6-5-2013

# The effect of using the iPad to enhance sight word acquisition of students with autism

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# THE EFFECT ON USING THE iPAD TO ENHANCE SIGHT WORD ACQUISITION OF STUDENTS WITH AUTISM

by

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A Thesis

Submitted to the

Department of Language, Literacy and Special Education

College of Education

In partial fulfillment of the requirement

For the degree of

Master of Arts in Special Education

at

Rowan University

May, 2013

Thesis Chair: Joy Xin, Ed.D.

**Dedication**

*To everyone I have ever known*

**Acknowledgments**

I would like to express my sincere acknowledgement to my thesis supervisor Dr. Joy Xin, whose comments and aid during this extensive process were invaluable. To everyone in my family, thank-you for your unwavering support and understanding these past three years, I could not have done this alone. I would also like to convey my deepest appreciation towards everyone else that either participated or had a role in the completion of this study. Furthermore, I am truly grateful to Rowan University and the Township of Gloucester for the scholarships and financial assistance they provided.

**Abstract**

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2012/13
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The purposes of this study was to (a) investigate the effectiveness of the Apple iPad as an assistive technology device to support students with autism spectrum disorders in their acquisition of sight words and (b) examine the social validity of using the iPad in the classroom. The participants were two 2nd and two 3rd graders diagnosed with autism spectrum disorders. Baseline data was collected by evaluating student progress of sight word acquisition at the end of each week for three weeks. A multiple baseline across students with AB phases was used in this study. During Intervention, the iPad was integrated into instruction for approximately 20 minutes every other day utilizing the app Phonics Genius. Lessons were divided into two 10-minute segments. During Part I, a random word was flashed on the screen and the student attempted to sound out the word. When the student was satisfied with his/her attempt, he/she would touch the screen and the word would be pronounced. During Part II, random words were set on a time delay which decreased each week of the intervention. The Students' acquisition of sight words was assessed at the end of each week for six weeks. Student satisfaction was evaluated by a brief survey. The findings indicate that the iPad can be successfully implemented as a computer-based sight word reading intervention for students with ASD.

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## Chapter 1

## Introduction

Literacy, the ability to read, write, and critically think, establishes the academic foundation of skills individuals need to succeed in school. Literacy is critical to the success of individuals ultimately in both their career aspirations and quality of life. Strong literacy skills are closely associated with having a good job, communicating with others, and accessing training opportunities (Bailey, Angell, & Stoner, 2011). Literacy has a broad meaning, standing for a range of knowledge, skills and abilities relating to not just reading but all content areas. The National Early Literacy Panel (Lonigan & Shanahan, 2009) indicated five key skill areas that should be targeted for all students. These areas include phonemic awareness, phonics, reading fluency, vocabulary, and reading comprehension. Teaching these reading skills is required because they do not develop naturally over time. An early identification of students at risk for literacy skill delay is important so that related interventions can be provided to remediate.

Literacy acquisition is a process requiring many interrelated skills such as alphabetics, reading fluency, vocabulary, and comprehension (Fallon, Light, McNaughten, Drager, & Hammer, 2004). At the core of literacy instruction is the development of phonemic awareness. Phonemic awareness is the ability to hear and manipulate the smallest units of sounds into spoken language. Through phonics instruction, students learn the relationship between phonemes (speech sounds) and graphemes (letters of the alphabet). Phonemic awareness also includes segmenting (breaking apart words into individual phonemes) and blending (the ability to say a

spoken word when its individual phonemes are said slowly) (Bursuck & Damer, 2007). These skills should be incorporated into instruction to make a balanced literacy program.

Literacy instruction is required for all learners, as mandated by the No Child Left Behind Act (NCLB) (United States Department of Education, 2001) and Individuals with Disabilities Education Improvement Acts (IDEIA) (United States Department of Education, 2004). Assistive Technology (AT) devices are indicated in IDEIA to support students with disabilities (Bailey et al., 2011). Students with deficits in literacy acquisition are at a severe disadvantage of missing many enriching experiences that may have an impact on their ability to live independently, participate in the community, engage in activities, and gain employment in the job market (Fallon et al., 2004).

There are many approaches to literacy instruction. Of these, explicit and systematic instructions have been considered as the most effective methods when teaching fundamental reading skills (Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006). Explicit instruction refers to the direct teaching of reading skills with clear outcomes, explaining the purposes for learning, and providing consistent feedback to correct mistakes. Systematic instruction identifies carefully selected skills that are organized into a logical sequence for instruction. Strategies such as modeling, guided practice, utilization of visual aids, independent practice, and assessment should be incorporated in the instructional process.

Autistic Spectrum Disorder (ASD) is a developmental disability. Children with this diagnosis demonstrate deficits in social and language skills, while restrictive and

repetitive interests are also typically present. According to the Center for Disease Control (2008), an estimated 1 out of every 88 children have been diagnosed with ASD and it is currently estimated that 1.5 million people in the United States have ASD. Although the cause of autism remains unclear, it is currently believed to be caused by neurological dysfunctions of an unknown origin with possible environmental influences (Semrud-Clikeman & Teeter-Ellison, 2007). While there is no known cure for autism, research has demonstrated that early identification and intervention remain the best strategies for achieving later success (Rogers, 1996). Many children with ASD experience deficits in language and communication. Thus, literacy development should include both verbal and non-verbal communication skills because both expressive and receptive language is needed for these children. It is important to develop a functional and symbolic communication system in which wants, needs, and choices can be expressed.

Utilizing Augmentative and Alternative Communication (AAC) for individuals with ASD has been studied since the 1980's (Mirenda & Mathy-Laikko, 1989). Results show positive outcomes of using AAC in areas such as peer interaction, motivation, and communication (Shane, Laubscher, Schlosser, Flynn, Sorce, & Abramson, 2011). Originally developed to provide expressive communication for individuals lacking functional speech, AAC devices have been shown to yield significant benefits for individuals with ASD (Mirenda, 2001). However, many Assistive Technology (AT) devices that are used for AAC are expensive and some are oversized for practical use. Currently, handheld electronic devices such as the iPad are affordable and easy to carry.

This new AT device supports a visual approach to teaching language that was impossible prior to the digital revolution (Shane et al., 2011). Phonemic awareness skills benefit all learners, even those with no natural speech. Phonemic awareness skills play a key role in the development of literacy, and handheld devices such as the Apple iPad may have significant benefits in teaching these skills to individuals with ASD (McClanahan, Williams, Kennedy, & Tate, 2012; Murray & Olcese, 2011).

**Statement of the Problem**

The iPad debuted in March 2010 and within 80 days sales topped over 3 million. Because of the iPad's popularity, educational technology proponents have reiterated arguments for the potential of using technology in classrooms (Murray & Olcese, 2011). Advocacy groups such as Autism Speaks and Autism New Jersey also point out the iPad's benefits for individuals with ASD. For example, the touch screen and its small size provide individuals a sense of control over their environment, in which they understand when to touch and how to respond to environmental cues. In addition, there are programs available for the iPad that assist in communication for those who have difficulty speaking or have language delays. To date, iPads and other handheld devices are still a relatively new phenomena and their use in the classroom as educational tools still requires significant empirical research to justify.

**Significance of the Study**

Literacy is crucial to ensuring learners are able to actively engage in their environment. Students with ASD present deficits in language development (Tager-Flusberg, Rodgers, Cooper, Landa, Lord, Paul, Rice, Stoel-Gammon, Wetherby, & Yoder,

2009; Lund & Light, 2003). Systematic and explicit instruction is considered an effective strategy in teaching language skills to these students (Ganz & Flores, 2008). Using technology such as computers in classrooms has been found to allow learners to interact with text and other people, as well as provide them with meaningful learning opportunities to enter the ever changing technological world (Wissick, 2001). The current technology of the Apple iPad may serve as an AAC tool to benefit individuals with ASD. However, little empirical research was found to demonstrate this benefit, especially in language instruction to enhance phonological awareness. This study attempts to expand the current knowledge based on AAC by utilizing the Apple iPad as an educational tool for elementary students with ASD to develop their phonemic skills. This study is not only to investigate this handheld electronic device in the classroom, but to examine its effect on student learning outcomes.

**Statement of Purposes**

The purposes of this study are to: (a) investigate the effectiveness of the Apple iPad as an AT device to support students with ASD in developing their phonemic skills, which is an essential component for literacy acquisition; (b) evaluate the effects of the iPad in sight word acquisition for students with ASD; (c) compare a variety of applications available to determine which are the most effective and beneficial for these student; (d) examine the feedback from students and the teacher in regards to their satisfaction with using the iPad as an instructional tool.

