements of digital devices children find to be appealing. Teachers must also evaluate the apps themselves in order to determine whether the app will provide age-appropriate material and activities in addition to content that is related to classroom curriculum. Finally, teachers must evaluate apps for their pedagogical soundness.

While there are existing research and position papers dealing with why, how, and when to use (or not use) instructional apps with young children, teacher perceptions of the apps are often a final deciding factor. Teachers often form their perceptions of the value of using digital apps by observing the way children respond to the apps in the classroom. If students do not seem interested in an app or if it does not hold their attention, the teacher may not choose to use the app again.

Statement of the Problem: How are Teachers Selecting Apps?

While the literature provides several examples of frameworks that could be used as teachers select apps for classroom settings, little if any data are available on whether teachers are

actually implementing these frameworks with their students. There is also limited research surrounding the question of how teachers make decisions about apps to use in the classroom, and what they value in apps they choose to use in the classroom setting. According to Powell (2014), teachers should take into consideration each child's skill level and individualize app selection to match the student's learning abilities. The ideal scenario is that teachers first identify objectives and use apps that help students reach age-appropriate educational goals, while taking into consideration the needs of each individual child who will be using the app (Powell, 2014). However, this may require a fair amount of time and research on the teacher's part, since one-size may not fit all in terms of the learning needs of the children in the classroom. The lack of data in this area indicates a need for more research to reveal what teachers value in apps used for educational purposes in the classroom, as well as research on how they are making decisions about which apps to use.

Purpose of the Study

This study is designed to examine what teachers value in each of the targeted early literacy apps chosen for analysis. The goal is also to determine how teachers are making the decision to use or not use apps for the students in their classrooms. More specifically, this study will address the following questions:

1. What are teachers' perceptions regarding the use of early literacy apps in the classroom?

2. What do teachers value when choosing apps to use in their classrooms?

3. What is the extent to which teachers place emphasis on engagement (design features) over pedagogical principles?

CHAPTER 2

Method

This is a descriptive study which is part of a larger project designed to gain information about children's engagement during encounters with three iPad apps targeting early literacy skills in children. The focus of the current study is on the teachers' reactions to examples of early literacy apps, their reflections on what they value about each app, and the reasons they would or would not use them in their classroom.

The Digital Apps

The study drew upon three iPad apps to gain information regarding teacher perceptions of iPad apps for early literacy. The apps that will be used are: *Endless Reader*, *Preschool Matching Game: Rhyming Words*, and *Hideout: Early Reading*.

Endless Reader. The *Endless Reader* iPad app, developed by Originator Inc., was selected because it is a very popular app that has received positive reviews, including over 2,000 five-star ratings on the iTunes App Store (2016) out of 2,753 ratings. It associates sounds with letters, blends sounds to make words, and associates written words with pictures and animated videos. In fact, many of the positive reviews of the app point out that the app draws children in and maintains their attention with entertaining spectacles and animations. A high level of engagement in an app is generally important for effectively highlighting early literacy skills.

Despite the advantages of engaging interactions, *Endless Reader* has pedagogical flaws which detract from sound instruction of early literacy skills to children. Some of these flaws include incorrect representation or association of letters and sounds, distortion of sounds when produced in isolation, and inaccurate blending of sounds into words. In addition, the activities in the app are not appropriate for the targeted age group. The creators of the app intended its use

for "ages 5 and under," but the focus is on reading (i.e., blending letters and sounds to make printed words), and the targets used are first grade and kindergarten-level patterns.

Preschool Matching Game: Rhyming Words. The *Preschool Matching Game: Rhyming Words* iPad app, developed by Alligator Apps, was selected because it is typical of the many rhyming apps available. This app uses colorful, attractive photos of real objects as prompts for children. The app allows children to tap on pictures of words to hear their names out loud, and then drag pictures of matching rhyming words together. The task is simple and consistent, meaning that children are able to quickly and easily determine how to manipulate the app and can be immediately successful.

While the photographs are attractive, they often represent obscure words, since these apps typically use items that are easily pictured but are not necessarily common words. The inclusion of uncommon nouns results in vocabulary with which children cannot relate, or words that are not salient for the child. Thus children do not gain exposure to rhyming skills within relevant, salient contexts, and the children may not be able to generalize the skill easily to other settings. The app also fails to provide adequate modeling or repetition of correct answers and allows users of the app to respond without gaining an understanding of the rhyming principle involved. The app relies on incidental exposure of rhyming and trial-and-error to teach children how to complete the rhyme-matching task.

Hideout: Early Reading. The *Hideout: Early Reading* iPad app, developed by faculty members at Brigham Young University was selected because it attempts to provide a theme-based context for introducing children to targeted rhyming words (e.g., words like *hop, shop, pop, top,* and *stop* are encountered while popping popcorn in a popcorn shop). *Hideout: Early Reading* provides children with frequent and explicit encounters with literacy targets in 'virtual'

situations. It presents skills (target phonic and phonological patterns) with compelling game-like functions, navigational choice, and contingent interactions: exploring how objects interact and creating spectacles by making objects react in funny or unexpected ways. The *Hideout: Early Reading* app uses game mechanics to highlight a pattern in a virtual context (e.g., going to a pop shop to pop popcorn). Because much information about the task is built into the theme-based activity, the response expectations appear to be clear. The various activities include a) associating letters with sounds, b) creating words by blending onsets (initial consonant or cluster) with rhyme endings (the vowel and final consonant or cluster), c) using words within a word family to describe an experience, and d) presenting a text about the experience that highlights the targeted phonemic pattern.

