Effect of Teaching Phonological Awareness Using iPad Applications on Reading Fluency

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Abstract

This study looks at the effect a phonics based iPad application has on three students' oral reading fluency scores. The results of this study are varied and do not show a functional relationship between the iPad application and correct words per minute (CWPM). Some of the data is promising, and CWPM increased in the desired direction. The iPad application used in this study could be beneficial to some students. More research needs to be conducted in order to prove a functional relationship between iPad applications teaching phonics and reading fluency.

To be successful in today's society, children must grasp early literacy skills. Literacy is a critically valuable asset in today's culture (Allor, Mathes, Roberts, Cheatham, & Champlin, 2010) because so much of day-to-day life revolves around reading, writing, and technology. New technology is redefining and advancing literacy every day (McClanahan et al., 2012). With technology readily available to people at a very young age, children have access to almost unlimited knowledge. Digital technologies are transforming children's thinking and learning every day. People can now learn with the aid of technology anywhere they please (Collins & Halverson, 2010).

Unfortunately, several researchers report as many as 20% of United States students suffer from literacy difficulties (Lyon, 1995; Shaywitz, Fletcher, & Shaywitz, 1994; as cited in McCutchen et al., 2002, p. 69). Without a firm foundation in literacy, these students will not be able to access the many technological resources available to them. They will struggle to keep up in today's digital society and eventually fall behind in school.

Without proper intervention, students with poor literacy skills often remain poor readers for life. A study by Francis, Shaywitz, Stuebing, Shaywitz, and Fletcher (1996) found that teachers considered 74% of children identified as poor readers in third grade to be poor readers in ninth grade (as cited in McCutchen et al., 2002, p. 69). Responding immediately to literacy problems decreases the negative effects on a child (Allor et al., 2010) while increasing a student's independent reading skills (Stahl, Duffy-Hester, & Stahl, 1998): "high-quality instruction, delivered early, can reduce later reading failure" (Clemens, Shapiro, & Thoemmes, 2011, p. 251).

Reading Skills

Good readers learn to process words quickly, allowing them to focus more on text comprehension (Allor et al., 2010; Clemens et al., 2011; Compton et al., 2005). When stuck on a word, good readers use their decoding skills efficiently to figure out the unknown words. Good readers use known words or letter combinations to help decode unknown letter strings (Compton et al., 2005). They effortlessly apply the decoding strategies to new situations without much thought. Reading words quickly or by sight indicates young readers have both phonemic awareness and decoding skills (Clemens et al., 2011) and can link the two skills together. When readers use these decoding skills, they tend to have higher reading achievement (Stahl et al., 1998).

By contrast, students with learning disabilities lack many basic literacy skills that good readers implement to help them succeed in reading. The most common reading problem is not having accurate and fluent word identification skills (Torgesen & Barker, 1995). Poor readers often cannot decode words by manipulating phonemes, or sounds, which interrupts their reading fluency and comprehension (Compton et al., 2005; Torgesen & Barker, 1995). When students are stuck on a word for long periods, they tend to forget what they read earlier on the page. Their understanding of the text decreases because the focus is on decoding words. Students cannot read assigned materials independently because they will spend too much time focusing on decoding words, rather than concentrating on the passage itself. When students do not understand what they read, they often become frustrated and stop reading the text.

Students with decoding problems may lack phonological awareness and/phonics, the idea that letters and combinations of letters represent sounds (Duff, Hayiou-Thomas, & Hulme, 2012; McCutchen et al., 2002; Stahl et al., 1998; Torgesen & Barker, 1995). Students must develop phonological awareness, the idea various sounds make up spoke words, in order to read unknown words (Clemens et al., 2011). Each individual sound in a word is called a phoneme (McCutchen et al., 2002; Stahl et al., 1998). Each phoneme correlates to a letter or letters in the alphabet; however, letters have different phonemes depending on their locations in the word. For example, one can pronounce the letter "a" in several different ways, based on its position in a word and the other letters surrounding it. Phonemes also do not always have a one-to-one correspondence with graphemes (letters), meaning that multiple letters can represent one sound. Consonant blends and consonant diagraphs, vowel digraphs, diphthongs, phonograms are types of phonemes that do not have one-to-one correspondence (Stahl et al., 1998). Because of the complicated rules related to phonics, students with learning disabilities often have difficulties making connections between written and spoken language (Torgesen, & Barker, 1995).