**Research Questions**

1. Will students with ASD increase their rate and accuracy of identifying sight words when an iPad is used during instruction?
2. Will students with ASD and the teacher be satisfied with the iPad device as an instructional tool used in Reading class?

**Definition of Terms**

*Assistive Technology* – Any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of children with disabilities. (Heflin & Alaimo, 2007)

*Augmentative and Alternative Communication* – includes all forms of communication (other than oral speech) that are used to express thoughts, needs, wants, and ideas. (Heflin & Alaimo, 2007)

## Chapter II

## Review of the Literature

### Instruction on Phonemic Awareness

Phonemic awareness is the ability to hear the smallest units of sound in spoken language and manipulate them. The English language has 41-44 individual sounds. Phonics involves the understanding that there is a predictable relationship between phonemes and graphemes. Phonemic awareness is needed first to ensure students will benefit from phonics instruction. Individuals that cannot hear, sound out, and decode the phonemes of spoken words will ultimately have difficulty relating these phonemes and graphemes to written words.

The teaching of phonemic awareness has evolved greatly over the past half century and has left educators with a vast amount of studies about what remains the most efficient method to instruct learners. In 1997, The National Reading Panel (NRP) was established to review the research on how children learn to read as well as the most effective research based practices. In April of 2000, this panel concluded that best practices incorporate explicit instruction in phonemic awareness, systematic phonics instruction, methods to improve fluency, and ways to enhance comprehension. Findings showed children who received explicit instruction in phonemic awareness improved their reading skills more than those who did not receive attention to phonemic awareness. The panel also concluded that students in kindergarten through sixth grade received significant benefits from explicit phonics instruction. In addition,

the panel noted while there were few studies demonstrating the use of computers in reading education, all 21 studies reviewed demonstrated positive results.

While there are many approaches to phonemic awareness training, segmenting and blending appear to have the most significant value for beginning reading programs (Griffiths & Stuart, 2013). Segmenting is the ability to break apart words into their individual phonemes or sounds. Blending, the opposite of segmenting, is the ability to say a spoken word when its individual phonemes are sounded out slowly. The ability to segment allows students to sound out words in text by breaking words down into individual phonemes. Blending helps students read unfamiliar words in text by combining single sounds into new words. For example,

- Segmenting – When asked to segment the word cat, a student will reply with the sounds "/c/-/a/-/t/".
- Blending – when the sounds /c/-/a/-/t/ are spoken slowly, the student will be able to respond "cat".

Ball and Blachman (1991) evaluated the effects of segmentation as well as instruction in letter names and sounds on kindergartener's reading and spelling skills. Results of the study showed that children's early reading and spelling skills improved when phonemic awareness instruction was combined with instruction connecting the phonemic segments to alphabet letters.

Included in the best approach to phonemic awareness training is the debate between explicit and implicit instruction. Explicit instruction outlines the learning goals for the student and offers a clear explanation of the skills presented. In implicit

instruction, the goals are not outlined. Rather, information is presented in a manner that allows the students to make their own conclusions and assimilate the information in a way that makes sense to them. A study at Vanderbilt University (Davis, Fan, Compton, Fuchs, Fuchs, Cutting, Gore, & Anderson, 2010) examined this debate as it applies to word learning. Findings demonstrated that learners benefitted from both approaches. However, through the use of functional magnetic resonance imaging (fMRI), they found that while students identified as excellent readers benefitted from both approaches equally, average readers were shown to have to work harder to learn through implicit instruction. While this research was conducted on adult learners, it does demonstrate the importance of explicit instruction for the majority of learners, and significantly implicates the need of explicit instruction for at risk students. Additional research demonstrated that the children who reflected upon and discussed the value, application, and utility of phonemic awareness through implicit instruction for the activity of reading at an explicit level performed better than those in the experimental group using drills and practices (Cunningham, 1990).

Phonemic awareness has a significant impact on children's early literacy skills and has a direct relationship to their reading levels in first and second grades (Adams, 1990). Children who could manipulate sounds at early ages had greater reading success at these grade levels (Adams, 1990). Studies have also demonstrated that children as young as three and four can demonstrate phonemic awareness and attend to sounds in words (Maclean, Bryant, & Bradley, 1987). It is also important for children to have an opportunity to play with language through natural play and nursery rhymes which

encourage the development of their phonemic awareness (Bryant, Bradley, Maclean, & Crossland, 1990). Thus, a language rich environment is also important. It is found that teaching phonemic awareness to first and second graders who have had difficulty reading results in significant improvements in their ability to read and spell words (Vellutino, Scanlon, Sipay, Small, Chen, & Pratt, 1996). Children advanced at phonemic awareness are more ready to read and are more successful in their future reading (Wasik & Hindman, 2011). Therefore, teaching phonics at an early age is crucial.

**Instruction of Phonics**

The importance of phonics instruction through systematic and explicit phonics programs has been established by both National Reading Panel (2000) and National Early Literacy Panel (2009). Armbruster, Lehr, and Osborn (2002) identified key components of systematic programs that teach phonics effectively. This study concluded that effective programs are teacher friendly as well as teach the skills of segmenting and blending to students. Effective programs should help students understand why they are learning letter sound relationships as well as help them apply their knowledge of phonics to authentic texts. Effective programs should be available to be modified based on the need of individual students and include instruction in the skills alphabetic knowledge, phonemic awareness, vocabulary development, reading of text, and systematic phonics instruction.

Ehri (2005) developed a five-phase model demonstrating the stages of word reading skills. The five phases include the Pre-Alphabetic Phase (words are read as memorized visual forms), Partial Alphabetic Phase (individuals begin to associate some letters with

their associated sounds and use that insight to recognize words), Full Alphabetic Phase (individuals have learned most common letter-sound associations and use that knowledge to decode unfamiliar words), Consolidated Alphabetic Phase (individuals recognize multi-letter sequences called chunks which leads them to learn longer words more easily), and the Automatic Phase (individuals recognize whole words quickly by sight, unconsciously associating letters with associated sounds, which allows for a focus on comprehension). As readers learn letter-sound relationships, their fluency in recognition increases until they are able to unconsciously recall the pronunciation and meaning of the known words.

**Instructional Approaches to Phonics**

The National Reading Panel (2000) identified five specific instructional approaches on phonics instruction. These approaches include two categories, traditional and contemporary (Stahl, 1998). Traditional approaches were the main approaches in the 1960's and 1970's and appeared to come back in the recent classroom. The traditional approach includes analytic phonics approach and synthetic phonics approach. Contemporary approaches includes spelling based approach, analogy based approach, and embedded phonics approach.

**Analytic phonics.** An analytic phonics approach is referred to as "implicit phonics". Using this approach, children are taught to analyze letter-sound relationships in previously learned words. This approach dates back to at least the seventeenth century, when John Amos Comenius, a teacher, educator, and writer contended that meanings, not abstractions, must come first in the reading experiences of young children. He

believed teaching isolated sounds first causes excessive stress on students much like putting the cart before the horse (Hildreth, 1957). During the 1960's, there was a national push in the direction of analytic phonics instruction with many basal reading series including manuals on teaching stories with an analytic approach. The analytic phonics approach requires students to know many words by sight. Using known sight words, teachers can direct students to make inferences about similar sounding words containing the same letter combinations (Macaruso & Walker, 2008).

An example of an analytic approach is the linguistic approach based on the theories of linguist Leonard Bloomfield (Bloomfield & Barnhart, 1961). In the 1960's some reading programs began to depart from the mainstream basal programs and include instruction focusing on recurring word patterns. Bloomfied reasoned that students should learn words in patterns, and introduce pronunciations of unknown words from known patterns. Decodable books utilizing this approach would have text like "Mat and Nat sat with a cat." Linguistic phonics does not emphasize naturally occurring text and often makes little sense. The decodable books often contain so many similar words that it becomes a visual tongue twister and a challenge for anyone to read (Adams, 1990).

**Synthetic phonics.** A synthetic phonics approach teaches children to convert letters or letter combinations into sounds, and then blend the sound together to form recognizable words. Using a Synthetic phonics approach, students are first presented the most common letter-sound associations in isolation and later use that knowledge to sound out words. For young children, letter-sound patterns need to be explicitly

taught, and children are introduced to a range of words that embody these patterns, with enjoyable and meaningful text to reinforce the patterns and to encourage children to read for comprehension and enjoyment (Bowey, 2006).