This app may effectively raise children's phonological sensitivity to rhyme patterns by focusing on simple sounds and words relevant to preschool-aged children. However, the concept of rhyming is not explicitly taught to children within the app. Instead, the app relies on incidental exposure to rhyming to help children learn and become familiar with the concept of rhyming in general.

Participants

Fifteen teachers from a Head Start program in central Utah participated in the study. Two of the participating teachers had prior exposure to the apps used because they took part as observers in the child engagement study, in which students responded to the three apps. All 15 teachers had varying levels of experience using iPad apps, and the 13 teachers who did not participate in the child engagement study had not been previously exposed to the three apps used in this study. However, all teachers had some prior experience observing their own students interacting with various iPad apps in their own classroom setting.

Procedures

The procedures consisted of first exposing the teachers to the apps and allowing them time to manipulate and interact with each app. Teachers were then interviewed and asked about their preferences or reactions to each of the three apps. The interviews were recorded and transcribed.

Introducing teachers to the apps. At the beginning of the introduction phase, the interviewers briefly demonstrated how to use each of the three apps to the teacher. The teacher was then given approximately 15 minutes to explore all three iPad apps. As the teachers interacted with the apps interviewers were nearby and available to answer questions; however, the teachers were not directly observed during this period of time.

Interviewing the teachers. Following the 15-minute time period provided to teachers for the exploration of the three apps, the teachers were interviewed for approximately 30 minutes each. Each interview was recorded using a digital recording device. During the interview phase the iPad was available so the teachers could refer back to the apps as needed. The interview consisted of questions regarding teacher background, the teachers' experience using an iPad, and the teachers' perceptions of the three iPad apps with which they interacted prior to the interview. The interview included a series of questions about the teachers' experience and background in the classroom, as well as questions about their opinions about technology and iPad apps. Questions included the following: How do you feel about exposing children to early literacy activities via the iPad? What experience, if any, do you have using the iPad in your classroom? What, if anything, did you like about this app? Would you use this app in your classroom, and why or why not? and Which of these apps would be most effective in teaching early literacy skills and why?

Transcribing the interviews. Video and audio recordings of the teachers' interviews were transcribed for verbal and nonverbal behaviors. Of interest for this study was the teachers' responses to key questions asked after they had interacted with the apps. Thus the transcriptions captured all verbal comments uttered by the interviewer and teachers throughout the entire interview. Head nods and shakes given as answers to interview questions from the interviewees were recorded as "yes" or "no" responses, respectively.

Undergraduate students were trained to perform transcriptions using audio recordings of the interview sessions. Procedures for determining reliability of the transcriptions were also established. Each of the student research assistants used the same transcription key and met together to compare transcriptions and ensure reliability between each transcriber.

Data Analysis

Data analysis consisted of organizing responses into common categories from the transcriptions of the teacher interviews. Phase one of the interaction, which involved introduction and exploration of the apps, was not included in this analysis. Following organization of the data into categories, data analysis involved comparing responses across the three iPad apps.

Analyzing Responses to Teacher Interview Questions

The responses of the teachers were analyzed and each response was assigned a category (or several categories) depending on the nature of the response. Categories emerged based on topics and trends found in the interview responses themselves. No *a priori* categories were used. Responses that commented on the same aspect of an app were grouped together. Responses that commented on more than one aspect of an app were included in each group or category mentioned. For example, if one teacher had commented, "I liked how the app gave me

sight words and had fun music" the categories drawn from that comment could be "appropriate pedagogical strategies" and "engaging auditory stimuli" since both pedagogical strategies as well as auditory stimuli were included in one response. Teachers were asked about what they liked or disliked about each of the apps, whether or not they would use it in their classroom, and why. The process for selecting categories in which to group responses was the same for each question and response.

Comparing Teacher Analyses Across iPad Apps

Following the categorization of interview responses, the data were analyzed to determine whether similarities and differences were common between each app. There were 15 teachers interviewed as part of this study. However, due to some inconsistencies in the interviewing process, not all teachers were asked all of the questions, and not all teachers responded to each question asked to them. All teacher responses were included in this analysis.

CHAPTER 3

Results

Results from this study provide information about teachers' perceptions of early literacy apps, including what they value in the apps and what kinds of apps they would use in their classrooms. The results also include teachers' feedback regarding specific apps that they encountered in this study. Direct quotes are used in the reporting of the results to illustrate detected themes.

Teacher Perceptions Regarding Use of Apps in the Classroom

When teachers were asked whether or not they believed it was beneficial to expose children to early literacy apps via the iPad, 8 out of 15 responded that they believed it was beneficial. Six teachers responded that they believed it was beneficial but also expressed reservations such as "it needs to be limited" or "there needs to be a balance." One teacher stated that she had "mixed feelings about having an iPad in the classroom or a computer in general." This teacher stated that she believed students get enough time on the iPad at home and that "they should be learning from other things besides technology."

Teacher Reactions to Individual Apps

Teachers identified what they liked and didn't like about the apps they encountered as part of the study and were asked to provide reasons as to why they would or would not use the particular app in their classroom. The teachers positive and negative reactions to each of the three apps (*Endless Reader*, *The Preschool Matching Game: Rhyming Words, and Hideout: Early Reading)* follow.

Endless Reader. Teachers were asked what they liked and didn't like about *Endless Reader* and whether they would use the app in their classroom. They were also asked to provide

reasoning as to why they would or would not choose to use the app in their classroom. Teachers were allowed to give more than one response, and each response was counted. *Endless Reader* is the app that associates sounds with letters, blends sounds to make words, and associates written words with pictures and animated videos. The creators of this app say the target group for this app is "ages 5 and under" and that the focus is on reading (i.e., blending letters and sounds to make printed words). See Table 1 for a summary of teacher responses to *Endless Reader*.