Teaching Literacy to Students with Learning Disabilities

Research has shown that teaching phonics as students read is more effective in helping students with learning disabilities develop literacy skills such as word recognition, reading fluency, and comprehension (Allor et al., 2010; Compton et al., 2005; Duff et al., 2012; Lemons, 2012). When students can connect the sounds to printed words, the instruction is more effective. Students learn to link similar letter patterns together and develop their own ways to remember what sounds the letter patterns make. Similarly, a study by Allor et al. (2010) revealed a correlation between phonemic awareness and decoding skills. When taught using a program that included phonemic awareness and decoding skills, more than half of the students with learning disabilities met the end-of-year benchmark for their grade level in oral reading fluency (Allor et al., 2010). A study by

Lemons (2012) showed similar results with students with Down Syndrome. In this study, researchers taught phonemic segmentation and nonsense word fluency. Following instruction, more than half of the students involved had an oral reading fluency score near or above the first grade benchmark (Lemons, 2012).

Students with learning disabilities most often require explicit instruction. Students often have a hard time generalizing information to different situations, so teachers should present information in the most basic form while also forming connections between concepts. Students with learning disabilities frequently cannot process large amounts of information at one time. Teachers should break lessons into small sections with headings or bullets to aid the student in processing information (Brown, 2010). Small chunks of information keep the students' interest as well. Many students focus for short amounts of time, so keeping lessons brief and explicit is important (Stahl et al., 1998).

Technology in Schools

Technology is a major resource in schools today; however, research shows that teachers do not use it to its fullest extent (Murray & Olcese, 2011). Teachers need to embrace the change in educational practices and take into account how people learn in the twenty-first century (ChanLin, 2007). In order to take full advantage of technology, teachers and school officials must understand its potential to change the interactions between teachers and students (Collins & Halverson, 2010). Students can now use technology in ways many current teachers never dreamed would be possible, and teachers need to understand this concept. Technology allows students and teachers to work together from a new learning and teaching perspective (Murray & Olcese, 2011) and provides many opportunities that would not be possible otherwise.

Technology has the power to enhance instruction and create rich learning environments when teachers use it effectively (ChanLin, 2007). Technology allows students to develop interest in topics by simply searching on a computer. Learning is more hands on and activity based because of technology. With the help of technology, classrooms can be learner oriented, where teachers highly encourage "learning by doing" (Collins & Halverson, 2010, p. 20). Students can easily research topics, prepare multimedia presentations, and teach their topics to the class. Not only do activities such as these teach students how to find information, but also the students must learn to present materials and prepare a presentation using many types of technology. The future of education rests on the advancement of technology and instructional strategies. Technology also allows teachers to structure instruction to fit the needs of all individual students.

Use of Technology to Instruct Students with Disabilities

Technology provides several benefits specifically for students with disabilities. One of the main advantages of technology is that students are more interested when teachers present information with technology (Brown, 2010). Children with learning disabilities and/or Attention Deficit Hyperactivity Disorder (ADHD) often lack interest and become easily distracted. Many students enjoy using technology and see it as a privilege or a fun game. Teachers can engage students more when instruction focuses on technology.

Students with disabilities also do not make connections between concepts that typically developing children would make automatically. Oftentimes, students with disabilities have misconceptions because they do not fully understand the concepts being presented. When learning a new concept, students with disabilities need to have their misconceptions corrected immediately so they do not learn incorrect information.

When using technology, students interact with the text on a deeper level. They have access to many expert sources, such as audio summaries, video clips, and links to other websites with a click of a button (Brown, 2010; Collins & Halverson, 2010; McClanahan et al., 2012). This extra information can help make abstract concepts more clear to a student and appeals to different learning styles. Through technology, students can receive information best suited to fit their individual learning style or needs. iPads are one form of technology that teachers can customize very easily for students with disabilities.