Two examples of synthetic phonics programs are the Orton-Gillingham approach and Direct Instruction. Orton-Gillingham begins with the direct teaching of individual letters and pairs them to sounds through a visual, auditory, kinesthetic, and tactile procedure. Eventually, blending is taught to read words, sentences, and stories containing taught sounds. Although the Orton-Gillingham approach has been utilized since the 1930's and case studies demonstrating its effectiveness date back to 1932 (Monroe, 1932), these case studies do not meet the criteria of qualitative research (Stahl, 1998). Given the small amount of empirical research available on this approach, it cannot be determined if this approach is any more effective than other approaches.

Direct instruction (DI) is based on the principles of applied behavioral analysis. Teachers using DI follow a carefully organized and detailed sequence of instruction following a script to ensure the material is presented properly. General characteristics of DI include small group instruction, unison responses, signals to encourage participation at specific times, rapid pacing, specific techniques to minimize errors, and ample praise as merited (Mayer, Azaroff, & Wallace, 2012). DI seeks to produce measureable improvements in student performance based on research validated instructional practices (Watkins & Slocum, 2003). The most common DI approach was first published as Distar (Engelmann & Brunner, 1969), and later changed its name to Reading Mastery. Instruction begins with learning letter sounds which proceeds to

blending and ultimately reading words in context. In the 1970's, Distar was the only program that produced achievements for students in low socioeconomic communities (Abt Associates, 1977). To date, there remains a need for more peer reviewed research to validate the effectiveness of Direct Instruction over other instructional practices.

Programs utilizing Direct Instruction, like Reading Mastery, incorporate many effective practices as outlined by the National Reading Panel (2000). In Reading Mastery, students identify sounds in words, connect sounds to letters, and blend sounds to form words. Although more empirical research is required to confirm DI's effectiveness for individuals with ASD, it does contain a number of promising practices. These practices incorporated by Direct Instruction benefitting students with ASD include instruction presented through brief activities that is structured, predictable, and requires frequent responding.

As the National Reading Panel (2000) stated, systematic phonics instruction produces significant benefits for students in kindergarten through sixth grade. The report noted that the effect of synthetic phonics was strongest in the early grades but reduced in the later grades. In a study by Johnston, McGeown, and Watson (2012), a comparison of analytic or synthetic phonics methods was examined. Findings indicated that the group taught by synthetic phonics performed better in word reading, spelling, and reading comprehension. However, some studies have not found a significant advantage of synthetic over analytic phonics (e.g. Torgerson, Brooks & Hall, 2006; Savage, Abrami, Hipps, & Dealt, 2009) As the National Reading Panel (2000) indicated,

educators should be cautious to give a blanket endorsement of any one particular instructional approach.

**Analogy-based phonics.** Analogy-based phonics is sometimes referred to as onset-rime and evolved from the work of Patricia M. Cunningham (1975/1976). In an analogy-based phonics approach, children learn to use parts of words families they have been taught to identify unknown words with similar parts. In essence, they decode words using words they know. For example, if a student can read the words *he, send, and table*, the student can use those words for decoding when examining an unknown word like *de/pend/able* (Stahl, 1998). Although the Stahl (1998) research supports the analogy approach, some caution might be considered since analogies should be taught after children recognize initial sound cues (Bruck & Treiman, 1992). It is noted that analogies can be a very powerful teaching approach but need to be taught only after a child has reached the phonetic cue level. It is also noted that analogy-based phonics instruction can be effective for low and normally achieving students when it is systematically and strategically implemented by regular teachers as part of a balanced literacy program.

**Spelling-based phonics.** In a spelling-based approach to phonics, children learn to segment words into phonemes and to make the words by writing letters for phonemes. This approach emphasizes phonetic spelling as the foundation for word reading. An example of a spelling-based approach to phonics is Word Study (Bear, Invernizzi, & Templeton, 1996). Word Study encourages students to compare and contrast different features of words. In Word Study, children use strategies such as

sorting to categorize words and pictures according to their common orthographic feature (Stahl, 1998). Invernizzi, Juel, and Rosemary (1996/1997) examined Word Study over a three-year period during tutoring sessions on low achieving first and second graders. Results showed that students demonstrated remarkable improvements in alphabetic knowledge, phonemic awareness, and word recognition. In addition, all students were able to read with at least 90% accuracy at the first grade level at the end of the intervention. The effects of Word Study are demonstrated best when it is used along with other instructional programs (Morris, Ervin, & Conrad, 1996). For example, Word Study could be provided together with tutoring sessions for students with reading disabilities. Additional research is needed to examine the effects of Word Study in isolation, though it appears to have promising implications for instruction.

**Embedded phonics approach.** This approach teaches children the letter-sound relationships during the reading of authentic, connected text. Embedded phonics should involve planned skills taught within the context of authentic literature. Reading Recovery, developed in the 1970's by Marie Clay, includes an embedded approach to phonics. Reading Recovery is a one-to-one program for students in the bottom 20% in reading skills during first grade (Clay, 1993). It begins with students attempting independent reading when teachers introduce a book. Then, students choose a book to reread for fluency development. Students will reread the book the next day and the teacher will conduct a running record and provide feedback immediately after the reading. The students are then directed to use magnetic letters to manipulate words, and write a sentence about the story with the teacher's help. This sentence is then cut

up and put back together. Iversen & Tunmer's study (1993) examined the effect of Reading Recovery by comparing three match groups of 24 at-risk readers. These students received instruction in Reading Recovery alone, Reading Recovery in combination with phonological recording skills, or some other standard intervention altogether. Findings demonstrated that the two groups using Reading Recovery preformed at very similar levels and better on assessments than those in the standard intervention group. Reading recovery was able to accelerate the progress of 35% of children who were struggling under other programs (Center, Wheldall, Freeman, Outred, & McNaught, 1995).

**Best practices for phonics instruction.** Determining the best practice for phonics instruction remains a challenging task. The literature reviewed to this point seems to favor a systematic approach, teaching a planned sequence of skills rather than as they are encountered in text (National Reading Panel, 2000). The English language is extremely complex, especially when words like row, read, and polish can be read two different ways. The good news is that 87% of the English language consists of words that are highly predictable (Venezky, 1970). It would appear logical that the best instruction would be a balanced approach tailored to the individual student needs. According to Stahl (1998), an effective program might include elements of whole language such as read alouds, invented spelling, and free reading as well as incorporating direct instructional approaches like sound-symbol relationships and the use of decodable texts. Students at-risk in reading may benefit from direct instruction to develop skills other children have already learned, while strong readers may benefit

from authentic guided reading. Phonics instruction is simply a map used to reach the ultimate goal of comprehending and making meaningful connections to literature. On the map are many different roads to reach that point, some longer or perhaps safer than others, but whichever the road chosen, educators need to be the signs along the way guiding students in the right direction.

**Effective Instructional Practices for Individuals with Autism**

The National Reading Panel (2000) and the National Early Literacy Panel (2009) indicated that decoding skills should be systematically taught. Even whole language advocates Susan Church (1996) and Regie Routman (1996) included chapters in their books on the importance of phonics instruction in the whole language approach. This is important to students receiving special education. The National Reading Panel (2000) also indicated that synthetic phonics had a significant effect on the reading skills of individuals with disabilities.

The No Child Left Behind Act of 2001 (NCLB) requires utilizing effective educational practices established on scientifically based research. This scientifically-based research should involve rigorous, systematic, and objective procedures to obtain reliable and valid knowledge relevant to education activities and programs. The call for scientifically-based instructional procedures for students with ASD was also mentioned by the National Research Council (2001). It is important that everyone involved in the decision making process for individuals with ASD educate themselves to better understand which objectively verified and effective intervention is most appropriate

(Simpson, 2005). Three basic questions should be considered when selecting an instructional method for children with ASD. These questions are as follows:

- What are the efficacy and anticipated outcomes of a particular practice and do they meet the student's needs?
- What are the potential risks associated with the practice?
- What are the most effective means of evaluating an approach?

The best programs appear to be those that include a variety of practices and are designed to address the needs of the individual (National Research Council, 2001). Simpson (2005) evaluated 33 commonly used interventions in the education of individuals with ASD. Of those 33, the only three determined to be scientifically-based interventions are Applied Behavior Analysis, Discrete Trial Teaching, and Pivotal Response Training. It is found that evidence-based practices should include careful selection and assessment of participants, as well as objective, reliable, and accurate measurements. Identifying evidence-based practices can be challenging, and it may be advantageous to explore best practices through the theoretical construct from which it is derived. According to Scheuermann and Webber (2002), three theories lay the foundational basis of educational practices for ASD: Behavioral, Developmental, and Perceptual-Cognitive.