Table 1

Number and Type of Positive and Negative Teacher Responses to Endless Reader

Positive Responses		Negative Responses	
Varied Introduction to Letters	14	Limited Exposure to Targets	1
Interesting Multi-Sensory Stimuli	15	Inappropriate Level of Difficulty	3
Appropriate Pedagogical Strategies	2	Difficulty with Shared Use	1

Note. Each type of positive or negative response was counted and categorized. Where appropriate, responses were counted in more than one category.

Positive responses. When asked what they liked about the *Endless Reader*, all 15 teachers shared specific positive feedback regarding the app. Positive teacher responses focused on the engaging auditory stimuli, the variety of ways that the words were used, the appealing visual presentation, and the overall level of engagement. Several teachers' responses included more than one aspect of the app that they liked; and each aspect mentioned was counted and categorized separately as seen in Table 1.

Varied introduction to letters and words. Endless Reader matches sounds with letters and associates written words with pictures; and it uses music, sounds effects, and animation to draw in users. All but one teacher (14 out of 15) indicated that they liked the letter-sound association provided to students as they used the app. Specifically, teachers liked that letter-

sound associations and blending examples were being provided to students in several different contexts, such as the letter alone, in various letter combinations, in a word, and in a sentence. They also liked the fact that the letter sounds were repeated and reinforced throughout the game. One teacher said, "I like that it sounds out each letter individually" while another said, "I like that when the word came out originally it stated the word and divided the letters out." Another teacher commented on the kind of sound used to introduce letters. This teacher stated, "I like that it gives you the [letter] sound in a cute, funny voice." Other teacher comments included "The kids enjoyed hearing the letter sounds, hearing the letter sounds and words in a sentence."

Interesting multi-sensory stimuli. The multi-sensory stimuli include the look of the app overall; the animations and characters; the presentation of the letters, words, and sentences, and how they interact with the auditory stimuli used within the app. Fifteen out of 15 teachers made a comment about the app in regard to the sensory stimuli (visual or auditory) and how these aspects of the app help keep children engaged and entertained. Three of the eight teachers who commented on this aspect of the app used the word "cute" to describe the animations and visual presentations and sounds included in the app. For example, one comment focused on the "cute funny voice" and how "kids were engaged and enjoyed it." Another teacher commented on how the visual and audio work together to teach children new letters and sounds. Finally, one teacher gave an overall statement saying that the app "does all three: visual, hearing, and practicing" which "gets a lot of different attention and involvement for [the students]." Therefore, some teachers felt that the multi-sensory stimuli seemed to help children stay engaged in the activities provided in the app.

Appropriate pedagogical strategies. Two teachers out of 15 commented directly about the way the app teaches new words to users. One teacher stated that the app "was giving me

sight words" and using them in sentences. The other teacher commented on the "variety of ways

the word is used." Providing the letter sounds and then the entire word in a sentence gives the

child an opportunity to see how the word is used in context, something that teachers seemed to

appreciate. These techniques are effective in helping individuals understand the meaning and

proper use of newly learned vocabulary words.

   Negative responses. When asked what they didn't like about the *Endless Reader* app, 11

out of 15 teachers responded with "nothing." The types of negative responses related to the

limited exposures to targeted skill, inappropriate level of difficulty, and difficulty with shared

use within the classroom. Some teachers included more than one aspect of the app that they

disliked in their response. Each aspect mentioned was counted and categorized separately as seen

in Table 1.

   Limited exposures to targeted skill. The version of *Endless Reader* used in this study was

a free trial version downloaded from the App Store. The full game includes one word beginning

with each letter of the alphabet (totaling 26 words) in Level 1, with additional words and

activities in Levels 2 and 3. The trial version used in this study provided a sample of the full

game at Level 1, including the first four words beginning with the letters A, B, C, and D. Each

activity in the app focuses on a central word. The trial version used provides the user with all

components of the lessons, while the number of words provided for users to manipulate is

limited to four words. The user must pay $29.99 for the full version of the app in order to

receive access to all of the words and levels within the app.

   Inappropriate level of difficulty. Three teachers commented on the level of difficulty of

the game. Two teachers who had three-year-old students in their classrooms commented that the

activities presented in this game such as spelling words, reading sight words, and using words in

a sentence are beyond the skill level of their students. These teachers did not think the app overall would be effective with the younger students, even though some aspects within the app such as letter naming and introduction of letter-sound associations were age-appropriate. Another teacher commented, "The words were said kind of fast" and "The tone of the voice saying [the words] was hard to understand." Generally speaking, these aspects of the app may make it difficult for younger users to understand words and learn effectively from the activities presented within the app.

Difficulty with shared use. One teacher commented on the difficulty of sharing the app among students due to the nature of the activities available. The app provides a word with individual letters that say their sound when touched. This teacher commented on this feature, saying, "If you have more than one child playing it, if they both have letters, it would be saying the sounds at the same time. . . If they were doing it individually that would probably be better." This teacher also voiced concerns about students having a difficult time remaining focused on the activity if there was more than one child using it at a time.

Opinions regarding classroom use. All teachers interviewed responded *"yes"* when asked whether they would use this app in their classroom. Two teachers responded *yes* with the condition that it would be used "for the more advanced kids" and if it was used "one-on-one with the teacher." Six of the 14 teachers responded that they would use it because it introduces sight words and letter/word recognition in addition to letter-sound associations to their students.