In a single-subject research study, McClanahan et al. (2012) used an iPad to deliver one-on-one instruction to a student with ADHD. The results of the study showed that the student sustained attention longer, improved work performance, and increased reading comprehension after using the iPad for several weeks. McClanahan et al. (2012) believe "the iPad and similar devices are the future of one to one educational delivery, if not education itself" (p. 20).

Currently, no research connects using iPads to teach phonological awareness to improve oral reading fluency. Research has shown that phonological awareness increases students' general reading skills and that technology is a useful tool to teach all students, especially students with disabilities. No research that connects the two fields of knowledge exists. Because technology is becoming such a vital part of education, it is imperative that researchers conduct studies on these topics.

Methods

Participants

The three male participants, Allen, Ryan, and Hayden, attended a fine arts academy in a small Texas urban school district. The students' ages were six, seven, and seven, respectively. The classroom teacher selected the study participants based on need for additional reading help. On report cards, Allen earned a 68% in reading, Ryan a 78%, and Hayden a 73%. These reading scores are the teacher's assessment of graded classroom work throughout the semester. The researcher measured oral reading fluency by calculating correct number of words read in one minute. Allen read about 12 correct words per minute (CWPM), Ryan read 17 CWPM, and Hayden read 11 CWPM. All fluency scores fell below the expected end of year first-grade average range: above 40 CWPM (University of Oregon, 2012).

Setting

The students attend a fine arts academy in a small Texas urban school district with a total enrollment is 6,369 students. The district consists of five elementary schools, one intermediate school, one middle school, and two high schools. The fine arts academy elementary school has a total enrollment of 340 students: there are two classes per grade level, Kindergarten through sixth grade. The focus of the school is fine arts. The students attend either art or music class every day.

The researcher went to the school four days a week at 9:45 AM, during reading groups. The teacher and researcher chose this time so students would miss as little instructional time as possible. When working together, the student and the researcher sat in the sunroom of the school. The sunroom had two large round tables and eight chairs at each table. The entire room had glass windows. Each student worked individually on the iPad for seven minutes and read a Dynamic Indicator of Basic Early Literacy Skills (DIBELS) passage aloud for one minute. Only one student worked with the researcher at a time.

Materials and Procedures

The students used an iPad application called Phonics Awareness. Features of this application included lessons on segmenting words, blending words, identifying long sounds, and identifying short sounds. The application provides specific verbal instructions for the student to follow. For example, in the segmenting section, the application asks the student to say “bat” slowly, and the application projects the correct segmentation for “bat,” which is /b/-/a/-/t/. The application then has students drag the letters into the correct order to spell “bat.” Another component of the application gives the phonemes (sounds) that each letter in the word stands for and has the student choose the final sound in the word. For example, the computer makes the sounds /m/-/a/-/n/, and asks the child to choose the final sound in the word. In the example above, the sound /n/ is the correct answer. The students progressed through the application at their own pace. To maintain procedural fidelity, the researcher did not provide any additional support while the students were working on the application.

Prior to implementing the study, the researcher trained a colleague to measure CWPM using DIBELS. The colleague collected inter-rater reliability during four sessions.

Measures

Reading fluency was measured by calculating the number of words a student read correctly in one minute. An adapted version of the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) oral reading fluency subtest was administered during baseline and intervention phases (see Appendix A). The oral reading fluency subtest requires students to read for one minute and measures word accuracy and speed of reading. The researcher slightly adapted the DIBELS test by having the students read the passage from the iPad screen.

Student errors were marked on a paper copy of the passage. Errors consisted of skipped and mispronounced words. Skipped words included those the student omitted and/or took more than two seconds to read. The researcher provided words when a student paused for two seconds, told the student to continue, and marked the word as an error. Mispronunciations were also marked as errors. Self-corrections did not count as errors but were monitored. At the end of one minute, the word on which the student stopped was marked. The researcher counted the total words read and subtracted errors to calculate CWPM. After each session, the researcher plotted CWPM on a line graph.