**Behavioral theory.** The behavioral theory identifies autism as a syndrome of behavioral deficits and excesses which have a biological basis but are amendable to change through carefully orchestrated, constructive interactions with the physical and social environment (Green, 2001). This theory indicates that children with ASD need

highly structured learning opportunities for learning essential skills. Their behavior can be explained by analyzing interactions between humans and the environment, thus making behavior predicable. The three scientifically-based approaches, Applied Behavior Analysis, Discrete Trial Teaching, and Pivotal Response Training, are developed based on this theory (Simpson, 2005).

**Developmental theory.** The Developmental Theory claims the resulting neurological differences from autism lead to delays in language, cognitive, social, and motor developments (Scheuermann & Webber, 2002). The proponents of this approach advocate teaching developmentally appropriate skills beginning with those the individual has not mastered and working towards more appropriate, functional skills. Approaches based on this theory include incidental and milieu teaching, using naturalistic approaches, leading to the development of functional skills with improved generalization. Although incidental teaching strategies appear to have instructional benefits for teaching skills and are incorporated within the principles of Applied Behavior Analysis (Zager & Shamow, 2005), they do not meet the criteria for scientifically based practices.

**Perceptual-cognitive theory.** According to this theory, it is believed that individuals with ASD have sensory, perceptual, and thinking differences resulting from a brain malfunction. This malfunction causes an over-stimulation by the external senses and difficulty processing sensory information (Scheuermann & Webber, 2002). These processing issues are addressed by presenting instruction one step at a time in highly structured and routine environments while limiting extraneous verbalizations. This

theory promotes visual cues and environmental support like picture schedules and the use of colors. Additionally, it stresses the need for priming before changes in routines are implemented and the importance of teaching individuals with ASD to attend and imitate.

Each of these three theories carries merit and efficacy for individuals with ASD, but no one theory has been found to be solely effective for each child with autism (Scheuermann, Webber, Boutot, & Goodwin, 2003). It may then, be appropriate to utilize a multi-theoretical approach and create an effective educational package for the individual student (Boutot & Smith Miles, 2011). A multi-theoretical approach heavily influenced in the principles of Applied Behavior Analysis may maximize a child's chances for success (Boutot & Smith Miles, 2011). It allows for the optimal agenda for a program to be created and include individual assessments, family and child-centered program decisions, ongoing data collection, and program evaluation using Applied Behavior Analysis (Boutot & Smith Miles, 2011).

**Phonics Instruction for Individuals with ASD**

According to Whalon, Otaiba, & Delano (2009), higher functioning children with ASD tend to have difficulty with comprehension, while decoding is a relative strength. They are typically good decoders and spellers, often demonstrating hyperlexia, the ability to speak written text with astounding accuracy (Mayes & Calhoun, 1999). While a common characteristic of hyperlexia is exceptional decoding and spelling skills, comprehension skills generally remain weak and need to be a focus of instruction (Grigorenko, Klin, Pauls, Senft, Hooper, & Volkmar, 2002). Nation, Clarke, Wright, &

Williams (2006) examined the reading abilities of 41 children with ASD aged six to fifteen. These children were assessed in the areas of isolated word recognition, reading accuracy, comprehension, and pseudo-word recognition. Most students displayed strong word reading abilities and weaknesses in comprehension.

Students with ASD that are lower functioning may benefit from instruction tailored to their visual strengths. Instruction for recognizing sight words could use whole words to reduce the demand on their auditory processing capabilities, which is necessary for segmenting and decoding (Heflin & Alaimo, 2007). A functional sight word vocabulary associating words to their meanings is essential for students on the lower end of the spectrum for fostering independence (Mirenda, 2003). Many individuals will have difficulties in phonics and comprehension despite where they are on the spectrum, and will therefore benefit from instruction in both areas (Whalon et al., 2009). In an examination of 11 peer-reviewed studies that were either code-focused (phonemic awareness, phonics, and fluency), meaning-focused (vocabulary and comprehension), or a combinational approach, it was found children with ASD benefit from a comprehensive reading program and phonics instruction (Whalon et al., 2009). Although children with ASD often develop adequate phonetic skills, instruction should focus on word families, word parts, and structural analysis (Calhoon, 2001).

**Computer-Assisted Instruction for Phonics Instruction**

IDEA (1990) defines assistive technology (AT) as any item, piece of equipment, or product system, whether acquired commercially, off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of children with

disabilities. This is an opportunity for teachers to utilize computer software as a possible mechanism to provide additional practice or even another mode of instruction for students with disabilities.

There is an extensive amount of software available focusing on reading and addressing the areas of phonemic awareness and phonological decoding. The following four criterions should be considered when selecting computer programs: the individual's needs, the specific task/functions to be performed, the specific technology, and the specific contexts of interaction (Raskind, Higgins, Slaff, & Shaw, 1998). In their preliminary evaluations, The National Research Council (2001) reported that well-designed software programs for supporting early literacy development produced gains in student performances.

It is estimated that 75–90% of individuals living with autism acquire functional expressive communication while approximately 25% remain nonverbal (Eaves & Ho, 2004). Nonverbal children are not able to functionally communicate with others using their voice. For these individuals, a Nonverbal Reading Approach (NRA) can be effectively delivered through computer-assisted instruction, thus freeing up teachers' time and providing students with the ability to practice decoding and word identification independently (Coleman-Martin, Heller, Cihak & Irvin, 2005). A NRA focuses on internal speech to instruct phonics. Students present words or sounds in their minds while the teacher verbally reads aloud. After practicing the whole word, the teacher presents only the first letter for practice before revealing each letter of the word for the students to practice in their mind. After students master the individual sounds, the focus turns to

reading the whole word in their heads slowly, then, quickly (Heller, Fredrick, Tumlin, & Brineman, 2002). A NRA is typically used with a phonological-based reading series and was effective when combined with computer-assisted instruction (Jones, Torgesen, & Saxton, 1987).

Computer-assisted instruction (CAI) has been used effectively to teach phonological awareness skills for individuals with ASD (Heimann, Nelson, Tjus, & Gillberg, 1995). It is found that individuals with ASD performed better identifying target words through CAI over traditional book formats (Williams, Wright, Callaghan, & Coughlan, 2002). It is also found that CAI can be effective for the NRA with students utilizing augmentative and alternative communication (AAC) devices (Coleman-Martin et al., 2005). CAI offers extensive opportunities for one-to-one interaction while requiring minimal supervision, eliminates possible embarrassment in front of classmates, can provide immediate feedback for errorless learning, and can track speed and accuracy of responses, which may alleviate boredom from traditional drill exercises (Coleman-Martin et al., 2005).

The use of high-tech AAC devices provides students with disabilities a tool to participate in meaningful literacy lessons (Beck, Bock, Thompson, & Kosuwan, 2002). These devices are designed to help individuals communicate and offer teachers a new way to teach phonological awareness. High-tech AAC devices can be used by students to identify letter-sound relationships. For example, when a student types a letter, a peer helper can produce its sound, and when a teacher asks what letter makes a specific phonetic sound, the student can type the letter with the device. After a foundation of

letter-sound correspondence is developed, the student can then begin forming words with individual phonemes and reproduce the word through the AAC's voice output (Wilkins & Ratajczak, 2009). High-tech AAC devices can also be used to develop phonetic blending skills. For example, a teacher could state the sounds /d/-/o/-/g/ and prompt the students to choose the corresponding picture on the device which will then produce the word verbally.

Identification and remediation of early literacy skill deficits have the potential to prevent more severe reading problems (Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan, 2001). Even with the extra supports, some students may still struggle with phonics-based instruction and benefit from whole-word instruction (Browder & Lalli, 1991). Direct, whole-word instruction has the potential to increase a student's self-confidence in reading ability, improve daily living skills, and reduce frustration associated with learning to read (Browder & Lalli, 1991). Constant time delay, a response prompting procedure that provides students with frequent opportunities to respond, obtain immediate feedback, and receive consequences for correct and incorrect responding, has been demonstrated as an effective method when applied to flash-card sight word instruction (Browder, Gibbs, Ahlgrim-Delzell, Courtade, Mraz, & Flowers, 2009). During constant time delay, the interval for responding is held constant across trials. When using time delay procedures, the ultimate goal is to provide students enough time to accurately respond, but not so much time that it reduces the pace of responding which could potentially lead to off-task behaviors (Skinner, Fletcher, & Henington, 1996). In a study by Yaw, Skinner, Parkhurst, Taylor, Booher, and

Chambers (2011), whole word instruction and constant time delay were implemented through a computer-based sight word reading intervention and results demonstrated increased rates of accurate responding and skills development. In the study, words were displayed on a computer screen and students were instructed to read each word before a recording of the word, set on a two-second time delay, was played. Findings demonstrated that computer-based sight word reading intervention was effective for enhancing the automatic reading skills of an individual with ASD and the skills were maintained.