Preschool Matching Game: Rhyming Words. Teachers were asked what they liked and didn't like about *Preschool Matching Game: Rhyming Words* and whether they would use the app in their classroom. They were also asked to provide reasons for why they would or would not choose to use the app in their classroom. *Preschool Matching Game: Rhyming Words*

provides colorful, attractive photos of real objects to represent rhyming words. The app allows children to tap on pictures of words to hear their names out loud and then drag pictures of matching rhyming words together. See Table 2 for a summary of teachers' positive and negative responses to *Preschool Matching Game: Rhyming Words*.

Table 2

Number and Type of Positive and Negative Teacher Responses to Preschool Matching Game: Rhyming Words

Positive Responses		Negative Responses	
Sufficient Rhyme Exposure	7	Lack of Engagement	6
Appealing Visual Presentation	5	Difficulty of Words	5
Clear Game Objective/Setup	6	Lack of Reinforcement	3
		Difficulty Manipulating	1

Note. Each type of positive or negative response was counted and categorized. Where appropriate, responses were counted in more than one category.

Positive responses. When asked what they liked about *Preschool Matching Game: Rhyming Words*, 14 out of 15 teachers had a positive response, while one teacher indicated that she did not like the app and did not provide any positive feedback. Positive teacher responses focused on the exposure to rhyming provided in the app, the photographs selected to represent words, the simplicity of the app, and the way the game can be easily self-guided by its users (children). While 15 teachers responded to this question, several teachers' responses included more than one aspect of the app that they liked; and each aspect mentioned was counted and categorized separately in Table 2.

Sufficient rhyme exposure. Preschool Matching Game: *Rhyming Words* presents several rhyming words to children in the form of photographs. When a photo is selected, the child can hear the word represented by the picture and select another image that may or may not represent

a corresponding rhyming word. When teachers were asked the question, "What do you like about *Preschool Matching Game*?" 7 out of 14 teachers made positive comments about the rhyming exposure and auditory stimuli provided to children who use the app. Responses included comments such as "I like that you could touch the pictures and it would say the names of them" and "I liked the exposure to rhyming."

Appealing visual presentation. Preschool Matching Game: Rhyming Words provides children with photographs of real items to represent rhyming words. Five out of 14 teachers made positive remarks about the photographs selected for use in the app as opposed to the use of cartoons within other apps. One teacher said, "I like the real pictures of real things." Another teacher simply stated, "I love that they use photographic pictures." These pictures allowed students to guess what word the photo represented and find a picture of a corresponding rhyming word.

Clear game objective and setup. Six out of 14 teachers commented on the way the game was set up, including the simplicity of the game and the fact that it could be self-guided by young learners. Comments such as "kids can do it easily" and "you can click on it multiple times and you can try until you get it right" indicated that the teachers liked that children could use this game and eventually be successful in matching rhyming pictures and words without much instruction on the teacher's part. Another teacher liked the way the pictures move and the task became more difficult as time goes on.

Negative responses. When asked what they didn't like about *Preschool Matching Game: Rhyming Words*, 13 out of 14 teachers gave specific feedback while one teacher said that she liked the app and offered no negative feedback. The 13 teachers commented on a) the lack of engagement, b) inappropriate level of difficulty of words chosen, c) lack of reinforcement of

rhyming sounds, and d) difficulty manipulating the app. One teacher's response included more than one aspect of the app that they disliked; and each aspect mentioned in each response was counted and categorized separately as seen in Table 2.

Lack of student engagement. *Preschool Matching Game: Rhyming Words* provided users with the task of matching rhyming words (presented in the form of a photograph) together. Teachers described this repetitive motion as "boring," "simple," and "bland." One teacher stated, "It would be good for a short amount of time" but "eventually it would be boring because it didn't go anywhere else." Two teachers compared it to other apps used in the study, saying that it wasn't as engaging, interactive, or fun. Another teacher thought the lack of interaction and engagement while playing the game could also lead to students "dragging [pictures] without thinking," thus defeating the purpose of the game. Out of the 14 responses received from teachers who were asked this question, six teachers believed the game was not interactive enough to hold the attention of their students.

Difficulty of words used within the app. The *Preschool Matching Game: Rhyming Words* app has a variety of real photographs used to represent rhyming words. While some teachers appreciated the varied selection of pictures used, others felt they were vague and difficult for their students to understand. Out of the 14 responses to the question, "What, if anything, did you dislike about the *Preschool Matching Game* app?" five teachers commented on the difficulty and obscurity of the words selected for use in the app. One teacher responded, "I didn't like some of the words they used such as *crustacean*. I couldn't tell which ones went together without touching them." The words associated with the pictures were described as being "not so intuitive," "confusing," and "over [the students'] head." Another example of a difficult or obscure vocabulary word used in the app was *bin*. The teacher responded with "pictures were

confusing and didn't represent the words well; *trash can* was actually *bin*." The difficulty of the words was also a concern for English Language Learners within the classroom, and one teacher voiced her concern by stating, "Some of my English Language Learners might not be familiar with some things. *Jar* and *car*, the Spanish words might not rhyme."

Lack of appropriate reinforcement of rhyming sounds. While the *Preschool Matching Game: Rhyming Words* provides several pictures of rhyming words as well as audio stimuli as the pictures are touched, the words are not repeated when a child accurately matches two pictures with rhyming names. This was a concern that three teachers commented on when asked what they disliked about the app. Teachers stated, "It would have been nice for practicing rhyming to repeat both words once you got them right" and "It recited the first [word] but not the second word, so it did not reinforce the rhyming." One teacher also commented on how the app provides audio reinforcement to users by saying "good job!" or "great!" whether or not children were able to match rhyming words effectively. The teacher described this as "praising [students] for not really doing what this app was created for."