Research Design

This study implemented a multiple-baseline, single-subject research design replicated across three subjects. The purpose of a multiple baseline design is to show a functional relationship between the independent variable (iPad application) and dependent variable (CWPM). Introducing the independent variable in a time-lagged fashion establishes experimental control. CWPM baseline data were recorded for each student before introducing the intervention. For example, Allen's baseline consisted of five sessions with intervention beginning on the sixth session. Ryan's baseline continued through the eighth session and Hayden's through the eleventh with inventions beginning in a time-lagged fashion during the ninth and twelfth sessions, respectively (see graphs).

Data Analysis

The researcher graphed each student's data on three separate line graph. Data were analyzed as the study progressed to determine if the participants' progress. The researcher visually analyzed data using methods common to single-subject research. Analyses included: (a) trends, (b) absolute and relative level change, (c) percentage of non-overlapping data, and (d) stability.

Trends within and across phases were analyzed using a split-middle method to demonstrate the intervention's effectiveness. Trends may show acceleration, deceleration, or zero-celeration. Absolute level change compares the last baseline data point with the first intervention data point showing the intervention's immediate impact. Relative level change is similar; the last half of baseline data points are averaged and compared to the first half average of intervention data. Larger positive level changes between two phases show a greater intervention effect. Overlapping data across phases illustrates minimal to no intervention impact because data remain within the same range. Non-overlapping data illustrates greater intervention impact across phases. Non-overlapping data in a therapeutic trend illustrates a desired effect. Data stability is analyzed by calculating a stability envelope within each phase showing the percentage of data inside and outside the envelope. Data are considered stable when approximately 80% of points per phase fall within the envelope. When combined, these measures create a strong analysis revealing the relationship between the independent and dependent variables.

Results

Figure 1 displays the results of the study. Each student's data are presented on separate graphs. Each graph includes two phases: baseline and intervention. There was no clear functional relationship between the iPad intervention and CWPM.