Computers can also be used as web-based literacy tools. For example, Web-based literacy tools like ABRACADABRA were created with the intent of delivering a balanced curriculum to support word reading, phonics, reading, listening comprehension, and fluency (Savage et al., 2009). Web-based tools also allow for a high degree of flexibility and customization to individual needs. Web-based literacy instruction has the benefit of being utilized for students that need additional practice mastering skills while allowing students strong in phonemic awareness to continue developing more challenging literacy skills. Individualized instruction is a key component and educators can select from an abundant amount of web-based programs which can be individualized to monitor the learner's progress. Helping make letter-sound relationships more concrete by exposing learners to language in a fun and engaging manner is another benefit.

There are many web-based programs available for phonemic awareness which can be used to reinforce classroom instruction and increase students' exposure with

print. These programs often include interactive games and frequently incorporate multimedia components, like video programs for teaching and practicing concepts while reinforcing language play concepts like rhyme. Web-based multimedia programs like PBS KIDS have the ability to manipulate words through animation to support emergent literacy through activities, stories, and songs.

While the results of several studies support the theory that technology can be utilized as an instructional aid for enhancing literacy acquisition (Bolstad, 2004 & Macarthur, Feretti, Okolo, & Cavalier, 2001), it is important to note conflicting evidence urging caution and questioning just how valuable technology actually is (Blok, Oostdam, Otter, & Overmaat, 2002). Technology is beneficial when implemented based on the student's individual needs and utilized effectively (Savage & Pompey, 2008).

In fact, technology creates a potential to increase motivation of students with ASD to complete tasks (Heimann et al., 2005). Using a computer requires eye contact with a monitor, which is advantageous for individuals with ASD because they often experience difficulty screening out peripheral sensory information (Schlosser & Blischak, 2001). These individuals also appear to have a natural interest in computers, possibly due to their need for visual and auditory stimulation (Heflin & Alaimo, 2007). Thus, computer-assisted instruction has benefits as a learning tool to these students.

**iPads as an Instructional Tool for Teaching Phonics**

The iPad has wide-ranging potential for use in special education. It can not only accomplish tasks utilized through computer-assisted instruction, but can also act as a student's AAC device. The iPad has the potential to be used for a variety of purposes in

classrooms. For Language Arts instruction alone, it can be used as a book for interactive read-alouds, a writing tool to practice letter formation and developing stories, a tool to present and reinforce whole group or individualized lessons, a communication device, and as an auto cue for enhancing reading skills. The iPad is a multi-sensory learning tool, delivering more than just visual support and auditory feedback, in that it provides tactile and kinesthetic feedback for learners.

One of the iPad's most attractive features is the extensive availability of applications (apps) to support literacy learning. Apps are web-based applications designed to be used entirely within the browser. Using apps, you have the ability to create documents, edit photos, and listen to music without having to install complicated software. There is an extensive amount of apps available to support phonological awareness. For example, there are apps for letter recognition and formation, matching letters to sounds, matching words to pictures, blending, and segmenting. Interactive stories are another way to engage learners in the literacy experience, and stories can be created from personalized photographs for familiar experiences. Apps can be used to teach or reinforce skills, and deliverer instruction systematically or as part of a game. A challenge for using apps in the classroom is not the quantity available, but choosing ones appropriate for the needs of the class and individual learners.

An online article, "The iPad: A Useful Tool for Autism" (Anonymous, 2013), identified several conveniences such as using it to facilitate communication and aid in instruction. The iPad uses a touch screen, making navigation more accessible for children with coordination and learning difficulties because they may find tapping and

sliding easier than typing or writing. The iPad can be easily carried, thus helping children that have trouble focusing and are often "on the go." Additionally, the iPad is a popular device among many children, and has potential to be utilized as a more socially acceptable AAC device.

The iPad can be incorporated into all instructional approaches, whether analytically to teach letter-sound relationships of previously learned words or synthetically to practice converting letter combinations into sounds. Many of the apps available can be customized to meet the needs of individuals across the spectrum, utilizing their visual strengths to teach sight words, word families, word parts, and structural analysis. The iPad can be used in a systematic approach, with some apps allowing teachers to design interactive Discrete Trial Training (DTT) Drills, a one-to-one instructional approach used to teach skills in a planned, controlled, and methodical manner. Advantages of this are that it broadens the way phonics instruction is presented and decreases down time between drills because it automatically records data.

The iPad also appears to have a place for phonics instruction among each of the theories laying a foundational basis for educational practices for individuals with ASD. The iPad can be incorporated into the behavioral theory by providing structured learning opportunities designed by teachers. It can be implemented into the developmental theory as a means to teach functional skills. For example, through video modeling students can focus on mouth movements to pronounce sounds. The iPad can also be incorporated into the perceptual-cognitive theory as is a multi-sensory device,

potentially helping students who experience overstimulation from external senses or have difficulty processing sensory information. For example, teachers could design drills with instructions and tasks heavy on visual cues and supports while minimizing extraneous verbalizations.

Unfortunately, to date, there is still limited empirical peer-reviewed research on using the iPad as an instructional tool for phonics instruction and developing phonetic awareness. There are, however, an extensive amount of positive testimonials available. Caution is urged in that many of the articles were written by software developers. It is also important to note that there were no articles implicating the iPad's use in the classroom as negative or harmful.

The benefits of CAI and high-tech AAC devices have already been demonstrated when paired with phonics instruction for students with ASD (Heimann et al., 2005; Wilkins & Ratajczak, 2009), and the iPad can be utilized effectively for both these tasks. The iPad has the additional benefits of being portable, cost effective, socially desirable, multi-sensory, and flexible to the needs of the students. By incorporating a variety of apps catered to students' skill levels and interests into their daily routines, educators are empowered with another tool for making meaningful connections with their students.

# Chapter III

# Method

## Context of the Study

**Setting.** This study was conducted in a suburban community which can be described as one of the fastest growing municipalities in Southern New Jersey with a population approaching 70,000 residents. In 2000, the New Jersey Department of Education issued its latest District Factor Group report (DFG), which ranks a community's socioeconomic status (SES) from A (lowest) to J (highest). This community received a ranking of DE, ranking it as a middle class suburban community.

The elementary school was established in 2001 and currently serves approximately 550 students from preschool to 5th grade. For students with special needs, in-class support and resource rooms are provided based on their individual needs. The school also offers an English Language Learner (ELL) program as well as an extensive autism program for students and their families throughout the district.

The self-contained autism program was developed based on the principles of Applied Behavior Analysis. As part of the program, each student receives 2 hours of Discrete Trial Training (DTT) each day, using a DTT book with approximately 20 drills. When a drill is mastered, it is moved into a maintenance book and a new drill is inserted. A token system is provided during DTT sessions in which students can work for a desired reward/break after earning a mandated number of tokens. There is also an allotted time in the schedule for whole group lessons or center-based instruction each day. Students in the autism program attend classes for Special Area subjects with non-

disabled peers. Many students in the program are also mainstreamed for academic subjects in general education or resource classrooms.

**Participants.** A total of four students, two 2nd and two 3rd graders diagnosed with Autism Spectrum Disorders (ASD) participated in the study. Each student has a one-to-one teacher aide as mandated in their Individual Education Plans (IEP). All participants are verbal and able to identify letters and phonetic sounds expressively and receptively. Table 3.1 presents the general information of the participating students and Table 3.2 lists DTT drills in their language learning. Reading levels were obtained by administrating the Fountas and Pinnell Benchmark Assessment. This assessment was chosen because it is the standard evaluation used by the school district to determine reading levels.

Table 3.1.

*Student Profiles*

| Student | Gender | Age | Grade | Reading Level |
|---|---|---|---|---|
| A | M | 9.2 | 3 | 1.0 |
| B | M | 8.2 | 3 | 1.5 |
| C | M | 7.11 | 2 | 2.0 |
| D | F | 9.3 | 3 | 2.5 |

Table 3.2.