Difficulty manipulating the app. One teacher disliked the fact that when a picture was dragged into a certain proximity to the correlating rhyming picture, the app would automatically place the picture being dragged into the correct position. This teacher expressed worry that the children would not pay attention to the words they were dragging toward each other because this feature pulls the pictures into the correct position. The teacher disliked the dragging feature within the app and had difficulty manipulating the app overall.

Opinions regarding classroom use. Thirteen teachers were asked whether they would use the *Preschool Matching Game: Rhyming Words* app in the classroom with their students. Seven out of 13 teachers responded with "yes." Five teachers responded that they might use it in

their classroom under certain conditions and one teacher responded with "no." Reasons given for using the app in the classroom only under certain conditions included the following: "some [students] will get bored," "I don't feel like it was [re]enforcing the rhyming," "It is not my first choice to use," "I would be more likely to use other [apps]," and "I don't want to keep pulling it back and telling the kids 'I need you to do it this way.'" The reasons teachers gave for not using the app in the classroom were similar to the responses teachers gave when asked the question "What, if anything, did you dislike about *Preschool Matching Game*?"

Hideout. *Hideout: Early Reading*, the app that provides children with frequent and explicit encounters with literacy targets in "virtual" situations, allows users to act upon objects to create spectacles (i.e., interesting scenes, displays, or actions on objects). Table 3 provides a summary of teacher responses to the *Hideout: Early Reading* app.

Table 3

Number and Type of Positive and Negative Teacher Responses to Hideout: Early Reading

Positive Responses		Negative Responses	
Engaging Auditory Stimuli	12	Inappropriate Level of Difficulty	4
Appealing Visual Presentation	6	Inappropriate Pacing	3
Ease of Use	1		

Note. Each type of positive or negative response was counted and categorized. Where appropriate, responses were counted in more than one category.

Positive responses. Fourteen out of 14 teachers responded positively to the *Hideout: Early Reading* app, and seven teachers said that there wasn't anything that they did *not* like about the app. The teachers commented on the engaging auditory stimuli, appealing visual presentation, and ease of use built into the app. Positive responses also related to the app being easy to use, stimulating the senses, and engaging the children. Several teachers' responses

included more than one aspect of the app that they liked; and each aspect mentioned was counted and categorized separately as seen in Table 3.

Engaging auditory stimuli. One of the main purposes of *Hideout: Early Reading* is to provide users with many examples of target phonic and phonological patterns. When teachers were asked the question "What do you like about *Hideout*?," 12 out of 14 teachers commented on some aspect of the auditory stimuli used within the app. Responses centered around the inclusion and repetition of the phonological patterns children were exposed to. Responses included "I like that it emphasizes letter sounds" and "There was a lot of repetition and it reinforced all the sounds." In addition to noticeable exposure to the sound patterns being targeted (phonic patterns and letter-sound associations), two teachers commented on the music, saying "Music is always good for children," and "I liked the music."

Appealing visual presentation. *Hideout: Early Reading* permits children to act on objects to create spectacles – funny or unexpected ways in which the objects move and interact. Six out of 14 teachers referred positively to the visual aspect of the app. Of these six teachers, three commented on how they liked the sound and visual combinations. Two comments pertaining to what the teachers liked about having auditory and visual stimuli combined within the app are as follows: "I like that it visually pops up as the word is said out loud" and "They [the students] could hear the sound over and over while they're seeing the letters." Additionally, another teacher mentioned that the "iPad [app] is very. . . sensory in a way." This teacher explained that the sensory aspect of viewing images on the screen while touching the screen would help students learn effectively. Teachers seemed to value appealing visual presentation due to the way it kept students' attention and helped them remain engaged while using the app.

Ease of use. One teacher did not comment on the visual or auditory aspects of the app, but, instead responded with "I loved that [app], most of the kids figured out what to do on their own." The ease of use and the fact that the students were able to manipulate the app independently was appealing to this teacher.

Negative responses. When asked what they didn't like about the *Hideout: Early Reading* app, seven of the teachers responded that there was nothing they disliked about the app; and they gave no further feedback about the app. The other seven teachers had concerns about either the level of difficulty or the various timing aspects of the app.

Inappropriate level of difficulty. Of the seven teachers that provided feedback on what they disliked about *Hideout: Early Reading* four teachers commented on the level of difficulty of the app. While not all of the teachers have three-year-old students in their classrooms, two teachers mentioned specifically that the vocabulary and skills needed to participate in the activities would be too difficult for three-year-old students. One of the activities requires students to drag the correct letter to its place within a word, which a teacher said would be too difficult for her students because "it is a higher skill." Specific activities were also mentioned in response to the question about what teachers disliked about *Hideout: Early Reading*. One teacher commented that it was "hard for [students] to get hens in the pen." Another teacher said that "it seemed to take a lot of popping before it got to the sentence [the written text that corresponds with the activity], and children might get frustrated."

Inappropriate pacing. Three teachers commented on some aspect of timing within the app. Teacher responses on the pace of the activities were mixed in terms of whether teachers believed they moved too fast or too slow for their students. One teacher said, "It takes a lot of time to get through all of them" while another teacher said, "I wish it showed the picture longer."

A teacher also made a comment about the words and sentences displayed at the end of an activity, and the time taken to show each of these. While she did not state that she disliked the incorporation of the sentences, she said that she believed her students would try to skip this section because they would want to move on to the next fun activity more quickly.

Opinions regarding classroom use. All 15 teachers who were interviewed said that they would use this app in their classroom. Six teachers gave a reason for why they would use the app in their classroom, and the reasons varied. Three out of six teachers said that the game would be interesting and engaging for the children. All three of them liked that the children were actually doing something instead of passively watching the screen. Another teacher stated that she believed the app would provide sensory stimulation for the children and help them "release some anxiety and energy." Finally, the last two teachers commented on how they valued the exposure to rhyming words the children would get and on how the app reinforces skills taught in the classroom.