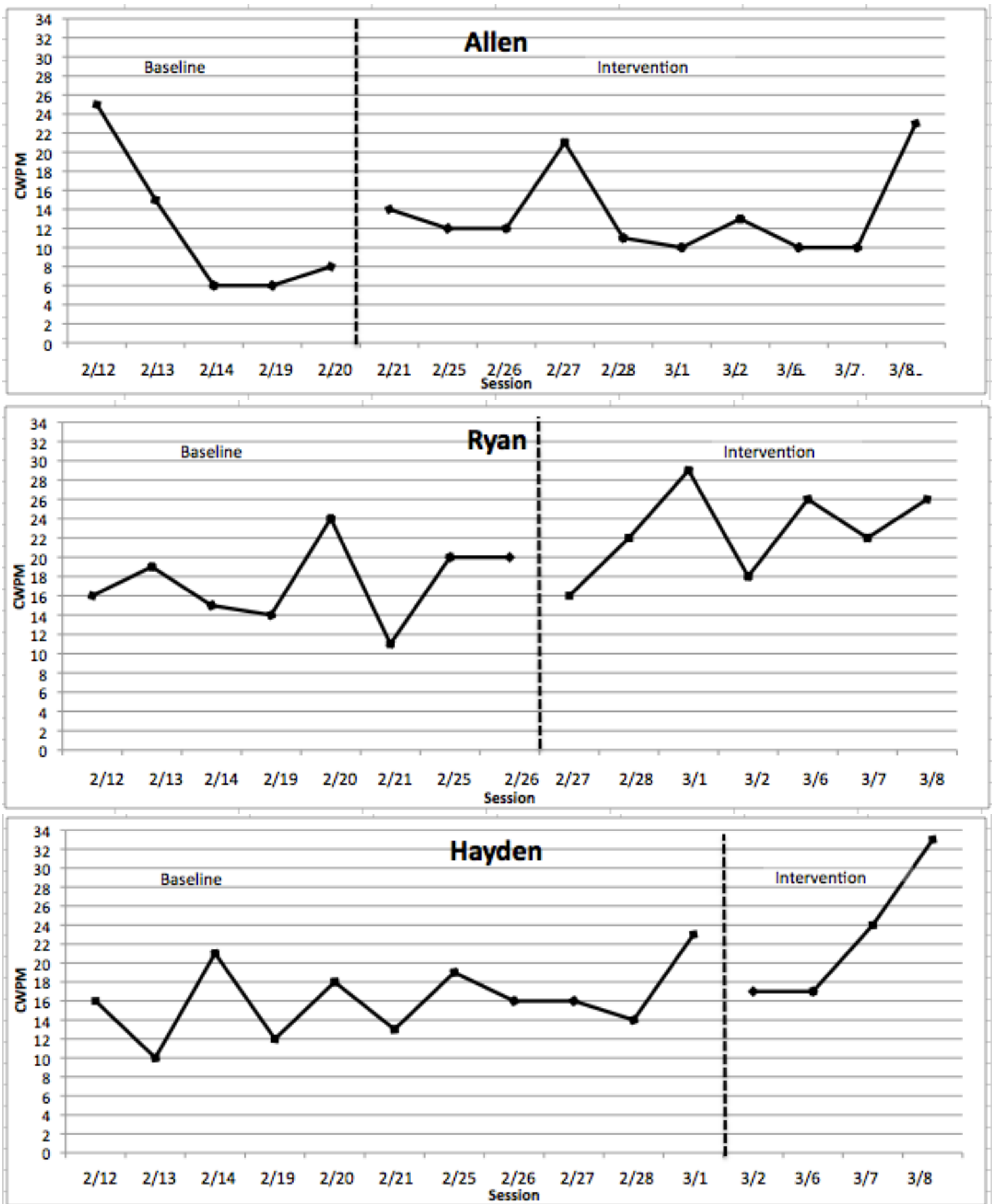

Figure 1. Allen, Ryan, and Hayden’s CWPM across baseline and intervention.

Allen

Allen's baseline data had a steep decelerating trend. The intervention data trend had zero-celeration. Three of the five baseline data points (60%) fell within the stability envelope indicating variable data, while 80% of intervention data fell within the stability envelope indicating stable data. The absolute and relative level changes between baseline and intervention phases increased by six words and five words, respectively. The percentage of non-overlapping data between phases was 0% meaning 100% of the data fell within the same envelope; when removing the outlier (26 CWPM), the percentage of non-overlapping data equaled 20%.

Ryan

Ryan's baseline and intervention data had a slight accelerating trend. About 75% of baseline data points and 63% of intervention data points fell within the stability envelope. An absolute level change of four words in the undesired direction occurred between baseline and intervention phases. A two word relative level change in the desired direction occurred. The percentage of non-overlapping data between phases equaled 43%.

Hayden

Hayden's baseline and intervention data had an accelerating trend. Although only 73% of baseline data points fell within the stability envelope, the data were fairly stable, and 75% of intervention data points. A relative and absolute level change between baseline and intervention phases were one word and six words, respectively. The percentage of non-overlapping data between phases equaled 50%.

Discussion

Relevance of Results

The data reveal the possibility that the intervention could benefit similar populations, but the benefits are unclear strictly based on this study. In this study, the goal was for CWPM to increase after the intervention. . When the researcher calculated relative level change, all three students showed a small improvement after the intervention phase. The changes seen with the students were relatively small considering the amount of words read overall in a minute. Allen only increased his CWPM by five words, Ryan by two words, and Hayden only by one word. Although the increases in CWPM are small, they are encouraging to the researcher because the students, after introduced to the intervention, did show slight improvements.

Similarly, all students showed an absolute level change from the last point in baseline to the first point after the intervention phase. Allen's CWPM showed the only immediate increase following the intervention. Allen's CWPM rate increased by six words. However, Ryan's absolute level change decreased by four words and Hayden's decreased by six words. These decreases were undesired effects. Ryan's and Hayden's reliance on sounding out words increased from baseline to intervention and likely caused the CWPM decrease. Their intense focus caused them to read fewer words overall. The mixed results do not support intervention effectiveness.