*Language Arts/Literacy Discrete Trial Drills*

| Student A | Student B | Student C | Student D |
|---|---|---|---|
| Sight Word Rec | Sight Word Rec | Synonyms | Harcourt Trophies |
| Journal | Noun ID | Handwriting | Journal |
| Rhyming | Journal | Contractions | Weekly Spelling |
| Word Families | Word Families | Reading for Meaning | Daily Language |
| Handwriting | Handwriting | Printing Book | Phonics |
| Weekly Spelling | Contractions | Journal | Homophones |
| Tactile Sight Words | Reading WH ?'s | Homophones | Editing |
| Phonics | Weekly Spelling | Editing | Pronouns |
| | Phonics | Weekly Spelling | |

***Student A.*** Student A has weak decoding and blending skills which affect his fluency and comprehension. He currently is placed in the Level I Reading Mastery program as his primary program and Edmark and Guided Reading as a secondary program. This student is very schedule-oriented and benefits from priming before any changes in routine. He also benefits from instruction presented in a multi-sensory format and ample practice time to acquire mastery. Student A is currently mainstreamed in a general education classroom for Science and Social Studies.

***Student B.*** Student B has weaknesses in decoding middle sounds of longer words and typically reads quickly and in a low tone unless verbally prompted to slow down and raise his voice. He currently is in Level II Reading Mastery as his primary reading program and Guided Reading as a secondary program. He follows a picture schedule throughout the day and has difficulty sustaining interest in activities, typically demonstrating a strong refusal to try new or unknown activities.

***Student C.*** Student C is at grade level academically but reaches his maximum frustration level quickly when learning new or unknown tasks. He enjoys reading and is currently mainstreamed in a general education classroom for Guided Reading. Reading Mastery Level II is used as a secondary program for him to develop comprehension strategies. This student benefits from lessons that are engaging and interesting.

***Student D***. Student D enjoys reading and is currently mainstreamed into a general education classroom for Guided Reading. Reading Mastery III and beginning chapter books such as the *Magic Tree House* and *Flat Stanley* series are provided as a secondary program to continue developing comprehension strategies. This student benefits from a multi-sensory approach with a strong foundation in kinesthetic learning.

***Teacher.*** The classroom teacher was the primary participant to implement the intervention and collect data. The teacher has nine years of special education experience working with various student populations. Currently, he is pursuing an advanced degree in Special Education.

**Materials**

**Reading programs.** The core reading programs included Guided Reading, SRA Reading Mastery, and the Edmark Sight Word Program. Based on the students' IEP goals, Language Arts and Literacy (LAL) drills are incorporated into their DTT instruction. This includes drills on topics such as handwriting, phonics, spelling, grammar, writing, editing, and pragmatics. While the majority of instruction is delivered one-to-one, whole group lessons and a cross-curricular approach allow students to practice the skills

learned throughout the day. The students also spend time each week on Lexia Reading, a software program that tracks students' progress as they master new skills.

**iPads.** *Phonics Genius* by Innovative Mobile Apps Ltd was the primary program. This free program, compatible with the iPhone, iPod touch, and iPad, shows a flash card style app designed to help children learn words by letter sounds. It consists of over 6,000 words grouped into 225 categories, including single letter and letter combination sounds. It is intended to encourage children to notice and think about the individual sounds in spoken words. There is also a listening game where children match visual and spoken words, as well as pre-recorded audio playback to help them hear each word clearly.

In this program, a letter or letter combination from the app's home screen can be selected. Users can then choose whether they want the sound at the beginning, middle, or end of a word set. In Learning Mode, students can view individual phonics flashcards and practice recognizing letter sounds and words. The app defaults to sounding out the word and highlights the letter sound in red face type on the flash card. In Game Mode, students can try to match a letter sound in a spoken word to as many as six different flash cards containing the same letter sound.

**The critical reading inventory** *(CRI)* (Applegate, Quinn, & Applegate, 2008). The CRI's wordlists were used to track student progress during the study. The CRI offers two similar word lists composed of 20 words each for grade levels from Pre-Primer to 12. The CRI measures the students' sight word vocabulary by flashing words from a list for one second before moving to the next word, and measures their decoding skills by

showing each word from the same list untimed to give students an opportunity to sound out unfamiliar words. A percentage was then calculated by dividing the number of correct responses by the total number of words on the list. The list used during baseline and Intervention was chosen at the level the student first scored below 70% on untimed responses. List A was used for baseline and list B for instruction.

**Checklists.** A checklist was developed to record student performance. This checklist recorded both rate and accuracy of students' sight word vocabularies. This checklist was adopted from the CRI and modified by including additional columns to track and compare student progress over the course of the study. All correct responses given independently or with a verbal prompt were marked with a (+) while incorrect responses or those requiring a more intrusive prompt were marked with a (-). See Figure 3.1 for an example of checklists.

| | **Week 1** | | **Week 2** | | **Week 3** | |
|---|---|---|---|---|---|---|
| *Sight Words* | *Flash* | *Untimed* | *Flash* | *Untimed* | *Flash* | *Untimed* |
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. | | | | | | |
| 7. | | | | | | |
| 8. | | | | | | |
| 9. | | | | | | |
| 10. | | | | | | |
| *Score* | /20 | /20 | /20 | /20 | /20 | /20 |
| *Score* | % | % | % | % | % | % |

*Figure 3.1.* Sample Checklist

## Procedure

**Baseline.** Data were collected by evaluating student progress at the end of each week with List A of the CRI for three weeks. DTT was primarily delivered by one-to-one teacher assistants. The classroom teacher monitored one of four sessions for approximately 20 minutes every two days. The students' primary and secondary reading programs were taught each day and the remaining drills were completed in random order but not repeated until all the drills had been completed. Students also spent 15 minutes every three days on the Lexia Reading Program.

**Intervention.** The iPad was provided into instruction for approximately 20 minutes during DTT every other day. Students continued to receive two hours of DTT each day as well as instruction in their reading programs. Lexia Reading also continued for 15 minutes every three days. List B of the CRI was used to assess student progress at the end of each week. The teacher instructed students individually in two groups. In week 1, two students started using iPads and two more students were added in the following week. Students received instruction using the iPad's *Phonics Genius* for 20 minutes every two days for six weeks. See appendix A for an example of a lesson plan.

The teacher divided the lesson into two parts. During Part I, a random word was flashed on the screen and the student attempted to sound out the word. When the student was satisfied with his/her attempt, he/she would touch the screen and the word would be pronounced. Students were told for every set number of words sounded out correctly, they would receive a piece of candy as a reinforcer of their choice.

During Part II, random words were set on a time delay which decreased each week of the intervention. Table 3.3 presents the time delay schedule. Students were instructed to read words as they flashed on the screen and the teacher recorded the number of correct responses over a 1-minute duration. Verbal praise was used to encourage students, and a break was offered as a reinforcer immediately after Part II.

Table 3.3.

*Time Delay Schedule*

| Week | Time Delay |
|---|---|
| 1 | 3 Seconds |
| 2 | 2 Seconds |
| 3 | 1 Seconds |
| 4 | 0.9 Seconds |
| 5 | 0.8 Seconds |
| 6 | 0.7 Seconds |

**Research Design**

A multiple baseline across students with AB phases was used in this study. The study started with two students week one and added two more students in week two. During Phase A, the baseline, the participants' routine was not changed from what typically occurs throughout the year. The only difference was an assessment at the end of each week for three weeks using List A of the CRI. During Phase B, the intervention, the iPad was used for 20 minutes every other day during student work sessions for six weeks with a focus on sight word reading. The iPad sessions with the teacher consisted

of Part I and Part II. The CRI List B was given each week to track student progress and the checklist was used to record each student's scores.

**Data Analysis**

A graph was presented as a visual display to compare student performance between phases A and B. The researcher attempted to determine whether incorporating the iPad into reading instruction would have a positive effect on students with ASD identifying sight words in terms of their rate and accuracy. To further examine the study's social validity, student satisfaction was evaluated by a brief survey. Figure 3.2 presents survey questions.

1. Do you have an iPad at home?
2. Did you enjoy using the iPad during work sessions?
3. Do you think the iPad helped you learn more?
4. Would you like to continue using the iPad in the classroom?
5. Which app was your favorite?