Teacher Opinions on Effectiveness of Each App in Teaching Early Literacy Skills

Twelve teachers were asked which app they believed would be most effective in teaching their students early literacy skills, and why. Teachers were allowed to list more than one app to answer the question as long as they provided reasoning for their answer. As shown in Table 4, nine teachers believed *Hideout* to be the most effective in teaching early literacy skills to their students. *Endless Reader* was chosen by seven teachers to be effective in teaching early literacy skills, while *Preschool Matching Game* was chosen by two teachers. Teachers' reasoning for choosing each of these apps varied; the majority of teachers commented that it depended on what principle they were teaching at the time, such as reading, rhyming, or letter sounds. Out of the 12 teachers who answered the question, "Which app would be most effective in teaching early

literacy skills and why?" eight teachers commented on some pedagogical aspect of the app as a reason for choosing it to teach literacy skills within the classroom. For example, one teacher commented that she would like to use *Endless Reader* in the classroom "for the sight words and letter sound recognition" that it provides. Another six teachers commented on the engagement aspect of the apps and how the children would enjoy using the app as they simultaneously learn literacy skills. One teacher said that they struggle to find "creative ways to make [learning] fun for [students]" and believed her students would benefit from using *Hideout* and *Endless Reader*.

Table 4

Teacher Opinions on the Apps' Effectiveness at Teaching Early Literacy Skills

Positive Responses – App is Effective at Teaching Literacy Skills	
Endless Reader	7
Preschool Matching Game	2
Hideout	9

Note. Each response was counted and categorized. Teachers were not limited to choosing one app in response to the question, "Which app would be most effective in teaching early literacy skills, and why?"

Summary of Results

The results of the study provided information about what components of each app teachers liked and disliked and why they may or may not select the app for use in their classroom. The findings will be summarized according to the three apps presented in this study: *Endless Reader, Preschool Matching Game: Rhyming Words*, and *Hideout: Early Reading*.

Endless Reader. All but one teacher made a positive comment about the auditory stimuli included in the *Endless Reader* app. Eight out of 15 teachers also commented about the visual stimuli. These two components were the focus of the teachers' positive feedback and the largest draw to the app overall. Teachers made comments about both working together to teach

literacy skills. One teacher remarked that the visual and sound combination would "help [students] learn the sounds and get them looking at words more." Another teacher liked that the app helped students "learn how to spell and read the words at the same time." While specific teaching methodologies were not mentioned, teachers viewed the combination of visual and audio components within this app as an effective way of teaching early literacy skills.

Preschool Matching Game: Rhyming Words. While teachers had positive things to say about the visual components of this app, 6 out of 14 teachers commented on the fact that *Preschool Matching Game* was difficult for their students either because of the complexity of the words chosen or the way in which the game must be manipulated. The notion that this game may be too difficult for students in the targeted age group to use independently may have contributed to the 5 out of 12 teachers indicating that they would not use this app in their classroom.

Hideout: Early Reading. Teacher feedback on the *Hideout: Early Reading* app centered on the auditory and visual components of the app. While only three teachers commented specifically on how the audio and visual work together within the app, it is clear that both components are necessary to create the most enjoyable experience for the user. Twelve out of 14 teachers gave positive comments about the audio stimuli provided in the game, and their reasons for doing so were based on pedagogical principles. The repetition and reinforcement of sounds included in the *Hideout: Early Reading* app was the aspect most commented on by teachers. Other teachers appreciated that the app teaches rhyming, and "has the ending sound" of words presented both visually and auditorily. The combination of visual and audio repetition of rhyming words is an aspect of this app that teachers valued.

Effectiveness of teaching literacy skills. The 12 teachers who were asked which app they believed would be most effective in teaching early literacy skills had mixed opinions. The majority (nine teachers) stated that they believed *Hideout: Early Reading* would be the most effective, while seven stated that *Endless Reader* would be effective. Only two teachers stated that they believed *Preschool Matching Game: Rhyming Words* would be effective in teaching their students early literacy skills.

CHAPTER 4

Discussion

The aim of this research was to obtain information about teachers' opinions about the use of early literacy apps in the early childhood classroom. The discussion includes reflections on findings, implications, limitations of the study, and recommendations for future research.

Reflections on Factors Teachers Consider when Choosing Apps

Analysis of the data provides information about teachers' perceptions regarding the use of early literacy apps in the classroom. The results suggest that when selecting apps, teachers value appropriate level of difficulty for students, game-like features included in the app, and the incorporation of multi-sensory stimulation.

Appropriate level of difficulty. The data suggest that when selecting apps for use in the classroom, teachers look for ones that are age-appropriate for their students. This was evident in teachers' comments about the *Preschool Matching Game: Rhyming Words*. While the name of the app implies that it would be appropriate for preschool-aged children, six teachers gave direct feedback about how the game was too difficult for their preschool-age students. One thing that made the app difficult was the complexity of the vocabulary that it included. The real-life photographs, while appealing visually, represented obscure and uncommon objects. Children learn to identify rhyme patterns in words that are common, those that have a large number of words within the targeted rhyme pattern, so the use of obscure and uncommon vocabulary could make it challenging for the rhymes to stick. Despite the fact that the name of the app implies that it is appropriate for preschool students, the majority of teachers were able to determine, by trying the app themselves, that the game would not be ideal or appropriate for classroom use.