Calculating 20% above and 20% below the CWPM median per phase creates stability envelopes. In this study, stable, accelerating data were needed to show a positive intervention effect. Allen's data were stable. His stability envelope ranged from 10 CWPM to 14 CWPM: 80% of the data points fell within this range. Ryan's baseline data were fairly stable. His stability envelope was about 14 CWPM to 20 CWPM: 75% of the data points fell within this range. Ryan's intervention data were unstable: approximately 63% of the data points fell within the stability envelope. Hayden's stability envelope included 64% of the data points: his CWPM range was 13 to 19 words.

To demonstrate the effectiveness of the iPad intervention, the data trend, or general direction of data points, should accelerate as time progresses. Allen's CWPM trend was zero, or flat, indicating no intervention effect. Ryan showed an accelerating trend during the intervention phase. Hayden showed a steep accelerating trend in the intervention phase. Ryan and Hayden's CWPM increases suggest a positive intervention effect.

The percentage of non-overlapping data reveals the intervention's impact: the higher the percentage, the greater the impact. Allen's data had 0% of overlapping data points, which shows the intervention had no overall effect on CWPM. Ryan's data had 43% of overlapping data points: this demonstrates a mild intervention effect. Hayden's data had 50% of overlapping data points, illustrating a moderate effect on Hayden's CWPM.

With multiple baseline studies, each new student serves as a replication within one study. In order to determine the functional relationship between the intervention and CWPM, all three students should show similar results. Because the results are so varied, the researcher cannot determine if the intervention had an overall effect. After analyzing the results, some of the data show promising implications for students with LD or ADHD. To be certain, more studies need to be conducted on this topic.

Inter-Rater Reliability

A colleague collected inter-rater reliability during the last four sessions of the study. The researcher and colleague agreed on CWPM 58% of sessions recorded (See Appendix B), which is extremely low and threatens internal validity. When there was a discrepancy between measured CWPM, it was not significant: the researcher and colleague disagreed by only one or two words (See Appendix C).

Limitations

This study has several limitations. First, the students involved in the study began working in a Response to Intervention (RTI) program around the same time the study began, which may have been a confounding variable. The instructional practices may have been contradictory. Second, the small sample size inhibits generalizability; other students' fluency may benefit from the iPad application. Third, the first grade passages may have exceeded the students' independent reading level. The passages first grade level; however, the students in the study were in the lower percentile of first grade students. Some of the words in the passages were too difficult for the students, even when they applied phonics rules. Fourth, time constraints may have negatively affected the amount collected. Hayden's intervention phase included only four sessions, and all students' data were accelerating when the intervention was stopped. Fifth, the iPad application had minimal effect on reading fluency. Lastly, inter-rater reliability was extremely low, which threatened internal validity.

Implications and Future Research

The findings of the study could help future teachers and parents. Using an iPad application as an additional form of instruction in a classroom or at home could be beneficial to students. This study did not prove the existence of a functional relationship between the iPad application and CWPM; however, it did not disprove the idea either. Using an iPad application that focuses on phonics and phonemic awareness will not harm a student's reading fluency rate. Future research should focus on using similar iPad applications with different populations. Another possibility for future research is focusing on increasing other literacy skills, such as comprehension or writing, using an iPad application.

References

Allor, J. H., Mathes, P. G., Roberts, J. K., Cheatham, J. P., & Champlin, T. M. (2010). Comprehensive reading instruction for students with intellectual disabilities: Findings from the first three years of a longitudinal study. *Psychology in the Schools, 47*(5), 445-466.

Brown, V. (2010). Review of research: Digital media learning supports individuals with cognitive disabilities. *Childhood Education, 87*(1), 68-71.

ChanLin, L. (2007). Perceived importance and manageability of teachers toward the factors of integrating computer technology into classrooms. *Innovations in Education and Teaching International, 44*(1), 45-55.

Clemens, N. H., Shapiro, E. S., & Thoemmes, F. (2011). Improving the efficacy of first grade reading screening: An investigation of word identification fluency with other early literacy indicators. *School Psychology Quarterly, 26*(3), 231-244.

Collins, A. & Halverson, R. (2010). The second educational revolution: Rethinking education in the age of technology. *Journal of Computer Assisted Learning, 26*, 18-27.