*Figure 3.2.* Student Survey

## Chapter IV

## Results

### Sight Word Acquisition

Student performance of sight word acquisition was evaluated by a weekly assessment and the rate and accuracy of their responses to the sight words were analyzed and converted into percentages. Table 4.1 presents their mean scores and standard deviations (SD) of sight word acquisition across phases. Figure 4.1 presents individual student's performance of sight word acquisition.

Table 4.1.

*Mean and Standard Deviation of Sight Word Acquisition*

| Student | Baseline | | | | iPad Intervention | | | |
|---|---|---|---|---|---|---|---|---|
| | *Flash* | | *Untimed* | | *Flash* | | *Untimed* | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| A | 38 | .02 | 55 | .05 | 56 | .03 | 75 | .15 |
| B | 55 | .10 | 73 | .12 | 43 | .21 | 58 | .20 |
| C | 38 | .08 | 53 | .03 | 51 | .18 | 70 | .10 |
| D | 58 | .08 | 78 | .12 | 48 | .30 | 73 | .30 |

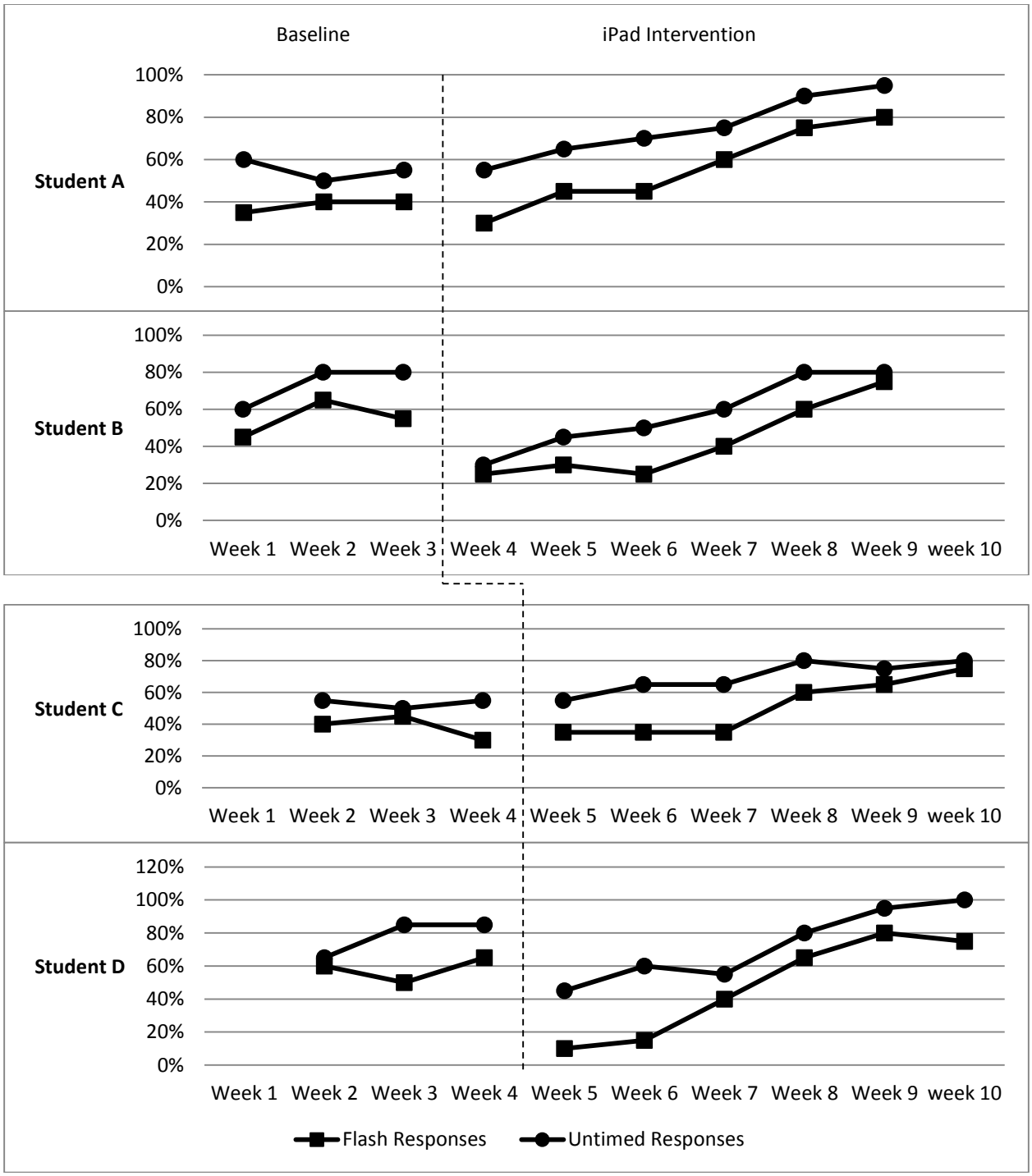


*Figure 4.1.* Individual student's performance of sight word acquisition

**Student A.** Student A was evaluated on a Primer level of sight word acquisition. His flash responses ranged from 35-40% with a mean of 38% during the baseline, while 30-80% with a mean of 56% during the iPad intervention. Untimed responses during the baseline ranged from 50-60% with a mean of 55%, and 55-95% with a mean of 75% during the iPad intervention. Results demonstrate that Student A's sight word acquisition of both flash and untimed responses during the iPad intervention increased comparing to that of the baseline.

**Student B.** Student B was evaluated on a 2nd Grade level during the baseline and a 3rd Grade level during the iPad intervention. His flash responses ranged from 45-65% with a mean of 55% during the baseline to 25-75% with a mean of 43% in the intervention. Untimed responses during the baseline ranged from 60-80% with a mean of 73%, while 30-80% with a mean of 58% during the iPad intervention. Results demonstrate that Student B's sight word acquisition of both flash and untimed responses during the iPad intervention increased comparing to that of the baseline.

**Student C.** Student C was evaluated on a 6th Grade level for both baseline and iPad intervention. His flash responses ranged from 30-45% with a mean of 38% during the baseline, and 35-75% with a mean of 51% during the intervention. His untimed responses during baseline ranged from 50-55% with a mean of 53%, while 55-80% with a mean of 70% during the iPad intervention. Results demonstrate that Student C's sight word acquisition of both flash and untimed responses during the iPad intervention increased compared to that of the baseline.

**Student D.** Student D was evaluated on a 9th level for both the baseline and iPad intervention. Her flash responses ranged from 50-65% with a mean of 58% during the baseline, while 10-75% with a mean of 48% during the intervention. Her untimed responses during the baseline ranged from 65-85% with a mean of 78%, and 45-100% with a mean of 73% during the iPad intervention phase. Results demonstrate that Student D's sight word acquisition of both flash and untimed responses during the iPad intervention increased comparing to that of the baseline.

**Student Satisfaction Survey**

All students were presented with an oral survey at the end of the study to examine the social validity of incorporating iPads into instruction as well as to evaluate their satisfaction with the iPad use. Table 4.2 and 4.3 present student responses to the survey questions.

Table 4.2.

*Student Responses to the survey*

| Questions | Student Responses | |
|---|---|---|
| | Yes | No |
| 1. Do you have an iPad at home? | 0% | 100% |
| 2. Did you enjoy using the iPad during work sessions? | 100% | 0% |
| 3. Do you think the iPad helped you learn more? | 75% | 25% |
| 4. Would you like to continue using the iPad in the classroom? | 100% | 0% |

Table 4.3.

*Student responses to app preference*

| Question | Student Response |
|---|---|
| 5. Which app was your favorite? | |
| • Phonics Genius | 0% |
| • Word Family | 25% |
| • Phonics Vowels | 25% |
| • ABC Alphabet | 25% |
| • Fun Rhyming | 25% |

The results of the survey shown in Table 4.2 indicate that the use of the iPad was viewed as a positive experience. Although the results of the survey show that none of the students have iPads at home, one student did indicate that he did has an alternative brand tablet at his home. While all students responded that they enjoyed using the iPad during work sessions, most (3 out of 4) felt the iPad helped their learning. When asked if they would like to continue using the iPad in the classroom, all responded "yes". When they were asked their favorite app available during the intervention, their responses varied, but Phonics Genius, the app used during intervention by the classroom teacher, was not chosen by any student as their favorite. Because a variety of other apps were available for students to use independently during Reading Centers, each student chose a different app as his/her favorite. These apps chosen include: Word Family, Phonics Vowels, ABC Alphabet, and Fun Rhyming (See Appendix B for a complete description of those apps).