A previous study by Lyman (2017) examined child engagement while using the three apps targeted in this study. The findings of this study also indicated that *Preschool Matching Game: Rhyming Words* may have been advanced for the age group targeted. According to the child engagement study, students who participated in using the *Preschool Matching Game: Rhyming Words* app demonstrated a need for more teacher direction while children were using the app, as compared to the two other apps examined, indicating that the tasks presented in *Preschool Matching Game: Rhyming Words* may have been too difficult for the students (Lyman, 2017). Therefore, the appropriate level of difficulty for an app may be one that allows the student to participate and learn without excessive teacher direction.

Alternatively, students may be able to complete the objective of the activity within the app (match all rhyming words together) without much teacher input, but this does not indicate that children are understanding or learning how to rhyme. They may keep trying to match random pictures together until the game is completed. This may be an indication that teachers should "try out" apps before letting students use them, and that there needs to be specific criteria for determining whether apps are at an appropriate level of difficulty for students.

Game-like features. Based on the results of this study, teachers seem to want to select apps that are educational but also include game-like features. Game-like features are activities in which the user is attempting to achieve a goal or complete an activity, leading to a consequence. *Hideout: Early Reading* was one app that teachers believed included both criteria, an educational component as well as game-like features. Twelve out of 15 teachers were asked whether they would use *Hideout: Early Reading* in their classroom, and all of them indicated that they would. The reasons for saying they would use the app varied. One teacher commented specifically that her students "like the apps for the games." She continued saying that the *Hideout: Early*

Reading app is "a game for them, a learning game. So that's why I would use it." Another teacher commented on game-like features in *Hideout: Early Reading* by saying the students "get to play a game, and that makes [learning] enjoyable." These teachers' responses indicate that when choosing apps for the classroom one thing they look for is game-like apps that incorporate learning. Students seem to be interested in game-like features, so by picking apps that have this, students may be motivated to use the game and learn from it more than if it didn't.

Incorporates multi-sensory stimuli. Teacher feedback indicated that the sound and picture combination coming from the app could work to excite and motivate users. The combination of visual and auditory stimuli refers to the coordination of the visual presentation or animation with associated sounds. For example, one teacher commented specifically on one activity in the *Endless Reader* saying that she liked because students "hear the word over and over when they put the letter onto the word." In this activity, the student touches a letter and drags it into the corresponding position in a word on the screen. The combination of the student finding, touching, and dragging a letter while listening to the sound that letter represents helps to keep the student engaged while learning.

One teacher commented that she believes apps that combine the "visual and sound" are appropriate and stimulating for those who are visual as well as auditory learners. While most apps combine visual and auditory stimuli within the app (coordinating movement and activities with corresponding sounds and/or music) the more senses that can be involved in learning, the better. Similarly, another teacher responded that she likes iPad apps because (in general) they include several senses (auditory, vision, tactile) and therefore help students learn by using multiple modalities.

Teachers seemed to appreciate the incorporation of spectacles in the *Endless Reader* app – auditory and visual stimuli that could attract children's attention and objects that moved in erratic or crazy ways. The activation of spectacles generally incorporated both visual and audio components. While activating spectacles is not the same as playing a game with a clear objective, it seems as though students are entertained and motivated by both types of activity. Rewards are also included in the form of a funny animation or sound as students complete an activity correctly. This type of reinforcement or reward at the end of a completed activity seems to be motivating for students.

It seems as if teachers feel that highly compelling visual and auditory stimuli raise children's level of attention and interest in the material presented in the app. Drawing upon highly sensory stimuli can help students stay motivated as they learn, and teacher feedback about including multi-sensory stimulation within apps was in regard to maintaining the students' interest and attention as opposed to the way targeted skills are taught. Teachers did not express caution or concern about students becoming overstimulated via digital devices; yet one teacher mentioned at the beginning of the study that she would like to limit overall exposure to digital devices in schools and have students learn using other (non-digital) approaches as well.

Implications Regarding Pedagogical vs. Design Features

Teachers encounter a challenging task when it comes to evaluating early literacy apps. In addition to attending to design features that can serve to keep children engaged, teachers must evaluate apps in regard to their pedagogical soundness. This study showed some instances of teacher awareness of pedagogy while other aspects of theoretical underpinnings went unnoticed.

It is clear that some teachers who participated in the study select apps that they believe will teach pedagogical principles accurately, as well as keep students engaged. Essentially, these

teachers want students to be learning while doing something instead of passively watching a screen. While teachers were not directly asked to analyze the pedagogical strength of the apps, teachers tended to notice a lack of repetition of rhyming word pairs and lack of appropriate reinforcement within the *Preschool Matching Game: Rhyming Words* app. It is clear that teachers recognize the importance of repetition and reinforcing rhyming sounds to children when teaching this skill; 7 out of 14 teachers commented on this and acknowledged it as a weakness in the app that could negatively affect their students' learning. Ten out of 12 teachers indicated that they did not believe this app would be effective in teaching children early literacy skills.

Teachers also made note of the level of difficulty of the words used in this app. Despite the name of the app, the words used within the app were beyond preschool level. Finding an appropriate level of difficulty for students is a pedagogical feature that teachers were aware of and recognized while trialing this app for a short period of time. The responses show that the teachers were aware of some pedagogical aspects of the games and are looking for apps that include appropriate teaching methodology, reinforcement, and level of difficulty for their students.