Compton, D. L., Olinghouse, N. G., Elleman, A., Vining, J., Appleton, A. C., Vail, J., & Summers, M. (2005). Putting transfer back on trial: Modeling individual differences in the transfer of decoding-skill gains to other aspects of reading acquisition. *Journal of Educational Psychology, 97*(1), 55-69.

Duff, F. J., Hayiou-Thomas, M. E., & Hulme, C. (2012). Evaluating the effectiveness of a phonologically based reading intervention for struggling readers with varying language profiles. *Reading and Writing, 25*(3), 621-640.

Francis, D. J., Shaywitz, S. E., Stuebing, K. K., Shaywitz, B. A., & Fletcher J. M. (1996). Developmental lag versus deficit models of reading disability: A longitudinal, individual growth curves study. *Journal of Education Psychology, 88,* 3-17.

Lemons, C. F. (2012). Effectiveness of decoding and phonological awareness interventions for children with down syndrome. *Exceptional Children*, *79*(1), 67-90.

Lyon, R. (1995). Towards a definition of dyslexia. *Annals of Dyslexia, 45*, 3-27.

McClanahan, B., Williams, K., Kennedy, E., & Tate, S. (2012). How use of an iPad facilitated reading improvements. *TechTrends, 56*(3), 20-28*.*

McCutchen, D., Abbott, R. D., Green, L. B., Beretvas, S. N., Cox, S., Potter, N. S., Quiroga, T., & Gray, A. L. (2002). Beginning literacy: Links among teacher knowledge, teacher practice, and student learning*. Journal of Learning Disabilities, 35*(1), 69-86.

Murray, O. T. & Olcese, N. R. (2011). Teaching and learning with iPads, ready or not? *TechTrends, 55*(6), 42-48.

Shaywitz, S. E., Fletcher, J. M., & Shaywitz, B. A. (1994). Issues in the definition and classification of attention deficit disorder. *Topics in Language Disabilities, 14*, 1-25.

Stahl, S. A., Duffy-Hester, A. M., Stahl, K. A. D. (1998). Theory and research into practice: Everything you wanted to know about phonics (but were afraid to ask). *Reading Research Quarterly, 33*(3), 338-355.

Torgesen, J. K., & Barker, T. A. (1995). Computers as aids in the prevention and remediation of reading disabilities. *Learning Disability Quarterly 18*(2), 76-87.

University of oregon. (2012). Retrieved from https://dibels.uoregon.edu/

Appendix A
Example DIBELS Passage

ORF Progress Monitoring 1

The Ant Hill

Dad and I took a hike in the woods. We walked for a long 14
time and stopped to take a rest. We sat down on a log and had a 30
drink of water. A big hill was nearby. 38

Dad said, “Look, there’s an ant hill.” 45

I walked up to the hill and took a closer peek. At first it 59
looked just like a dirt hill. Then I noticed a few ants running 72
around. I looked closer. I saw little ants carrying pieces of 83
mushroom. The pieces were almost as big as the ants. 93

“What are they doing, Dad?” I asked. 100

“They’re taking food inside the hill. They probably have 109
thousands of ants to feed inside.” Dad said, “Watch this.” He 120
gently poked a twig into a small hole on the hill. All of a sudden, 135
many ants came out. 139

“The ants are on alert, trying to protect their hill,” he said. 151

I bent down to look closer. Some ants climbed on my shoes. 163

“We should leave now,” Dad said. Dad and I walked and 174
walked until we were home. Now whenever I see one ant, I stop 187
and think about the city of ants they might be feeding and 199
protecting. 200

Total words: _____ – errors: _____ = words correct: _____

Appendix B
Inter-Rater Reliability Chart

Researcher (CWPM Score)	Colleague (CWPM Score)	Difference (Words)	Agreement
12	12	0	Yes
10	8	2	No
10	10	0	Yes
23	22	1	No
18	19	1	No
26	24	2	No
22	22	0	Yes
26	26	0	Yes
19	19	0	Yes
19	19	0	Yes
24	25	1	No
33	33	0	Yes

Appendix C
Inter-Rater Reliability Comparison Graphs