# Chapter V

# Discussion

## Response to Research Questions

The purpose of this study was to investigate the effects of using the iPad to enhance the sight word acquisition of students with autism. The first research question addressed students with ASD using the iPad during instruction to increase their rate and accuracy of identifying sight words. The findings indicate that the iPad can be successfully implemented as an assistive technology device for supporting these students in developing their phonemic skills. Results show that all students increased their response rate and accuracy when identifying the sight words using the iPad. During the baseline, the highest percentage gain for both flash and untimed responses was 20%, whereas the minimum percentage gain during the iPad intervention was 25% and its largest was 65%. The average gain for all participants during the baseline of flash scores was 2.5% and the untimed was 8.75%. In comparison, after the third week of intervention, the average accuracy gain for flash scores was 11.25% and the untimed was 13.75%. Thus, it is important to note that the average gain in accuracy scores for both flash and untimed responses after the third week of the iPad intervention yielded higher positive outcomes as compared to the baseline. Ultimately, the average accuracy gain after the intervention was 51.25% for flash responses and 42.5% for the untimed, demonstrating an increase in students' rate and accuracy responding.

The second research question addressed the social validity of using the iPad in the classroom. The results of the student survey indicated that the use of the iPad was

viewed favorably by all students and that they all liked to continue using iPads in the classroom. Most students (75%) also felt that the iPad increased their learning potential. As the classroom teacher, I was very pleased with the educational outcomes demonstrated when using the iPad in the classroom, and believe that it could be an effective tool in the education of students with ASD.

The findings of this study are consistent with previous research (Yaw et al., 2011). In their studies, computer-based sight word reading enhanced word reading for a student with ASD (Yaw et al., 2011). This current study extended that finding by examining the effects of using the iPad as a computer-based sight word reading intervention on four individuals with ASD. Instead of using Microsoft PowerPoint to construct a computer-based sight word reading system, a handheld device, the iPad was applied in the classroom, and similar positive outcomes were found. The findings may add information to computer-assisted instruction in reading, especially sight word learning.

**Limitations**

There are some limitations in this study. The first was the sample size of participating students because there were only four students involved. Thus, the findings may not be generalized to other students with ASD because of the vast variety of characteristics of this population. Another limitation was the instrument of *The Critical Reading Inventory* as an assessment tool and administering only one assessment for baseline and another for the intervention. It is possible the students only increased their recognition of the 20 sight words they were assessed on. Third, various kinds of

apps were used on the iPad, and each program may have a unique impact on the individual student. It may be difficult to determine which one is more effective than others.

**Implications**

The use of the iPad creates a new avenue to incorporate a variety of practices to best meet the needs of individual students with disabilities. It is found that the iPad can be effective because it caters to students with ASD's visual strengths through the screen's various images. The results demonstrate that after using Phonics Genius and a selection of supplementary apps for instruction, the accuracy of the students' sight word responses increased. These findings have positive implications for teachers in the classroom. For example, the iPad has thousands of educational apps available in all content areas that can be tailored to the needs and interests of individual students. Many of these apps can automatically collect and graph each student's individual progress, thus saving teachers time. Additional benefits include that the iPad is light and versatile, which allows access to data or notes to be taken while on the go, and that it is an all-in-one media tablet, making the organization of materials easier.

Although this study demonstrated the use of the iPad was successful at increasing student sight word acquisition, there is potential to apply its use across other subjects/areas. In this study, students commented that they wanted to use the iPad, which in turn increased their motivation in learning. As their motivation increased, they paid more attention to the class assignments and teacher's instruction. For example, simply pulling the iPad out before or during whole group lessons was extremely

effective at maintaining student attention. In addition, the iPad's vast interactive qualities were combined with other technology such as a computer and document camera to maximize student learning, participation, and attention.

**Conclusions/Recommendations**

Despite the positive results of this study, further studies to examine the potential benefits of using the iPad in other academic areas should be considered. Future research may increase the sample size to validate the findings for students across the spectrum. Further studies may include additional time to evaluate if students' skills generalize to other reading areas. A larger sample of random selected sight words should be used to ensure students master the skills learned rather than memorization only. In order to have an accurate comparison between phases, baseline data collection may need to be extended.

As indicated by the National Research Council (2001), best practices using a variety of instructional tools have been suggested to meet the needs of students with ASD. In the future, I would like to use the same procedures in this study for my students to develop their phonemic awareness. Also, I would like to use Phonics Genius and other apps to enhance students' skills of recognizing letters, phonemes, and digraphs. I plan to continue using the iPad in my classroom as an instructional tool not only to enhance phonemic awareness, but all content areas. Because of the possible benefits this relatively new technology offers, I believe continued empirical research to examine all aspects of the iPad as an instructional tool is warranted.

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## APPENDIX A

## Lesson Plan

**Materials:** Timer, iPad with *Phonics Genius* app, Part 1 data collection form, Part II data collection form, and assorted candy reinforcers.

**Procedure:**

*Part I*

1. Tell students they are going to sound out as many words as they can. Give them a target number of words that they need to sound out in a row to receive a reward. Start with a low number and increase incrementally by one.
2. Open the app Phonics Genius.
3. Scroll to the end and choose "shuffle."
4. Students attempt to sound out word displayed on the screen. When they are satisfied with their answer choice, they touch the screen to determine if they were correct.
5. Keep track of the number of correct responses provided by students and stop when they achieve the target number. Record on the data sheet provided if the target was reached. If the target was not reached, write the number of correct responses given before an error was made, then lower the target number by one.
6. Give verbal praise and a candy reinforcer if they successfully reach their goal. Use verbal encouragement to try again if goal is not met. If student is showing signs of frustration.
7. Complete as many trials in ten minute duration as possible.

*Part II*

1. Tell student they are again going to try and read as many words as they can. This time the words will only stay on the screen for a specified time delay.
2. Open the app Phonics Genius.
3. Scroll to the end and choose "shuffle."
4. Students attempt to sound out word displayed on the screen. The time delay decreases each week for 6 weeks.
5. Set a timer for one minute and record the number of correct responses on the data sheet provided for that duration.
6. Give ample verbal praise and encouragement, especially when their previous record is broken.
7. Complete trial again until ten minute duration has past.
8. Offer a 5-minute break immediately follow Part 2.

Time Delay Schedule

| WEEK | TIME DELAY |
|---|---|
| 1 | 3 seconds |
| 2 | 2 seconds |
| 3 | 1 seconds |
| 4 | 0.9 seconds |
| 5 | 0.8 seconds |
| 6 | 0.7 seconds |

Student_____ Date_____

## iPad Intervention (Teacher Part 1)

| Date | Target Number | Achieved Target (+) | Number of correct responses given if the target was not achieved |
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Student_____ Date_____

## iPad Intervention (Teacher Part 2)

| Date | Time Delay | # of words | # of words | # of words | # of words | # of words | # of words |
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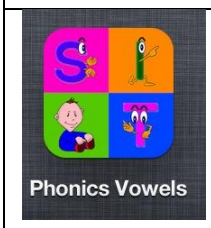
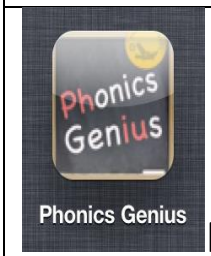
**APPENDIX B**

**Application Descriptions**

| APP | DESCRIPTION |
|---|---|
|  Fun Rhyming | **Company:** AbiTalk Incorporated<br>**Cost:** $2.99<br>**Target Skill Area:** Rhyming words<br>**Description:** A fun game for young children by finding pairs of matching words. |
|  Phonics Vowels | **Company:** AbiTalk Incorporated<br>**Cost:** $2.99<br>**Target Skill Area:** Phonics<br>**Description:** Learn phonics vowel sounds, and letter combinations with this fun kids' game. |
|  Word Family | **Company:** AbiTalk Incorporated<br>**Cost:** $2.99<br>**Target Skill Area:** Word Families<br>**Description:** Students practice 56 word family groups using images with a lot of animations and interactions for each word. |
|  ABC Phonics Rocks! | **Company:** Hetal Shah<br>**Cost:** $1.99<br>**Target Skill Area:** Phonics<br>**Description:** Introduces the phonetic sounds of each letter and builds the foundation. Presents 125+ words for children to sound out and spell. |
|  Phonics Genius | **Company:** Innovative Mobile Apps<br>**Cost:** Free<br>**Target Skill Area:** Phonics/Sight Words<br>**Description:** Over 6,000 words grouped by phonics sounds. |