While teachers recognized some pedagogical weaknesses in the *Preschool Matching Game: Rhyming Words a*pp, few, if any pedagogical flaws were pointed out in the *Endless Reader* app. *Endless Reader* includes pedagogical flaws such as incorrect letter-sound association and distortion of sounds in isolation, such as assigning a sound to a silent "e." Additionally, as mentioned, the level of target words used within the app is beyond preschool age. Nevertheless, only one teacher noticed that the level of target words and overall skills needed to succeed in the app were beyond the skill level of a preschool-aged child. Out of the 15 teachers who were asked to give feedback on what they disliked about the app, only 4 had any

input at all. It is important for teachers to identify possible pedagogical flaws within apps they choose to use in their classrooms. However, in the case of this study, time to explore each app was limited and the version of *Endless Reader* teachers tested had limited options and words available, which could have impacted their ability to recognize such pedagogical flaws within the app. Furthermore, the initial excitement accompanying the appealing visual presentation and engaging auditory stimuli within *Endless Reader* could have distracted teachers from observing such pedagogical flaws in the short amount of time allotted to use the app.

Teachers did notice appropriate pedagogical principles included in the *Endless Reader* app. For example, appropriate repetition and reinforcement was used, sight words were provided to users, it included some appropriate letter-sound association and the words were used in sentences. They noticed the techniques the app used to teach new principles and liked that aspect of it. Ultimately, however, the overall focus of the feedback was on engagement and how students were so engaged in this game because of the fun spectacles and sounds.

It is uncertain whether teachers value engagement over sound pedagogical principles based on the current study. According to the results of the study, teachers seem to value apps that provide entertaining auditory and visual components, are easy to use, expose children to a targeted literacy skill of either letter-sound association or rhyming, and use words as well as tasks that are age-appropriate. While these categories are specific to the apps chosen within this study, they may be applicable to other similar early literacy apps. However, if other apps had been used, teachers may have chosen other features as their likes and dislikes. Engagement was emphasized within the study; teachers were specifically asked about whether they thought their students would enjoy the game and would be engaged in the game. On the other hand, teachers were not directly asked whether they believed an app used in the study had pedagogical flaws.

It seems as though teachers notice characteristics within apps that will keep students engaged more quickly or easily than they notice pedagogical flaws or principles within an app. Nevertheless, according to the results, an app must include both appropriate pedagogical principles as well as features that make it engaging in order for teachers to want to use it in the classroom. The balance between these two is unclear, and is most likely different for each teacher, according to preference. A teacher may select an app due to highly engaging features, even if they know it has minor pedagogical errors. On the other hand, an app that is completely pedagogically sound but is considered "boring" to students (no game-like features, not engaging) will most likely not be selected for classroom use. While there needs to be a balance between these two categories, no app will be perfect at both and teachers may need to compromise in one area or another when selecting apps for their students.

According to teacher feedback, *Preschool Matching Game: Rhyming Words* contained pedagogical flaws (inappropriate level of difficulty of words used) and was not very engaging for students. Teachers did not want to use this app in their classroom because they did not think it would hold the attention of their students. *Hideout: Early Reading* and *Endless Reader* seemed to have a better balance of engagement and appropriate pedagogical principles, and teacher feedback focused on areas that fall within these two categories. The majority of teachers wanted to use these two apps in their classroom.

Limitations

There are limiting factors within the present study that must be considered when interpreting the results. These include limited teacher exposure to the apps, small sample size and inconsistencies in responses, and lack of experimental design.

Limited exposure to apps. Teachers were given 15 minutes to explore all three iPad apps for this study, allotting roughly 5 minutes for teachers to use each app. While researchers were not directly observing teachers while they used the apps, they were nearby to answer questions as needed. The limited amount of time teachers had to experiment with each app could have affected their responses to interview questions. In addition, teachers may have not had enough time to complete all activities within the app to determine if they were age-appropriate for their students, or whether the children in their class would enjoy the game. While the majority of teachers did not notice pedagogical flaws or aspects in each of the games, they may have been able to identify these after continued exposure and use.

Two teachers had slightly more exposure to the apps due to their participation in the child engagement study. This inconsistency could have also affected the data because not all teachers were equal in terms of time spent being exposed to the apps.

Small sample size and inconsistency of responses. The small sample size of 15 teachers, combined with inconsistency of responses, leads to limitations in the application of findings. Missing teacher responses could have been due to inconsistency in the interview process, such as the interviewer skipping a question or lack of teacher response to a question due to confusion or distraction. Not all teachers answered all questions asked to them, and not all teachers were asked all of the questions, leading to fewer than 15 responses for some questions. One teacher interview was missing responses to two questions due the recording device stopping the recording before the interview had ended. However, if all 15 teachers had participated in each section and interviews had been consistent, the sample size used in the current study would still be relatively small. The results of the study provided interesting and valuable insights about

teachers' opinions about apps, but the results cannot be applied to populations outside the current study.

Lack of experimental design. This study used a qualitative design which provided information about specific teachers' opinions regarding the use of apps in the classroom. However, because this was descriptive study, the results cannot be generalized beyond the current participants.

Recommendations for Further Research

This study provided valuable insights as to what teachers like and dislike about specific early literacy apps, yet more research is needed to discern what specific criteria teachers use to select apps for classroom use. Further research could focus on asking teachers what processes they go through when choosing an app for the classroom, and what aspects they specifically look for in the apps they choose to use in their classroom. Leaving the questions open instead of asking teachers specifically about topics such as engagement or pedagogical skills could give a more in-depth perspective of what teachers value in early literacy apps.

On the other hand, asking teachers specifically about sound pedagogical principles within apps could also provide valuable information about how and if teachers are looking for this criterion. A focus group or user experience studies could be used to gain insights as to what teachers notice in apps, and how teachers manipulate apps before allowing students to use them in the classroom. Teachers could also be asked what they do (or what they believe should be done) in order to determine whether the app is at an appropriate level for the students in their classroom.

Further research should be done to attempt to see what children understand and learn from encountering specific educational or early literacy apps. This research could provide

teachers with a deeper understanding of what characteristics they should look for when choosing

apps that will be most effective for students' learning.

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